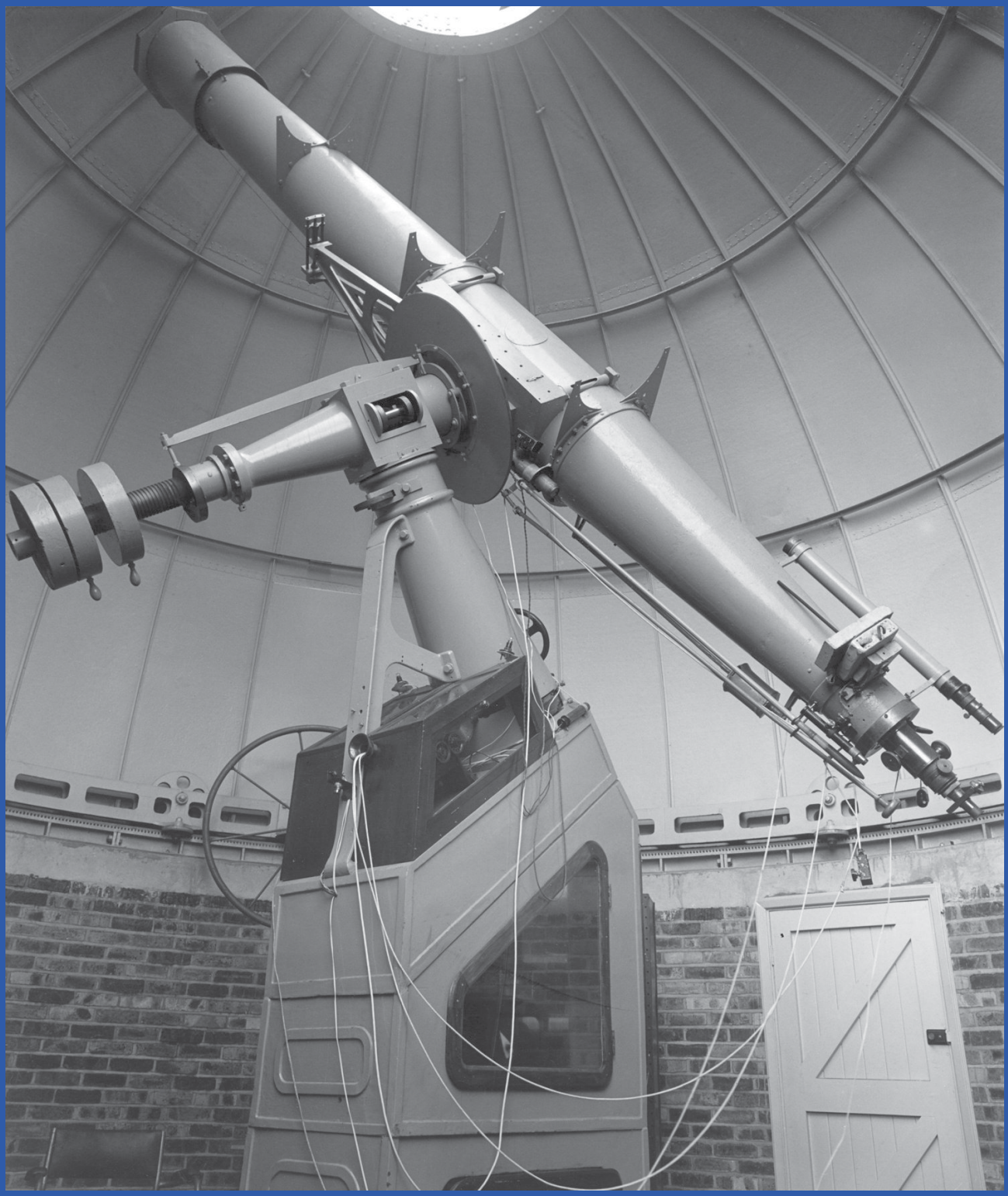
Keele Observatory Annual Report 2010



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From the Directors

The year 2010 marked a new phase in the history of Keele University's Observatory. Founded in 1962 as a circular dome housing the then 88-year old 31cm Grubb refractor, it underwent a major expansion in the mid-1970s with the addition of the second dome housing the 61cm Thornton reflector and the lecture theatre joining the two. However, thirty years later the structure of the building had started to show worrying signs of degradation. In 2008, we were at last in a position to execute a plan of major refurbishment of the building, including also an upgrade of the observing facilities. This had become possible thanks to Keele's Key Fund and a grant from the Wolfson Foundation; we are grateful to Robin Cross, who played an instrumental role in securing this funding. The work on the building was done and finished in 2009 (Fig. 1), and it was re-inaugurated on the 2nd of February of 2010 by Lord Rees, the Astronomer Royal and President of the Royal Society. The coming years are likely to see further improvements to the observatory complex, along with the upgrade of the Thornton telescope's control system.

This was also a year of changes in management. After having seen the observatory through the refurbishment process, Prof. Nye Evans had begun preparing to hand over directorship to Dr. Jacco van Loon, who has assumed charge from 2011 onwards. One result of the change you have before you: the first Annual Report of a professionally run outreach and research facility.

We would also like to take this opportunity to thank all the dedicated, skillful and hard-working people, who make Keele Observatory a success.

Jacco van Loon, incoming Director
Nye Evans, outgoing Director

Figure 1 Keele Observatory in ca. 2003 (top) and in late 2009 (bottom).

Administrative report

Personnel

Keele Observatory is operated and maintained by a unique partnership between the Keele Astrophysics Group in the School of Physical and Geographical Sciences at Keele University, and a group of skilled and enthusiastic volunteers, the Observatory Support Team a.k.a. "The Observatory Crew." In 2010 the Crew was composed of James Albinson, Alan Bagnall, Dave Caisley, Edd Doody, Stephen Doody, Keith Heron, Paul Klimczak, Alan Mason, St.John Robinson and Matthew Stretch, with an advisory role by former Director and founder of Keele Observatory, Ron Maddison.

Finances

The refurbishment of Keele Observatory was financed with a £250,000 grant from the Wolfson Foundation, Keele University's Key Fund, and matching government funding, a total of £360,000.

Keele Observatory must be self-sufficient to maintain its facilities and support its activities. The building is part of the School of Physical and Geographical Sciences, and the directorate of Estates are responsible for servicing and maintaining the infrastructure. The equipment, however, needs regular attention carrying some expenses with it. Therefore we seek to generate a steady income, while offering our services to the public for free or for a small donation. Major developments will require external funding.

In order to create accountability, and to facilitate planning and optimizing operations, a financial budget is created. For 2010 an account of the income is given (Table 1), with the aim of presenting a complete account (i.e. including expenditure) for 2011 – which will then allow a forward projection, i.e. setting a budget for the subsequent year(s).

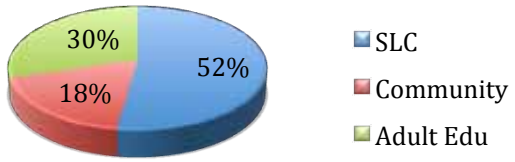


Table 1 Financial account for 2010.

Income	
Science Learning Centre	£300.00
Community group visits	£103.00
Adult Education	£170.75
	£573.75

Income was generated mainly through events organized by the Science Learning Centre West Midlands at Keele University, which are professional courses for teachers. Community groups were usually asked for a £1 per head donation, and Adult Education sessions generated additional income. Workshops for schools were offered gratis in 2010, as part of a pilot scheme coordinated by KeeleLink.

Infrastructure developments

Opening of the refurbished Observatory

The refurbished Observatory was officially inaugurated on the 2nd of February, 2010, by Lord Rees of Ludlow, Astronomer Royal, President of the Royal Society and Professor at the University of Cambridge. He delivered an inspirational speech.

Figure 2 Lord Rees (left) and Vice-Chancellor Dame Janet Finch (right), with the 31cm Grubb refractor from 1874.

The new name given to the facility was "Keele Earth and Space Observatory", as it was envisaged that in future it would be expanded with a visitor centre including also exhibits related to the Earth and the environment. But this was rendered obsolete with the planning of a separate "Sustainability Hub" at the site of Keele Home Farm. We shall therefore refer to our facility simply as "Keele Observatory."

The opening event was attended by about 50 people, and was covered in the local media including BBC Radio Stoke.

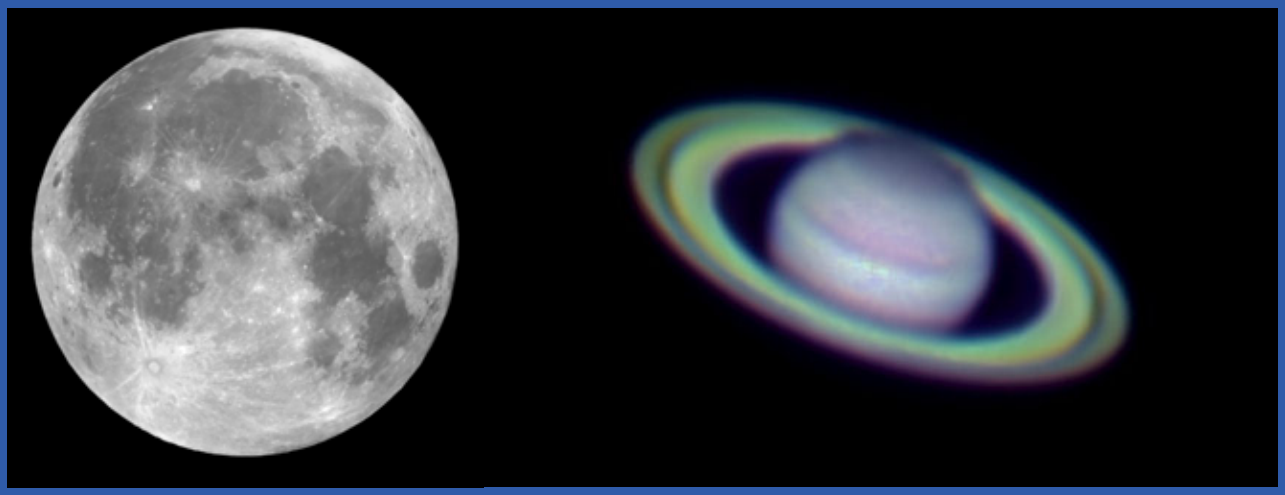
Engineering work on the Thornton

By St.John Robinson

Whilst only maintenance activities were carried out on the 12" Grubb refractor, in line with keeping it in service, the 24" Thornton reflector (Fig.3) saw a number of modifications made to the existing telescope platform to support the acquisition of new equipment and planned upgrades to the command and pointing control system to be done by the firm AWR.

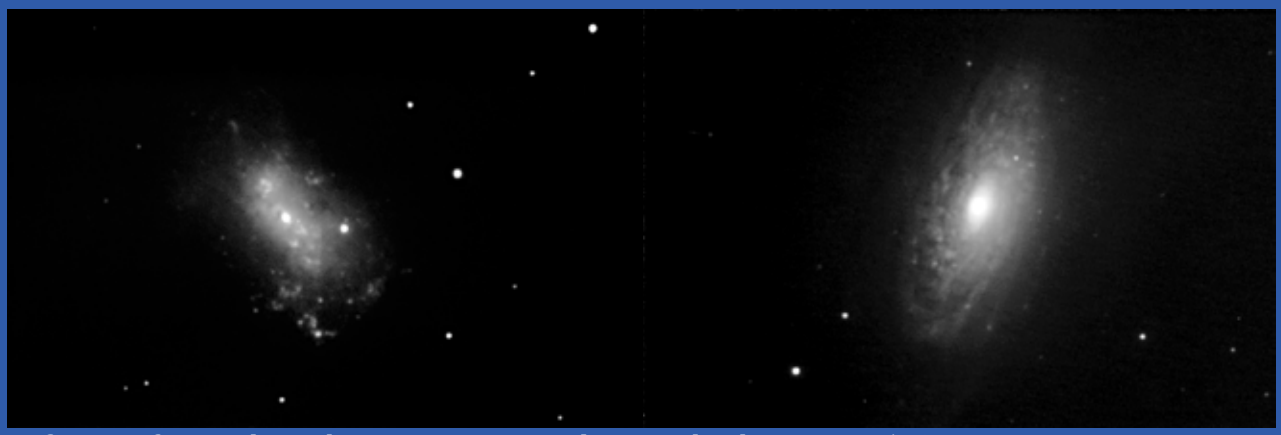
Image Gallery Supplement

All images were taken with the SBIG ST7 camera on the Keele Observatory's 61cm Thornton reflector unless otherwise stated, and are by courtesy of Dr. Iain McDonald.

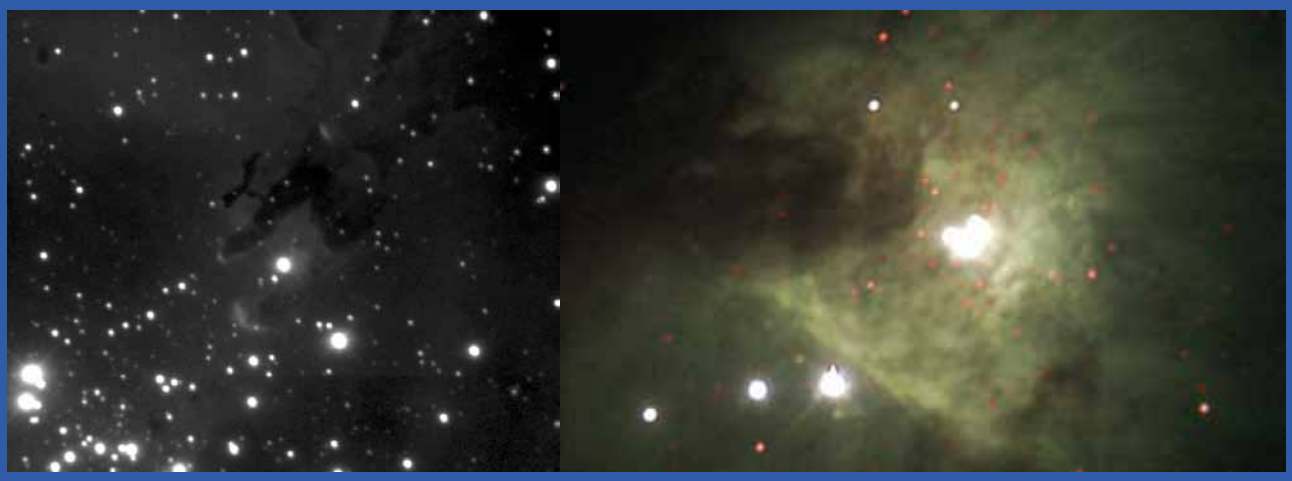


Left: The Full Moon just after the 7 September 2006 lunar eclipse, mosaicked from individual images. *Right:* Planet Saturn, imaged with a digital camera through the 31cm Grubb refractor.

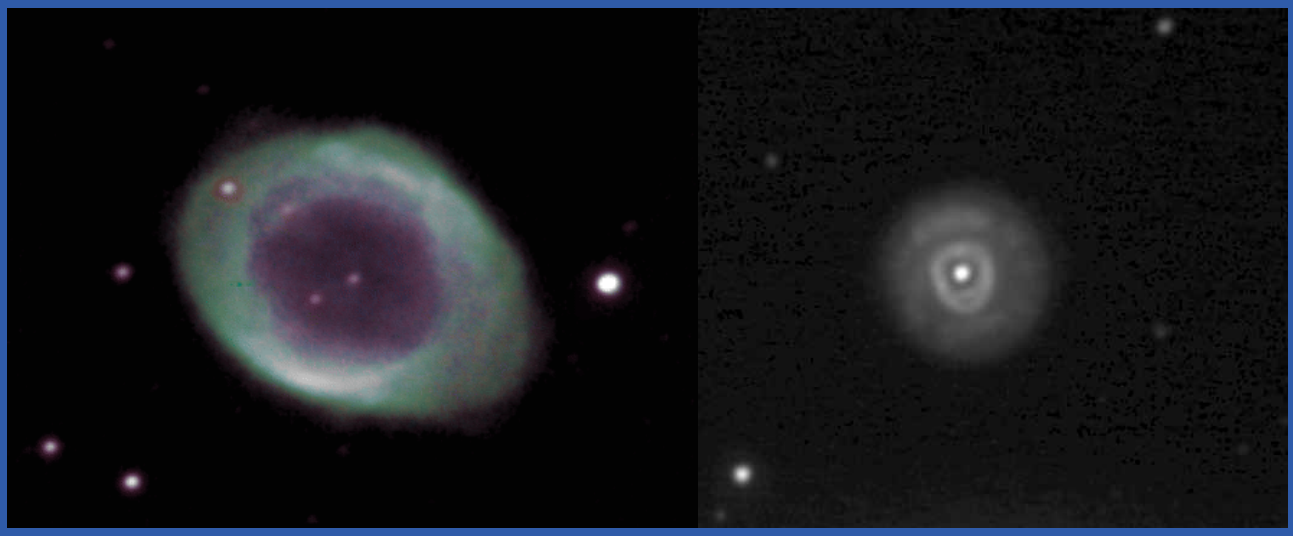
Left: Globular cluster M13. *Right:* The central part of nearby spiral galaxy M33 (Triangulum). Both images are composites of stacked images taken through VRI filters and in white light.



Left: Dwarf irregular galaxy NGC4449. *Right:* Spiral galaxy NGC3521.



Left: The "Elephant Trunks" in the Eagle Nebula (M16) – see J.M. Oliveira, 2009, Handbook of Star Forming Regions Volume II, ed. B. Reipurth, ASP Monograph Publications Vol. 5, p.599. *Right:* The Orion Nebula (M42), with dust-enshrouded young stars revealed in the (infra)red.



Left: The Ring Nebula (M57). *Right:* The Eskimo Nebula (NGC2392), both planetary nebulae.

Left: The Bubble Nebula (NGC7635) surrounding a massive star. *Right:* The Crab Nebula (M1) remnant of supernova 1054, where the oxygen-rich fragments of the exploded star are green.

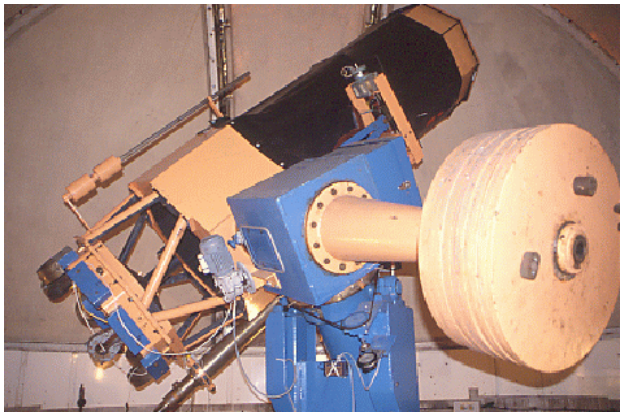


Figure 3 The 24" (61cm) Thornton reflector.

The new equipment includes a new 24" F4.49 primary and secondary mirror, spider support and a Wynne corrector. New optical collimation tools include a Hotech collimation laser and a set of 2" Catseye tools and a 1.25" Ronchi grating.

The existing focus platform was accurately squared to the telescope serrurier truss by defining the focuser axis in relation to the truss assembly. This axis is now marked on a fixed plate opposite the focus platform; this will aid in optical collimation and CCD imaging.

The new spider assembly received initial modifications to facilitate finer control of the mechanical and optical alignment of the secondary mirror. This was achieved by the fitting of a bearing ball to the end of each of the three adjustment rods that control the orientation of the secondary mirror housing with respect to the primary mirror and focus platform.

With the acquisition of a Wynne corrector it was necessary to fabricate an adapter plate to attach the corrector to the traveling focus plate ahead of the existing SBIG ST7 CCD camera. The design of the adapter plate allows for removal of the Wynne corrector without disturbing the position of the camera.

It was noticed during bench testing of the focus platform, camera and Wynne corrector that the focusing motor gearbox assembly was slipping: the paxolin gears were damaged beyond repair. The original synchronous motor was therefore replaced with a direct drive stepper motor.

Bench testing the focus platform with the new stepper motor installed and camera and Wynne corrector in position showed that in certain orientations the platform stepper motor could stall. This was traced to binding of the traveling focus plate on its three threaded support rods. The three moving assemblies were reworked to include self-aligning bearings and housings. Focusing to the micron level has proven readily repeatable.

The telescope control upgrade required eliminating some residual end float in the declination fast slew worm drive. This was achieved by fixing a large diameter fine threaded bolt with a bearing ball fixed in the end to take up the end float at the free end of the worm shaft. At the other end of the worm shaft some stock material was removed to allow the fitment of a ball thrust race with a spacer taking the load to the outer race of the worm drive bearing. Additional aluminium cages were fabricated to fit around the rubber bush that interfaces the fast slew gearbox to the worm drive and has eliminated play between the components.

A small amount of end float was removed from the tangent arm worm drive, which was previously masked by the other problems described previously.

The RA worm wheel and worm drive were cleaned to remove the old lubrication and debris, and they were then re-lubricated.

New equipment on order includes a Finger Lakes CL1-10 filter wheel assembly that is a double carousel arrangement to carry eight 2" filters of choice plus 2 clear, plus associated mounting adapter.

To accommodate the new FLI filter carousel, Wynne corrector and new 4k × 4k CCD camera that is being developed as a joint venture between Keele University and e2v, will require a major re-work of the upper serrurier truss and the existing focus platform over and above that which has already been carried out. It was proposed that this work would be carried out during the early Summer of 2011 when the days are long and observing nights are short.

Research activities

Observations

Engineering work on the 61cm Thornton reflector limited its availability for science. However, on 27 November a series of 535 20-s exposures were obtained of the egress of the new discovery, transiting exo-planet Qatar-1b, helping refine its parameters. A photometric accuracy around a per cent was achieved, which improves when averaging sets of these short exposures. These data have now been published in Alsubai et al. (2011). This is the fourth time the Thornton telescope has contributed to a discovery publication of an exo-planet.

Solar observations

As the Sun emerged from its long and deep minimum, Stephen Doody was active in perfecting electronic photography with a Lumenera camera through the Coronado 4cm solar telescope (Fig. 4).

Figure 4 Coronado 4cm solar telescope with Lumenera camera showing the Sun.

Two examples are presented here (Fig. 5), giving a taster of what is to come in the next few years as the Sun peaks in its new cycle of surface magnetic activity.

Publications

In 2010 one research publication appeared, based on data from Keele Observatory:

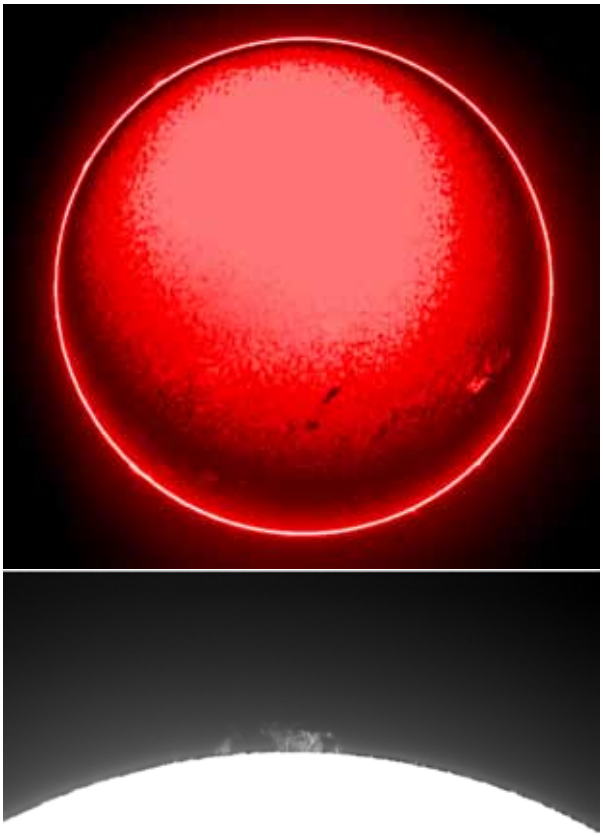


Figure 5 The Sun imaged with the 4cm Coronado telescope in August 2010, on the 14th (top) and on the 28th (bottom).

I. McDonald, J.Th. van Loon, A.K. Dupree & M.L. Boyer, Monthly Notices of the Royal Astronomical Society, **405**, 1711: "*Discovery of long-period variable stars in the very metal-poor globular cluster M15*"

Figure 6 The Galactic globular cluster M15 imaged with the 61cm Thornton telescope by former Keele Ph.D. student Dr. Iain McDonald.

The massive Galactic globular cluster M15 (Fig. 6), some 34,000 light years from Earth, has a metal content about 200 times

below that of the Sun. It was monitored with the Thornton telescope for more than two years, and a couple of red giant stars appeared to slowly vary in brightness. One of them, K825 showed a regular variation with a period of about 350 days. This is the first time such pulsations have been found in such primitive stars, a major scientific achievement resulting from the use of Keele Observatory.

Appeal for information on the astrograph

In February 2010, Dr. Ron Maddison, former Director and founder of Keele Observatory, placed an appeal in the magazine of the Royal Astronomical Society, for information on the lost 13" astrograph which had originally been used with the 12" Grubb refractor in Oxford:

R. Maddison, Astronomy & Geophysics, **51**, 1.06: "*Has anyone seen our camera?*"

Outreach activities

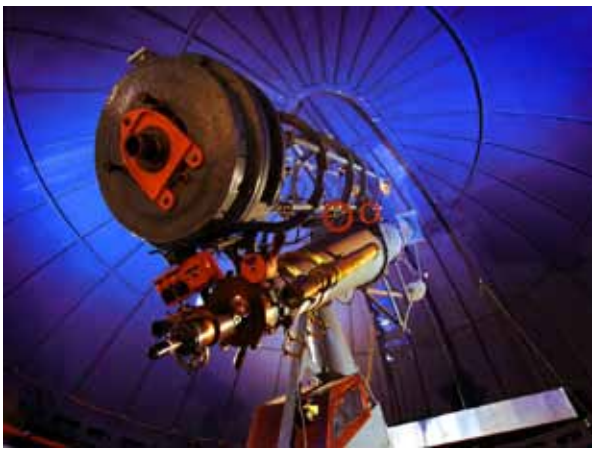


Figure 7 The 12" (31cm) Grubb refractor.

Public viewings

In 2010, about 270 visitors had signed the visitors' book, but experience shows that perhaps as many (or more) visitors may not have signed it.

Visitors are usually treated to views through the historic 31cm Grubb refractor (Fig. 7), a.k.a. the "Oxford refractor", or given a tour of the observatory when the weather is adverse.

Schools and teachers

The Science Learning Centre West Midlands, based at Keele University, hosted three events for teachers in 2010 that included the use of the Observatory. A total of 39 teachers were reached in this way.

KeeleLink is Keele University's Widening Participation unit working with schools and colleges. Three workshops were held at the Observatory in 2010, as part of a pilot scheme. These included "spectroscopy", "impacts", "Sun & Moon", and "rockets". While delivered by science mentors (postgraduate students), faculty at the Astrophysics Group were involved in the design and delivery of the first session. These events reached 56 learners, in Key Stage 2 and 5.

Community group visits

Five community group evening visits took place in the Autumn of 2010, in which over a hundred Brownies and Scouts learnt a great deal about telescopes, astronomy, and astronomers from Prof. Nye Evans.

Adult Education sessions

By Prof. Rob Jeffries

Starting in October 2010, Prof. Rob Jeffries organised an Astrophysics Discussion Group on Wednesday evenings at the Observatory, focusing on the topic "Exoplanets and Life in the Universe". The group met on a fortnightly basis and was attended on average by about 25 participants. There were sessions on the formation of planetary systems and the detection of planets around other stars using radial velocity, astrometric and transiting techniques, as well as other more indirect methods such as the presence of debris discs. Towards the end of the year (and into 2011) there were lots of exciting news stories to talk about from both the Super-WASP transit survey (of which Keele is a major partner) and the Kepler satellite.

Keele Observatory Publications 1

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Keele Observatory – http://www.astro.keele.ac.uk/Observatory

Front cover: the 12” (31cm) Grubb refractor from 1874, at Keele Observatory in the 1960s.