The Armagh Observatory and Planetarium

Annual Report and Accounts
For the year ended 31 March 2020

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The Trustees' Annual Report for the year ended 31 March 2020

The Board of Governors, who are the Trustees for the Armagh Observatory and Planetarium (AOP) has pleasure in presenting its annual report and financial statements for this charity for the year ended 31 March 2020. These financial statements have been prepared in accordance with the accounting policies set out in note 1 to the accounts, with the guidance issued by the Department of Finance on the form and contents of the Annual Reports and Accounts of Executive Non-Departmental Public Bodies, *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995* and Accounting and Reporting by Charities: Statement of Recommended Practice (SORP) applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS102).

The sponsor Department for the Armagh Observatory and Planetarium is the Department for Communities (DfC) (the Department).

Background to Charitable Status

Historically the Armagh Observatory and the Armagh Planetarium were treated as being distinct institutions; being two component divisions of a single statutory corporation and arms-length body (ALB), 'The Governors of the Armagh Observatory and Planetarium' as described in *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995*. This 1995 Order superseded the original 1791 Act of the Irish Parliament entitled '*An Act for Settling and Preserving a Public Observatory and Museum in the City of Armagh For Ever'*, and an Amendment of 1938 ('The University and Collegiate and Scientific Institutions Act [Northern Ireland], 1938').

The principal function of the Armagh Observatory, founded in 1789 as part of Archbishop Richard Robinson's vision to see the creation of a university in the City of Armagh, is to undertake original research of a world-class academic standard that broadens and expands our understanding of astronomy and related sciences.

The Armagh Planetarium was founded by Dr Eric Mervyn Lindsay, the seventh director of the Armagh Observatory, and was officially opened on 1 May 1968. The Planetarium's primary activity is to disseminate scientific and technical knowledge of a wide range of scientific and STEM subjects, and to promote public understanding of astronomy and science through its programme of educational services for schools and the wider public.

From 1 April 2016 the Charity Commission for Northern Ireland has registered *The Governors of the Armagh Observatory and Planetarium* as a charity under reference number NIC 103948**.**

Objectives and Activities

The organisation's statutory functions are set out at Article 4 of *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995*. The Order requires that '*the Governors shall, for the purpose of developing and improving the knowledge, appreciation and practice of astronomy and related sciences, maintain and manage the Armagh Observatory and Planetarium and may take such other action as the Governors may think proper for the purpose of acquiring or disseminating knowledge relating to astronomy and related sciences'.*

Armagh Observatory is the oldest scientific institution in Northern Ireland, and the longest continuously operating astronomical research institute in the UK and Ireland. Armagh Planetarium is also the oldest operating planetarium in the UK and Ireland.

The Vision statement of the unified organisation is:

'Armagh Observatory and Planetarium is renowned throughout the world as a unique Centre of Excellence for research, education, inspiration and outreach in space and science.'

Mission

The Mission of the Armagh Observatory and Planetarium is:

"To advance the knowledge and understanding of astronomy and related sciences through interactive engagement and the execution, promotion and dissemination of astronomical research nationally and internationally, in order to enrich the intellectual, economic, social and cultural life of all members of the community".

The organisation operates on the international stage and is underpinned by core funding from the Department and the receipt of external grants from the UK Science and Technology Facilities Council (STFC), and other grant-awarding bodies.

The Corporate Plan 2018-21 is underpinned by three themes of research, education and outreach, and history and heritage. These themes are described in the more detailed vision documents on which the corporate plan is built. Added to these is a fourth theme of leadership and governance which enables an efficient, effective, sustainable and accountable operating framework.

At the end of 2019-20 there were 24 permanent employees which consists of approximately one-third Research, one-third Education and one-third Corporate. At year end, an additional 10 temporary employees were engaged, 3 of these filling vacancies within the established structure and the remainder on short term temporary projects. AOP also recruited a number of casual staff who are employed on an ad hoc basis to meet operational needs. In addition, there is an Emeritus Director, an Emeritus Research Astronomer and 12 external research associates and academic visitors.

Public Benefits

The Trustees confirm that they have complied with their duty to have regard to the guidance on Public Benefit produced by the Charities Commission of Northern Ireland under section 4(b) of the Charities Act (the public benefit requirement statutory guidance) and that this has informed the activities of the organisation in the year to 31 March 2020. This is demonstrated in the following summary of Principal Activities which provides detail on how the organisation has delivered against its objectives and the public benefit which has flowed from this.

Principal Activities

Impact of COVID-19 Pandemic

The restrictions imposed by the UK government in an effort to limit the impact of the Covid-19 pandemic resulted in closure of all AOP facilities from 20 March 2020. All staff commenced remote working. The organisation quickly adopted technology to facilitate good communication and exchange of information, mainly building on the underlying technology of Microsoft 365 which was already in place. Recognition was given to the challenges of lone working, and management were constantly reviewing the various activities, with ongoing consideration for the mental and physical well-being of staff and students.

The various sections of the Annual Report provide some indication of the impact of the restrictions and the response of the various departments.

Ultimately, there will be a residual impact to the closure which can not be fully assessed at this stage. However, there is no reason to believe that it will affect the ability of the organisation to continue as a going concern. While admissions income will be drastically reduced, there will be substantial savings associated with cancellation of events, reduction in maintenance activity and lower energy usage. In addition, both public sector funding and research grants are being availed of to offset costs associated with the pandemic.

Introduction to AOP Research and its International Standing

AOP is one of the oldest scientific research institutes in the British Isles with a long-established reputation of research excellence. It is also one of very few astronomical institutions in the world to have a state-of-the-art planetarium through which its research can be effectively communicated and where a research-informed outreach and public engagement activity can be sustained.

AOP is engaged in front-line research in several key areas of astrophysics. These range from the study of our Sun and Solar System to that of distant galaxies, in keeping with the long and varied history of scientific achievements of the Armagh Observatory and with the desire to be perceived by the public as leaders in of all strands of astronomical research that are communicated through the Planetarium.

Between a quarter to one third of AOP research is funded by the award of project-specific external grants mainly from the Science & Technology Facilities Council (STFC), together with a number of minor ad hoc grants. These grants support projects led by individual research astronomers with the provision of PhD scholarships, post-doctoral research assistant salaries, computing equipment and observation/conference travel funding.

AOP research also requires the use of state-of-the-art observing and computing facilities internationally in order to obtain new astronomical data and allow their analysis. STFC and UK government support provides access to world-class international facilities, and AOP research staff regularly win telescope time on some of the best and most sought-after telescopes in the world such as the ESO Very Large Telescope (VLT) or the Hubble Space Telescope (HST).

In addition, through the AOP's membership of the UK SALT Consortium, its research staff have access to the 11-metre diameter Southern African Large Telescope (SALT). Similarly, AOP is also a founder member of the

international consortia involved with the GOTO (Gravitational-wave Optical Transient Observer) project, LOFAR (LOw Frequency ARray) radio telescope project and a consortium member of the CTA (Cherenkov Telescope Array) gamma-ray observatory.

These facilities can be extremely expensive to run (e.g. the running cost of one observing night at VLT is about £50,000 and a mid-size observing program with HST would be ten times more) so that through the award of their use, the international astronomical community essentially entrusts AOP to make effective use of the data.

In this respect, AOP research staff also play a full role in the international astronomical community. For instance, they serve on committees of bodies such as the Royal Astronomical Society or the International Astronomical Union (IAU), assess grant and research proposals on behalf of external funding agencies, review scientific papers and edit international academic journals, and act as external PhD examiners in the UK and beyond. AOP researchers also sit on scientific advisory panels or lead specific projects with future ground-based observing facilities (Vera Rubin Observatory, ELT-METIS, VLT-BlueMUSE), space satellites and missions (ESA future Plato and Comet Interceptor missions) and large-scale surveys (MOONs).

Finally, the restoration of the Observatory's historic telescopes has brought opportunities to reintroduce some visual observing from Armagh, while new computer and camera technology has enabled a variety of automatic observational programmes to be undertaken at AOP, recording data autonomously. This includes two meteor camera systems, one being part of a European network seeking to track and recover freshly fallen meteorites (FRIPON), as well as a European-wide network for lighting forecasts (LINET).

Research Highlights

In order to provide a practical understanding of how the work of AOP research contributes to understanding of the cosmos and the region's international reputation, the following provides some highlights of the research undertaken at AOP in the past financial year. This draws from international collaborations and the award of observing time on highly competitive facilities, as well as from DfC direct support allowing AOP to participate in several key international projects (such as SALT, GOTO, IST, I-LOFAR, Comet Interceptor and CTA). Full bibliographic references can be found in the publication list appended to this report.

Stellar and Galaxy Evolution

Introduction

When we look up on a dark night, we may think that stars are immutable and isolated. Yet, although stars can live for as long as the age of the Universe, they can also undergo dramatic changes in matter of seconds. They are also not truly disconnected. Some are found in pairs or tight groups and more generally stars are related to each other through the very way in which they form and evolve. Stars are indeed born from giant clouds of gas and return matter to those clouds, seeding the birth of new stars as they fade away or sometime explode in dramatic events. Furthermore, stars produce the heavy elements necessary to make not only new stars and planets but also us humans. To study and understand stars in all their manifestations it is therefore necessary to understand life as we know it, or as it may be found one day on planets around other stars.

In turn, the formation history of stars relates to the formation and evolution of the galaxies that contain them. Some galaxies indeed no longer appear to form stars, unlike the case of the Milky Way. This may depend on whether fresh gas is available around them, on whether they have collided with other galaxies in the past or possibly also on whether their central supermassive black hole suddenly becomes active and pours out tremendous amounts of energy capable of clearing its host galaxy of any star-forming gas material. Finally, galaxies are carried by the general expansion of the Universe and the evolution of the dominant, yet unknown dark-matter material in which they themselves are embedded. Understanding the formation and evolutions of stars and galaxies therefore ultimately means understanding our origin in relation to the very fabric of the Universe.

Recent results

AOP stellar studies range from the most massive and brightest young stars to the faintest and evolved stars or stellar remnants. Recent theoretical investigations in the way massive stars shed material through stellar winds led by Jorick Vink's student Erin Higgins and post-doctoral STFC assistant Andreas Sander has delved into how the strength of these winds depends on the metal content of massive stars, leading to a better understanding on the formation of the brightest red supergiant stars (e.g. like Betelgeuse in the Orion constellation) and eventually to stellar-mass black holes *(e.g. Higgins & Vink 2020; Sander, Vink & Hamann 2020)*. Using polarimetry, a technique that reveals how light is reflected by a surface, or affected by the presence of a magnetic field, Stefano Bagnulo and AOP visiting fellow John Landstreet have obtained data from the European Very Large Telescope (VLT) in Chile, the WHT in Canary Islands, and the CHFT in Hawaii, to compile the most comprehensive catalogue of measurements for the magnetic field of nearby white dwarfs, 50 years after the discovery of the magnetic fields in these stellar remnants by John Landstreet *(Bagnulo & Landstreet 2019a and 2019b; Landstreet & Bagnulo 2019 and 2020*). Their work has

led to the conclusion that at least one star out of five will end its life with a strong magnetic field at its surface. The presence of exotic species on stellar surfaces is a pointer to unusual physics. Since lithium is normally destroyed at temperatures of a million degrees, its appearance on the surface of some red giants is puzzling. Working with a Chinese group and former student Xianfei Zhang, Simon Jeffery has been studying how the merger of a tiny white dwarf star with a red giant could produce the observed lithium *(Zhang et al. 2020).* At the other end of the atomic mass scale, huge excesses of lead point to how ultraviolet light can create 'cloud layers' of particular ions in the atmospheres of faint blue stars *(Naslim, Jeffery & Woolf 2020)*

In the Milky Way, Michael Burton and his former student at the University of South Wales developed a new technique to map the amount of carbon locked in interstellar dust, finding that this amounts to about one-tenth of the carbon present in the gas phase of the interstellar medium *(Gunay, Burton et al. 2020)*. This will allow to map the total distribution of carbon, which is of critical importance for tracing the motions and total amount of gas in the Galaxy provides the chemical base of all life as we know it. Finally, Marc Sarzi continues to lead his survey of galaxies in the Fornax cluster producing, in particular, an important study that relates directly to the processes of star formation and the latest stages of stellar evolution. Indeed, in *Martin-Navarro et al. (2019)* the Fornax3D team shows for the first time how VLT observations can map variations for the fraction of low-mass stars across different parts of galaxies, which are presumably due to different amounts of turbulence in the gas from which they formed,

The role of SALT

The South African Large Telescope (SALT) is the largest telescope in the Southern Hemisphere, providing unparalleled access to the skies for its shareholders of whom, through membership of the UK SALT consortium, AOP is one. Participation in this major international facility brings visibility throughout the worldwide research community and allows AOP and just a few other UK universities to engage in collaborations with other SALT international partners. In turn, through such partnerships, AOP receives a return in terms of telescope time allocation that is equivalent to roughly 10 times its contribution. In 2019 alone, over 120 AOP unique astronomical observations have already been made, targeting some of the most exotic stars in the Universe. These will contribute to several upcoming discovery papers and also to the training of postgraduate research students at AOP. Participation in SALT also allows AOP to explore opportunities through the SALT Collateral Benefits Programme to develop links between local schools in N. Ireland and in South Africa.

Using SALT, Simon Jeffery currently leads a survey of chemically peculiar subdwarf stars in the southern sky. These are stars that are in the final stages of their lives but their histories from birth to the present are very diverse. By exploring the abundances of key elements such as hydrogen, helium, carbon, oxygen, and iron, and of exotic elements such as lead and zirconium, these histories and internal physics can be explored. Highlights of these AOP-led SALT observations include a new analysis of the helium star DY Cen, a star that has shrunk by a factor of 80 in the last 100 years and which has a surface excess of strontium more than 10,000 times the concentration found in the Sun, and of EC 22536−5304, the most lead-rich subdwarf discovered to date *(Jeffery & Miszalski 2019)*. A treasure trove of data for exotic stars still awaits detailed analysis and promises exciting new discoveries. Jorick Vink and AOP visiting student Cormac Larkin are using SALT to complete the census of massive stars in the low-metallicity environment of the Small Magellanic Cloud, their prime search is for the elusive binary 'stripped' Helium stars, which have been hypothesized to exist since the 1960s but which have as yet failed to be revealed in large numbers. Thanks also to AOP's contribution SALT will continue to develop its instrumentation, and the introduction of a new near-infrared spectrograph will facilitate the study of star formation processes in nearby galaxies.

Transient and Periodic Phenomena

Introduction

Apart from the bright planets which the Greeks called "wandering stars", the night sky might appear to be unchanging, with the stars in one season being exactly the same as those seen in the last. However, astronomers from the ancient world detected new stars, "novae", which suddenly appeared in the night sky and then gradually faded from view. We now know that these types of "transient" events occur when one star circling its companion unloads sufficient amounts of matter on it to make it explode. The first repeating "variable" star was first detected in the early 17th century when the star called "Mira" was observed to change in its brightness on a timescale of nearly a year. We now know that Mira is a star which contracts and expands in size over this length of time. In fact, if we were to look at each star with sufficient precision and length of time, we would find that every star is variable in some (and usually many) ways.

Today "Time Domain Astrophysics" is the study of how and why stars and other celestial bodies change their apparent characteristics (such as brightness) over time, either as an unpredictable outburst – the *transients* such as supernova explosions and black hole – black hole collisions – or as a continuum of change – the *periodic* variables. These studies are central to discovering how stars form, live and die. By observing them in detail we can test models which have been proposed to explain their behaviour. If a model can't account for the observations, then it's back to the drawing board! However, the diversity of variable stars requires different observing strategies. Explosive events are extremely rare and short-lived, so that in order just to catch a glimpse of them it is necessary to observing the entire

sky every night. On the other hand, targeted monitoring lasting many months is necessary to unravel the minute vibrations of Sun-like stars, but there are plenty of them.

Recent results

In the study of periodic phenomena, long continuous monitoring with extremely high accuracy has proved necessary to discover the signals due to exoplanets, star spots and gentle vibrations present in or around many stars. For these, space craft are essential to overcome the negative impact of air turbulence in the atmosphere (which makes star twinkle), with Kepler/K2 (NASA 2000-2018), TESS (NASA 2018-) and Plato (ESA, from 2026) being pivotal missions. Using Kepler/K2 and TESS, Simon Jeffery has continued to study the interior structure of hot subdwarf stars (*Baran et al. 2019; Reed et al. 2020a*), also through the theoretical work of his student Holly Preece who showed how tides affect the way hot subdwarfs oscillate (*Preece et al. 2019a)*, which in turn is influenced by how their interiors boil (*Preece et al. 2019b)*. New classes of pulsating star continue to be discovered. In each case, the oscillation requires a driving mechanism, and in many cases it is novel. For instance, blue large-amplitude pulsating stars were first identified only recently in 2017 and in a theoretical study AOP student Conor Byrne and Simon Jeffery demonstrated how the pulsation of these stars is due to a specific layer within them where iron concentrates and to the intrinsic way with which this element absorbs light (*Byrne & Jeffery* 2020). Satellites such as TESS are also perfect instruments to study the accretion process in binary stars. One such study was of the system called CD Ind which Ramsay and colleagues *(Hakala et al 2019)* were able to observe the accretion stream tracking around the magnetic field of the white dwarf. Computer modelling was able to predict how the accretion flow interacted with the magnetic field and where it impacted the white dwarf.

The role of GOTO

The announcement of the discovery of gravitational waves from merging black holes by an international team in February 2016 was met with world-wide acclaim and the award of the Nobel Prize for Physics the following year. It was the fruit of half a century of building instruments with the exquisite sensitivity required to detect passing gravitational waves and opens up an entirely new way of studying the universe. Because of the way the detectors work and where they are located, the exact position in the sky of the merging black holes is not known. Instead the location is constrained to a wide arc of the sky spanning hundreds of square degrees (the Moon has an apparent diameter of 1/2 degree). If astronomers were able to locate the optical counterpart of the gravitational wave event it would be possible to derive much more information about it and on the underlying physics of the black holes.

AOP was able to become a partner of the international project the Gravitational-wave Optical Transient Observer (GOTO) through a successful bid for funds from DCAL in Jan 2015. Its prime goal is to detect the optical counterpart of gravitational wave events. The first GOTO node of telescopes is located on the summit of the island of La Palma in the Canaries, which is one of the world's best sites to observe the night sky. In the summer of 2019 GOTO made a successful bid to the STFC for £3.2M to allow a second node to be built on La Palma and one node in Australia. AOP was able to secure additional investments from DfC, which together with our international partners should secure the funding of a second node in Australia which would complete our vision of imaging the whole sky every few nights.

Although the prime aim of the project is to detect the optical counterpart of gravitational wave events, the data products will prove to be a treasure trove of information which will allow for the study of supernovae, X-ray transients, interacting binaries, pulsating stars, flare stars, comets and asteroids. It has already led to the discovery and announcements of many supernovae through the Transient Name Server sponsored by the IAU Supernova Working Group. It will be a resource for astronomers at AOP and be an excellent educational tool. In fact, they already form the basis an on-going PhD project funded by STFC. Gavin Ramsay is a member of the GOTO Executive Board that oversees and manages the project, in particular the expansion of the La Palma node and the development of the Australian node. Although the project is still at an early stage, the publications using GOTO data will start to bear fruit over this coming year.

Solar Physics and Stellar Flares

Introduction

Although the aurora (or Northern Lights in the northern hemisphere) has been known for thousands of years, it wasn't until Richard Carrington observed a white light flare on the Sun in 1859, which was followed by aurora only 18 hours later that were recorded in Armagh, that the connection with the Sun was first made. These auroral storms can also cause disruption to human activity – in 1989 the electricity grid in Canada was disrupted by a flare from the Sun causing widespread blackouts. Today such an event is listed in the UK Governments Risk Register. The first flares were seen from low-mass dwarf stars nearly a century ago. In the optical they generally appear as a rapid brightening (by factors up to 4,000) followed by a slower decline and have now been seen at all electromagnetic wavelengths. Research into stellar activity from all types of stars is now very topical for at least three reasons: it can mask or indeed give false positive detections of exoplanets; stellar flares could affect the chemistry of the atmospheres of exoplanets making them unsuitable for life forming, and thirdly that large scale ground based surveys and missions like *Kepler*

and *TESS* have been used to search for activity cycles on stars across the main sequence which gains insight to their magnetic field and how often super-flares might occur on the Sun.

Recent results

Solar research this year continued to focus on small-jet features involving colleagues from India and our nearest neighbour, Queen's University Belfast. Projects included: (i) observations and modelling of a jet launched by a filament eruption (*Doyle et al. 2019b)* (ii) the observations of rapid forced reconnection in the solar corona *(Srivastava et al. 2019)* (iii) multi-wavelength observations of rotating features called "swirls" *(Shetye et al. 2019)* These projects involved data from the Swedish Solar Telescope, the Solar Dynamics Observatory and the Interface Region Imaging Spectrograph.

The Armagh stellar flare group (Gerry Doyle, Lauren Doyle and Gavin Ramsay) continue to use *K2* and *TESS* data to study flares from low-mass M stars and Solar type stars. Indeed, the aim of Lauren's thesis (completed in May 2020) was to compare Solar eruptions and flares from stars which have internal properties that are quite different to Solar type stars. Studies of the Sun have shown that sunspot activity and solar eruptions are strongly correlated – regions of the Sun with many sunspots are found to be the typical point of origin for most solar flares. Using TESS data, the Armagh stellar flare group found that in M dwarfs stellar flares do not appear to originate from large active star spots. Furthermore, there are a number of stars which are very rapidly rotating but do not show flares. This is unexpected since more flares are expected from stars which are rapidly rotating *(Doyle, Ramsay & Doyle 2019a).* Furthermore, in the last chapter of her thesis, Lauren Doyle not only found that Solar-type stars show evidence of a connection between star spots and flares, but also observed several "super-flares" capable of affecting the chemistry of the atmosphere of any exoplanets that might be orbiting these stars.

The role of IST and I-LOFAR

IST The Inouye Solar Telescope (previously known as DKIST) saw its first light in January 2020, producing the highest resolution image of the Sun's surface ever taken, enabling the study of features as small as 30km (18 miles) in size at a distance of 150 million kilometres. AOP became involved in the project 6 years ago when, via a special call from Department for Culture Arts and Leisure (DCAL), funding was awarded to assist in building detectors for three of the telescope's instruments. In collaboration with Queen's University Belfast we set-up the UK DKIST Consortium, which then received funding from the Science & Technology Facilities Council. Coupled with funding from various UK universities and Andor Technology in excess of £4m was raised, most of which went directly into the Northern Ireland economy. It is the Andor detectors that captured the first-light image which was published world-wide, demonstrating how the involvement in such a major international project raises the profile of Northern Ireland, Armagh and AOP on the international stage of science.

IST is the largest solar telescope in the world with a focus on understanding the Sun's explosive behaviour. The telescope reveals features that are three times smaller than anything seen before and does so multiple times a second. Observing the fingerprints of atoms and ions throughout the solar atmosphere will help us explain the dynamic nature of the Sun and solar-like stars, giving us opportunities for discoveries of processes we had no idea existed. The first call for research proposals will be in May 2020. Gerry Doyle and his PhD student Nived Nhalil will be involved in this project over the coming years.

LOFAR (Low Frequency ARray) is a flagship European science project that is revolutionising our understanding of the Universe, attracting students into careers in science and technology and driving new developments in IT. It consists of an international network of antennas spread across seven countries including the Netherlands, Germany, England, Poland, France, Sweden and, most recently, Ireland. I-LOFAR, the Irish station, is in the grounds of Birr Castle, which AOP was able to join as a partner thanks to a DCAL capital contribution in 2016 aimed also at strengthening North/South STEM cooperation, resonating with Armagh's and Dunsink's involvement in the first North/South agreement since partition to build the Armagh-Dunsink-Harvard (ADH) telescope in South Africa in 1947.

In collaboration with DIAS, AOP have jointly appointed a new Lindsay student who will use I-LOFAR and the full LOFAR array to explore plasma emission bursts produced by coronal shock fronts and plasma emission bursts produced by coronal shock fronts on the Sun and in other low-mass stars. Gerry Doyle and Gavin Ramsay have recently obtained LOFAR time to look for coronal mass ejections from an active low-mass dwarf star but in general the low-frequency radio emission of M dwarfs is currently poorly explored. These radio observations will be complemented by optical data from GOTO and TESS to study stellar flares and in particular to further constrain the incidence of super-flares on solar-like stars and their impact for the habitability of planets around them. In this respect, TESS will allow the observation of ~400 Solar-type stars over the span of several months which will be the equivalent of observing the Sun for thousands of years.

Solar System Studies

Introduction

Our Solar System is an extraordinary natural laboratory to study the formation and evolution of planetary systems around the Sun and other stars. Our work here feeds into fundamental questions about how the Solar System and the Earth formed and the development of life in the Universe. Our study of comets, asteroids and planets impacts on models of solar system formation, the ever-present hazard to civilization if asteroids or comets hit our planet and on the origin of water and organic compounds necessary for life to exist. The space industry benefits from improved detailed knowledge and understanding of the near-Earth and interplanetary environment.

Recent results

At AOP Apostolos Christou leads the study of the so-called Trojan asteroids, which exist within gravitational "safe havens" that precede and follow planets as they move around the Sun. Mars is the only inner rocky planet with such Trojan companions. The first of such Mars Trojans, discovered 30 years ago, was named "Eureka" in reference to the famous exclamation by Ancient Greek mathematician Archimedes. In previous work, Christou and STFC post-doctoral assistant Galin Borisov found more Mars Trojans near Eureka and that indeed the members of this “Eureka family” share the same chemical composition. Many such families exist in the asteroid belt between Mars and Jupiter and are thought to be the results of ancient, gigantic collisions. With colleagues from Italy, the US and Chile, the AOP team found that the Eureka family was probably created not by a collision, but through the slow action of solar radiation *(Christou, Borisov et al. 2020).* Indeed, over many millions of years this has the effect of spinning up small asteroids like Eureka, until eventually they come apart and the pieces end up forming a new family of asteroids. Furthermore, radiation from the Sun will then go on to cause the smaller pieces to drift apart and escape their Trojan safe havens. This process could therefore account for the formation of many non-Trojan asteroids, forming a new paradigm of Trojans as “asteroid nurseries”. This project required access to supercomputers to run simulations, which was secured by a successful funding bid to DfC by Gerry Doyle allowing AOP to buy shared access to the RoI High Performance Computing (HPC) facilities with the Dublin Institute of Advanced Studies (DIAS).

Apostolos Christou also completed work as lead author of a review chapter to appear in a new book by Cambridge University Press. The book is written by an international cadre of experts on meteoroids, the Solar System’s smallest objects and is intended to become the standard reference text in the field. The chapter deals with the relatively new subject of “extra-terrestrial meteors’’, in other words the meteor or “shooting star” phenomenon as it occurs on planets other than the Earth. The book, which is also co-edited by AOP meteor expert and AOP visiting fellow David Asher, was published in October 2019.

The COMET INTERCEPTOR Space Mission

The European Space Agency (ESA) recently approved a space mission to encounter a comet coming from the edge of our Solar System; the launch is expected in 2028. A novel idea sets this mission apart. So far, spacecraft have approached comets that are already well known and have gone around the Sun already several times. Therefore, it is very likely that the comet material has been “processed” by solar radiation and the space environment, and it is no longer in pristine condition. By contrast, here we are interested in comets on their first trip around the Sun, made of unprocessed material preserved in the cold outer parts of the solar system. To achieve the goal of visiting such a new comet, the spacecraft will be launched before the comet is found and will wait in deep space for instructions. Once a suitable target comet is found, instructions will be sent from the ground to guide the spacecraft to the comet (hence the name **Comet Interceptor**). Studying the material brought for the first time to the heat and light of the Sun will give us the opportunity to look at the solar system as it was when it formed. AOP is contributing to the development of the instrument that will send to Earth comet images (including polarimetric images) obtained with a fish-eye lens. Stefano Bagnulo is an expert in polarimetric observations and a member of the mission team. The images to be obtained from Comet Interceptor will show the view from inside the comet as the spacecraft flies through it and encounters jets of dust and gas emanating from the comet nucleus.

High Energy Astrophysics

Introduction

High energy astrophysics is one of the most important and exciting areas of contemporary astronomy, involving the phenomena and physical processes that produce the most energetic photons and particles in the Universe. It allows the study of the properties of matter under physical conditions which cannot yet be reproduced in the laboratory and relates to some of the most dramatic astrophysical phenomena, such as supernovae explosions, the mergers of neutron stars and the origin of gravitational waves, the accretion of matter onto black holes and the acceleration of particles at near light speed in collimated galactic-scale jets. For the most part, high energy astrophysics necessitate space telescope observations, so the drive to fully understand the astrophysical engines of powerful X-ray or gamma-ray sources goes hand in hand with the space industry and innovation.

Results

Key to understanding the astrophysical engines generating high-energy particles is to know their exact distance, since this allows to deduce how intrinsically powerful such sources are. In this respect, Michael Burton assisted in the radio measurements that were instrumental to pin down the distance to a new supernova remnant clouds (SNRs) almost on the opposite side of the Milky Way with respect to our Solar system *(Maxted et al. 2019)*. This helps in validating SNRs as the prime candidate sources of Galactic cosmic rays with energies up to several PeV – comparable to the most energetic particles that can be produced on Earth in the CERN Large Hadron Collider in Switzerland. Another Galactic source of high-energy radiations are high-mass X-ray binaries (HMXBs), where one of the stars is a compact remnant of stellar evolution (a neutron stars or a stellar-mass black hole) that emits X-ray light as it accretes matter received from its companion star. HMXBs are exceptional astrophysical laboratories that offer a rare glimpse into the physical processes of both massive stars and compact objects. With his expertise in stellar winds, Andreas Sander has been instrumental in the modelling efforts to understand an important subset of the HMXBs where the compact objects accrete matter solely from the stellar winds of the donor stars *(Hainich et al. 2020).*

The study of how accretion of matter on stellar mass-black hole works may also apply to larger systems such as supermassive black holes (SMBHs) at the centre of galaxies, which in turn is key to understand how SMBHs could affect the evolution of their host galaxies. Indeed, when clouds of gas or stars happen to fall into SMBHs, their surrounding regions become incredibly active, giving off fantastic amounts of energy in the form of light or jets of energetic particles. In turn, these are thought to be capable of shutting down the formation of new stars in galaxies, either directly by expelling all gas in them or indirectly by warming it up to very high temperatures, which also prevents gas from being converted into new stars. Thanks to VLT observations he obtained for M87 – the massive galaxy whose central SMBH was recently imaged thanks to Event Horizon Telescope observations – Marc Sarzi has contributed to confirming that indeed through their jets SMBHs can make the gas surrounding galaxies more turbulent and hot *(Li et al 2020)*. Conversely, Marc Sarzi's student Boris Nedelchev conducted a comprehensive study of over 600,000 nearby galaxies with active SMBHs and found little or no evidence that these could expel their galaxy host gaseous material, questioning the direct role of SMBHs in halting star formation in galaxies *(Nedelchev, Sarzi & Kaviraj 2019)*.

CTA – the Cherenkov Telescope Array

The Cherenkov Telescope Array (CTA) is an international project to establish the world's first observatory for astronomy in the extreme gamma-ray energy range of the spectrum. More than 1,500 scientists from 31 countries are involved in the project, which will equip sites in the northern and southern hemispheres – in La Palma in the Canary Islands and on the Atacama plateau in Chile – with an array of telescopes. CTA will provide an order-of-magnitude improvement in sensitivity over existing instruments, with substantial gains in angular resolution and energy range. CTA will be transformational for gamma ray astronomy, and a cornerstone of multi-messenger investigations combining data from gravitational wave detectors, longer wavelength electromagnetic observations and neutrino detectors. CTA will investigate topics from fundamental physics, such as searches for dark matter and evidence for axions and quantum gravity, through to astrophysical questions, including particle acceleration, relativistic jets, and the role of high energy particles in star and galaxy formation.

AOP's vision is to be renowned as a centre of excellence for research, education, inspiration and outreach in space and science. This requires continual and sustained efforts to renew, refresh and revitalise both the organisational expertise and infrastructure to ensure that AOP is well-placed to anticipate, maximise and respond to emerging opportunities within the fields of astronomy and space research. AOP has joined the CTA project in response to such an emerging opportunity. AOP is a member of the UK consortium participating in the CTA, together with the Universities of Oxford, Durham, Leicester and Liverpool. The STFC has provided the principal support for the UK's participation in the CTA, with the DfC facilitating AOP's participation in the UK consortium. This will help ensure that Armagh and Northern Ireland can be full participants in a world leading international scientific project with corresponding worldwide name recognition. The UK consortium is leading the design and development of one of the prototype camera systems being built for the telescope, the CHEC camera (Compact High Energy Camera), able to respond to cascades of blue photons that are generated when gamma rays from celestial sources strike the top of the Earth's atmosphere. These cascades last for only a few billionths of a second, making them extremely challenging to record.

AOP is also providing science support for the CTA project through the provision of complementary survey data obtained with the Mopra radio telescope that shows with unprecedented detail the distribution of the cold molecular gas clouds – the very fuel of star formation – within the Milky Way Galaxy. This contribution is important to CTA because much of gamma ray emission from our Galaxy is produced by the interaction of ultra-high energy cosmic rays with the nuclei of molecules found in these cold gas clouds. The Mopra survey will therefore provide the "template" of the distribution of these nuclei needed in order to interpret gamma ray images that the CTA will produce.

AOP is further contributing to UK leadership in the provision of outreach to the CTA project, bringing our expertise in planetarium shows and technology. We are developing a short planetarium show illustrating the multi-wavelength

universe and introducing the CTA as the new tool to explore the universe at the highest energies. This is being written for Digistar planetariums and will made publicly (and freely) available through the Digistar cloud.

Education and Community Outreach

Planetarium
Armagh Observatory and Planetarium is a special place that brings together fundamental research and public curiosity about the nature of the cosmos, all within a heritage environment that is rich in scientific history. Four pillars underlie and support the public programme of AOP; education, inspiration, entertainment and outreach. The Planetarium was established in 1968 and is world-renowned as an innovative centre of excellence in promoting the public understanding of science.

At the Planetarium, the primary activity is the education and the distribution of scientific and astronomical knowledge. The Planetarium also strives to promote public understanding of astronomy and science to a large audience base of all ages, from nursery to seniors via a school's educational programme and science offering to the wider public. Several new programmes have been implemented this year to target additional audiences such as a weekly toddler takeover which is of benefit to the community and brings in repeat visitors on a weekly basis. These visitors tend to be local and thus they are being introduced to the Planetarium at a young age and will grow up through our different programmes of activity. Another audience that we have targeted are those that are interested in a differential experience and something that is unique, and we achieved that through merging science with music and art. Our programme of Dome Nights began with an hour show in our dome where the music of Holst was enjoyed alongside moving imagery of the planets to a packed audience. It is an aim to continue these unique experiences in the future with different music ranging from classical to U2 to Pink Floyd. We also developed a programme dedicated to Junior Cycle education in the south of Ireland and have had successes this year in targeting Junior Cycle classes to attend for morning sessions.

The unique selling point of the Planetarium is the digital theatre in the Dome, which brings visitors on a journey through the cosmos to the furthest reaches of our Universe like never before – all from the comfort of a seat in Armagh. The education staff deliver interactive and engaging presentations which have received positive feedback from schools and the general public. Some of the topics that are concentrated on have been meteorite impacts, the planets, current astronomical phenomena and Earth sciences. Through the large number of visitors coming through its doors the Planetarium also plays a key role in promoting and enhancing tourism within the Armagh City, Banbridge and Craigavon Borough Council area.

This year we put additional focus on our online presence in terms of keeping people interested and up to date on astronomy news. Astronomical understandings are part of our everyday lives today through topics such as daylight savings time, Moon phases, the seasons, the calendar both meteorological and astronomical to name but a few. By posting about these occurrences and items such as the ISS flyover times, we create a hub of instant information and AOP becomes known as the place to come for astronomy information that is trusted.

One of the major challenges this year came after the successful February half-term. It had been planned for the Planetarium to close-down for three weeks to complete an exciting upgrade of the digital theatre with works also planned on our shop and café. Unfortunately, just as the upgrade began the first impacts of Covid-19 in Northern Ireland began to be felt, with the installation team recalled by their company after having dismantled the current projectors. All schools bookings, corporate bookings and external outreach events have had to be cancelled amid the pandemic. However, the education team have excelled during this time with online activities, interviews, experiments for kids and competitions to name but a few. We are focussed on keeping the public engaged with AOP and have done this through providing dome shows online in partnership with Evans and Sutherland. Having increased our Facebook followers by over 2,000 as well as increases on other online platforms, we will keep engaging with the public during the coming months in 2020-21 financial year and look forward to re-opening our doors once again at the earliest opportunity.

Highlights from AOP's Programme of Events in 2019-20
During 2019-20 AOP had two major events to celebrate. The 50th anniversary of the fall of the Bovedy meteorite which fell in Northern Ireland and the major global 50th anniversary was that of the Apollo 11 Moon landing. AOP wanted to be the place and hub for both of those celebrations and thus began the hashtag #placeforspace.

The build-up to both anniversaries began early in the year and to solidify our anniversary message we were able to attend the SportsNI schools event held in Newtownabbey in April where we delivered outreach activities and gave marketing materials to over 800 primary school pupils. We also began an outreach marketing event around shopping centres such as Rushmere in Craigavon, Victoria Square and The Quays in Newry. These outreach events brought a lot of attention to our events and were very successful.

In April the Bovedy celebrations began when we held an art-meets-science event through artist Noel Connors. Noel created an art piece that was put together with moving images on the Planetarium dome called "Bovedy illuminations".

This was exhibited in the Planetarium and in the Armagh Marketplace Theatre. A dedicated Bovedy meteorite event was held on the anniversary day of the fall of the meteorite with talks from a variety of astronomers and the Gilmore family from Bovedy (who found and donated the meteorite to the Planetarium) were in attendance.

In June we were privileged to host the Institute of Physics Teachers conference where the IoP delivered activities to secondary school teachers. This was a great event where we made links with secondary school teachers.

In July we began a series of events starting with Heroes and Legends where the Planetarium was full of Sci-Fi characters, sets and props and was followed by Minecraft workshops the following week. We also started a new outdoor tour of our Astropark grounds which proved to be a very popular add-on to visitors coming for a dome show. The tour, which lasted an hour, was taken by our education staff and some of our PhD students. It allowed us to make use of our outdoor space and has given us ideas and scope for further development in this area.

The IAU exhibition "Above and Beyond" came to Armagh on the 17 July and we organised the exhibition to be exhibited around Armagh with the County Museum, Armagh Robinson Library, No. 5 Vicars' Hill and the Market Place Theatre all involved in hosting a piece of the exhibition. We had 5,000 views of the exhibition over three weeks. The major event that we had planned was for the Apollo 11 Moon Landing 50th anniversary. Called "Museum of the Moon on the Mall" we installed Luke Jerram's Museum of the Moon as the centrepiece in the middle of the Mall in Armagh. Surrounded by activities such as Moon caricatures, balloon modelling and live music we had over 6,000 visitors to the Mall and 3,200 recorded as coming up to the Planetarium for dome shows over a two-day event. The Moon was particularly spectacular at night and many people came late at night to see the amazing feature. Along with the event we launched a new dome show "CapCom Go!" which was extremely well received. Given that The Open Golf was held in Portrush on the same weekend we were extremely happy with the crowds that turned up at the event.

AOP hosted the Irish National Astronomy Meeting (INAM2019) in the Planetarium during September using the Copernicus Hall for the conference presentations, together with the planetarium theatre for additional presentations. This is the annual gathering of the professional astronomy community across the island of Ireland. The meeting featured contributions from both the research and education arms of AOP. The public lecture was delivered by Professor Garret Cotter of Oxford University on the "Mysteries of Black Holes and the Big Bang". INAM was immediately followed by hosting the British Astronomical Association (BAA) in the Observatory and the Planetarium. The BAA is the leading society for amateur astronomers in the UK, who chose to hold their annual meeting in Armagh in 2019.

A new dome show "Unseen Universe" was premiered in the Planetarium in October in the presence of Lord and Lady Rosse from Birr Castle. Unseen Universe tells the story of the emerging field of multi-messenger astronomical discovery, i.e. of observations of the cosmos made outside the traditional optical portion of the spectrum. The story started, however, with the discovery of the spiral nebulae made with the Leviathan Telescope at Birr by the 3rd Earl of Rosse and Armagh's 3rd Director, Romney Robinson, in the middle of the 19th century, opening the realm of the galaxies to humanity's exploration of the cosmos. The dome show was written by Terrence Murtagh, who had served as the 3rd Director of the Armagh Planetarium. The occasion revived the rich historical links between Armagh and Birr, adding to an AOP staff engagement day held in Birr in July.

During the October half-term for the first time we screened a dedicated Halloween dome show which brought in repeat visitors. The show proved to be very popular and we had to hold two additional screenings daily during the half-term.

In November a special event was held for viewing the transit of Mercury across the Sun, an event which happens 13 times per century, on average. This involved a workshop conducted for schools in the Planetarium, followed by viewing the transit from telescopes placed on the Human Orrery, as well as through the Grubb 10-inch telescope in the Robinson Memorial Dome. 4th Director of the Observatory JLE Dreyer viewed the transit of Mercury with this telescope in 1914, used for compiling the NGC catalogue, with the very last observations he made with the instrument. A transit of Mercury was also observed by James Archibald Hamilton in 1782, which led to his appointment as the first Director of Armagh Observatory in 1790. Further, the telescopes from AOP's King George III collection were displayed in the Board Room during the event, including the Short telescope that King George used to observe the transit of Venus from his palace in Kew in 1769.

Also in November the 13th Robinson Lecture (held in memory of the Observatory's founder, Archbishop Robinson) was delivered in the Planetarium by Professor Monica Grady of the Open University, on the topic of "Collisions and Catastrophes". Professor Grady also delivered the Robinson School's lecture at Lismore Comprehensive School in Craigavon on the topic of "Are We Alone", attended by the A-level physics classes of several local schools.

In December we ventured into another first ever event at AOP with "Mission Santa". We wanted to provide a different experience for visitors over Christmas and merged Santa with science and astronomy. We had 2,295 people who experienced Mission Santa with sell-out shows. The feedback from this event was extremely positive and many people commented how it was the best Christmas family event they had attended.

Other events during the year included providing guided tours of the Observatory and Astropark (such as on European Heritage Day and Armagh Georgian Day). Our regular programme of StarTrackers continued this year and were well attended as well as a new venture into arts and dome shows through our Dome Nights Planets 360 event when we sold out our theatre show for a journey through the planets to Holst's Planet Suite music. We kept links with the ABC council through other events such as the 7 Hills Blues Festival. A-Level pupils were attracted to courses held at the Planetarium which was held onsite and then online due to the Covid-19 pandemic. We also launched a new junior Cycle programme for schools in the south, whilst staff also attended the Royal Belfast Hospital for Sick Children to deliver science to children who were in hospital for extended stays. This provided light relief to children during long hospital stays. Regular engagement with popular events such as Museum Week, World Space Week, Maths Week, the NI Science Festival continued this year.

As previously mentioned, the Covid-19 pandemic had a major effect on our March activities with school visits, corporate bookings and outreach visits cancelled. It effected our annual attendance which was on course to meet the 55,000 visitor target this year – but we are committed to keeping our audience engaged, to making meaningful links with other people and getting the AOP brand and name out there nationally and even internationally as well. Through our marketing activities we have a steady stream of good news stories circulating from AOP and we will continue this work into the 2020-21 financial year.

History and Heritage

History & Heritage Policy

As the custodian of many valuable and historic scientific instruments, scientific records, books, journals and artworks, Armagh Observatory and Planetarium is proud of its rich and deep history and heritage. Our heritage policy is to progressively restore the historic buildings, scientific instruments, and historic books and other archives in our possession, placing the restored material where possible, on display, or close to its original location in the Grade A-listed Georgian Observatory building. The objective is to maintain the integrity of the Library, Archives and Historic Scientific Instruments as a coherent collection for future generations in the City of Armagh and to preserve this historic material and improve the environmental conditions in which it is held. We seek to widen access to this material where possible so that researchers, visitors and future generations will be able to enjoy our collection, access our material for individual research projects and appreciate more clearly the context in which the historic material was first acquired and then transferred into the 'museum' collection. Eleven virtual tours are available online through our website (www.Armagh.space).

In pursuance of our heritage objectives AOP has been working to achieve the Museum Accreditation Standard. The Accreditation Scheme is the industry standard for museums and galleries. The Scheme outlines and guides organisations towards best practice in the management and governance of museums. The Scheme does this by supporting and encouraging museums to meet agreed standards in how they: run the museum; manage their collections; and engage with their users.

During 2019-20 AOP continued to develop and implement a wide-ranging Project Plan for museum accreditation. The plan encompasses key areas including planning, management and governance; resource planning; security assessment and planning; collections care, conservation and development; and understanding and developing the experience for users. This work involves developing, updating and implementing comprehensive policies and procedures for the management and care of our collections. For this purpose, AOP engaged the services of an experienced museum expert from its sister museum, the Armagh Robinson Library.

The work being undertaken in these areas is helping AOP ensure that our collections and museum offering are managed sensitively with due consideration being given to the needs of the research function in a full-time operational scientific institution. A collections management system has been obtained, and work has started to migrate the existing MySQL data bases for the archives and the library into it. This work will also support us in catering for the needs of visitors and in meeting the conservation and preservation requirements of our valuable collections.

Library & Archives

The Observatory's suite of technical equipment is complemented by a Library and Archives which, together, represent one of the premier specialist collections of their kind in the world. The Library, Archives and Historic Scientific Instruments collection contains a unique variety of historic books and manuscripts, images, photographic plates, scientific instruments, clocks and other artefacts concerning the development of modern astronomy from the Age of Enlightenment up to the present day with specific reference to the important discoveries and scientific contributions made by the international research community here at Armagh. In recent years more than 25,000 records have been added to the on-line, publicly accessible archives and library database, with many linking to associated images or digitized documents. The library catalogue, containing over 3,000 entries, is also available on-line (www.armagh.ac.uk).

Meteorological Record
As part of the organisation's primary research role, staff take daily readings of a wide range of meteorological parameters at Armagh and maintain the Observatory's unique 225-year long meteorological record and databank. This is believed to be the longest daily climate series in the UK and Ireland from a single site and one of the longest in the world. The climate station has been continuously maintained since December 1794 with readings currently taken every day at 09:00 (GMT). The World Meteorological Organisation (WMO) has recognised Armagh with centennial station status for its longevity and importance in contributing to the climate record.

Calibration of these data has enabled researchers and government agencies to use the Armagh series for reports and research into global warming. The data contributes to the UK Meteorological Office's main climate database and are released to the general public on a monthly basis through press releases and on our climate website (http://www.climate.armagh.ac.uk/archives.html) whilst also contributing to the UK Meteorological Office's main climate database.

Climate change is a subject of strategic importance for Northern Ireland as we move into an era of rapid climate variability, and the Armagh's unique climate record provides an exceptionally long historical baseline, enabling better informed judgements to be made as to how Northern Ireland's climate has responded and is responding to climate change world-wide.

The Met Office has now declared the automated weather station fully operational, following a period of data validation. This will now provide the primary source of key weather data in the Met Office records (e.g. temperature, pressure, rain fall, windspeed) since it is automatically uploaded to the Met Office. However, manual collection will still continue, and provides the only source for some of the data collected (e.g. sunshine) at Armagh. Maintaining the collection of the meteorological data has been prioritised over the Covid-19 lockdown period, and has continued uninterrupted..

Gravity Station
On August 29, 2019 the Ordnance Survey of Northern Ireland conducted their first measurements of the acceleration due to gravity, *g*, from Armagh using a Gravity Station beside the stone circle on top of the Hill of Infinity. The preliminary value found for *g* is 9.814 554 151 5 m s^{-2} with an error of around 10 nm s^{-2} (i.e. of +/- 1 in the penultimate digit). This is easily the most accurate measurement ever made of the acceleration due to gravity in Armagh. An article in the Astronotes blog giving further information on this measurement (https://armaghplanet.com/measuring-earths-gravity-at-aop.html).

Support

AOP is committed to ensuring fit for purpose governance and support services to support the delivery of organisational objectives.

ICT
The comprehensive research computer facilities are used primarily for numerical analysis, computer modelling and data reduction. The computers and peripherals are largely funded by the Department, but occasionally by external research grants. Staff require access to high-end Apple Mac and Linux workstations.

A review and modernisation programme of ICT requirements to include Research, Education and Corporate needs was further progressed in 2019-20 to ensure compliance with GDPR and other information security requirements and use of modern and accessible operating environments. An internal audit of IT Security and Systems was conducted providing satisfactory assurance.

Finance
AOP now has a well-established finance function. Financial policies and procedures are continually being enhanced to ensure that the organisation meets the governance standards required. This includes the application of public sector procurement controls, meeting prompt payment targets and providing regular and ad hoc financial information within the organization and to DfC.

It has been recognised since the establishment of the new management structure that AOP's core budget is not sufficient to service the needs of the organisation as outlined in an approved strategic review. In 2019-20 an additional resource allocation to meet the agreed gap was provided along with the core allocation. This greatly assisted AOP to manage its finances more effectively and to bid for in-year funding for projects to add value and support delivery of objectives.

Human Resources
A Human Resources strategy has been developed and approved and the Action Plan for 2019-20 included:

- Restructuring and recruitment – ongoing
- Policy and Procedures review – complete
- Engagement and Culture – annual employee survey and engagement events completed

An internal audit of HR was completed during the year resulting in an overall 'satisfactory' rating. All of the recommendations made were either implemented before year end or scheduled to be implemented in the first quarter of 2020-21.

Governance
Governance and accountability continue to be strengthened and improved and risk reduced as demonstrated by external and internal audit reviews.

Estates Management
AOP manages an extensive estate which includes 9 separate buildings, including the Grade A listed Observatory and a 14 acre historic estate. There are also a number of leases associated with land and property.

During the year AOP continued to evaluate the options, risks, adequacy and sustainability of the current government subvention for AOP as outlined in its approved Strategic Outline Case for future development. This included completion of a Conservation Management Plan and other surveys to support development of an outline business case to ensure heritage assets are protected and develop the estate to meet future needs.

Achievements and Performance

The targets set for the Armagh Observatory and Planetarium in the 2019-20 Business plan are shown in the following table. The actual performance achieved is shown along with the corresponding achievement for the previous financial year (where appropriate).

While targets were achieved or exceeded in many areas, a number were not met. It is challenging to maintain a credible PhD student programme. AOP had been on target to exceed visitor numbers in part due to its ambitious Summer 2019 and Christmas 2019 programmes, however a 3-week planned closure for dome equipment upgrade was unavoidably extended due to the Covid-19 pandemic and associated restrictions. A new pre-OBC stage was introduced to support AOP's long-term strategy in light of which the original target was rendered unachievable. Whilst the target set in respect of improving employee satisfaction there was an improvement in the percentage of responses ranked >3 and a recognition that some of the questions were not appropriate.

Theme	KPI	Description	Target	As at 31 March 2020	Progress	As at 31 March 2019	Comments
Research	**1**	Number of articles published in refereed scientific journal publications in 2019-20	50	68	136%	66	
	2	Maintain a credible PhD student programme of 12 PhD students (10 students by 31/3/20) 2018-19 target had been to increase baseline back to 12 students at any one time by 2021	10	9	90%	REVISED KPI	Achieving an annual intake of 3 PhD students per year is an important objective for continuing the vitality of AOP's research programme. This is, however, challenging to achieve.
	3	Enhancement of AOP research environment (10 research visitors during 2019-20)	10	14	140%	NEW KPI	
Education and Community Outreach	**4**	Increase visitor numbers to 55,000 by 31/3/20	55,000	52,693	96%	44,301	Visitor numbers effectively relate to 10-month period. Planetarium closed from 24 February. Planned 3-week dome upgrade remains incomplete due to impact of Covid-19 pandemic on work.
	5	Visits from schools who have not visited in the last 5 years (10 new schools during 2019-20)	10	27	270%	NEW KPI	
	6	Visits from schools eligible for Extended Schools Programme (% of total school visitors by 31/3/20)	40%	51%	127.5%	48%	
	7	Post Primary School pilot (5 schools during 2019-20)	5	7	140%	NEW KPI	
	8	Visit from community groups outside normal target audience of schools and families (20 group visits by 31/3/20)	20	54	270%	NEW KPI	
	9	Increase tours promoting AOP wider assets (Astropark, Observatory) (30 events during 2019-20)	30 events	61	203%	NEW KPI	
History and Heritage	**10**	Progress long-term strategy (by 31/3/20 to have developed an OBC for consideration by DfC/DoF)	OBC completed		15%	NEW KPI	With DfC approval, in June 2019 a 'pre-OBC' stage was introduced to address gaps in data and evidence required to complete OBC and be in a better position to progress in 2020-21. The pre-OBC stage work plan is 80% complete. Study visits were curtailed due to coronavirus pandemic and Q4 feasibility work was not possible due to delay in procuring and completing
Leadership and Governance	**11**	Improve Employee Satisfaction at work through increased training, development etc (Achieve above 50% average ratings 4 or higher in December 2019 employee survey)	50% average ratings 4 or higher		34%	NEW KPI	It must be noted that the percentage of average rating of >3 has increased. Based on comments received and discussion within the Project Juno group it is agreed that some of the questions are not appropriate and a new survey should be developed in 2020.
	12	Increase income from commercial activity (admissions, facility hire, shop and café sales) (£260,000 gross income by 31/3/20 (from £239,000 actual gross income in 2018-19))	£260,000	£307,497	118%	£160k (admissions only)	

Financial Review: Armagh Observatory and Planetarium

Operating Results

In the financial year to 31 March 2020, the value of charity funds decreased by £451,941, summarised below.

			2020	2019
			£	£
Total incoming resources			3,750,857	2,574,744
Total outgoing resources			(3,281,374)	(2,897,663)
Net income / (expenditure)			**469,483**	**(322,919)**
Gains/(losses) on the revaluation of fixed assets			28,576	(71,033)
Actuarial gains/(losses) on defined benefit pension scheme			(950,000)	281,000
Net movement in funds for the year.			**(451,941)**	**(112,952)**
Movement in Unusable Funds				
Capital financing				
	Capital grants received		1,452,000	292,600
	Government grant fund		(513,873)	(495,198)
Revaluation reserve			(189,179)	(265,950)
Pension reserve			(1,147,000)	200,000
Movement in Usable Funds				
Restricted			25,669	(112,559)
Unrestricted			(79,558)	268,155
			(451,941)	**(112,952)**

The total income for the year was £3.751m, an increase of £1.176m from 2018-19, mainly due to an increase in capital grant income.

Expenditure was £3.281m, an increase of £0.384m from the previous year. Staff costs remain the largest component of operational expenditure. The number of permanent staff in post is consistent with the previous year.

Unrestricted operating costs are funded primarily by Departmental Grant-in-aid. The balance of such unrestricted operating costs is funded by contributions from external grants, trading activities and miscellaneous income. We continue to seek other funding streams to maintain this important source of funds. In 2019-20 the Department provided 84% of the total income through recurrent and capital grant allocations (2018-19: 79%).

Net Assets

Net assets at 31 March 2020 were £8.837m (31 March 2019: £9.288m).

Reserves

Armagh Observatory and Planetarium has total accumulated funds of £8.837m at 31 March 2020 (31 March 2019: £9.288m). The reserves policy is included in note 1 of the accounts. Funds are as follows:

Funds at 31st March	**2020**	**2019**
	£	£
Restricted funds	142,129	116,460
Unrestricted funds	3,572,759	2,714,190
Revaluation Reserve	7,516,629	7,705,808
Pension Reserve	(2,395,000)	(1,248,000)
Total Charity Funds	**8,836,517**	**9,288,458**

Going Concern

The Trustees are satisfied that the organisation is a going concern on the basis that it has a reasonable expectation that it will continue in operation for the foreseeable future. The financial statements are therefore prepared on a going concern basis

Pension Liability

Armagh Observatory and Planetarium is a member of Northern Ireland Local Government Officers' Superannuation Committee (NILGOSC) which manages Local Government Pension Scheme (LGPS) Northern Ireland, which in turn provides a defined benefits pension to employees. The scheme is currently in deficit and at 31 March 2020 the deficit was calculated by independent actuaries at £2,395,000 (2019: £1,248,000).

Key Risks and Uncertainties

At year end, the key risks were identified as:

- Lack of sufficient funding to continue growth and support a thriving research organisation (including impact as a result of Covid-19);
- Failure to achieve implementation of new Digistar equipment; and
- Failure to be able to function effectively due to risk from coronavirus restrictions.

As part of the Risk Management Strategy, management regularly review the inherent level of risk for each of the above and how the risk is currently managed. An Action Plan is documented to reduce the level of risk, mindful of the risk appetite of the organisation. This Risk Register is reviewed on a quarterly basis by the Audit and Risk Assurance Committee and approved by the Management Committee. Many of the above risks derive from the uncertainty around funding. Until Armagh Observatory and Planetarium has both a budget appropriate to its needs and long-term security of funding, this situation is likely to continue. In managing these funding risks, the organisation has developed and maintained close communication links with the Department and submitted in-year monitoring bids for additional funding while carefully monitoring spend and budgets.

The above risks also take account of recommendations from internal and external audit investigations and reports. Significant progress has been made in addressing the weaknesses identified in previous years and considerable effort has been put into the management of these risks going forward.

Plans for Future Periods

Progression of an Outline Business Case, in partnership with the Department, the local council and other stakeholders with an interest in developing on or adjacent to the estate is also a high priority.

In addition to this, furtherance of the organisation's core activities in research, education and outreach and history and heritage are set out in its business plan for 2019-20.

AOP submitted a Business Plan for 2020-21 for consideration by DfC. The Business Plan was produced prior to the Covid-19 pandemic and it is recognised that many of the objectives and targets are no longer achievable.

AOP will follow closely the Northern Ireland Executive Recovery Plans and forward plan in accordance the guidance provided. However, AOP anticipate that Covid-19 will impact its public facing services for the remainder of 2020-21. AOP is reassessing budget projections and expenditure accordingly.

Structure, Governance and Management

The Armagh Observatory and Planetarium is a single statutory corporation and arms-length body (ALB), 'The Governors of the Armagh Observatory and Planetarium' are as described in *The Armagh Observatory and Planetarium (Northern Ireland) Order 1995*.

This 1995 Order superseded the original 1791 Act of the Irish Parliament entitled '*An Act for Settling and Preserving a Public Observatory and Museum in the City of Armagh For Ever*', and an Amendment of 1938 ('The University and Collegiate and Scientific Institutions Act [Northern Ireland], 1938').

The Armagh Observatory and Planetarium is a registered charity.

Board of Governors

The Armagh Observatory and Planetarium is governed by a Board of Governors. Membership of the Board of Governors consists of:

- the Church of Ireland Archbishop of Armagh;
- the Dean of the Church of Ireland Cathedral of Armagh;
- the other members of the Chapter of the Church of Ireland Cathedral of Armagh;
- one Department nominee;
- one Queen's University Belfast (QUB) nominee; and
- up to three additional members nominated by the Board of Governors.

The Armagh Observatory and Planetarium (Northern Ireland) Order 1995 (the Order) places a statutory duty on "the Governors of Armagh Observatory and Planetarium" to maintain and manage Armagh Observatory and Planetarium with the purpose of "developing and improving the knowledge, appreciation and practice of astronomy and related sciences."

In accordance with paragraph 8(1) of Schedule 1 of the Order, the Governors have delegated primary responsibility for the governance and management of Armagh Observatory and Planetarium to a Management Committee.

The Board of Governors (the Board) has retained a role to ensure that the culture and character, history and patrimony embodied in Armagh Observatory and Planetarium are protected and preserved and that the institution is managed in line with the statutory purpose outlined in the Order. This role will normally be fulfilled through an Annual Review meeting (visitation) where the Board will receive assurance as to the management and performance of Armagh Observatory and Planetarium from the Management Committee.

Management Committee of Armagh Observatory and Planetarium

The Board has delegated primary responsibility for the governance and management of Armagh Observatory and Planetarium to a Management Committee. The Management Committee has corporate responsibility for ensuring that Armagh Observatory and Planetarium fulfils the aims and objectives set by the Department and approved by the Minister and for promoting the efficient, economic and effective use of resources. The Management Committee provides leadership, challenge, oversight, support and encouragement to the Chief Executive and staff.

The Management Committee comprises:

- three nominees from the Board of Governors;
- six nominees from the Department appointed through open competition;
- one nominee of Queen's University, Belfast;
- one nominee of the Science and Technology Facilities Council (STFC);
- one nominee of the Dublin Institute for Advanced Studies (DIAS);
- a Chair appointed through open competition; and

- up to three additional members co-opted by the Board of Governors. This is by exception and subject to Departmental approval.

Audit and Risk Assurance Committee (ARAC)

The ARAC is a sub-committee of the Management Committee established in accordance with DAO (DFP) 06/13 - Corporate governance in central government departments: Code of Good Practice NI 2013, and in line with the HM Treasury Audit and Risk Assurance Committee Handbook (DFP 05/14) to advise the Board of Governors, the Management Committee and the Director of Armagh Observatory and Planetarium as Accounting Officer and to support them in their responsibilities for issues of organisational risks, internal control, governance and their associated assurances and in reviewing the reliability and integrity of these assurances.

Staffing Policy and Remuneration Committee

The Staffing Policy and Remuneration Committee is a sub-committee of the Management Committee and advises it on employment issues and provides assurance that Armagh Observatory and Planetarium employment policies and practices are compliant with legal and statutory requirements.

Further details on the membership of these Committees is set out in the Governance Statement on pages 25 to 34.

Reference and Administrative Details

Name of the Charity

The charity is registered and operates under the name of the Governors of the Armagh Observatory and Planetarium.

Charity number

Registered with the Charity Commission for Northern Ireland 103498

Principal Office

College Hill, Armagh, BT61 9DG

Trustees (and Board of Governors)

Archbishop Richard Clarke, (Chair, retired 2 February 2020)
The Very Rev Dean G Dunstan
The Venerable Archdeacon T Scott
The Venerable Archdeacon A Forster (resigned 7 December 2019)
Rev Canon W J A Dawson
Rev Canon W M Adair
Rev Canon R J N Porteus
Rev Canon Dr P Thompson
Rev Canon J Moore
Rev Canon D Hilliard
Rev Canon B Paine
Professor R Oudmaijer
Mr W G Berry
Professor A Hibbert
Professor A Fitzsimmons (from 18 April 2019)
Mr R Wilson (from 1 December 2019)

Director and Accounting Officer

Professor Michael Burton

Auditors

Northern Ireland Audit Office, 106 University Street, Belfast, BT7 1EU

Internal Auditors

Grant Thornton (NI) LLP, 12-15 Donegall Square West, Belfast, BT1 6JH (3 year contract ended 31 March 2020).

Cavanagh Kelly, 36-38 Northland Row, Dungannon, BT71 6AP (effective from 1 April 2020).

Bankers

Danske Bank, Donegal Square West, Belfast, BT1 6JS.

Register of Interests

A Register of Interests is maintained for Board and Committee Members and the Executive Team and is available for inspection at the Principal Address. Declared Interests by Board and Committee Members and the Director are available on AOP website – www.armagh.space.

Related party transactions are shown in note 22 of the accounts.

Personal data related incidents

Armagh Observatory and Planetarium has considered the requirement to report personal data related incidents. It is content that there were no such incidents in the year ended 31 March 2020.

Disclosure of Audit Information

So far as the Accounting Officer is aware, there is no relevant audit information of which AOP's auditors are unaware. The Accounting Officer has taken all necessary steps to make himself aware of any relevant audit information and to establish that the AOP's auditors are aware of that information.

Events after the end of the reporting period

Apart from issues arising from the Covid-19 pandemic discussed elsewhere in this report, there were no events since the end of the financial year requiring disclosure.

Archbishop John McDowell
Chair of the Board of Trustees
Date: 21 September 2020

Professor Michael Burton
Chief Executive
Date: 21 September 2020

Remuneration and Staff Report — Armagh Observatory and Planetarium

Remuneration Policy

Board Members

Board members do not receive any remuneration. They receive travel and subsistence allowances at rates and on conditions determined by Armagh Observatory and Planetarium, subject to Departmental approval. No Board member receives pension benefits or makes pension contributions in their capacity as a Board member.

Senior Managers

The Chair of the Board of Trustees or his nominee is responsible for monitoring and reviewing the performance of the Chief Executive in accordance with the SCS Pay Strategy.

The Chief Executive is responsible for monitoring and reviewing the performance of the Senior Managers in accordance with The Northern Ireland Civil Service Pay Strategy.

Pay and Conditions of Service

The staff of Armagh Observatory and Planetarium, (other than post-doctoral research assistants who were paid in accordance with academic scales in use by Queens University, Belfast) are subject to levels of remuneration within the general NICS pay structure, as approved by the Department and Department of Finance. Current terms and conditions for staff are those set out in its Employee Handbook.

Policy on duration of contracts, notice periods and termination payments

Senior staff, including the Chief Executive, are permanent employees of Armagh Observatory and Planetarium. The notice period for senior staff is three months. Termination payments are in accordance with contractual terms and those of the principal Civil Service Pension Scheme (NI).

The following tables provide details of the remuneration and pension entitlements of the Director of the organisation.

Remuneration (Audited Information)

Single Total Figure of Remuneration						
	Salary (£'000)		**Pension Benefits (to nearest £'000)**		**Total (£'000)**	
Official	**2019-20**	**2018-19**	**2019-20**	**2018-19**	**2019-20**	**2018-19**
M.G. Burton	80-85	80-85	27,000	27,000	105-110	105-110

The value of pension benefits accrued during the year is calculated as (the real increase in pension multiplied by 20) plus (the real increase in any lump sum) less (the contributions made by the individual). The real increases exclude increases due to inflation and any increase or decrease due to a transfer of pension rights.

Pension Entitlements (Audited Information)

Official	**Accrued pension at pension age as at 31/03/20**	**Real increase in pension at pension age**	**Accrued Lump Sum at 31/03/20**	**Real Increase in Lump Sum**	**CETV at 31/03/20**	**CETV at 31/03/19**	**Real Increase in CETV**
	£'000	**£'000**	**£'000**	**£'000**	**£'000**	**£'000**	**£'000**
M.G. Burton	5-10	0-2.5	0	0	86	59	19

The CETVs above have been calculated in accordance with guidance from the Department of Finance in Employer Pension Notice EPN09/2020. When calculating the real increase in CETV and the pension benefits accrued during the year 2019-20 for the single total figure of remuneration, NILGOSC takes account of inflation. The CPI increase for September 2019 was 1.7%. The in-service revaluation rate for the Career Average Revalued Earnings Scheme was also 1.7%.

1. The Director of Armagh Observatory and Planetarium is the person in a senior position having authority and responsibility for directing and controlling the activities of the organisation.

2. The salary of Director shown above is based on the Northern Ireland Senior Civil Service Grade 5 pay scale. No bonus was paid in the year and the Director received no benefits in kind.

3. The service contract of the Director of Armagh Observatory and Planetarium commenced on 01 August 2016.

4. Pension benefits are provided through the Northern Ireland Local Government Officers' Superannuation Committee Pension Scheme (NILGOSC).

5. Retirement pension will be based on 1/49th of salary paid in year and pension is based on career average earnings. Details can be obtained at http://www.nilgosc.org.uk.

6. The real increase in pension payable, lump sum and cash equivalent transfer value (CETV) shown above have been adjusted to take account of inflation and market investment factors. The CETV figures include the value of any pension benefit in another scheme that the individual has transferred to NILGOSC.

7. A CETV is the actuarially assessed capitalised value of the pension scheme benefits accrued by a member at a particular point in time. The benefits valued are the member's accrued benefits and any contingent spouse's pension payable from the scheme. A CETV is a payment made by a pension scheme to secure pension benefits in another scheme when the member leaves a scheme and chooses to transfer the benefits accrued in their former scheme.

Pay Multiples of Permanent Employees (Audited Information)

	2019-20	**2018-19**
Band of highest paid director's total remuneration (£'000)	80-85	80-85
Median total remuneration*	£33,896	£30,971
Ratio	2.43	2.65

*Total remuneration includes salary. It does not include severance payments, employer pension contributions and the cash equivalent transfer value of pensions.

Reporting bodies are required to disclose the relationship between the remuneration of the highest paid worker in the organisation and the median remuneration of the organisation's workforce. The banded remuneration of the highest paid director in 2019-20 was £80,000 - £85,000 (2018-19: £80,000 - £85,000). No employee received remuneration in excess of the highest paid director. Remuneration of permanent employees ranged from £18,000 to £81,000 (2018-19 £18,000 to £82,000).

Total Staff Costs (Audited Information)

	Permanent staff	**Others[1]**	**2020**	**2019**
	£	**£**	**£**	**£**
Wages and salaries	1,014,841	193,623	1,208,464	1,183,424
Social security costs	101,100	1,994	103,094	96,201
Employer's pension contributions	203,379	2,302	205,681	185,815
Defined benefit pension additional service cost	166,000	-	166,000	46,000
Termination costs	-	-	-	92,500
	1,485,320	197,919	1,683,239	1,603,940

[1] *"Others" includes £164,369 for agency staff*

Average staff numbers

	Permanent staff	**Others[2]**	**2020 Number**	**2019 Number**
Average staff numbers	23.3	9.9	33.2	30.6

[2] *"Others" includes 1.4 fixed term, 3.7 casuals and 4.8 agency staff*

Staff banding

The number of employees whose employee benefits (excluding employer pension costs) exceeded £60,000 was:

	2020	2019
£80,001 - £90,000	1	1

Staff Composition – employed (full time equivalent)

	Male	Female
Directors/senior managers	2.6	2.0
Other employees	10.9	12.9

Local Government Pension Scheme (LGPS) Northern Ireland

The Local Government Pension Scheme (Northern Ireland) is a defined benefit scheme, which will provide benefits on a career average revalued earnings basis from 1 April 2015. Prior to this date pension benefits were calculated on a final salary basis.

From 1 April 2015 a member will build up pension at a rate of 1/49th of their pensionable pay each year. Any membership during the period from 1 April 2009 to 31 March 2015 provides for a retirement pension calculated at the rate of 1/60th of pensionable pay for each year of membership. Before 1 April 2009 a member of the Scheme accrued retirement benefits at the rate of 1/80th (pension) and 3/80ths (tax-free lump sum) of their pensionable pay for each year of membership up to 31 March 2009. At retirement, members may give up some pension for additional lump sum, subject to HM Revenue and Customs (HMRC) limits. The conversion rate is £12 additional lump sum for every £1 of pension given up.

The Scheme is funded by contributions made by both employees and employers who have been designated as employing authorities or admitted to the Scheme. Prior to 1 April 2009, employees' contribution rates were fixed at 6% of their pensionable remuneration (except for those who were entitled to contribute to the scheme at 5% before 1 February 2003 and have remained in continuous employment). Tiered employee contribution rates, determined by the whole-time equivalent rate of pay, were introduced from 1 April 2009. The rates applicable for 2019-20 were:

Pensionable Pay	Contribution Rate
£0 - £14,800	5.5%
£14,801 - £22,600	5.8%
£22,601 - £37,700	6.5%
£37,701 - £45,700	6.8%
£45,701 - £90,400	8.5%
More than £90,400	10.5%

Employer contribution rates are determined by the Scheme's actuary every three years. Following the results of the 2019 actuarial valuation, the Committee agreed with its actuary the employer contributions and deficit recovery contributions for the following three years, effective from 1 April 2020. The next valuation is due as at 31 March 2022.

Sickness Absence

Staff absenteeism for the period 1 April 2019 to 31 March 2020 was 47 days (2019: 128.5 days) which equates to an average per FTE of 0.72% (2019: 2.66%).

Staff Policies

As an equal opportunities employer, Armagh Observatory and Planetarium does not discriminate against staff or applicants for posts on any grounds, including disability. Care is taken to ensure the needs of disabled applicants are considered in the application process. Armagh Observatory and Planetarium also considers and introduces reasonable adjustments to support the employment of people with disabilities and to support the continuing employment of staff who have a disability.

Armagh Observatory and Planetarium is committed to the priorities as set out in legislation on equality, disability, discrimination, health and safety, child and vulnerable adult protection, data protection and freedom of information.

Expenditure on External Consultancy
Expenditure on external consultancy during the year was £nil (2018-19: £nil).

Off-payroll Engagements
There were no "off-payroll" engagements in place as at 31 March 2020, nor were any arrangements entered into between 1 April 2019 and 31 March 2020.

Exit Packages (Audited Information)

Exit package cost band	No of compulsory redundancies	No of other departures agreed	Total no. of exit packages by cost band	Total no. of exit packages by cost band
	2019-20	2019-20	2019-20	2018-19
£90,001-£100,000	-	-	-	1
Total no. of exit packages	-	-	-	1
Total resource cost	Nil	Nil	Nil	92,500

Signed:

Professor Michael Burton
Accounting Officer for the Armagh Observatory and Planetarium

Date: 21 September 2020

Statement of the Responsibilities of the Governors and Accounting Officer

Under the Audit and Accountability (Northern Ireland) Order 2003 the Governors are responsible for keeping proper accounts and proper records in relation to the accounts, and for preparing a statement of accounts in respect of each financial year in such form and containing such information as the Department, with the approval of the Department of Finance, shall direct.

The Accounting Officer has personal responsibility for the propriety and regularity of the public finances for which he is answerable and for the keeping of proper accounts. He is required to sign the accounts thereby accepting personal responsibility for their proper presentation and to sign the Governance Statement. The Accounting Officer's relevant responsibilities, including his responsibilities for the propriety and regularity of the public finances and for the keeping of proper records, are set out in Managing Public Money Northern Ireland.

The accounts are prepared on an accruals basis and give a true and fair view of the organisation's state of affairs at the end of the financial year and of its income and expenditure, total recognised gains and losses and cash flows for the financial year. The accounts have been prepared in accordance with the Statement of Recommended Practice applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102). The financial statements comply with the guidance issued by the Department of Finance on the form and contents of the Annual Reports and Accounts of Executive Non-Departmental Public Bodies and in particular:

- suitable accounting policies have been selected and applied consistently (subject to changes arising on the adoption of new accounting standards);
- reasonable and prudent judgements and estimates have been made;
- applicable accounting standards have been followed, subject to any material departures disclosed and explained in the financial statements;
- the financial statements have been prepared on the going concern basis, unless it is inappropriate to presume that the organisation will continue in business.

The Accounting Officer is also responsible for safeguarding the assets of the organisation and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities.

Statement of Disclosure of Information to the Auditors

So far as the Accounting Officer of the Armagh Observatory and Planetarium, in office at the date of the approval of these financial statements, is aware:

- there is no relevant audit information relating to these respective charitable organisations of which the auditors are unaware;
- he has taken all the steps that he ought to have taken as Accounting Officer in order to make himself aware of any relevant audit information relating to these charitable organizations and to establish that the auditors are aware of that information;
- he confirms that the Annual Report and Accounts as a whole is fair, balanced and understandable; and
- he confirms that he takes personal responsibility for the Annual Report and Accounts and the judgements required for determining that it is fair, balanced and understandable.

Armagh Observatory and Planetarium: Governance Statement

1. Compliance with Corporate Governance Code

In March 2019 the Department of Finance published Partnerships between Departments and Arm's Length Bodies: NI Code of Good Practice. The Code aims to set out principles of good practice which can be applied to derive greater value from, and bring consistency to, relationships between departments and Arm's Length Bodies.

Armagh Observatory and Planetarium in so far as they are relevant for an arms-length body, complies with the principles of good practice in the Code.

2. Financial Reporting

The Board of Governors, Management Committee and Directors of the Armagh Observatory and Planetarium are required to prepare a statement of accounts for each financial year to be laid before the Northern Ireland Assembly. The accounts are prepared to show a true and fair view of the Organisation's financial activities during the year and the financial position at the end of the year.

In preparing the Armagh Observatory and Planetarium accounts, the Board of Governors and Management Committee of the Armagh Observatory and Planetarium are required to:

- comply with the Government Financial Reporting Manual (FReM);
- observe the accounts direction issued by the government, including the relevant accounting and disclosure requirements, and apply suitable accounting policies on a consistent basis;
- make judgments and estimates that are reasonable and prudent;
- state whether applicable accounting standards and statements of recommended practice have been followed, and disclose and explain any material departures in the financial statements;
- prepare the financial statements on the going concern basis, unless it is inappropriate to presume that the Armagh Observatory and Planetarium will continue in operation.

3. Governance Framework

Accounting Officer

Name	Accounting Officer
Professor Michael Burton – Director and Chief Executive, Armagh Observatory and Planetarium	From 1 September 2016 onwards

Board of Governors

The Armagh Observatory and Planetarium is governed by a Board of Governors. Membership of the Board of Governors consists of:

- the Church of Ireland Archbishop of Armagh;
- the Dean of the Church of Ireland Cathedral of Armagh;
- the other members of the Chapter of the Church of Ireland Cathedral of Armagh;
- one DfC nominee;
- one Queen's University Belfast (QUB) nominee; and
- up to three additional members nominated by the Board of Governors.

During 2019-20 Archbishop Clarke, Chair of the Board of Governors, retired. There was also one resignation from and one appointment to the Chapter of the Church of Ireland Cathedral of Armagh and hence the Board of Governors. In addition, the QUB nominee position was replaced and an appointment to the vacancy from within the Board of Governors nominees made.

BOARD OF GOVERNORS			
GOVERNOR	**DATE OF APPOINTMENT**	**DATE OF EXPIRY**	**MEETINGS ATTENDED (max. 1)**
Chair: Archbishop Richard Clarke	15 December 2012	Retired – 2 February 2020	1
The Dean Very Rev G Dunstan	4 December 2011	None	1
The Venerable Archdeacon T Scott	9 November 2006	None	0
The Venerable Archdeacon A Forster	11 October 2015	Resigned – 7 December 2019	1
Rev Canon W M Adair	10 September 2008	None	0
Rev Canon W J A Dawson	1998	None	0
Rev Canon D Hilliard	13 March 2016	None	0
Rev Canon J Moore	13 March 2016	None	1
Rev Canon W B Paine	7 May 2017	None	0
Rev Canon R J N Porteus	1998	None	0
Rev Canon Dr P Thompson	13 January 2019	None	1
Professor A Fitzsimmons	18 April 2019	1 May 2024	1
Professor R Oudmaijer	20 November 2008	None	1
Professor A Hibbert	28 March 2014	None	1
Mr R Wilson	1 December 2019	30 November 2024	n/a
Mr W G Berry	1 January 2011	31 December 2020	1

At the annual meeting on 22 May 2019 the Board of Governors reviewed the minutes from the Management Committee and the Audit and Risk Assurance Committee meetings between June 2018 and March 2019 (draft). The Board formally retrospectively approved the Annual Report and Accounts 2017-18 and granted the Archbishop delegated authority to sign off the Annual Report and Accounts 2018-19; considered the Management Report for 2018-19 which included the Director's Report, Corporate Plan Objectives; Key Performance Indicators, Finance Budget Report to March 2019 and the Risk Register as at 24 April 2019 and approved the draft 2019-20 Business Plan.

The Board is satisfied that comprehensive arrangements are in place to ensure that high-quality information is received to enable it to make informed decisions. Internal controls are in place to validate the accuracy and completeness of information presented to the Board.

Minutes of the meeting records the business carried out and actions agreed.

Management Committee of Armagh Observatory and Planetarium

The Management Committee comprises:

- a Chair appointed through open competition;
- three nominees from the Board of Governors;
- six nominees from DfC; (one vacant)
- one nominee of the Queen's University, Belfast;
- one nominee of the Science and Technology Facilities Council (STFC);
- one nominee of the Dublin Institute for Advanced Studies (DIAS); and
- up to three additional members co-opted by the Board of Governors. This is by exception and subject to Departmental approval.

During 2019-20 a one year extension was granted to two of the DfC nominees until 31 December 2020 and three DfC nominees were extended for another term until 30 April 2023. There remains one vacant DfC nominee position on the Management Committee. The Board of Governors replaced one of its nominees and made a nomination to the vacant Board of Governors' position.

MANAGEMENT COMMITTEE			
MEMBER	**DATE OF APPOINTMENT**	**DATE OF EXPIRY**	**MEETINGS ATTENDED (max. 4)**
Chair: Mr J Briggs	1 January 2018	31 December 2022	4
Professor T Ray	4 March 2009	None	3
Professor M Merrifield	1 January 1999	None	0
Professor R Oudmaijer	20 November 2008	None	2
Mr B Hannam	1 January 2011	Up to 31 December 2020	4
Dr M McKay	1 January 2011	Up to 31 December 2020	4
Professor L Harra	1 November 2014	30 April 2023	4
Mr S Brown	1 November 2014	30 April 2023	4
Mr P McGurgan	1 November 2014	30 April 2023	3
Professor M Mathioudakis	11 November 2016	10 November 2021	3
Canon D Hilliard	7 June 2016	10 June 2019	0
The Dean: Very Rev G Dunstan	10 June 2019	9 June 2024	4
Mr R Wilson	1 December 2019	30 November 2024	2

During 2019-20 the Management Committee considered a wide range of business. The Committee received regular updates from its two sub-committees, the Audit and Risk Assurance Committee and the Staffing Policy and Remuneration Committee and approved relevant reports. Regular governance reports such as the Bi-Annual Assurance Statement, the Risk Register, Key Performance Indicators and Finance monitoring reports were reviewed and approved. The Management Committee also received updates on progress in delivering the AOP Vision. The Management Committee will continue to guide and contribute to AOP Vision.

During 2019-20 the Management Committee also considered its role and effectiveness in shaping the vision and future direction of AOP. Two facilitated sessions were held to consider this and the Chair will take forward actions and recommendations arising from these discussions during 2020-21.

Internal controls are in place to validate the accuracy and completeness of information presented to the Management Committee.

Minutes of the meetings record the business carried out and actions agreed.

Audit and Risk Assurance Committee

The Audit and Risk Assurance Committee is drawn from the Management Committee and comprises a minimum of four and maximum of five members.

AUDIT AND RISK ASSURANCE COMMITTEE	
MEMBER	**MEETINGS ATTENDED (max. 4)**
Chair: Mr B Hannam	4
Professor L Harra	4
Mr P McGurgan	3
Mr S Brown	4

During 2019-20 the Audit and Risk Assurance Committee considered reports from Internal Audit on progress against their audit plan and progress on outstanding recommendations; reports from external audits on the 2018-19 Annual Report and Accounts; review of the Accounting Officer's Governance Statement and Assurance Statements and the Board's Assurance Statement and review of risk registers.

The Committee is satisfied that the integrated approach, the frequency of meetings, the breadth of the business undertaken and the range of attendees at meetings of the Committee has allowed the Committee to meet the governance requirements of the organisation and assisted the Management Committee to demonstrate its stewardship of the public resources with which it is charged.

The Committee is satisfied that the organisation now has robust risk management arrangements in place which are in line with the good practice in the HM Treasury 'Orange Book' and are reviewed regularly by the Management Committee.

The Committee is also satisfied, from the evidence provided at meetings that a detailed work programme exists with the aim of implementing the recommendations arising from Internal Audit and External Audit. Significant progress has been made in implementing outstanding recommendations.

Minutes of the meetings record the business carried out and actions agreed.

Staffing Policy and Remuneration Committee

The Staffing Policy and Remuneration Committee aims to meet quarterly, prior to the Management Committee meetings.

The Committee advises the Directors, Management Committee and/or Board of Governors when there are specific matters relating to the terms of employment, temporary promotions and pay to be considered.

In 2019-20, amongst other matters, the Committee considered the areas of:

- Staffing Structures including Temporary Employment;
- Recruitment;
- Review of Terms and Conditions of Employment and Employment Policies; and
- was updated on a range of Human Resources issues including progress against a Human Resources Strategy and Action Plan.

The Committee comprises four named members of the Management Committee.

EMPLOYMENT CONDITIONS AND REMUNERATION COMMITTEE	
MEMBER	**MEETINGS ATTENDED (max. 4)**
Chair: Professor T Ray	3
Dr M McKay	4
Mr S Brown (chaired December meeting)	4
Mr J Briggs	4

Conflicts of Interest

The organisation also maintains a register of interests to ensure that potential conflicts of interest can be identified and addressed in advance of Board, Management Committee and other Committee discussions. The register is formally revisited on an annual basis. Where conflicts exist, they are recorded in the Committee minutes and the Chair of the meeting decides the most appropriate way of managing the conflict which may include that member not taking part in discussions or making decisions on certain matters or being excluded for part/all of that meeting.

The Register of Interests Policy was reviewed in 2019-20, as a result, the completed Register of Interests for Board of Governors, Management Committee and senior staff will be published on the AOP website in accordance with central government guidance.

Directors and Secretary

Professor Michael Burton, Director and Chief Executive, Armagh Observatory and Planetarium

The Corporate Manager provides a range of secretarial support services to the Board of Governors, Management Committee, Audit and Risk Assurance Committee and Staffing Policy and Remuneration Committee.

4. Business Planning and Risk Management

Business Planning

The Mission of Armagh Observatory and Planetarium is:
"To advance the knowledge and understanding of astronomy and related sciences through interactive engagement and the execution, promotion and dissemination of astronomical research nationally and internationally in order to enrich the intellectual, economic, social and cultural life of all members of the community".

This aligns closely with the aims and objectives of AOP's sponsor - the Department for Communities (DfC) and also with the broader aims and objectives of the Northern Ireland Executive's Programme for Government. The organisation's unified Corporate Plan received Departmental approval on 6 November 2017.

The work of the Observatory encompasses both internationally acclaimed research and a unique cultural heritage — scientific, historical, architectural — as well as maintaining the unique daily climate series (the longest daily series from a single site in the UK and Ireland) and undertaking a world-class programme of science in the community, which complements the Planetarium's main business of education.

The Planetarium's main business is education, and all age and social groups are welcome to visit. The educational programmes and demonstrations are designed to include participation by children of pre-nursery age up to senior citizens and all age groups in between. The primary educational aim of the Planetarium is to endorse and promote the Science, Technology, Engineering, Arts and Mathematics (STEAM) agenda which promotes scientific careers to young people. All of the ancillary activities support the primary aim, with the additional target of offering excellent value for money, both to the visitors taking part and to the public purse. The Planetarium maintains a focus on being inclusive so that all children can enjoy the Planetarium experience.

Full details of all AOP's activities are provided in comprehensive Annual Reports which are available in hard copy on request or online at: www.armagh.space.

No Ministerial Directions have been given regarding the work of the Armagh Observatory and Planetarium.

Risk Management

Risk Management is an essential element of the Armagh Observatory and Planetarium's corporate governance framework and is closely linked to the system of internal control and business planning process. A robust risk management process assists AOP in identifying and managing issues which may hinder the achievement of objectives. The arrangements are regularly reviewed.

As well as ensuring that there is an effective system in place to deal with threats to AOP's aims and objectives, the organisation encourages a proactive approach to innovation and well-managed risk taking where there is potential to realise sustainable improvements in the organisation's research and educational services. For this reason the organisation's Risk Appetite is 'Open'.

The Management Committee sets the risk appetite for AOP. The Accounting Officer, Senior Management Team and other staff are responsible for ensuring that residual risks are reduced to a level as low as reasonably practicable and wherever possible consistent with the level of risk appetite established by the Management Committee.

Quarterly updates are provided to the Audit and Risk Assurance Committee on the development and implementation of the risk management process across AOP. The Audit and Risk Assurance Committee provides the Accounting Officer with objective advice on issues concerning the risk, control and governance of the organisation and the associated assurances. An update on the main points considered by the Audit and Risk Assurance Committee is provided to the Management Committee following each meeting.

In March 2020, the Court of Appeal upheld an earlier decision by the High Court in a case involving The Charity Commission for Northern Ireland whereby its enabling legislation does not empower any members of staff to discharge its statutory duties or functions of Commissioners. A similar situation pertains within AOP, in that the Armagh Observatory and Planetarium (Northern Ireland) Order 1995 does not make specific provision for the Governors to delegate their functions to management and staff. The legal implications for AOP have been considered by the Governors and DfC. As AOP does not award grants to other bodies, the court decision implies very low risk for AOP pending any required legislative changes. In addition, three Governors sit on the Management Committee which oversees key decision making.

5. Fraud and Information Risk

The Accounting Officer of the Armagh Observatory and Planetarium has overall responsibility for managing the risk of fraud including:

- developing a fraud risk profile and undertaking a regular review of the fraud risks associated with each of the key organisational objectives in order to keep the profile current;
- establishing an effective fraud prevention policy and fraud response plan, commensurate with the level of fraud risk identified in the fraud risk profile;
- designing an effective control environment to prevent fraud commensurate with the fraud risk profile;
- operating appropriate pre-employment screening measures;
- establishing appropriate mechanisms for reporting fraud risk issues, reporting significant incidents of fraud, and coordinating assurances about the effectiveness of fraud prevention policies to support the Governance Statement;
- liaising with the Audit and Risk Assurance Committee;
- ensuring that all staff are aware of the organisation's fraud prevention policy and know what their responsibilities are in relation to combating fraud;
- ensuring fraud awareness training is provided as appropriate and, if necessary, more specific fraud prevention training and development is provided to relevant staff;
- ensuring that vigorous and prompt investigations are carried out if fraud occurs, is attempted or is suspected by the establishment of a Fraud Investigation Oversight Group;
- ensuring, where appropriate, legal and/or disciplinary action against perpetrators of fraud;
- ensuring, where appropriate, disciplinary action against supervisors where supervisory failures have contributed to the commission of fraud;
- ensuring, where appropriate, disciplinary action against staff who fail to report fraud;
- taking appropriate action to recover assets and losses; and
- ensuring that appropriate action is taken to minimise the risk of similar frauds occurring in future.

Risks to data and information held by the organisation are owned and managed by individuals designated as information asset owners. The Executive Officer responds to requests for information under the Data Protection and Freedom of Information Acts following consultation with the Accounting Officer and the organisation's governing committees, as appropriate.

6. Governance and Accountability

The Organisation seeks to achieve excellence in good governance, in particular the precepts: (1) leadership; (2) effectiveness; (3) accountability; and (4) sustainability.

The Chair has a particular leadership responsibility for securing the sustainability and vitality of the organisation in the long term; giving advice and direction in formulating the organisation's forward look and overall strategy; ensuring that account is taken of guidance provided by the Minister or the Department; promoting the efficient and effective use of staff and other resources; encouraging high standards of probity amongst staff and Board and Committee members alike; and ensuring that the Board and its committees meet at regular intervals throughout the year and that the Minutes of meetings accurately record the decisions taken and, where appropriate, the views of individual Board members.

Within the Armagh Observatory and Planetarium, leadership was exercised by the Director and his Senior Management team who are responsible for the management and effective operation of their organisation. Their operational responsibilities include:

- developing, implementing and monitoring the strategic and operational plans;
- undertaking financial management and Accounting Officer responsibilities;
- managing and developing a team of highly qualified professional and administrative staff;
- identifying and attracting sources of external income;
- promoting their respective organisations in relevant local, national and international arenas; and

- promoting Public Understanding of Science with the objective of improving the level of scientific literacy in the community and to ensure a strong link with government policy and the STEM agenda.

Members of the Board of Governors and of the Management Committee and their various sub-committees exercise an effective challenge function on the leadership team in accord with their respective roles in the organisation. They also provide guidance and advice on strategic and operational matters such as Human Resource issues, accountability and relationships with stakeholders.

The members of these committees are drawn from a very wide community background within, and beyond, Northern Ireland, and provide the Organisation with a correspondingly wide range of expert knowledge and advice. All the committees of the Organisation operate with full transparency and accountability, and over the last year have proved effective in the discharge of their duties and responsibilities.

It was agreed by the Board of Governors and the Management Committee that the proposed governance changes arising from the Review removed the need for the current Board of Governors to complete an internal self-assessment of its effectiveness.

The Board of Governors and supporting Committees receive assurances from the Director and his Senior Management Team and Internal Audit that the governance and accountability processes are being managed effectively.

7. Sources of Independent Assurance

Internal Audit

Grant Thornton had been appointed as Internal Auditors for the 3 years 2017-18 – 2019-20. Their work was carried out in accordance with the Public Sector Internal Audit Standards.

The three year Audit Strategy was approved by the Audit and Risk Assurance Committee in September 2017 and the 2019-20 Audit Plan for the Internal Audit work in June 2019.

The Audit and Risk Assurance Committee considered reports on the following areas:

Audit Assignment	**Priority**	**Assurance Rating**
Human Resources Management		Satisfactory
HR Strategy and Policies	Low	
New Joiners Process	Low	
Recruitment Processes	Medium	
Flexi Working Hours and Annual Leave Forms	Low	
Staff Appraisal Forms	Medium	
Monitoring of Training	Medium	
Staff Absences	Low	
Financial Management and Reporting		Satisfactory
Financial Policies and Procedures Manual	Low	
Long Term Financial Planning	Low	
IT Systems and Security		Satisfactory
Information Security and Business Continuity	Low	
Governance of IT Policies, Processes and Procedures	Medium	
Access Management	Medium	
Internal Audit Follow Up-2019/20		

In terms of the Internal Audit Follow Up-2019/20, there were 22 outstanding items to be considered. Of these 13 had been fully implemented, 2 were no longer applicable and 7 items remained. Of these 2 were partially implemented, 1 low priority had not been implemented and 4 were not yet due.

An overall ‘satisfactory’ internal audit assurance opinion has been provided.

External Audit

The organisation is also subject to independent scrutiny from the Northern Ireland Audit Office. The Audit Office is independent of Government and is tasked by the Assembly to hold the Northern Ireland Departments and their Agencies to account for their use of public money. The Comptroller and Auditor General works closely with the Assembly's Public Accounts Committee which can require Accounting Officers and senior officials to account for their actions in relation to the management of public funds.

A representative from the Northern Ireland Audit Office is invited to all Audit and Risk Assurance Committee meetings.

8. Review of the Effectiveness of the System of Internal Governance

The system of internal governance is designed to manage risk to a reasonable level, rather than to eliminate all risk of failure to achieve certain policies, aims and objectives; it can therefore only provide reasonable and not absolute assurance of effectiveness. The system of internal governance is based on an ongoing process designed to identify and prioritise risks to the achievement of the Armagh Observatory and Planetarium policies, aims and objectives; to assess the likelihood of the events occurring and the impact should they be realised; and to manage the risks effectively, efficiently and economically. The system of internal governance has been in place in the Armagh Observatory and Planetarium for the year ended 31 March 2020 and up to the date of approval of the annual accounts, and accords with Department of Finance guidance.

As previously detailed in Section 3, the responsibilities of the Accounting Officer include the need to maintain a sound system of internal control which supports the achievement of the organisation's policies, aims and objectives. The review of the effectiveness of the system of internal governance has been informed by the assurances provided by relevant parties such as: Internal Audit and the Senior Management Team. Where weaknesses have been identified these have been promptly drawn, through normal reporting mechanisms, to the attention of the Audit and Risk Assurance Committee, Management Committee and/or Board of Governors, as appropriate.

The main procedures in place to monitor the effectiveness of the system of internal governance are as follows:

- ongoing independent assessment of the Observatory's research outputs;
- regular reports by financial staff on progress against principal financial targets and the projected financial outcome for the year and progress reports by staff responsible for major projects;
- detailed progress reports to the Management Committee and Board of Governors at their regular meetings and inclusion of performance measures and results against targets in the annual operating plan;
- annual reports on the system of internal control from internal auditors to the Audit and Risk Assurance Committee;
- regular Accountability meetings with officials from the Sponsor Department to consider operational and strategic issues and matters relating to the system of internal control;
- Bi-Annual Assurance Statements and ALB Quarterly Monitoring Data Collection Templates submitted to the Sponsor Department;
- periodic review of the Armagh Observatory and Planetarium Risk Register by the Audit and Risk Assurance Committee, the Management Committee the Accounting Officer and Senior Management Team and the Sponsor Department;
- continuous assessment of the quality of research through peer review of grant applications, applications for telescope time, and the submission of scientific papers to academic journals of international standing by Armagh Observatory staff;
- peer review of the research quality, capability and output of the Observatory, and through participation in an objective external Assurance Committee, which provide an opinion on the adequacy and effectiveness of the system and contain recommendations for improvement; and
- Report to those Charged with Governance from Northern Ireland Audit Office to the Audit and Risk Assurance Committee, the Management Committee and the Board of Governors on the annual accounts, providing an opinion on the state of affairs of the organisation and its total incoming resources and expenditure of resources.

All reports based on the internal audits include opinions on the adequacy and effectiveness of risk management and the control framework in place. These matters are considered by the Audit and Risk Assurance Committee and are reported by the Audit and Risk Assurance Committee Chair to the Management Committee and the Board of Governors.

A range of weaknesses identified in the organisation's control systems and internal governances are set out within the next section. Upon identification, plans were immediately put into place to addresses these issues.

9. Internal Governance Divergences

Update on Prior Years:

Of the 11 internal audit recommendations outstanding from previous years, there is 1 remaining medium recommendation, which is partially implemented, as follows:

Recommendation	Priority	Status
Oversight and management of external contracts should be formally allocated to an individual within the organisation	Medium	The Corporate Manager is now responsible - awaiting audit confirmation

Identification of New Issues:

Of the new issues identified by internal audit during 2019-20 there remain 6 outstanding, as follows:

Recommendation	Priority	Status
HR – a clear audit trail of Committee approval of HR Strategies and Policies; Policies to be reviewed and approved by SPRC prior to MC approval; Induction and Leavers Policies to be developed; Policies to be updated to reflect current practice and all HR Policies in use should be shared with relevant staff.	Low	Completed. Induction and Leavers policies approved March 2020. HR policies published on internal Sharepoint site for access by all staff.
HR – provide education/training on completion and use of staff appraisal forms; HR to sample check forms; follow-up of training and all forms to be retained on file.	Medium	Completed May 2020.
Financial Management – AOP to formally document its long-term financial planning in association with AOP's long-term strategy	Low	Long-term planning is not currently deemed feasible due to AOP funding structure. The matter is subject to ongoing management review.
IT Systems and Security – develop an Incident Management process document; define and list categories and response timing of information security incidents.	Low	Delayed to September 2020 in line with other IT policies and procedures below. On target for completion.
IT Systems and Security – develop annual review process for IT policies, processes and procedures; review draft IT policies; update all policies, processes and procedures with policy ownership, reviewers, names of documents and review dates; include 'Draft' in policy title until approved; mark as 'Final' when approved; maintain master policy database tracker; review 2003IT Information Security Policy and remove Incident Procedures and Data Protection Impact Assessment sections to create specific procedural documents; formally document environmental controls for server rooms; define frequency of changes to PINS/passcodes.	Medium	Target has been revised from June 2020 to September 2020 to reflect ongoing consultation in relation to policies.
IT Systems and Security – document procedures regarding employee's access upon termination of contract, agreement or employment in 2001IT Logical Access Policy; provide further detail to Section 6.2.6 and expand on the monitoring maintenance and provision of privileged accounts and document local administrator rights, including the roles and responsibilities of Astronomers and the processes and controls in place to manage the rights.	Medium	Target has been revised from June 2020 to September 2020. A process and timetable for agreeing procedural arrangements has been agreed.

During 2019-20, NIAO identified one important issue to be addressed by management in their areas of responsibility, as follows:

Recommendation	Priority	Status
While we recognise the difficulty in obtaining information from CPD and/or contractors on a timely basis in relation to capital works there is an onus on management to be able to substantiate that capital works accrued for in the year had been completed at the year end. As such, we recommend that management consider what other contemporaneous evidence that they can capture at the year-end to evidence the stage of completion of capital works. We note that AOP had intended to capture photographic evidence of the extent of works at 31 March 2020 however due to Covid-19 restrictions this was not possible.	2	AOP management recognise their responsibility to accurately ascertain and reflect the financial state of affairs at year end in accordance with generally accepted accounting principles. In future, where there are capital works just prior to year-end and in the absence of documentary evidence, we will make every effort to gather as much contemporaneous evidence as possible to substantiate capital expenditure records up to 31 March. Unfortunately, this action was frustrated by Covid-19 lockdown in March 2020.

10. Conclusion

The Armagh Observatory and Planetarium has an effective governance structure and is operating to a high standard of integrity and probity.

In signing this report, I have taken assurances, where available, from the Audit and Risk Assurance Committee and I will continue to monitor the Internal Audit and Northern Ireland Audit Office recommendations to ensure that all issues are appropriately addressed.

To the best of my knowledge this report provides a fair and accurate reflection of the business of the Armagh Observatory and Planetarium and of the status of the controls and checks that have been put in place to regulate and inform the organisation's committees.

Signed:  **Date: 21 September 2020**

Professor Michael Burton
Accounting Officer
Armagh Observatory & Planetarium

Armagh Observatory and Planetarium
Refereed Journal Publications: April 2019 – March 2020

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Armagh Observatory and Planetarium
Non Refereed Journal Publications: April 2019 – March 2020

Ackley K., et al., inc. **Ramsay G.**, 2019a, LIGO/Virgo S190814bv: no candidates from GOTO imaging observations, GRB Coordinates Network, 25337, 1, https://ui.adsabs.harvard.edu/abs/2019GCN.25337....1A

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Ackley K., et al., inc. **Ramsay G.**, 2020b, LIGO/Virgo S200225q: No notable candidates in GOTO imaging, GRB Coordinates Network, 27317, 1, https://ui.adsabs.harvard.edu/abs/2020GCN.27317....1A

Ackley K., et al., inc. **Ramsay G.**, 2020c, GRB 200306C: GOTO upper limits, GRB Coordinates Network, 27332, 1, https://ui.adsabs.harvard.edu/abs/2020GCN.27332....1A

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Belskaya I., et al., inc. **Borisov G.**, 2019, in EPSC-DPS Joint Meeting 2019. Polarimetry in study of near-Earth asteroids. pp EPSC–DPS2019–885

Borisov G., **Christou A.**, **Bagnulo S.**, Cellino A., Dell'Oro A., 2019, in EPSC-DPS Joint Meeting 2019. The lunar-like mineralogy of the Martian Trojan asteroid (101429) 1998 VF31. pp EPSC–DPS2019–1254

Burton M. G., 2019, Two hundred years old still going strong, Astronomy and Geophysics, 60, 5.10,

Cellino A., **Bagnulo S.**, **Christou A.**, Belskaya I., 2019, in EPSC-DPS Joint Meeting 2019. The unusual properties of (101955) Bennu, as found by OSIRIS-REx, were not unexpected. pp EPSC–DPS2019–89

Christou A., 2019, in AAS/Division of Dynamical Astronomy Meeting. Earth's missing Trojans: Lessons from Mars and the role of radiation forces. p. 100.06

Christou A. A., 2020, in IAU General Assembly. Testing the Yarkovsky-driven evolution of the Eureka cluster with LSST. pp 44–45, doi:10.1017/S1743921319003429

Christou A., Dell'Oro A., **Borisov G.**, Jacobson S., Cellino A., Unda-Sanzana E., 2019, in EPSC-DPS Joint Meeting 2019. Production and escape of Trojan asteroids by non-gravitational forces at 1.5 au from the Sun. pp EPSC–DPS2019–224

Cutter R., et al., inc. **Ramsay G.**, 2020, LIGO/Virgo S200213t: No notable candidates in GOTO imaging, GRB Coordi- nates Network, 27069, 1, https://ui.adsabs.harvard.edu/abs/2020GCN.27069....1C

Dermott S. F., **Christou A.**, Li D., 2020a, in IAU General Assembly. The common origin of family and non-family asteroids: Implications. pp 23–23, doi:10.1017/S1743921319003302

Dermott S. F., Li D., **Christou A. A.**, 2020b, in Elmegreen B. G., Tóth L. V., Güdel M., eds, IAU Symposium Vol. 345, IAU Symposium. The common origin of family and non-family asteroids: Implications for meteorites and NEAs. pp 281–282, doi:10.1017/S1743921318008591

Fraser Wyper P., **Doyle L.**, Scullion E., 2019, in Solar Heliospheric and INterplanetary Environment (SHINE 2019). Observations and MHD modelling of a confined filament eruption & helical jet. p. 106

Green M., et al., inc. **Ramsay G.**, 2019, in Tovmassian G. H., Gansicke B. T., eds, Compact White Dwarf Binaries.

Krugly Y., et al., inc. **Borisov G.**, 2019, in EPSC-DPS Joint Meeting 2019. Photometry and polarimetry of near-Earth asteroids (3200) Phaethon and (155140) 2005 UD. pp EPSC–DPS2019–1989

Li D., Johansen A., Mustill A., Davies M., **Christou A.**, 2019, in EPSC-DPS Joint Meeting 2019. Serving two masters: Triton as an immigrant planetary moon. pp EPSC–DPS2019–431

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Mong Y. L., et al., inc. **Ramsay G.**, 2020b, LIGO/Virgo S200302c: No notable candidates in GOTO imaging, GRB Coordinates Network, 27330, 1, https://ui.adsabs.harvard.edu/abs/2020GCN.27330....1M

Moutsouroufi K., et al., inc. **Christou. A.**, 2019, in EPSC-DPS Joint Meeting 2019. Evaluating introductory seminars on observational astronomy, using the Europlanet Evaluation Toolkit. pp EPSC–DPS2019–1749

Nezic R., **Bagnulo S.**, Jones G., **Borisov G.**, 2019, in EPSC-DPS Joint Meeting 2019. Polarimetric study of 8 Kreutz comets observed by STEREO. pp EPSC–DPS2019–1698

Rojas Montes E. Y., **Vink J.**, 2019, in Oskinova L. M., Bozzo E., Bulik T., Gies D. R., eds, IAU Symposium Vol. 346, IAU Symposium. Testing how massive stars evolve, lose mass, and collapse at low metal content. pp 98–101, doi:10.1017/S1743921319001297

Ramsay G., Kennedy M., Hakala P., **Jeffery C. S.**, 2019, Spectroscopic observations of AM CVn binary candidates MGAB-248 and MGAB-249, The Astronomer's Telegram, 13048, 1, https://ui.adsabs.harvard.edu/abs/2019ATel13048....1R

Sander A. A. C., 2019, in Oskinova L. M., Bozzo E., Bulik T., Gies D. R., eds, IAU Symposium Vol. 346, IAU Symposium. Massive star winds and HMXB donors. pp 17–27, doi:10.1017/S1743921318007652, https://ui.adsabs.harvard.edu/abs/2019IAUS..346...17S/abstract

Sharp H., Cashion M., Walsh J., Barth A. J., Shields J., **Sarzi M.**, 2020, in American Astronomical Society Meeting Abstracts. Stellar Kinematics of NGC 4203, American Astronomical Society Meeting Abstracts. p. 304.30

Shenar T., et al., inc. **Sander A.**, 2019b, in Oskinova L. M., Bozzo E., Bulik T., Gies D. R., eds, IAU Symposium Vol. 346, IAU Symposium. Spectroscopy of complete populations of Wolf-Rayet binaries in the Magellanic Clouds. pp 307–315, doi:10.1017/S1743921319001303

Steeghs D., et al., inc. **Ramsay G.**, 2019, IceCube 190730A: No counterpart candidates or blazar activity in GOTO observations, GRB Coordinates Network, 25255, 1, https://ui.adsabs.harvard.edu/abs/2019GCN.25255....1S

Steeghs D., et al., inc. **Ramsay G.**, 2020, LIGO/Virgo S200115j: No notable candidates in GOTO imaging, GRB Coordinates Network, 26794, 1, https://ui.adsabs.harvard.edu/abs/2020GCN.26794....1S

Street R. A., et al., inc. **Vink J. S.**, 2020, Impact of Rubin Observatory LSST Template Acquisition Strategies on Early Science from the Transients and Variable Stars Science Collaboration: Time-critical Science Cases, Research Notes of the American Astronomical Society, 4, 41, doi:10.3847/2515-5172/ab812a, https://ui.adsabs.harvard.edu/abs/2020RNAAS...4...41S

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Williams D., et al., inc. **Burton M. G.**, 2019, The Cherenkov Telescope Array. p. 291

Armagh Observatory and Planetarium Presentations: April 2019 – March 2020

Date	Speaker	Title	Location	Country	Category
04 Apr 2019	M. Burton (with staff and PhD students)	Astronomy in the A Level Physics Syllabus (Class 3)	Armagh Learning Community, Royal School/Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Teaching
13 Apr 2019	M. Burton	The Bovedy Illuminations - Remembering 50 Years Since the Fall of the Bovedy Meteorite (with Noel Connor)	Market Place Theatre and Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
16 Apr 2019	M. Burton	Measuring the Heavens from Armagh	Ballyhegan and Kilmore Community Heritage Association, Stonebridge, Co Armagh	Northern Ireland	External Outreach
25 Apr 2019	M. Burton A. Christou J. S. Vink	An Evening with Bovedy - Celebrating 50 Years Since the Fall of the Bovedy Meteorite (includes talks by AOP Astronomers and external presenters)	A Night with Bovedy Event, Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
13 May 2019	J.S. Vink	ODYSSEUS	VLT Flames Tarantula Survey (VFTS) Meeting, Edinburgh, Scotland	Scotland	Research
14 May 2019	M.E. Bailey	Earth's Place in Space: Discovering Humanity's Shared Celestial Heritage	Leitrim Astronomy Club, Ballinamore Library, Ballinamore, Co. Leitrim, Ireland	Ireland	External Outreach
21 May 2019	J.D. Landstreet	Studying Weak Magnetic Fields in White Dwarf Stars with ESPaDOnS (jointly with S. Bagnulo)	CFHT in the 2020s, A Time of Research, Excellence and Transformation (the CFHT Users' Meeting 2019), Montreal, Quebec, Canada	Canada	Research
27 May 2019	A. Sander	Hydrodynamic Modelling of Massive Star Atmospheres (Invited)	The Radiating Universe in the Era of Multi-Messenger Astrophysics, Shanghai, China	China	Research
28 May 2019	J.S. Vink	Radiative Transfer & Stellar Winds (Invited)	The Radiating Universe in the Era of Multi-Messenger Astronomy, Shanghai, China	China	Research
29 May 2019	M. Sarzi	Supermassive Black Holes, the DNA of Galaxies	Institute of Physics Lecture, University of Hertfordshire, England	England	External Outreach
06-Jun-2019	G. Borisov	The Diversity of the Chemical Composition of the Martian Trojan Asteroids (Invited)	Joint Conference of the Sub-Regional European Astronomical Committee (SREAC) and the Bulgarian Astronomical Society (BgAS), Sofia, Bulgaria	Bulgaria	Research
10 Jun 2019	A. Christou	Earth's Missing Trojans: Lessons from Mars and the Role of Radiation Forces	50th Annual Meeting of the Division of Dynamical Astronomy of the American Astronomical Society, Boulder, Colorado, USA	USA	Research
10 Jun 2019	J.S. Vink	Massive Stars and Black Holes	Talk, Work Experience Students, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Education
19 Jun 2019	A. Sekhar	Kozai Mechanism Vs GR Precession in Daytime Arietids	IAU Commission F1 Meteoroids Conference, Bratislava, Slovakia	Slovakia	Research
19 Jun 2019	J.S. Vink	Linking Herbig and T Tauri Stars with Linear Spectro-Polarimetry. In Gaia's View of Pre-Main Sequence Evolution.	University of Leeds, England	England	Research
24 Jun 2019	C.S. Jeffery	The SALT Survey of Chemically Peculiar Subdwarfs	sdOB9 Conference, Hendaye, France	France	Research
27 Jun 2019	C. Byrne	Atomic Diffusion in Chemically Peculiar Hot Subdwarfs	sdOB9 Conference, Hendaye, France	France	Research

Date	Speaker	Title	Location	Country	Category
27 Jun 2019	C.S. Jeffery	Subdwarfs as Laboratories for Stellar Physics	sdOB9 Conference, Hendaye, France	France	Research
27 Jun 2019	C.S. Jeffery	Helium Stars, Heavy Metal, Pulsations, Hypervelocities and Explosions	sdOB9 Conference, Hendaye, France	France	Research
27 Jun 2019	A. Sander	Quantifying Hot Star Feedback and their Influence on the ISM	EWASS S10 – The Feedback in the Star Formation Process, Lyon, France	France	Research
27 Jun 2019	J.S. Vink	The True Population of Luminous Blue Variables	EWASS, Lyon, France	France	Research
28 Jun 2019	A. Sander	The Mass Loss of Classical Wolf-Rayet Stars	EWASS SS17 – Key Ingredients in Massive Star Evolution, Lyon, France	France	Research
28 Jun 2019	J.S. Vink	The Most Massive Stars in the Universe	EWASS, Lyon, France	France	Research
04 Jul 2019	E. Higgins	The Early Universe and Massive Stars	50 Plus Expo, Everglades Hotel, Derry, Co. Londonderry	Northern Ireland	External Outreach
09 Jul 2019	S. Bagnulo	Stellar Magnetism	Western University, Ontario, Canada	Canada	Research
20 - 21 Jul 2019	M. Burton	Above and Beyond: The IAU Centenary Exhibition	IAU Exhibition, Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
22 Jul 2019	C.S. Jeffery	Galactic White Dwarf Mergers	STFC UK-China Meeting, Manchester, England	England	Research
23 Jul 2009	J.S. Vink	Massive Star Evolution Revealed in the Mass-Luminosity Plane	STFC UK-China Meeting, Manchester, England	England	Research
27 Aug 2019	M.E. Bailey	Overview of the Solar System: Focus on Comets	STFC Solar System Plasmas Summer School, University of Aberystwyth, Wales	Wales	Research
27 Aug 2019	C.S. Jeffery	Heavy Metal Subdwarfs and Hypervelocities	Stars on the Run II Conference, University of Potsdam, Germany	Germany	Research
04 Sep 2019	M. Burton	A Method to Map the Aliphatic Component of Dust in the Interstellar Medium	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
04 Sep 2019	A. Christou	The Martian Trojans, A Dynamic Population of Asteroids at 1.5 au from the Sun	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
04 Sep 2019	R. Nežič	Polarimetric Observations of Comets with STEREO Spacecraft	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
05 Sep 2019	H. Alexander	Astronomical Research, The Public and You	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Education
05 Sep 2019	M. Burton	Using a Planetarium Dome for Scientific Visualisation	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
05 Sep 2019	C. Byrne	Radiaitive Levitation in Post-Common-Envelope Binary Stars	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
05 Sep 2019	A. Sander	Next-Generation Stellar Atmosphere Models as Mass-Loss Laboratories	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
06 Sep 2019	M.E. Bailey	Light Pollution and its Impact: Inspiring Astronomy and Sustainable Development at Davagh Forest	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research

Date	Speaker	Title	Location	Country	Category
06 Sep 2019	J.S. Vink	Finding the Biggest Star in the Universe	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
07 Sep 2019	M.E. Bailey	Giant Comets and Their Impacts Through Time: The Most Recent Giant Comet and its Impact on Civilization	British Astronomical Association Autumn Meeting, Armagh City Hotel, Armagh, Co. Armagh	Northern Ireland	External Outreach
07 Sep 2019	M. Burton	Armagh Observatory and Planetarium - A Short History	British Astronomical Association Autumn Meeting, Armagh City Hotel, Armagh, Co. Armagh	Northern Ireland	External Outreach
07 Sep 2019	J.S. Vink	The Origin of the Solar System	British Astronomical Association Autumn Meeting, Armagh City Hotel, Armagh, Co. Armagh	Northern Ireland	External Outreach
08 Sep 2019	M. Burton (with T. Watts)	A Grand Tour of the Armagh Observatory	British Astronomical Association, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
18 Sep 2019	H. Preece	The Effect of Tidal Interactions on Hot Subdwarf B Stars and Their Pulsations	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
20 Sep 2019	G. Borisov	The Lunar-Like Mineralogy of the Martian Trojan Asteroid (101429) 1998 VF31	EPSC-DPS Joint Meeting 2019, Geneva, Switzerland	Switzerland	Research
20 Sep 2019	R. Nežič	Polarimetric Study of 8 Kreutz Comets Observed by STEREO	EPSC-DPS Joint Meeting 2019, Geneva, Switzerland	Switzerland	Research
23 Sep 2019	S. Bagnulo	A Gentle Introduction to Night Time Astronomical Polarimetry	Invited Introductory Lecture, "Polarimetry as a Diagnostic Tool in Astronomy", Torun Summer School, Poland	Poland	Research
25 Sep 2019	S. Bagnulo	Spectropolarimetry with VLT	"Polarimetry as a Diagnostic Tool in Astronomy", Torun Summer School, Poland	Poland	Research
26 Sep 2019	S. Bagnulo	Spectropolarimetric Low-Resolution Data Reduction and Analysis	"Polarimetry as a Diagnostic Tool in Astronomy", Torun Summer School, Poland	Poland	Research
26 Sep 2019	A . Christou	The Martian Trojan Asteroids: A Natural Experiment in Asteroid Evolution	Lund Observatory, Department of Astronomy and Theoretical Physics, Lund University, Sweden	Sweden	Research
27 Sep 2019	A. Sander	Massive and Very Massive Runaway Stars	Stars on the Run II, Potsdam, Germany	Germany	Research
30 Sep 2019	C.S. Jeffery	The SALT Survey of Chemically Peculiar Subdwarfs	University of Cambridge, England	England	Research
Sep - Oct 2019	M. Burton	Wisdom begins with Wonder: A Vision for the Armagh Observatory and Planetarium	Delivered to multiple audiences including: 22 October 2019, Shared City Summit, Armagh Robinson Library, Armagh, Co. Armagh	Northern Ireland	External Outreach
02 Oct 2019	G. Ramsay	Space Weather on Other Stars	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
02 Oct 2019	J.S. Vink	Linear Spectro-Polarimetry to Unravel Inner Disk Dynamics (Invited)	The UX Ori Stars and Related Topics, St. Petersburg, Russia	Russia	Research
07 Oct 2019	M. Burton	Astronomy in Antarctica	Northern Ireland Amateur Astronomy Society, Ballyclare, Co. Antrim	Northern Ireland	External Outreach
09 Oct 2019	G. Ramsay	Measuring the Brightness of Stars from Space: Flares, Outbursts, Exoplanets and the Inside of Stars	Irish Astronomical Association, Bell Lecture Theatre, Queen's University, Belfast, Co. Antrim	Northern Ireland	External Outreach
10 Oct 2019	C. Duffy	The Spatial and Temporal Variation of Mg II Emission Profiles in the Solar Atmosphere	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research

Date	Speaker	Title	Location	Country	Category
16 Oct 2019	M.E. Bailey	Carleton's Astronomy and How Astronomers Put Stars in the Sky	William Carleton 2019 Summer School. CARLETON 150: William Carleton (1794-1869), Writer and 19th-Century Social Historian, Fivemiletown, Co. Tyrone	Northern Ireland	Research
16 Oct 2019	M. Burton	Using the Spectrum to Look Further into Space	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
17 Oct 2019	J.S. Vink	The Heaviest Stars and Black Holes in the Universe	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
24 Oct 2019	A. Christou	The Martian Trojans: A Natural Experiment in Asteroid Evolution	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
25 Oct 2019	C.S. Jeffery	Stellar Atmospheres: 1. Introduction	Yunnan Astronomical Observatory, Kunming, China	China	External Teaching
25 Oct 2019	C.S. Jeffery	Stellar Atmospheres: 2. Theoretical Framework	Yunnan Astronomical Observatory, Kunming, China	China	External Teaching
28 Oct 2019	C.S. Jeffery	Stellar Atmospheres: 3. Computational Tools	Yunnan Astronomical Observatory, Kunming, China	China	External Teaching
29 Oct 2019	C.S. Jeffery	Stellar Atmospheres: 4. Example Class 1	Yunnan Astronomical Observatory, Kunming, China	China	External Teaching
30 Oct 2019	C.S. Jeffery	Stellar Atmospheres: 5. Spectra Analysis	Yunnan Astronomical Observatory, Kunming, China	China	External Teaching
30 Oct 2019	G. Ramsay	Measuring the Brightness of Stars from Space: Flares, Outbursts, Exoplanets and the Inside of Stars	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
31 Oct 2019	C.S. Jeffery	Stellar Atmospheres: 6. Example Class 2	Yunnan Astronomical Observatory, Kunming, China	China	External Teaching
31 Oct 2019	B. Nedelchev	Using the MANGA IFU Survey to Trace the Importance of Accretion Events in the Triggering of Optical AGN Activity and the Formation of Kinematically Distinct Components	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
04 Nov 2019	M.E. Bailey (with J.A. Finnegan and C. Bell)	Assessing the Quality of Dark Skies Around Davagh Forest (Poster Paper, Contributed)	14th European Symposium for the Protection of the Night Sky, Mulranny, Co. Mayo, Ireland	Ireland	Research
05 Nov 2019	M.E. Bailey (with G. Bond and A. White)	Workshop on IDA Dark Sky Place Application and Reporting Preparation	14th European Symposium for the Protection of the Night Sky, Mulranny, Co. Mayo, Ireland	Ireland	Research
06 Nov 2019	J.S. Vink	Heavy Stars and Black Holes	University of Sheffield, England	England	Research
07 Nov 2019	C.S. Jeffery	Stellar Atmospheres: 1. The Model Atmosphere	Beijing Normal University, China	China	Research
07 Nov 2019	A. Sander	Next-Generation Stellar Atmosphere Models: From Understanding Spectra to Creating a Virtual Laboratory	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
09 Nov 2019	C.S. Jeffery	Careers in Astrophysics	Beijing Normal University, China	China	External Teaching
09 Nov 2019	M.E. Bailey	Sir Thomas Maclear FRS. Astronomer-Surgeon from Co. Tyrone: Astronomical and Scientific Accomplishments	Ulster History Circle Blue Plaque Celebration for Thomas Maclear, Newtownstewart, Co. Tyrone	Northern Ireland	External Outreach
11 Nov 2019	C.S. Jeffery	Stellar Atmospheres: 2. The Line Profile	Beijing Normal University, China	China	External Teaching
12 Nov 2019	C.S. Jeffery	Stellar Atmospheres: 3. Spectral Analysis	Beijing Normal University, China	China	External Teaching

Date	Speaker	Title	Location	Country	Category
13 Nov 2019	J.S. Vink	Top 3 Astronomical Discoveries of 2019	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
21 Nov 2019	A. Sander	Next-Generation Stellar Atmosphere Models: From Understanding Spectra to Creating a Virtual Laboratory	ARI Institute Colloquium, Heidelberg, Germany	Germany	Research
09 Dec 2019	A. Christou	The Martian Trojan Asteroids: A Natural Experiment in Asteroid Evolution	Paris Observatory, Paris France	France	Research
17 Dec 2019	C.S. Jeffery	White Dwarf Mergers and Nucleosynthesis	Chemical Elements in then Universe: Origin and Evolution, Indian Institute of Astrophysics, Bangalore, India	India	Research
06 Jan 2020	M.E. Bailey	Armagh Observatory's Societal Impacts and Longterm Climate Archive: Celebrating More than 225 Years of Scientific Research in Armagh	Northern Ireland Amateur Astronomical Society (NIAAS), Ballyclare, Co. Antrim	Northern Ireland	External Outreach
08 Jan 2020	C.S. Jeffery	The Shape and Size of the Universe	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
10 Jan 2020	M. Burton	Master Planning for a New Planetarium	Workshop, Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
10 Jan 2020	A. Sander	Next-Generation Stellar Atmospheres with Hydrodynamics as Stellar Feedback Laboratories	RAS Specialist Discussion Meeting on Radiation Hydrodynamics, London, England	England	Research
21 Jan 2020	A. Christou	Meteoroid Streams at Mercury	Surface-Bounded Exospheres Workshop, International Space Science Institute, Bern, Switzerland	Switzerland	Research
28 Jan 2020	C.S. Jeffery	How Big is the Universe? and Other Questions	Planetarium Star Trackers Night, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
31 Jan 2020	M. Burton with Helen McLoughlin	Planets, Stars and Galaxies – Space Physics for the GCSE	Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Teaching
03 Feb 2020	M.E. Bailey	Armagh Observatory. Societal Impacts and Longterm Climate Archive: Celebrating More than 225 Years of Scientific Research in Armagh	Causeway U3A, Agherton Parish Centre, Portstewart, Co. Antrim	Northern Ireland	External Outreach
05 Feb 2020	A. Sander	Rare But Important: Why the Universe is Shaped by Massive Stars	Irish Astronomical Association, Bell Lecture Theatre, Queen's University, Belfast, Co. Antrim	Northern Ireland	External Outreach
06 Feb 2020	C. Byrne	Atomic Diffusion and Pulsation in Post-Common-Envelope Binary Stars	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
07 Feb 2020	A. Sander	Understanding Massive Stars and their Influence	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
11 Feb 2020	M.E. Bailey	Armagh Observatory - Societal Impacts and longterm Climate Archive: Celebrating More than 225 Years of Scientific Research in Armagh	Craigavon Historical Society, Craigavon Civic Centre, Co. Armagh	Northern Ireland	External Outreach
14 Feb 2020	M. Burton	Kepler's Law and Exploring the Solar System	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
14 Feb 2020	A. Christou	Eclipses in the Solar System	Planetarium Star Trackers Night, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach

Date	Speaker	Title	Location	Country	Category
19 Feb 2020	S. Bagnulo	A High-Precision Survey of Magnetic Fields in White Dwarfs within 20 Parsec from the Sun	University of Warwick, England	England	Research
20 Feb 2020	M. Burton (with T. Watts)	Navigating the Stars	Carrickfergus Museum, Carrickfergus, Co. Antrim	Northern Ireland	External Outreach
21 Feb 2020	A. Sander	Expert for Stellar Evolution	"Ask an Astronomer" Outreach Event, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
03 Mar 2020	M.E. Bailey	Light Pollution and Its Impact: Inspiring Astronomy at Davagh Forest	Clogher Women's Institute, British Legion Hall, Clogher, Co. Tyrone	Northern Ireland	External Outreach
04 Mar 2020	M. Burton (with staff and PhD students)	Astronomy in the A Level Physics Syllabus (Class 1 held onsite, Class 2 and 3 held online)	Armagh Learning Community, Royal School/Armagh Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Teaching
11 Mar 2020	A. Sander	Next-Generation Stellar Atmospheres and the Crucial Role of Wolf-Rayet Stars	ARC Seminar, Queen's University, Belfast, Co. Antrim	Northern Ireland	Research
11 Mar 2020	J.S. Vink	Aluminium from Very Massive Stars	ChETEC Meeting, York, England	England	Research
16 Mar 2020	P. Galán de Anta	On the Fragility of Thin-Disc Structures in Galaxies	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
18 Mar 2020	M. Burton	Astronomy in Antarctica	Astrobytes, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Internal Outreach
26 Mar 2020	C.S. Jeffery	DY Centauri: from red giant to [WC] star in 100 years	Seminar, Armagh Observatory and Planetarium, Armagh, Co. Armagh	Northern Ireland	Research
27 Mar 2020	M. Sarzi	Supermassive Black Holes	Facebook live, replacing standard Planetarium Star Trackers Night due to Covid-19	Northern Ireland	Internal Outreach

Armagh Observatory and Planetarium
Education and Outreach Activities: April 2019 - March 2020

Date	Event Description	Location	Personnel	Category
03 Apr to 10 Apr 2019	2018-19 A-Level Physics Course in association with Armagh Area Learning Community	Royal School, Armagh, BT61 9DH	M. Burton, Staff and Students	Teaching
05 Apr 2019	SportsNI Outreach Event - Celebration of Sport	Valley Leisure Centre, Church Lane, Newtownabbey, BT36 7LJ	Staff	Outreach
10 Apr 2019	Outreach with Dome	St Mary's Primary School, Mullymesker, Bellanaleck, Enniskillen, Co. Fermanagh, BT92 2AB	R. Mee, N. Parke	Outreach
13 Apr 2019	Talk: The Bovedy Illuminations - Remembering 50 Years Since the Fall of the Bovedy Meteorite (with Noel Connor)	Market Place Theatre and Armagh Planetarium, Armagh, Co. Armagh, BT61 7BW	M. Burton	Outreach
16 Apr 2019	Talk: Measuring the Heavens from Armagh	Ballyhegan and Kilmore Community Heritage Association, Stonebridge Parish Hall, Stonebridge, Co Armagh, BT61 8QJ	M. Burton	Outreach
25 Apr 2019	Mikes Meteorite Talks	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
25 Apr 2019	An Evening with Bovedy - Celebrating 50 Years Since the Fall of the Bovedy Meteorite (with Jorick Vink, Tolis Christou, Mike Simms and Terrence Murtagh)	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	M. Burton A. Chirstou J. S. Vink	Event
30 Apr 2019	Toddler Takeover Tuesday for April	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
04 May 2019	Force Academy Jedi Training	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
06 May 2019	Make a Kite Workshop	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
14 May 2019	Talk: Earth's Place in Space: Discovering Humanity's Shared Celestial Heritage	Leitrim Astronomy Club, Ballinamore Library, Ballinamore, Co. Leitrim, Ireland	M. E. Bailey	Outreach
27 May 2019	Space Origami Workshop	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	C. Allison	Event
28 May 2019	Share a Story Outreach	The Orchard Pre-School, 14 Ballyhegan Road, Loughgall, Armagh, BT61 8PX	S. Mackle, H. McLoughlin	Outreach
28 May 2019	Toddler Takeover Tuesday for May	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
28 May 2019	Share a Story Outreach	The Grove Nursery School, Ballynahone Crescent, Armagh, BT60 1EE	S. Mackle, H. McLoughlin	Outreach
29 May 2019	Share a Story Outreach	Benburb Community Playgroup, 3 Drumgose Road, Dungannon, BT71 7JT	S. Mackle, H. McLoughlin	Outreach
29 May 2019	Talk: Supermassive Black Holes, the DNA of Galaxies	Institute of Physics Lecture, University of Hertfordshire, England	M. Sarzi	Outreach
31 May 2019	Rushmere Shopping Centre - Outreach	Rushmere Shopping Centre, 4 Central Way, Craigavon, BT64 1AA	R. Mee, staff	Outreach
01 Jun 2019	Rushmere Shopping Centre - Outreach	Rushmere Shopping Centre, 4 Central Way, Craigavon, BT64 1AA	H. Mcloughlin, A. Taylor	Outreach
05 Jun 2019	Victoria Square Shopping Centre – Outreach	Victoria Square Shopping Centre, 1 Victoria Square, Belfast, BT1 4QG	H. Mcloughlin, staff	Outreach
07 Jun 2019	Foyleside Shopping Centre - Outreach	Foyleside Shopping Centre, 19 Orchard Street, Derry, BT48 6XY	H. Alexander	Outreach

Date	Event Description	Location	Personnel	Category
08 Jun 2019	CapCom Go Launch (Publicity Event)	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
10 Jun to 14 Jun 2019	Cahoots School Space Event	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
10 Jun 2019	Talk: Massive Stars and Black Holes	Work Experience Students, Armagh Observatory and Planetarium, Armagh, Co. Armagh	J. S. Vink	Education
13 Jun 2019	The Quays Shopping Centre - Outreach	The Quays Shopping Centre, 26 Bridge Street, Newry, BT35 8QS	N. Parke	Outreach
20 Jun 2019	IoP Teachers Conference	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Education
21 Jun 2019	Summer Solstice at Beaghmore Stone Circles Event in association with Mid Ulster Council	Beaghmore Stone Circles, Blackrock Road, Cookstown, Co. Tyrone, BT80 9PB	S. Mackle, N. Parke, R. Nežič	Outreach
25 Jun 2019	Toddler Takeover Tuesday for June	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
02 Jul 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
03 Jul 2019	Children's Hospital Visit	The Royal Belfast Hospital for Sick Children, 247 Grosvenor Road, Belfast, BT12 6BA	N. Parke	Outreach
04 Jul 2019	Talk: The Early Universe and Massive Stars	50 Plus Expo, Everglades Hotel, Derry, Co. Londonderry, BT47 2NH	E. Higgins	Outreach
06 Jul to 07 Jul 2019	Heroes and Legends Exhibition Weekend	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
09 Jun 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
11 Jul to 13 Jul 2019	Minecraft on the Moon	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
12 Jul to 31 Aug 2019	Astropark Tours in July and August	Armagh Observatory and Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Education
16 Jul 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
16 Jul 2019	Stakeholder Event: A Special Preview Showing of A New Planetarium Show CapCom Go	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
17 Jul to 31 Jul 2019	IAU Exhibition - Above and Beyond: Making Sense of the Universe for 100 Year Exhibition, 17 - 31 July 2019. (Includes Talk by M. Burton). In association with the Armagh County Museum, Armagh Robinson Library, No. 5 Vicars' Hill and Market Place Theatre	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	M. Burton, Staff and Students	Event
20 Jul to 21 Jul 2019	Museum of the Moon on the Armagh Mall - A family event on the Mall to celebrate the 50th Anniversary of the Moon Landing with the Museum of the Moon (a touring artwork by Luke Jerram) and live entertainment and family workshops.	The Mall, Armagh, Co. Armagh, BT61 9AJ	Staff and Students	Event
23 Jul 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
30 Jul 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
06 Aug 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
10 Aug 2019	Kyle Riley: Sing to Me	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event

Date	Event Description	Location	Personnel	Category
13 Aug 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
16 Aug to 17 Aug 2019	Scientific Sue: The Science of Dragons	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
20 Aug 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
24 Aug to 25 Aug 2019	Jedi Saturday and Sith Sunday - Force Academy Training	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
26 Aug 2019	Public Talk: "Apollo 11 To the Moon and Back, Half a Century Ago" by Paul Evans	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
26 Aug 2019	Wee Wonders	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
26 Aug 2019	One Giant Leap Last Blast	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
27 Aug 2019	Summer Toddler Takeover Tuesdays	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
04 Sep to 06 Sep 2019	Irish National Astronomy Meeting (INAM2019)	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
04 Sep 2019	Public Talk: "Mysteries of Black Holes and The Big Bang" by Professor Garrett Cotter and Premier of full dome Planetarium Show "Unseen Universe" part of the INAM2019	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
05 Sep 2019	Talk: Astronomical Research, The Public and You	Irish National Astronomy Meeting, Armagh Observatory and Planetarium, Armagh, Co. Armagh	H. Alexander	Education
07 Sep 2019	Talk: Giant Comets and Their Impacts Through Time: The Most Recent Giant Comet and its Impact on Civilization	British Astronomical Association Autumn Meeting, Armagh City Hotel, Armagh, Co. Armagh, BT60 4FR	M. E. Bailey	Outreach
07 Sep 2019	Talk: Armagh Observatory and Planetarium - A Short History	British Astronomical Association Autumn Meeting, Armagh City Hotel, Armagh, Co. Armagh, BT60 4FR	M. Burton	Outreach
07 Sep 2019	Talk: The Origin of the Solar System	British Astronomical Association Autumn Meeting, Armagh City Hotel, Armagh, Co. Armagh, BT60 4FR	J. S. Vink	Outreach
08 Sep 2019	Talk: A Grand Tour of the Armagh Observatory BAA Observatory Tour and Dome Show, part of the British Astronomical Association Weekend Meeting	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	M. Burton (with T. Watts)	Event
14 Sep 2019	European Heritage Open Day: Free Astropark Tour at 11am and 4pm	Armagh Observatory and Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
Sep 2019 to Oct 2019	Talk: Wisdom begins with Wonder: A Vision for the Armagh Observatory and Planetarium	Delivered to multiple audiences including: 22 October 2019, Shared City Summit, Armagh Robinson Library, Armagh, Co. Armagh, BT61 7DY	M. Burton	Outreach
07 Oct 2019	Talk: Astronomy in Antarctica	Northern Ireland Amateur Astronomy Society, Ballyclare High School, Ballyclare, Co. Antrim, BT39 9HJ	M. Burton	Outreach
09 Oct 2019	Talk: Measuring the Brightness of Stars from Space: Flares, Outbursts, Exoplanets and the Inside of Stars	Irish Astronomical Association, Bell Lecture Theatre, Queen's University, Belfast, Co. Antrim, BT7 1NN	G. Ramsay	Outreach
12 Oct 2019	Bubbly Maths with Bubbiz: Maths Week 2019	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
22 Oct 2019	Premiere of New Dome Show Unseen Universe	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event

Date	Event Description	Location	Personnel	Category
28 Oct 2019	Wee Wonders: Halloween Theme	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
29 Oct 2019	Half-Term Observatory Tour and Dome Show x 2	Armagh Observatory and Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
29 Oct 2019	Forensic Science Detective Workshop	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
30 Oct to 31 Oct 2019	Scientific Sue: Potions and Explosions	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
01 Nov 2019	Adult Only Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
02 Nov 2019	Kyle Riley: Little Folk	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
02 Nov 2019	Spooky Space: Halloween Dome Show	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
05 Nov 2019	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
09 Nov 2019	Talk: Sir Thomas Maclear FRS. Astronomer-Surgeon from Co. Tyrone: Astronomical and Scientific Accomplishments	Ulster History Circle Blue Plaque Celebration for Thomas Maclear, Newtownstewart Centre 2000, Newtownstewart, Co. Tyrone, BT78 4AP	M. E. Bailey	Outreach
11 Nov 2019	Transit of Mercury Viewing and Exhibition	Armagh Observatory and Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff and Students	Event
12 Nov 2019	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
19 Nov 2019	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
20 Nov 2019	Children's Day: Open Workshops	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
26 Nov 2019	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
27 Nov 2019	2019 Robinson Lecture, Collisions and Catastrophes by Dr Monica Grady. Startracker Observing Evening	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
30 Nov 2019	Armagh Planetarium Georgian Day Activities and Shows	Armagh Observatory and Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
30 Nov to 23 Dec 2019	Mission Santa	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
10 Dec 2019	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
16 Dec 2019	Wee Wonders Christmas Party	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
30 Dec 2019	Startracker Observing Evenings	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
31 Dec 2019	Toddler Takeover NYE Extravaganza	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
03 Jan 2020	Dome Nights: The Planets 360	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
06 Jan 2020	Talk: Armagh Observatory's Societal Impacts and Long Term Climate Archive: Celebrating More than 225 Years of Scientific Research in Armagh	Northern Ireland Amateur Astronomical Society, Ballyclare High School, Ballyclare, Co. Antrim, BT39 9HJ	M. E. Bailey	Outreach
10 Jan 2020	Talk: Master Planning for a New Planetarium	Workshop, Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	M. Burton	Event
28 Jan 2020	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. McLoughlin	Event

Date	Event Description	Location	Personnel	Category
28 Jan 2020	Startracker Observing Evening. (Includes Talk "How Big is the Universe? and Other Questions" by C.S. Jeffery).	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
31 Jan 2020	Talk: Planets, Stars and Galaxies – Space Physics for the GCSE	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	M. Burton with Helen McLoughlin	Teaching
03 Feb 2020	Talk: Armagh Observatory. Societal Impacts and Longterm Climate Archive: Celebrating More than 225 Years of Scientific Research in Armagh	Causeway U3A, Agherton Parish Centre, Portstewart, Co. Antrim, BT55 7AH	M. E. Bailey	Outreach
05 Feb 2020	Talk: Rare But Important: Why the Universe is Shaped by Massive Stars	Irish Astronomical Association, Bell Lecture Theatre, Queen's University, Belfast, Co. Antrim, BT7 1NN	A. Sander	Outreach
11 Feb 2020	Toddler Takeover	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Mcloughlin, staff	Event
11 Feb 2020	Talk: Armagh Observatory - Societal Impacts and Long Term Climate Archive: Celebrating More than 225 Years of Scientific Research in Armagh	Craigavon Historical Society, Craigavon Civic Centre, Co. Armagh, BT64 1AL	M. E. Bailey	Outreach
14 Feb 2020	Startracker Observing Evening. Part of Northern Ireland Science Festival 2020. (Includes Talk "Eclipses in the Solar System" by A. Christou).	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Alexander	Event
17 Feb 2020	Glimpse into the Armagh Observatory. Part of Northern Ireland Science Festival 2020	Armagh Observatory and Planetarium, Armagh, Co. Armagh, BT61 9DB	H. Alexander	Event
18 Feb 2020	Little Professors. Part of Northern Ireland Science Festival 2020	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	H. McLoughlin	Event
19 Feb 2020	Make a Kite Workshop. Part of Northern Ireland Science Festival 2020	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
20 Feb 2020	Comet 101 Workshop. Part of Northern Ireland Science Festival 2020	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
20 Feb 2020	Navigation by the Stars. Part of Northern Ireland Science Festival 2020 (Includes Talk by M. Burton).	Carrickfergus Museum, 11 Antrim Street, Carrickfergus, Co Antrim, BT38 7DG	M. Burton, T. Watts	Event
21 Feb 2020	Wee Wonders	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
21 Feb 2020	Ask the Astronomer. Part of Northern Ireland Science Festival 2020	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff and Students	Event
22 Feb 2020	The Sounds of Space Talk by Tomasz Rozek (2 Talks: Polish and English). Part of Northern Ireland Science Festival 2020	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
22 Feb 2020	Agriculture in Space Talk by Tomasz Rozek (Polish and English). (2 Talks: Polish and English). Part of Northern Ireland Science Festival 2020	Armagh Planetarium, Armagh, Co. Armagh, BT61 9DB	Staff	Event
04 Mar 2020	2018-19 A-Level Physics Course in association with Armagh Area Learning Community (Class 1 held onsite, Class 2 and 3 held online).	Royal School, Armagh, Co. Armagh, BT61 9DH	M. Burton, Staff and Students	Teaching

THE ARMAGH OBSERVATORY AND PLANETARIUM

THE CERTIFICATE AND REPORT OF THE COMPTROLLER AND AUDITOR GENERAL TO THE NORTHERN IRELAND ASSEMBLY

Opinion on financial statements

I certify that I have audited the financial statements of the Armagh Observatory and Planetarium for the year ended 31 March 2020 under the Armagh Observatory and Planetarium (Northern Ireland) Order 1995. The financial statements comprise the Statement of Financial Activities, the Balance Sheet, the Cash Flow Statement and the related notes including significant accounting policies. The financial reporting framework that has been applied in their preparation is applicable law and the Charities SORP. I have also audited the information in the Remuneration and Staff Report that is described in that report as having been audited.

In my opinion the financial statements:

- give a true and fair view of the state of the Armagh Observatory and Planetarium's affairs as at 31 March 2020 and of its total incoming resources and expenditure of resources for the year then ended; and
- have been properly prepared in accordance with the Armagh Observatory and Planetarium (Northern Ireland) Order 1995 and Department for Communities directions issued thereunder.

Emphasis of Matter

I draw attention to note 10 of the financial statements, which describes the material valuation uncertainties for Land and Buildings due to the consequences of the COVID-19 pandemic. My opinion is not modified in respect of this matter.

Opinion on regularity

In my opinion, in all material respects the expenditure and income recorded in the financial statements have been applied to the purposes intended by the Assembly and the financial transactions recorded in the financial statements conform to the authorities which govern them.

Basis of opinions

I conducted my audit in accordance with International Standards on Auditing (UK) (ISAs) and Practice Note 10 'Audit of Financial Statements of Public Sector Entities in the United Kingdom'. My responsibilities under those standards are further described in the Auditor's responsibilities for the audit of the financial statements section of this certificate. My staff and I are independent of the Armagh Observatory and Planetarium in accordance with the ethical requirements of the Financial Reporting Council's Revised Ethical Standard 2016, and have fulfilled our other ethical responsibilities in accordance with these requirements. I believe that the audit evidence obtained is sufficient and appropriate to provide a basis for my opinions.

Conclusions relating to going concern

I have nothing to report in respect of the following matters in relation to which the ISAs (UK) require me to report to you where:

- the Armagh Observatory and Planetarium's use of the going concern basis of accounting in the preparation of the financial statements is not appropriate; or
- the Armagh Observatory and Planetarium has not disclosed in the financial statements any identified material uncertainties that may cast significant doubt about the Armagh Observatory and Planetarium's ability to continue to adopt the going concern basis.

Other Information

The Board of Governors, who are the Trustees, and the Accounting Officer are responsible for the other information included in the annual report. The other information comprises the information included in the Trustees' annual report other than the financial statements, the parts of the Remuneration and Staff Report described in the report as having been audited, and my audit report. My opinion on the financial statements does not cover the other information and I do not express any form of assurance conclusion thereon.

In connection with my audit of the financial statements, my responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or my knowledge obtained in the audit or otherwise appears to be materially misstated. If, based on the work I have performed, I conclude that there is a material misstatement of this other information, I am required to report that fact. I have nothing to report in this regard.

Opinion on other matters

In my opinion:

- the parts of the Remuneration and Staff Report to be audited have been properly prepared in accordance with Department for Communities directions made under the Armagh Observatory and Planetarium (Northern Ireland) Order 1995; and
- the information given in the Trustees' Annual Report for the financial year for which the financial statements are prepared is consistent with the financial statements.

Responsibilities of the Trustees and Accounting Officer for the financial statements

As explained more fully in the Statement of the Responsibilities of the Governors and Accounting Officer, the Trustees and the Accounting Officer are responsible for the preparation of the financial statements and for being satisfied that they give a true and fair view.

Auditor's responsibilities for the audit of the financial statements

My responsibility is to examine, certify and report on the financial statements in accordance with the Armagh Observatory and Planetarium (Northern Ireland) Order 1995.

My objectives are to obtain evidence about the amounts and disclosures in the financial statements sufficient to give reasonable assurance that the financial statements are free from material misstatement, whether caused by fraud or error. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs (UK) will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

A further description of my responsibilities for the audit of the financial statements is located on the Financial Reporting Council's website www.frc.org.uk/auditorsresponsibilities. This description forms part of my certificate.

In addition, I am required to obtain evidence sufficient to give reasonable assurance that the expenditure and income recorded in the financial statements have been applied to the purposes intended by the Assembly and the financial transactions recorded in the financial statements conform to the authorities which govern them.

Matters on which I report by exception

I have nothing to report in respect of the following matters which I report to you if, in my opinion:

- adequate accounting records have not been kept; or
- the financial statements and the parts of the Remuneration and Staff Report to be audited are not in agreement with the accounting records; or
- I have not received all of the information and explanations I require for my audit; or
- the Governance Statement does not reflect compliance with the Department of Finance's guidance.

Report

I have no observations to make on these financial statements.

KJ Donnelly
Comptroller and Auditor General
Northern Ireland Audit Office
106 University Street
Belfast
BT7 1EU

2nd October 2020

Armagh Observatory and Planetarium

Statement of Financial Activities for the year ended 31 March 2020

	Note	Unrestricted Funds 2020 £	Restricted Funds 2020 £	**Total Funds 2020 £**	Unrestricted Funds 2019 £	Restricted Funds 2019 £	**Total Funds 2019 £**
Income from:							
Charitable activities	2	1,930,504	1,707,667	**3,638,171**	1,824,764	659,634	**2,484,398**
Other trading activities	4	112,686	-	**112,686**	90,346	-	**90,346**
Total incoming resources		2,043,190	1,707,667	**3,750,857**	1,915,110	659,634	**2,574,744**
Expenditure on:							
Charitable activities	5	3,065,947	163,000	**3,228,947**	2,527,179	324,261	**2,851,440**
Other trading activities	7	52,427	-	**52,427**	46,223	-	**46,223**
Total outgoing expenditure		3,118,374	163,000	**3,281,374**	2,573,402	324,261	**2,897,663**
Net income / (expenditure)		(1,075,184)	1,544,667	**469,483**	(658,292)	335,373	**(322,919)**
Transfers between funds	15	1,518,998	(1,518,998)	**-**	447,932	(447,932)	**-**
Other recognised gains/(losses):							
Gains/(losses) on the revaluation of fixed assets	10	28,576	-	**28,576**	(71,033)	-	**(71,033)**
Actuarial gains less provisions on defined benefit pension scheme	16	(950,000)	-	**(950,000)**	281,000	-	**281,000**
Net Movement in Funds		(477,610)	25,669	**(451,941)**	(393)	(112,559)	**(112,952)**
Reconciliation of funds							
Total funds brought forward at 1 April 2019		9,171,998	116,460	9,288,458	9,172,391	229,019	9,401,410
Total funds carried forward at 31 March 2020		8,694,388	142,129	8,836,517	9,171,998	116,460	9,288,458

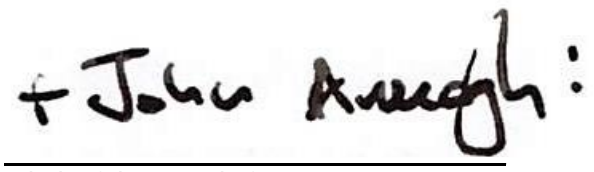
All amounts above relate to continuing operations of the organisation.
The notes on pages 58 to 70 form part of the financial statements.

Armagh Observatory and Planetarium

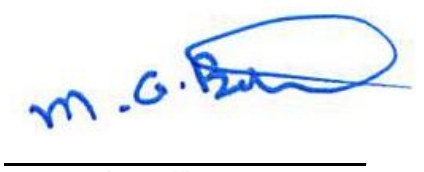
Balance Sheet as at 31 March 2020

	Note	2020	2019
Fixed Assets		**£**	**£**
Intangible assets	9	217,250	-
Tangible assets	10	8,739,283	8,091,188
Heritage Assets	11	2,598,595	2,598,595
Total fixed assets		11,555,128	10,689,783
Current assets			
Stocks	12	13,913	17,920
Debtors	13	116,484	105,352
Cash at bank and in hand	18	371,486	599,322
Total current assets		501,883	722,594
Creditors: amounts falling due within one year	14	(825,494)	(875,919)
Net current assets		(323,611)	(153,325)
Total assets less current liabilities		11,231,517	10,536,458
Creditors: amounts falling due after more than one year		-	-
Net assets excluding pension liability		11,231,517	10,536,458
Defined benefit pension scheme liability	19	(2,395,000)	(1,248,000)
Net assets		**8,836,517**	**9,288,458**
Funds			
Restricted funds	15	142,129	116,460
Unrestricted funds	15	3,572,759	2,714,190
Revaluation Reserves	15	7,516,629	7,705,808
Pension Reserve	15	(2,395,000)	(1,248,000)
Total Charity Funds		**8,836,517**	**9,288,458**

The financial statements on pages 55 to 70 were approved by the Board of Trustees of Armagh Observatory and Planetarium on 21 September 2020 and were signed on its behalf by:



Chair of the Board of Trustees
Archbishop John McDowell



Accounting Officer
Professor Michael Burton

Armagh Observatory and Planetarium

Statement of cash flows for the year ended 31 March 2020

	Note	2020 £	2019 £
Net cash provided by operating activities	17	616,214	236,649
Cash flows from investing activities:			
Interest received		306	666
Proceeds from sale of tangible fixed assets		2,902	216
Purchase of intangible fixed assets		(140,000)	-
Purchase of tangible fixed assets		(707,258)	(312,060)
		(844,050)	(311,178)
Increase / (decrease) in cash and cash equivalents		(227,836)	(74,529)

Further detail is reported in Notes 17 and 18.

Reconciliation of net cashflow to movement in net cash funds

		2020 £	2019 £
Decrease in cash and cash equivalents in the year		(227,836)	(74,529)
Cash and cash equivalents at 1 April 2019		599,322	673,851
Cash and cash equivalents at 31 March 2020	18	371,486	599,322

The notes on pages 58 to 70 form part of the financial statements.

Armagh Observatory and Planetarium

Notes to the financial statements for the year ended 31 March 2020

1 Summary of significant accounting policies

(a) Basis of accounting

These financial statements have been prepared in accordance with the historical cost convention as modified by the revaluation of certain assets. The accounts comply with relevant accounting standards and disclosure requirements issued by the Department of Finance. In all other aspects the financial statements comply with the Statement of Recommended Practice applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS102) (Charities SORP (FRS102)).

The Trustees of Armagh Observatory and Planetarium confirm that they have complied with their duty to have regard to the guidance on Public Benefit produced by the Charities Commission of Northern Ireland under section 4(b) of the Charities Act (the public benefit requirement statutory guidance) and that this has informed the activities of the organisation in the year to 31 March 2020.

The Trustees are satisfied that the organisation is a going concern on the basis that it has a reasonable expectation that it will continue in operation for the foreseeable future. The financial statements are therefore prepared on a going concern basis.

(b) Incoming resources

Grant income from Department for Communities (DfC) is shown in the Statement of Financial Activities in the year in which it is received. Grants that relate to specific capital expenditure are initially recognised in the SOFA and transferred to a restricted fund, Government Grant for Fixed Assets. Where no restriction on the use of the assets exists the value is transferred to an unrestricted fund. Grants that relate to specific research projects are recognised in the Statement of Financial Activities and transferred to a restricted fund. Once the relevant conditions for recognition (entitlement and certainty of value) have been met, they are transferred to funds to match the relevant expenditure. Other grants are credited to the Statement of Financial Activities when received.

(c) Resources expended

Resources expended are accounted for on an accruals basis. Expenditure is classified under the principal charitable activities of Research, Education and Governance & Support.

(d) Pension scheme

The organisation provides pension benefits to its employees by participating in the Local Government Pension Scheme for Northern Ireland, administered by Northern Ireland Local Government Officers' Superannuation Committee (NILGOSC), which is a defined benefit scheme. Annual contributions to the NILGOSC scheme are determined by the scheme and based on actuarial advice. The operating costs of providing retirement benefits to the organisation's employees are recognised in accounting periods in which the benefits are earned by employees, and the related finance costs and other changes in value of the assets and liabilities are recognised in the period in which they arise.

(e) Intangible fixed assets

Intangible fixed assets represent contributions to global astronomical research projects, financed by capital grant. They are identifiable, for example, as part of a major telescope installation. The organisation gains benefit in the form of research participation or collaboration, which in turn contributes to the research outputs. Intangible fixed assets are stated at cost and amortised over the expected life of the project.

(f) Tangible fixed assets

The cost of tangible fixed assets is their purchase cost or valuation together with any incidental costs of acquisition. Depreciation is calculated so as to write off the cost or valuation of tangible fixed assets, less their estimated residual values, on a straight-line basis over the expected useful economic lives of the assets concerned. Land is not depreciated.
The principal annual depreciation rates used are as follows:

Buildings	Remaining asset life as valued
Digistar	20%
Fixtures and fittings	10 - 25%
Office equipment	6.67 - 25%
Scientific equipment	10 - 25%
Astropark	2%
Exhibits and grounds equipment	6.67 - 25%
Motor Vehicles	20%

Land and buildings are included in the balance sheet at depreciated replacement cost, estimated value in use or market value. Land and buildings are professionally revalued at least every 5 years in accordance with accounting guidance. Land and buildings were last revalued as at the 31st March 2020. Revaluation gains (losses) are transferred to a revaluation reserve. Land and buildings in years where no revaluation occurs are restated using indices.

Land and Buildings were revalued by Land and Property Services in accordance with the RICS Valuation Standards, insofar as these are consistent with the requirements of the client. The valuations were undertaken having regard to International Financial Reporting Standards (IFRS) as applied to the United Kingdom public sector and in accordance with HM Treasury guidance, International Valuation Standards and the requirements of the Royal Institution of Chartered Surveyors Valuation – Professional Standards. As at the valuation date, LPS considered it prudent to advise that market evidence gathered as part of their valuation exercise, for comparison purposes, has attached to it, due to the worldwide impact of the COVID-19 pandemic, an increased level of uncertainty in terms of informing opinions of value. The valuations are therefore reported on the basis of ‘material valuation uncertainty’ as per VPS3 and VPGA10 of the RICS Global Standards. Consequently, less certainty and a higher degree of caution should be attached to them than would normally be the case.

Notes to the financial statements for the year ended 31 March 2020 (continued)

Other fixed assets (non Land & Buildings) with a life estimated over 5 years have a net book value of £52,787 at 31st March 2020. This accounts for 0.6% of the net book value of fixed assets. The Trustees do not consider it appropriate to carry out an annual indexation of such assets on grounds of immateriality.

(g) Heritage Assets

Armagh Observatory was founded in 1789 and from this date the Observatory has collected through its operations scientific items, books, furniture and other artefacts which would be considered heritage assets. It is not the policy of Armagh Observatory and Planetarium to acquire heritage assets but has collected such assets through donations and operations. At 31 March 2019, the majority (92% by value) of heritage assets were valued by Sotheby's of London for insurance purposes with reference to auction estimates for replacement. The remainder were valued by Ulster Museum and experienced members of management. It is policy to regularly review the valuation of heritage assets. Given that they were last valued in March 2019, the Trustees consider that this value remains appropriate.

Heritage assets are summarised in four categories: Books; Clocks and watches; Scientific instruments; and Furniture, Artworks, etc, and are recorded in catalogues and on databases. Historic buildings which have heritage value are included within operational assets. These were included within the recent property revaluation as operational assets and continue to be used for operational purposes.

(h) Stocks

Stocks are stated at the lower of cost and net realisable value. In general, cost is determined on a first in first out basis. Provision is made where necessary for obsolete, slow moving and defective stocks.

(i) Debtors

Debtors comprise amounts due from customers, grants due, prepaid expenses and value added tax.

(j) Cash at bank and in hand

Cash held in bank accounts payable on demand and cash floats.

(k) Creditors

Creditors comprise payments due to suppliers and accruals for amounts due at the year end.

(l) Fund accounting

The organisation has various types of funds for which it is responsible, and which require separate disclosure. These are as follows:

Restricted funds

Grants or donations received which are earmarked by the donor for specific purposes. Such purposes are within the overall aims of the organisation.

Unrestricted funds

Unrestricted funds, comprising designated funds and undesignated funds, are those which are expendable at the discretion of the trustees in furtherance of the objectives of the organisation. In addition to expenditure on the provision of services, such funds may be held in order to finance capital investment and working capital.

Designated funds include the donated assets fund, the government grants fund and the general fund. The general fund is the day to day operating fund.

Donated assets are the buildings and grounds donated to the organisation in 1790 by it's founder Archbishop Richard Robinson. The value is adjusted annually by any revaluation of the underlying assets.

The government grant fund represents the capital financing of the Charity's tangible fixed assets. The fund is reduced annually by a value equivalent to depreciation charged on the related assets.

Undesignated funds - These represent the revaluation reserve which records the movement from the revaluation of the Charity's assets and a pension reserve which matches the long term liability of an underfunded defined benefits pension scheme.

(m) Reserves policy

The Armagh Observatory and Planetarium adopts a risk-based approach to establishing a sound system of control covering all types of risks to the aims and objectives of the organisation. There is a need to retain a sufficient level of unrestricted cash reserves to meet the risks associated with financial contingencies, uncertainties and demands.

Armagh Observatory and Planetarium budgets to operate on an annual basis within a balanced funding formula of grant in aid and self generated income. Annual operating surpluses / (deficits) are kept to a minimum and are transferred to an unrestricted general reserve at 31 March each year. The policy is reviewed on an annual basis. The level of general funds at 31 March 2020 was £183,998 (£271,248 at 31 March 2019).

The reserves are held in a short-term bank deposit account within the NICS banking arrangements, with any interest earned being used to fund operating costs.

Notes to the financial statements for the year ended 31 March 2020 (continued)

2 Income from charitable activities

	Note	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
Grant Income					
DfC Recurrent grant-in-aid		1,704,500	-	1,704,500	1,661,180
DfC VES grant-in-aid		-	-	-	92,500
DfC In-year capital grant-in-aid		-	1,452,000	1,452,000	292,600
Total grant-in-aid from the DfC		1,704,500	1,452,000	3,156,500	2,046,280
Income from other grants and receipts	3	2,162	255,667	257,829	256,282
Total Grant Income		1,706,662	1,707,667	3,414,329	2,302,562
Operating Income					
Admissions		207,082	-	207,082	160,190
Profit on disposal of fixed assets		2,902	-	2,902	-
Miscellaneous income		13,858	-	13,858	21,646
Total Operating Income		223,842	-	223,842	181,836
Total Income from Charitable Activities		**1,930,504**	**1,707,667**	**3,638,171**	**2,484,398**

3 Income from other grants and receipts

	Note	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
STFC Research, Visitor and Travel grants		-	255,667	255,667	254,275
Space Awareness Project		-	-	-	-
IAESTE		-	-	-	-
Royal Society		-	-	-	900
Sundry donations		2,162	-	2,162	1,107
Total other grants and receipts	2	2,162	255,667	257,829	256,282

4 Income from other trading activities

	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
Shop income	95,279	-	95,279	74,625
Rental income	17,407	-	17,407	15,721
Total Income from other trading	112,686	-	112,686	90,346

5 Expenditure on charitable activities

	Note	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
Research	6	986,190	163,000	1,149,190	1,194,069
Education	6	1,055,250	-	1,055,250	751,416
Governance and Support	6	1,024,507	-	1,024,507	905,955
		3,065,947	163,000	3,228,947	2,851,440

Notes to the financial statements for the year ended 31 March 2020 (continued)

6 Expenditure on charitable activities

	Note	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
Research					
Staff costs		472,344	90,944	563,288	658,206
Direct costs		161,834	72,056	233,890	263,368
Support costs		160,967	-	160,967	116,372
Depreciation		191,045	-	191,045	156,123
	5	986,190	163,000	1,149,190	1,194,069
Education					
Staff costs		323,041	-	323,041	238,462
Direct costs		217,196	-	217,196	120,025
Support costs		211,291	-	211,291	127,939
Depreciation		303,722	-	303,722	264,990
	5	1,055,250	-	1,055,250	751,416
Governance and Support					
Staff costs		796,910	-	796,910	707,272
Direct costs		29,142	-	29,142	9,917
Support costs		179,348	-	179,348	174,741
Depreciation		19,107	-	19,107	14,025
	5	1,024,507	-	1,024,507	905,955

Included within Governance and Support costs are the following governance costs:

	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
Management Committee expenses	2,848	-	2,848	2,608
Audit	26,537	-	26,537	27,651
	29,385	-	29,385	30,259

The cost of audit shown above includes £20,000 fees payable to Northern Ireland Audit Office for statutory audit. NIAO does not provide any other service.

7 Expenditure on trading activities

	Unrestricted Funds 2020 £	Restricted Funds 2020 £	Total Funds 2020 £	Total Funds 2019 £
Trading				
Direct costs	52,427	-	52,427	46,223
	52,427	-	52,427	46,223

Notes to the financial statements for the year ended 31 March 2020 (continued)

8 Average staff numbers and related costs

	Permanent staff	Others	2020 Number	2019 Number
Average staff numbers	23.3	9.9	33.2	30.6

Staff costs comprise:	Permanent staff £	Others £	2020 £	2019 £
Wages and salaries	1,014,841	193,623	1,208,464	1,183,424
Social security costs	101,100	1,994	103,094	96,201
Employer's pension contributions	203,379	2,302	205,681	185,815
Defined benefit pension additional service cost	166,000	-	166,000	46,000
Termination costs	-	-	-	92,500
	1,485,320	197,919	1,683,239	1,603,940

The number of employees whose employee benefits (excluding employer pension costs) exceeded £60,000 was:

	2020 Number	2019 Number
£80,001 - £90,000	1	1

The key management personnel of the organisation comprise the trustees and the executive director.

The total amount of employee benefits (including employer pension contributions) received by the executive director for his services to the organisation was £97,194 (2019: £97,603).

There was no remuneration paid to trustees during the year (2019: nil). Travel and subsistence expenses totalling £801 was reimbursed to 2 trustees (2019: £159 to 2 trustees).

Average student numbers and related costs (not included above)

	2020 Number	2019 Number
PhD students	7	8

	2020 £	2019 £
Student maintenance grants & stipends	109,493	137,153

Notes to the financial statements for the year ended 31 March 2020 (continued)

9 Intangible fixed assets

				2020	2019
				£	£
Cost					
At 1 April 2019				-	-
Additions				140,000	-
Transfer from Fixed Assets				200,450	-
Disposals				-	-
At 31 March 2020				340,450	-
Depreciation					
At 1 April 2019				-	-
Transfer from Fixed Assets				83,671	-
Charge for year				39,529	-
Disposals				-	-
At 31 March 2020	-	-	-	123,200	-
Net book value					
At 31 March 2020	**-**	**-**	**-**	**217,250**	**-**
At 31 March 2019	**-**	**-**	**-**	**-**	**-**

Intangible fixed assets were previously included in Fixed Assets under the heading of Scientific Equipment. Additions this year were funded by DfC in year capital grant-in-aid.

10 Tangible fixed assets

	Freehold Land & buildings	Exhibits grounds and Astropark	Digistar Projection System	Scientific Equipment	Other Equipment & Vehicles	Total
	£	£	£	£	£	£
Cost or valuation						
At 1 April 2019	7,592,768	575,378	1,200,332	806,421	686,274	10,861,173
Asset revaluation	(189,179)	-	-	-	-	(189,179)
Additions	288,664	97,800	487,788	(1,786)	338,176	1,210,642
Transfer to Intangible Assets	-	-	-	(200,450)	-	(200,450)
Disposals	-	-	(1,196,140)	(19,877)	(6,980)	(1,222,997)
At 31 March 2020	7,692,253	673,178	491,980	584,308	1,017,470	10,459,189
Depreciation						
At 1 April 2019	-	511,157	1,163,729	655,168	439,931	2,769,985
Adjustment for asset revaluation	(217,755)	-	-	-	-	(217,755)
Charge for year	217,755	43,929	35,800	16,796	160,064	474,344
Transfer to Intangible Assets	-	-	-	(83,671)	-	(83,671)
Disposals	-	-	(1,196,140)	(19,877)	(6,980)	(1,222,997)
At 31 March 2020	-	555,086	3,389	568,416	593,015	1,719,906
Net book value						
At 31 March 2020	**7,692,253**	**118,092**	**488,591**	**15,892**	**424,455**	**8,739,283**
At 31 March 2019	**7,592,768**	**64,221**	**36,603**	**151,253**	**246,343**	**8,091,188**

Tangible fixed asset additions of £1,210,642 as shown above were funded by DfC in-year capital grant-in-aid together with minor proceeds of sale of assets.

As a result of the recent and ongoing COVID-19 pandemic events, and in line with current RICS guidance, LPS have advised that market evidence gathered as part of the recent valuation has attached to it, due to the worldwide impact of the pandemic, an increased level of uncertainty in terms of informing opinions of value. Whilst at this stage there is no evidence of impairment as at year-end, the future impact of COVID-19 on land and building values cannot yet be accurately assessed therefore the need for further future valuations will remain under consideration, subject to resources.

If the land and buildings had not been valued, they would have been included at the following amounts:

	2020	2019
	£	£
Cost	2,637,517	2,346,853
Aggregate depreciation	(972,557)	(920,084)
Net book value based on historic cost	1,664,960	1,426,769

Notes to the financial statements for the year ended 31 March 2020 (continued)

10 Tangible fixed assets (continued)

Included within Additions above are certain assets under construction:

Freehold Land & buildings	Digistar Projection System	Total
£	£	£
247,448	487,788	735,236

Depreciation on tangible fixed assets for the year was £474,344 (2019: £435,137).

Land and buildings include grounds and buildings with a net book value of £1,880,451 (2019: £1,872,759) which were donated to the organisation in 1790 by Archbishop Richard Robinson, the founder of the organisation.

Armagh Observatory and Planetarium includes in fixed assets any expenditure over £1,500 (on an item or group of related items) which is expected to be used for more than a year.

11 Heritage assets

At Valuation	Books	Clocks & Watches	Scientific Equipment	Furniture, Artworks, etc	Total
	£	£	£	£	£
Carrying Amount at 1 April 2019	546,975	572,600	1,298,900	180,120	2,598,595
Transfers	-	-	-	-	-
Disposals	-	-	-	-	-
Depreciation / impairment	-	-	-	-	-
Carrying Amount at 31 March 2020	546,975	572,600	1,298,900	180,120	2,598,595

Armagh Observatory was founded in 1789 and from this date the Observatory has collected through its operations scientific items, books, furniture and other artefacts which would be considered heritage assets. It is not the policy of Armagh Observatory and Planetarium to acquire heritage assets but has collected such assets through donations and operations.

Summary of heritage asset transactions

There were no purchases, donations, charges for impairment or disposals of heritage assets in the five years ended 31 March 2020. £60,061 of historic telescopes and £5,100 of meteorites were transferred from tangible fixed assets to heritage assets during the year ended 31 March 2019.

12 Stocks

	2020	2019
	£	£
Goods for resale	13,913	17,920

13 Debtors

	2020	2019
	£	£
Trade debtors	4,475	4,237
Prepayments and accrued income	18,877	54,243
Other debtors	93,132	46,872
	116,484	105,352

14 Creditors: amounts falling due within one year

	2020	2019
	£	£
Trade creditors	283,313	316,685
Accruals and deferred income	516,603	526,279
Taxation and social security	25,578	32,955
	825,494	875,919

Notes to the financial statements for the year ended 31 March 2020 (continued)

15 Statement of Funds

	At 1 April 2019	Income	Expenditure	Revaluation	Transfers	At 31 March 2020
	£	£	£	£	£	£
Restricted Funds						
Government grant for fixed assets	-	1,452,000	-	-	(1,452,000)	-
Restricted resource grants	116,460	255,667	(163,000)	-	(66,998)	142,129
Total restricted funds	**116,460**	**1,707,667**	**(163,000)**	**-**	**(1,518,998)**	**142,129**
Unrestricted Funds						
Designated Funds						
Donated assets reserve	1,712,591	-	-	-	7,692	1,720,283
Government grant for assets	730,351	-	-	-	938,127	1,668,478
General fund	271,248	2,043,190	(3,118,374)	-	987,934	183,998
	2,714,190	**2,043,190**	**(3,118,374)**	**-**	**1,933,753**	**3,572,759**
Undesignated Funds						
Revaluation reserve - Land & Buildings	6,414,334	-	-	28,576	(217,755)	6,225,155
Revaluation reserve - Heritage Assets	1,291,474	-	-	-	-	1,291,474
Pension reserve	(1,248,000)	-	-	(950,000)	(197,000)	(2,395,000)
	6,457,808	**-**	**-**	**(921,424)**	**(414,755)**	**5,121,629**
Total Unrestricted Funds	**9,171,998**	**2,043,190**	**(3,118,374)**	**(921,424)**	**1,518,998**	**8,694,388**
Total Funds	**9,288,458**	**3,750,857**	**(3,281,374)**	**(921,424)**	**-**	**8,836,517**

Details of Transfers between funds	**£**
Release of restricted resource grant available to offset overheads	(66,998)
Release of deferred capital grant	(513,873)
Transfer of defined benefit pension service and interest cost	(197,000)
Transfer of depreciation adjustment on asset revaluation to general fund	(217,755)
Transfer of donated asset reserve to match building valuation	7,692
General fund	**987,934**

16 Analysis of net assets between funds

	Pension Reserve	Revaluation Reserve	Unrestricted Funds	Restricted Funds	Total Funds
	£	£	£	£	£
Tangible fixed assets	-	6,225,155	2,731,378	-	8,956,533
Heritage assets	-	1,291,474	1,307,121	-	2,598,595
Current assets	-	-	359,754	142,129	501,883
Creditors: amounts falling due within one year	-	-	(825,494)	-	(825,494)
Pension scheme liability	(2,395,000)	-	-	-	(2,395,000)
Net assets/(liabilities)	(2,395,000)	7,516,629	3,572,759	142,129	8,836,517

17 Reconciliation of net expenditure to net cash flow from operating activities

	2020	2019
	£	£
Net expenditure for the year per statement of financial activities	469,483	(322,919)
Adjustments for:		
Depreciation	513,873	435,137
Interest received	(306)	(666)
Loss/(profit) on disposal of assets	(2,902)	447
Defined benefit pension scheme service and interest cost less contributions payable	197,000	81,000
Decrease/(increase) in stock	4,007	(6,417)
(Increase)/decrease in debtors	(11,132)	23,496
Decrease)/increase in creditors	(553,809)	26,571
Net cash provided by operating activities	616,214	236,649

Notes to the financial statements for the year ended 31 March 2020 (continued)

18 Analysis of cash and cash equivalents

	31 March 2020 £	1 April 2019 £
Cash at bank and in hand	371,486	599,322
Total cash and cash equivalents	371,486	599,322

19 Pension scheme

Introduction

The disclosures below relate to the funded liabilities within the Northern Ireland Local Government Officers' Superannuation Pension Fund (the "Fund") which is part of the Local Government Pension Scheme (Northern Ireland) (the "LGPS") and certain related unfunded liabilities which have been separately disclosed. The LGPS is a funded defined benefit plan with benefits earned up to 31 March 2015 being linked to final salary. Benefits after 31 March 2015 are based on a Career Average Revalued Earnings scheme. Details of the benefits earned over the period covered by this disclosure are set out in 'The Local Government Pension Scheme Regulations (Northern Ireland) 2014' (as amended) and 'The Local Government Pension Scheme (Amendment and Transitional Provisions) Regulations (Northern Ireland) 2014' (as amended). The unfunded pension arrangements relate to termination benefits made on a discretionary basis upon early retirement in respect of members of the Local Government Pension Scheme under the 'Local Government (Early Termination of Employment) (Discretionary Compensation) Regulations (Northern Ireland) 2007'.

Funding / Governance Arrangements of the LGPS

The funded nature of the LGPS requires participating employers and their employees to pay contributions into the Fund, calculated at a level intended to balance the pension liabilities with investment assets. Information on the framework for calculating contributions to be paid is set out in 'The Local Government Pension Scheme Regulations (Northern Ireland) 2014' and the Fund's Funding Strategy Statement. The last actuarial valuation was at 31 March 2019 and the contributions to be paid until 31 March 2023 resulting from that valuation are set out in the Fund's Rates and Adjustment Certificate. The Northern Ireland Local Government Officers' Superannuation Committee is responsible for the governance of the Fund.

Assets

The assets allocated to the Employer in the Fund are notional and are assumed to be invested in line with the investments of the Fund for the purposes of calculating the return over the accounting period. The Fund holds a significant proportion of its assets in liquid investments. As a consequence there will be no significant restriction on realising assets if a large payment is required to be paid from the Fund in relation to an employer's liabilities. The assets are invested in a diversified spread of investments and the approximate split of assets for the Fund as a whole (based on data supplied by the Committee) is shown in the disclosures. The Committee may invest a small proportion of the Fund's investments in the assets of some of the employers participating in the Fund if it forms part of their balanced investment strategy.

The NILGOSC actuary, Aon Hewitt Ltd, has provided the following details for the purposes of accounting for the Observatory and Planetarium's joint share of the scheme deficit in accordance with FRS 102 at 31 March 2020.

Key assumptions used by the actuary were:

	31/03/2020 %	31/03/2019 %
Discount rate	2.30	2.40
CPI inflation	2.00	2.20
Pension increases	2.00	2.20
Pension accounts revaluation rate	2.00	2.20
Salary increases	3.50	3.70

Mortality assumptions

	2020 Years	2019 Years
Males		
Pensioner member aged 65 at accounting date	21.8	22.6
Active member aged 45 at accounting date	23.2	24.3
Females		
Pensioner member aged 65 at accounting date	25.0	24.9
Active member aged 45 at accounting date	26.4	26.7

Asset Allocation

	Value at 31/03/2020 %	Value at 31/03/2019 %
Equities	42.6	59.5
Property	10.0	11.2
Government bonds	26.1	16.5
Corporate bonds	12.6	7.0
Cash	4.7	2.7
Other	4.0	3.1
Total	100.0	100.0

Notes to the financial statements for the year ended 31 March 2020 (continued)

19 Pension scheme (continued)

Reconciliation of funded status to balance sheet

	2020 £'000	2019 £'000
Fair value of assets	8,918	10,731
Present value of funded defined benefit obligation	(11,311)	(11,977)
Funded status (deficit)	(2,393)	(1,246)
Present value of unfunded defined benefit obligation	(2)	(2)
McCloud judgement provision		
GMP Indexation and Equalisation provision		
Liability recognised on the balance sheet	(2,395)	(1,248)

The split of the liabilities at the last valuation between the various categories of members is as follows:

Active members	34%
Deferred pensioners	25%
Pensioners	41%

Amounts recognised in statement of financial activities

	Year to 31/03/2020 £'000	Year to 31/03/2019 £'000
Operating cost		
Current service cost	(374)	(239)
Financing cost		
Interest on net defined benefit liability	(31)	(35)
Additional provisions		
McCloud judgement provision	-	(173)
GMP Indexation and Equalisation provision	-	(35)
Pension expense recognised in statement of financial activities	(405)	(482)
Allowance for administrative expenses included in Current Service Cost	5	3

Asset gains recognised in statement of funds

	Year to 31/03/2020 £'000	Year to 31/03/2019 £'000
Asset gains/(losses) arising during the period	(2,007)	626
Liability gains/(losses) arising during the period	1,057	(137)
Total amount recognised in statement of funds	(950)	489

Changes to the present value of defined benefit obligation

	Year to 31/03/2020 £'000	Year to 31/03/2019 £'000
Opening defined benefit obligation (restated)	11,979	11,276
Current service cost	374	239
Interest expense on defined benefit obligation	284	291
Contributions by participants	75	64
Actuarial (gains)/ losses on liabilities	(1,057)	137
Net benefits paid out	(342)	(238)
Closing defined benefit obligation	11,313	11,769

Changes to the fair value of assets

	Year to 31/03/2020 £'000	Year to 31/03/2019 £'000
Opening fair value of assets (restated)	10,731	9,831
Interest income on assets	253	256
Remeasurement gains/(losses) on assets	(2,007)	626
Contributions by the employer	208	192
Contributions by participants	75	64
Net benefits paid out	(342)	(238)
Closing fair value of assets	8,918	10,731

Notes to the financial statements for the year ended 31 March 2020 (continued)

19 Pension scheme (continued)

Actual return on assets

	Year to 31/03/2020 £'000	Year to 31/03/2019 £'000
Interest income on assets	253	256
Gain/(loss) on assets	(2,007)	626
Actual reurn on assets	(1,754)	882

Sensitivity Analysis
Funded LGPS benefits

Discount rate assumptions

Adjustment to discount rate	**+0.1%pa**	**Base Figure**	**-0.1%pa**
Present value of total obligation (£m)	11.125	11.311	11.500
% change in present value of total obligation	-1.60%		1.7%
Projected service cost (£m)	0.345	357.000	0.370
Approximate % change in projected service cost	-3.50%		3.60%

Rate of general increase in salaries

Adjustment to salary increase rate	**+0.1%pa**	**Base Figure**	**-0.1%pa**
Present value of total obligation (£m)	11.322	11.311	11.290
% change in present value of total obligation	0.2%		0.2%
Projected service cost (£m)	0.357	0.357	0.357
Approximate % change in projected service cost	0.0%		0.0%

Rate of increase to pensions in payment and deferred pension assumption, and rate of revaluation of pension account assumptions:

Adjustment to pension increase rate	**+0.1%pa**	**Base Figure**	**-0.1%pa**
Present value of total obligation (£m)	11.519	11.311	11.108
% change in present value of total obligation	1.8%		-1.8%
Projected service cost (£m)	0.370	0.357	0.345
Approximate % change in projected service cost	3.6%		-3.5%

Post retirement mortality assumption

Adjustment to mortality age rating assumption	**-1 year**	**Base Figure**	**+1 year**
Present value of total obligation (£m)	11.676	11.311	10.949
% change in present value of total obligation	3.2%		-3.2%
Projected service cost (£m)	0.371	0.357	0.343
Approximate % change in projected service cost	4.0%		-3.9%

McCloud Judgement

In December 2018 the Government lost a Court of Appeal case (the 'McCloud/Sargeant' judgement) which found that the transitional protection arrangements put in place when the firefighters' and judges' pension schemes were reformed were age discriminatory. The Government applied to the Supreme Court for permission to appeal the Court of Appeal judgement, however this application was denied on 27 June 2019.
The next stage is for the case to be referred to the Employment Tribunal to agree the remedy, following appropriate consultation. Current expectations are this will not be known until 2020/21.

While the judgement was not in relation to members in the LGPS, the Government announced in a Written Ministerial Statement on 15 July 2019 *"... as 'transitional protection' was offered to members of all the main public service pension schemes, the government believes that the difference in treatment will need to be remedied across all those schemes"* . The remedy is likely to differ by scheme depending on the transitional protections adopted.

The actuarial report assumes the remedy applies to all members in service on 1 April 2015, on retirement only (not prior withdrawal), and on members' benefits only (not dependant benefits). Actuaries have calculated an average potential McCloud liability uplift factor for past service liabilities (as a % of Pay) and future service costs (as a % of Pay) for members at each age (split males and females), based on assumptions adopted by the Fund to report IAS 26 figures at 31 March 2019. All the demographic assumptions underlying the estimate will be consistent with the 2019 valuation. These uplifts have been applied to the AOP membership data from the 2019 valuation, to calculate a potential McCloud liability uplift (past and future service).

19 Pension scheme (continued)

GMP Indexation and Equalisation

Guaranteed Minimum Pension (GMP) is a portion of pension that was accrued by individuals who were contracted out of the State Second Pension between 6 April 1978 and 6 April 1997. The rate at which GMP was accrued, and the date it is payable, is different for men and women, meaning there is an inequality for male and female members who have GMP. This was a consequence of the State Pension itself being unequal at the time.On 26 October 2018 the High Court ruled in the Lloyds Bank case that equalisation for the effect of unequal GMPs is required. The ruling confirmed that trustees have a duty “to equalise benefits for men and women so as to alter the result which is at present produced in relation to GMPs". HM Treasury have, however, gone on record since the Lloyds judgement to say, "Public sector schemes already have a method to equalise guaranteed minimum pension benefits, which is why we will not have to change our method as a result of this judgment."

Prior to 6 April 2016, public service pension schemes and the State Pension worked in tandem to ensure pension increases on State Pension and LGPS pension kept line with inflation. The LGPS (NI) was not required to pay any pension increases on GMPs accrued before April 1988 and was only required to pay limited increases on GMPs accrued after 1988 (CPI inflation capped at 3% p.a.). In return, the Additional Pension (AP) element of the State Pension paid top-up payments to pensioners to give inflation protection on the GMP element where this was not provided by the LGPS. However, reforms were made to the State Pension system in April 2016 which scrapped AP and therefore removed the facility for central government to fully index the combined pension through AP.

In March 2016 the government introduced an ‘interim’ solution’ for public sector schemes to pay full inflationary increases on GMPs for those reaching State Pension Age (SPA) between 6 April 2016 and 5 December 2018 to ensure these members continued to receive full inflationary increases on the combined public sector scheme and State pensions. This was included in the 2016 valuation of the Fund and was therefore recognised on the balance sheet for years ending in 2017 and recognised in OCI in the same year.

In January 2018 the interim solution was extended to individuals reaching SPA on or before 5 April 2021. The additional liability was not recognised on the balance sheet over 2017/18 - our advice at the time was this was unlikely to be material. Further the Government has indicated that it is committed to continuing to compensate all members of public sector pension schemes reaching SPA after 5 April 2021. The Government's view is that this solution meets equalisation requirements. We understand auditors are generally taking the view that it would be reasonable to include some allowance in the calculations for this additional liability, where this is material.

The AON Hewitt Ltd approach for accounting periods ending in 2020 is therefore to include a liability for GMP Indexation for all members whose State Pension Age is after 6 April 2016 (not just those covered by the second interim solution).

20 Capital commitments

Capital commitments at 31 March 2020 totalled £443,836 (2019: £50,000) in respect of expenditure on projects commenced during the year. DfC has agreed funding for 2020/21.

21 Contingent liabilities

There were no contingent liabilities at the 31st March 2020 (2019: £nil).

22 Related-party transactions

None of the members of the Board of Governors, the Management Committee, the Director or other related parties have undertaken any material transactions with the Armagh Observatory and Planetarium during the year. The Armagh Observatory and Planetarium has had various material transactions with a number of Government Departments, Executive Agencies and Non-Departmental Public Bodies in Northern Ireland and the UK. Most of these transactions have been with DfC, Construction and Procurement Delivery (CPD), Strategic Investment Board (SIB), the Science and Technology Facilities Council (STFC) and the Education Authority (EA). DfC provides recurrent and capital grant-in-aid (note 2), SIB provides professional advisory services, the STFC provides grants for research projects (note 2) and CPD and EA are the Centres of Procurement Expertise for the organisation. The Royal School Armagh leases land for playing fields at a nominal rent.

No other related party transactions took place in the year, other than certain trustees' expenses already disclosed in note 8.

23 Losses and special payments

There were no losses or special payments during the year.

Notes to the financial statements for the year ended 31 March 2020 (continued)

24 Financial instruments

As the cash requirements of the Observatory and Planetarium are met through grants from DfC and other grant funding bodies, financial instruments play a more limited role in creating risk than would apply to a non-public sector body of a similar size. The majority of financial instruments relate to contracts to buy non-financial items in line with the Observatory's expected purchase and usage requirements and the Observatory and Planetarium is therefore exposed to little credit, liquidity or market risk.

25 Additional disclosures to comply with the Financial Reporting Manual (FReM)

FReM requires non-departmental public bodies to regard grant-in-aid received as contributions from controlling bodies giving rise to a financial interest in the residual interest of the body and hence accounting for as financing, that is by crediting them to income and expenditure reserve. In addition FReM requires grant-in-aid to be accounted for on a cash basis.

However, as the organisation is required to prepare accounts in accordance with the SORP for charities, DfC has given the organisation permission to continue to treat grants as income. If the Observatory and Planetarium were required to comply with the FReM the result of this compliance would be as follows:

Statement of Financial Activities prepared under FReM

	Note	2020 £	2019 £
Incoming resources			
Incoming resources from research and other non-DfC grants	2	257,829	256,282
Operating income	2	223,842	181,836
Trading income	4	112,686	90,346
Total incoming resources		594,357	528,464
Resources expended			
Direct expenditure of the organisation		3,281,374	2,897,663
Total Resources expended		3,281,374	2,897,663
Net deficit for the year		(2,687,017)	(2,369,199)
Loss/(gain) on revaluation of Fixed Assets		28,576	(71,033)
Actuarial (loss)/gain on pension scheme		(950,000)	281,000
Amount transferred to funds		(3,608,441)	(2,159,232)

Analysis of funds prepared under the FReM

		2020 £	2019 £
Balance at 1 April 2019		9,288,458	9,401,410
Grant-in-aid received in the year	2	3,156,500	2,046,280
Net operating costs for the year		(3,608,441)	(2,159,232)
Balance at 31 March 2020		8,836,517	9,288,458

26 Events after the Reporting Date

1) Adjusting Events:

There were no events after the reporting date which would require adjustment to the financial statements.

2) Non-adjusting Events:

There were no events after the reporting date which would require disclosure in the financial statements.

The Accounting Officer authorised the issue of these financial statements on 21 September 2020.