**Impact template (REF3a)**

**Institution:** Liverpool John Moores University

**Unit of Assessment:** 9 (Physics)

**a. Context**

The Astrophysics group at LJMU, later the Astrophysics Research Institute (ARI), was formed in 1992, around the research strengths of the founding staff in studying the rapid variability or outbursts of stars and other astrophysical sources (time-domain astrophysics). The first major initiative of the group, in 1996, was the New Generation Astronomical Telescopes (NGAT) project, led by LJMU and part funded through the European Regional Development Fund (ERDF). Industrial Development and Public Engagement were integral parts of this project. A spin-out company, Telescope Technologies Limited (TTL) was set up to build a versatile telescope optimised for time-domain astrophysics. This project became the Liverpool Telescope (LT) and TTL eventually built 4 further state-of-the art optical telescopes sited on 3 other continents. The TTL Board consisted of representatives of the University, and the Industrial and Commercial and Public sectors. Public Engagement was driven at Project Board level by representatives of the University, and the National Museums and Galleries on Merseyside (NMGM). Observing time on the LT is set aside for public outreach activities. This resource forms the core of the National Schools' Observatory (NSO), but also supports amateur astronomers.

The social and economic impact of the NGAT project was quantified in returns to the ERDF; it resulted in the creation or safeguarding of 228 jobs, contracts to 38 SMEs, 5000 increased visitors per year, all in the Merseyside region. ARI founded the National Schools' Observatory (NSO) in 1998, but also formed a partnership with Merseyside Integrated Transport Authority (Merseytravel) that engendered the development of the Spaceport visitor centre, opened in 2005. Through TTL they formed strong industrial partnerships, including that with a Merseyside company, SENAR Precision Engineering Ltd. Following the completion of the LT, and the sale of 4 other telescopes, TTL was sold to an entrepreneur in 2005, to build the Las Cumbres Observatory Global Telescope Network.

The Institute has grown significantly since the end of that seminal ERDF project, and the research portfolio is now much wider. ARI now routinely engages with a broad set of regional, national and international partners. Our case studies focus on the industrial and public engagement, but ARI also impacts significantly upon science policy, e.g. ASTRONET's strategic plan for the development of European Astronomy, on behalf of all of the major funders of astronomy in Europe. ARI staff are also actively engaged in the development of Research Council policy on astronomy.

**b. Approach to impact**

The external impacts of the ARI's research work are focussed on its influence on interest in and uptake of science among the general population, particularly school-age children, and the up-skilling and enhanced awareness of commercial opportunities provided to SMEs.

Public Engagement (PE) work centres on the National Schools' Observatory (NSO) as an educational resource and the Spaceport science centre. Both have been developed in a highly structured way. The NSO grew from a Research Council-funded feasibility study in 1996, through a regional (EU ESF-funded) project to the national and international project (with RCUK, University and benefactor funding) that exists today with a clearly defined strategy and plans. Similarly, Spaceport originated from a feasibility study in 1998 via Regional Development funds, which grew into a formal partnership with Merseytravel to implement the concept as an educational centre, a visitor attraction and a development project for an economically deprived area, to secure the funding from a range of sources, to design and build the exhibits and then to move onto operation and refreshment through the joint Development Group that exists today.

Public engagement is managed by a dedicated unit of 6 staff, led by A. Newsam. This is focussed upon the NSO, but maintains a wider outreach responsibility. Funding for the unit comes partly from grant income, but largely from the University, via LJMU's Widening Participation strategy as stated in its agreement with the Office for Fair Access (OFFA) to attract promising students of diverse backgrounds. We are guided by the NSO Board, including teachers, industrial expertise and other external stakeholders, and by the Spaceport Design and Development Group, including

representatives from LJMU's Business Development unit, Merseytravel and the ARI.

The ARI encourages (through funding and administrative support) all research staff and research students to talk to the public about their research. Updates on engagement activities are given at termly open meetings of staff and students, plus annual Away Days. Research staff members hold detailed discussions with the NSO about suitable research-led educational projects. Where such activities form a significant part of an individual's duties, allowance is made through the University's Workload Allocation Model. Achievement in the area of impact is also recognised within the University through the Personal and Professional Development Review (PDPR) process, and in the criteria for promotion, with for example, Newsam being awarded a chair in Astronomy Education in 2012 (one of only 2 in the UK primarily for outreach in astronomy).

Staff talk about their research to the media (TV, radio, newspaper and web press coverage), communities (particularly local astronomical societies), visitors to cultural and leisure services such as Spaceport (for example at the annual Merseyside Astronomy Day), business and industry (through contracts and exchange of information via the ARI's LT Group), schools, colleges and lifelong learning (e.g. through the NSO, schools talks and workshops - such as our annual Work Experience Week for year 11 students). Our research students are active in engagement, for example via their major contributions to our annual Work Experience Week for schools; to BBC North-West's contribution to 'Stargazing Live' on one of the Mersey Ferries (January 2012); and to the Royal Horticultural Society's (RHS) 'NSO Galaxy Garden' at Tatton Park (July 2013).

Our Industrial Development work has evolved directly from the NGAT project and its regional supplier network. Co-ordinated by the LT Group led by Steele, interaction with industry is based around technological need for the development of both the telescope and its instrumentation, to keep it at the forefront of research capability internationally, and also other projects, such as WEAVE, a powerful new multi-object spectrograph for the William Herschel Telescope on La Palma in the Canary Islands, with seven times the capability of its predecessor. ARI is a full WEAVE consortium member with strong participation in its detector development.

LJMU is currently leading a design study for a next-generation successor to the LT, LT2, with significant involvement from Merseyside and North Wales industry (see section (c) below).

ARI participates in regional, national and international initiatives, including:

- ESA's ESERO programme (Newsam is a regional Space Ambassador);
- Ogden Trust's Schools Partnership programme (Habergham is co-funded as a PDRA).
- Rotary International's 'Excitement of Science' Events at the Royal Institution (2009 saw ARI's 4$^{th}$ participation in these events);
- Edexcel (Newsam advises on curriculum development);
- The IOP (Newsam was the UK National Lecturer in 2009; and it funded workshops to train teachers in the use of the NSO and the Faulkes Telescopes);
- The House of Commons Science and Technology Committee enquiry into astronomy and particle physics (Bode provided expert witness evidence);
- STFC (Bode chairs its Advisory Panel for Public Engagement, and Newsam was awarded a Public Engagement Fellowship from 2011 to 2013);
- Keynote lectures (Collins delivered the 2009 David Elder Lecture at Strathclyde University).
- The EU ASTRONET strategic initiative (Bode was Task Leader of the Infrastructure Roadmap and Newsam a member of its Education, Recruitment/Training and Public Outreach Panel).

We have an agile approach to exploit opportunities. Fast-track instrument development such as RINGO2 (a fast readout imaging polarimeter) for the LT was enabled by internal seed-corn funding and in-house design in partnership with a local SME with whom a relationship had been built over many years - the whole process from initial science-driven imperative to a functioning instrument on the telescope taking only 6 months. In Public Engagement we work to reach non-traditional audiences as opportunities present themselves – with activities from shopping-centre science demonstrations to award-winning theatre productions. In December 2012 we were approached by a garden designer to develop a themed show garden for the RHS Tatton Show which became the 'NSO Galaxy Garden: Watch This Space'. The concept, influenced by ARI research into stellar and galaxy evolution, was selected as one of 5 successful entries from 35. We augmented the RHS

contribution of £10k via internal University funds, commercial sponsorship and a grant from the IOP, to provide a total budget of £25k. The garden was built and staffed throughout the show in July 2013 by volunteers, including ARI researchers and pupils from NSO schools. The garden was explored by 11,473 visitors, was awarded a Gold Medal and special Creativity prize, and featured on national and local media, including BBC TV's *Gardeners' World* (2.5 million viewers).

Assessment of the impact of our work occurs in several ways. Detailed reports are presented at each of our various Boards. Statistical data on general PE activities are gathered via web-based forms that all ARI staff and students complete on an ongoing basis. In 2012 for example, supported in part by STFC funding, ARI staff gave more than 200 talks to 14,000 members of the public, with the majority gathering some sort of formal, anonymous feedback. External partners (e.g. Merseytravel) also gather such data and share them with us as appropriate (see e.g. Case Study 65/09/2). More in-depth analysis occurs via specially commissioned external agencies (e.g. Case Study 65/09/1). All feedback is then used to inform future practice, from adjusting individual talks and activities, through to informing long term PE strategies.

**c. Strategy and plans**

Our Impact strategy is guided by our external Advisory Board and internal ARI Development Group (involving LJMU Business Development, Research, and Alumni Relations teams). Impact is a standing item on the Management and Advisory Board agendas; is a major part of our published Strategic Plans, and is the subject of significant investment of staff time and resources.

The ARI Management Board has formalised a specific Impact Strategy to enhance our work in the areas of Engagement, Industry and Policy. Its main strands involve: (i) Spreading the impact culture and good practice via measures including training in evaluation techniques; introducing engagement activity into annual staff PDPRs; requiring all submitted papers to be discussed with outreach staff. (ii) Building stronger links with our partners, beneficiaries and audiences, including the development of a media strategy for ARI. (iii) Enhancing the economic/industrial impact of our major technology initiatives through supplier days and enhanced links with local trade bodies. Significant planned developments over the next 5 years then include:

(a) Greatly enhancing the reach and impact of the National Schools' Observatory. The University endorsed the NSO's 5 year plan in 2013, providing central funding at the level of £265k p.a. Targets here include 400 teachers trained p.a.; 20,000 active users, including 8,000 teachers across the UK over the period, and a major enhancement to the NSO's resources and the public's awareness of its capabilities. (b) Strengthening our relationship with, and impact from, Spaceport. We will continue to develop new exhibits and visitor experiences jointly with Merseytravel to showcase our research and education activities to the general public. In particular, we will develop further the programme of school visits.

(c) Capitalising on the potential of the proposed next generation robotic telescope. The University has invested £200k in a feasibility study for 'LT2' - a larger, faster and generally more capable robotic telescope than LT. The science case has been developed and the outline technical specifications defined. Funding partnerships are in train, including coordinated proposals for EU Regional Development Funds in Merseyside and the Canary Islands (ERDF 2014/20). The former fits within the Liverpool City Region ERDF 'Smart Specialisation' framework. A local supplier network will then be developed and capitalized upon.

(d) Further commercialisation of activities. A large multinational company funded a feasibility study in 2012 into the commercialisation of some of our outreach and distance learning activities for the international market. The outcome has been positive and has resulted in the development of new distance learning courses, with plans to at least double our international market share by 2015.

**d. Relationship to case studies**

The submitted case studies cover the areas of Cultural and Social Impact (65/09/1: NSO and 65/09/2: Spaceport) and Economic Impact (65/09/3: SENAR). The NSO exemplifies our strategic aim to use astronomy research to inspire the nation's young people to study STEM subjects. Spaceport embodies our long-held aspiration not only to excite the general public about our work, but to inform and entertain them at the same time, whilst enhancing the local economy. Our work with SENAR encapsulates the symbiotic relationships we have developed with regional SMEs over many years where we enhance our research capability, whilst the company gains new skills, markets and publicity and in turn creates and protects highly skilled jobs.