Impact case study (REF3b)

Institution: Liverpool John Moores University

Unit of Assessment: 9 (Physics)

Title of case study: Spaceport: Combining Engagement, Research and Regeneration

1. Summary of the impact (indicative maximum 100 words)

Spaceport is a Visitor Centre in an historic ferry terminal on the banks of the Mersey which showcases astronomy and space exploration. As a project it combines the research experience and knowledge of LJMU with the tourism credentials of Merseytravel. Merseytravel oversees the Merseyside public transport system, to promote and develop the transport network to meet the region's economic, social and environmental needs. As an attraction, Spaceport regularly exceeds visitor number predictions (currently at 70,000 per year) and brings in excess of £2M p.a. into a regeneration area. The continuing participation of LJMU has ensured that the centre remains up to date with new exhibits that link directly to LJMU's astronomical research and special events featuring LJMU astronomers and others, which are designed to extend its audience (e.g., for amateur astronomers or schools from inner-city areas).

2. Underpinning research (indicative maximum 500 words)

The Astrophysics Research Institute (ARI) which recently celebrated its 20th anniversary, has already achieved international leadership in several fields. ARI developed and now operates the World's largest fully robotic telescope – the Liverpool Telescope (LT) **[Ref 1]** (leads – Bode: ARI Director, Steele: LT Director, Carter: LT Project Scientist). The LT is a national astronomy facility of the UK, extensively used through a number of international agreements by the wider international community of astronomers.

One of the primary attributes of the telescope is its ability to react very rapidly to unpredictable changes in astronomical objects. This has enabled ARI researchers to develop a world lead in the study of a number of transient astronomical phenomena. The most extreme are Gamma-Ray Bursts (GRBs) – titanic explosions associated with the death throes of exotic objects in distant galaxies **[Ref 2]**. The LT has also enabled the ARI to lead in research into other transient phenomena such as Supernovae and Novae **[Ref 3]**. Such dramatic events capture public interest and feature strongly in events at Spaceport.

Linked to this work on transients is research into theoretical and observational aspects of stellar evolution. ARI research encompasses the environments in which stars are formed, their subsequent evolution, and the evolution of star clusters and of galaxies **[Ref 4]**. This research, therefore, covers all aspects of the "life cycle" of stars which is a key component of the educational journey through the centre, including specially designed exhibits that explore the evolution of different types of star, and show how spectral information can be used to understand stars.

Building upon this research background the ARI provides leadership of major international projects investigating the nature and evolution of galaxies in clusters **[Ref 5]**, and in the field **[Ref 6]**. The tools for this are the most advanced international astronomical facilities, telescopes both on the ground and in space, as well as the in-house LT.

The Royal Astronomical Society's 2008 Group Award for outstanding achievement was shared by two ARI staff members working on surveys of galaxies. ARI continues to develop leads in new areas of activity, and ARI staff are working actively on the next generation of surveys and the instruments to carry them out.

3. References to the research (indicative maximum of six references)

[Ref 1] Steele I., et al, "The Liverpool Telescope: performance and first results", 2004, Proceedings of the SPIE, 5489, p679, *10.1117/12.551456, peer-reviewed, 70 citations*

[Ref 2] * Mundell C. et al, "Early Optical Polarization of a Gamma-Ray Burst Afterglow", Science, 2007, 315, 1822, *10.1126/science.1138484, editor selected and peer-review, 32 citations*

[Ref 3] * Bode M., Harman D., O'Brien T., Bond H., Starrfield S., Darnley M., Evans A., Eyres S., "Hubble Space Telescope Imaging of the Expanding Nebular Remnant of the 2006 Outburst of the Recurrent Nova RS Ophiuchi", 2007, Astrophysical Journal, 665, p63, *10.1086/520929,*

peer-reviewed, 56 citations

[Ref 4] Salaris M., Weiss A., Ferguson J., Fusilier D., "On the Primordial Scenario for Abundance Variations within Globular Clusters: The Isochrone Test", 2006, Astrophysical Journal, 643, p1131, *10.1086/504520, peer-reviewed, 31 citations*

[Ref 5] Collins, C.A., et al. "Early assembly of the moset massive galaxies", 2009, Nature, 458, p603, *10.1038/nature07865, peer-reviewed, 61 citations*

[Ref 6] * Baldry, I.K., Glazebrook, K. & Driver, S. P. "On the galaxy stellar mass function, the mass-metallicity relation and the implied baryonic mass function" 2008, Monthly Notices of the Royal Astronomical Society 388, p954, *10.1111/j.1365-2966.2008.13348.x, peer-reviewed, 151 citations*

(Citation data from the Astrophysical Data Service as of 23rd October 2013)

4. Details of the impact (indicative maximum 750 words)

Spaceport is an Astronomy and Space visitor centre based adjacent to one of the three terminals for the Mersey Ferry (which is the top paid-for tourist attraction in the Liverpool area). It is a joint venture between Merseytravel, the mass-transit authority for Merseyside, and LJMU. Spaceport grew from a merger of the aims of the two entities: LJMU desired to enhance the public engagement with its research, the Liverpool Telescope project, and astronomy and space exploration in general. Merseytravel wished to exploit a historic asset and develop education and tourism in the area. Merseytravel was an ideal partner for us as they are a leading organisation in the region for tourism ventures, sharing a similar educational vision.

Spaceport has the aim of enhancing the regeneration of the Seacombe and Birkenhead areas on the banks of the Mersey. The Spaceport business plan was based originally on predicted visitor numbers of 90,000 in the first year (2005/06), dropping gradually to 50,000 (as seen in comparable attractions). However, numbers have remained high, stabilising at around 70,000 per year (2012/13) **[Source 1]**. This attests both to the quality of the centre and the appeal of the subject area. Using a standard model for measuring the economic activity of tourism (STEAM model 2010, **[Source 2]**), this equates to a net gain of more than £2M per year. Spaceport also contributed towards the success of Mersey Ferries being ranked 1st in the City Region in 2008, when Liverpool was European Capital of Culture. Because of this success, the original targets for the regeneration have been met or exceeded. These included the creation of an estimated 50 new jobs, both direct and indirect, which equates to a gross value added of £1.4M p.a. to the City Region **[Source 3]**.

LJMU research has had a significant impact on all areas of Spaceport from its conception. Prior to the opening of the centre in 2005, astronomers from the ARI were involved in all stages of the design process for the attraction, from the tender process through to final "signing off". That relationship has been maintained, with continuing impact deriving from access to the combined skills, knowledge and experience of a broad-based research-active department that feeds into the centre to make it relevant, current and exciting.

Most importantly, Spaceport is designed (through its exhibits and activities) specifically to allow the staff at ARI to engage with a range of different audiences. For example, the annual Merseyside Astronomy Day combines a series of talks by professional astronomers with a day-out at Spaceport. As well as organising the event, which has run near Easter every year since 2006, LJMU provides the majority of the speakers. Subjects have included stellar evolution (Salaris, May 2012), supernovae (Davies, April 2013), telescope development (Steele, March 2009), active galaxies (Mundell, April 2013) and cosmology (Collins, April 2008). The event has sold out every year and receives consistently excellent feedback (100% would recommend friends to come to the next event).

As part of its continuing commitment to public engagement, the University recently (2012-13) invested £75k in developing a new interactive exhibit: The Observatory. This was developed during 2012-2013 and was devised by LJMU researchers. It brings the latest research and educational data from the LT into Spaceport where visitors can explore and interact with it. The exhibit was launched in July 2013, and will be constantly refreshed by the ARI with ongoing research, including immediate access to time-critical observations from the LT (such as discovery and follow-up of Gamma Ray Bursts and supernovae - Mundell, Bersier) and their interpretation and importance. Initial evaluation of The Observatory (immediately pre-launch) shows that this immediacy and

connection to current research is an important factor in its appeal. We will be continuing the evaluation as the exhibit is enhanced to ensure that this impact is maintained.

In addition to the economic benefits, Spaceport forms a key strand of our schools' outreach programme, and is a recognised 'public face' of the National Schools' Observatory. Input from LJMU has led to a good mixture of cutting-edge astronomy and curriculum-centred content, both in the exhibits themselves, and in the teacher packs and support material. This has ensured that Spaceport is now a prime destination for school trips from across North West England and North Wales – more than half of its visitors in 2011/12 were school children. Further development of the centre is coordinated by a joint Merseytravel/LJMU development team, led by LJMU astronomers.

Spaceport, therefore, is a showcase for our ongoing research into the universe that provides public engagement, education and a stimulus for economic regeneration.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[Source 1] Digest of Tourism Statistics, Liverpool City Region 2012: http://www.liverpoollep.org/docs/DigestTourismStatistics.pdf *(Evidence of the economic impact of tourism on the region and the application of the STEAM model)*

[Source 2] The Mersey Partnership Economic Review 2012: http://www.liverpoollep.org/docs/Economic_Report_2012.pdf *(The role of tourism in the wider regional economy and predictions for growth)*

[Source 3] The Business Development Manager of Mersey Ferries