Institution: Keele University

Unit of Assessment: B9 Physics

a. Context

As a medium-sized university Keele has chosen to focus its research in the UoA-9 Physics area in one research group, namely astrophysics. The group uses a wide range of ground-based and space-based observatories worldwide, publishing research across a swathe of astrophysics. Since astronomy is very much "blue skies" research the main impact of our work beyond the research community is on public interest and understanding of science and inspiring the study of science and the universe, particularly in young people. Much of our research, especially into exoplanets, lends itself well to this purpose.

b. Approach to impact

Our approach to maximising the impact of our research can be divided into: (1) national/international impact, and (2) our local area.

(1) At the national/international level we issue press releases. The creation of a new Directorate of Marketing and Communications in 2011, with a dedicated press officer, and consequent specialist PR advice, has led to increased national and international media profile. Those relating to the WASP/exoplanets area are described in a REF-3b case study. Those in other areas include:

* A 2008 NASA/JPL-Caltech press release deriving from Keele-led observations of globular cluster Omega Centauri with NASA's Spitzer Space Telescope. [http://www.spitzer.caltech.edu/news/274-ssc2008-07-Spitzer-Sees-Shining-Stellar-Sphere]

* A 2010 ESO press release regarding the discovery with ESO's VLT of the 300-solar-mass star R136a1, the most massive and most luminous star known.[http://www.eso.org/public/news/eso1030/] This resulted in coverage on TV news (BBC News, Channel 4 news) and major newspapers (Telegraph, The Times, Guardian, Independent).

* A 2011 press release by Science regarding the pulsating red giant HD 181068, resulting in cover age by the BBC News website and other media.[http://www.bbc.co.uk/news/science-environment-12990213]

* A 2012 NASA/JPL-Caltech press release regarding the Keele-led discovery of "Buckyballs" (solid C60 molecules) in space, resulting from observations of XX Oph using NASA's Spitzer Space Telescope. [http://www.jpl.nasa.gov/news/news.php?release=2012-047]

2) At the regional and local level we again highlight Keele's research through the media, but also focus on personal interaction with the public, particularly school children, both by bringing the public onto campus and by visits to schools.

The Stoke-on-Trent conurbation is relatively deprived, having bottom-quartile rates of GCSE attainment and with over half the population living in bottom-20% areas of deprivation [http://www.apho.org.uk/resource/item.aspx?RID=50353]. The presence of frontline research at Keele serves the local area as a focus and inspiration for interest in science, particularly in an area like astronomy, which readily connects to young people and the wider public.

We thus bring visitors onto campus to Keele's Earth and Space Observatory, for example arranging events in conjunction with Stargazing Live (resulting in 1000 visitors in each of Jan 2012 and Jan 2013), or in conjunction with astronomical events such as visible comets, and at such events we emphasize links to the astrophysics research at Keele.

For example in 2013 BBC 1's Midlands Today has twice featured broadcasts from Keele, about Keele research that had featured on the 2012 Stargazing Live programs (15th Jan 2013), and about Comet Pan-STARRS (13th March 2013). Over the REF period Keele astronomers have given 7 interviews on BBC Radio Stoke, and have featured in 7 articles in Stoke's local paper, The Sentinel.

These articles included invitations to the regular open evenings at Keele Observatory, resulting in a steady stream of visitors, who can, for example, view the planets through our 12" refractor. We also host visits by local school and scout groups. In total (including events such as Stargazing Live) the observatory hosts in the region of 3000 public visitors per year. We run several CPD courses per year for science teachers in conjunction with the West Midlands Science Learning Centre at Keele, showing them how research can be integrated into the science curriculum. We organise regular Adult Education evening classes at the Observatory, which again feature our research, and are also a platform for astrophysics PDRAs and PhD students to gain experience in presenting their research to the public.

In addition to bringing people onto campus, we visit local schools with an STFC-funded portable planetarium, dubbed the "Exoplanetarium" (as described further in REF-3b), and operated by academic staff and STEM students. The University supports this innovation through Keele's broader Widening Participation program. The Exoplanetarium forms almost half of Keele's total schools activity in terms of pupil interactions. The bespoke planetarium presentations make an impact in several ways: (i) The Exoplanetarium is extremely popular; shows are being presented to approximately 30 schools and 3000 school children (of all ages) per year, as well as shows at open days and local museums that exhibit to a further 1000 members of the public. Our evaluation shows that 65% of secondary pupils are prompted to consider HE as an option after our visits; afterwards 89% know what an exoplanet is! There is some targeting of these visits to schools in deprived areas – about 60% of pupils are from the 40% most deprived postcodes. (ii) We interact with many tens of science teachers per annum, and their feedback demonstrates that they find it inspiring and a trigger for further exploration of space topics with their pupils. 95% said the Exoplanetarium sessions benefited their pupils. (iii) The Exoplanetarium is a tool for training aspiring scientists – undergraduates and postgraduates – in public understanding of science. So far 40 Student Ambassadors have been recruited, trained and sent out to schools.

At the university level Keele has a major program of Widening Participation events (e.g. Keele UNIFEST 2013, a 3-day residential programme for Year 11 and 12 school children, encouraging them to aim for university) and the astrophysics group contributes ``masterclasses'' based on our research and designed to make science interesting and accessible to them. We also present our "Exoplanetarium" shows to campus visitors, reaching a further 1000 children per annum via this route.

c. Strategy and plans

Given the importance of outreach in our local area, a commitment to and aptitude for outreach has featured in the appointment of astrophysics academics, and in job descriptions, and is also given full weight in Keele's Workload Allocation Model for assigning teaching and other academic duties. The University continues to support the Observatory and Exoplanetarium initiatives through staff time, capital expenditure and running costs.

Over the REF period Keele has developed the Earth and Space Observatory into an attractive science destination, and have benefitted from a 2008 grant of £250,000 from the Wolfson Foundation, government matching funding of £145,000, and donations from Keele Alumni and the Keele Key Fund of £40,000. This has resulted in the refurbishment of our telescopes and domes (a 12" refractor and a 24" reflector) and the provision of a lecture theatre at the Observatory, primarily for public outreach. Other funding includes £13,000 from Friends of Keele for an outdoor viewing platform, for use with portable telescopes. The Keele Key fund also granted £8,000 towards the purchase of a new portable planetarium dome.

We have recently (Oct 2013) purchased a 6" H-alpha solar telescope, designed for use both at the Observatory and for taking to the public, for example to pedestrian areas of local town centres. The funding came from the RAS (£1000), STFC (£4000) and Keele (£5000). A further project will be the development of a radio telescope, for daytime science education.

In the future we will continue to promote Keele's Earth and Space Observatory as THE science destination for the Stoke-on-Trent area, in conjunction with the nearby Sustainability Hub, which focuses on the Earth environment. We will continue to promote our Exoplanetarium as Keele's major off-campus science-outreach activity. We are developing another 20 "Student Ambassadors" as STEM advocates, and will do the same for future cohorts. We will be putting emphasis on evaluating the effectiveness of these activities, in order to develop and target them further. Underpinning all this is the presence of forefront astrophysics research, broadcast through the local media, and enthusing school children and the wider public in the Stoke-on-Trent conurbation. Promotion criteria explicitly recognise impact and external engagement activities.

d. Relationship to case studies

One case study, on exoplanets and the WASP project, is a particularly prominent part of our overall astrophysics outreach activity. The second case study (on the development of synchrotron and neutron-scattering facilities) relates to past Keele research in the physics area, which is now continued by Keele's Institute for Science & Technology in Medicine, and is thus being submitted to a different UoA in the current REF.