



Herschel and the Mysteries of the cold universe

Final report

August 2009



Science & Technology
Facilities Council



science made simple®

Science and Technology Facilities Council
Science in Society small awards scheme
Herschel and the mysteries of the cold universe

Summary

Launched in May 2009, The Herschel Space Observatory is the largest infrared space observatory launched to date. Equipped with a 3.5 metre diameter reflecting telescope and instruments cooled to close to absolute zero, Herschel will observe at wavelengths that have never previously been explored. The Project is coordinated by the European Space Agency with support from STFC. UK researchers based at Imperial College, London and Cardiff University have been central to the development of instrumentation on the satellite.

The Project involved the development and delivery of a science show for Year 9 and 10 pupils. The show was developed in consultation with researchers and used demonstrations, multimedia and volunteers to bring the science of space-based astronomy to life

Aims

The aims of the project were as follows:

- Raise awareness of the exciting challenges faced when astronomers need to get above the Earth's atmosphere - in particular to make infrared observations of star and galaxy formation with the Herschel Space Observatory
- Challenge secondary school students with extra-curricular material that shows how the electromagnetic spectrum beyond the visible can provide us with new information about the Universe
- Use the technology developed for the Herschel Space Observatory as a hook to engage students with physics and engineering topics
- Show practical applications of infrared radiation (e.g. thermal imaging and remote sensing)
- Help teachers address some of the more contemporary areas of astronomy and support their teaching by giving them access to the latest research information
- Show students the process of how science works by using the Herschel Space Observatory as a case study.

Project development

Show content

The show uses demonstrations, volunteers and multimedia clips produced by ESA to illustrate the science behind the observatory and what it hopes to discover about the formation of stars and galaxies.

The show is focussed on 3 key areas:

What is a telescope - An introduction to reflecting and refracting telescopes. Telescopes are described as light collectors and as devices for looking into the past due to the finite speed of light. To demonstrate this a convex lens is used to produce an image, and a concave mirror is used to focus a light source onto flash cotton which ignites.

The advantages of space-based astronomy are discussed and the location of L2, home to Herschel, is demonstrated.

The Electromagnetic spectrum - An overview of the Em spectrum is used to show the importance of observing at different wavelengths. Demonstrations of Ultra violet and near infra red sources show some common uses for these wavelengths. A thermal camera purchased by the Physics and Astronomy department at Cardiff University has been available for some performances. This allows the demonstration of live IR imaging. The importance of IR astronomy is emphasised with reference to red-shift and the absorption and reemission of energy by interstellar dust. The importance of cooling the telescope to temperatures well below those it is detecting is also introduced.

The instruments - A beamsplitter is used to show how a single light source can be directed to multiple detectors. The instruments on the Herschel observatory are described and a demonstration of flame tests is used to illustrate the use of spectroscopy to analyse light from stars.

As the first images are obtained from the observatory they will be included in the presentation. Ongoing contact with members of the Herschel Outreach Group means that the show content can continue to develop as results are obtained from the mission.

Recruitment and delivery

10 schools were recruited for delivery of the first shows. 5 days were offered in South Wales and 5 in East Anglia. Marketing was carried out by direct mail and through the Science and Engineering Ambassador scheme in Norfolk.

Schools were charged a nominal fee of £75 with the rest of the costs covered through the project. The project included rural and urban schools and gave science made simple the opportunity to work with new schools.

A total of 12 shows were presented in 10 venues. The total audience was 2665

Delivery took place in April in East Anglia. Delivery for South Wales took place during July. Originally this was planned for February but snow forced school closures making it necessary to reschedule these dates.

The show length was nominally 50 minutes but was adapted to suit the time available in lesson slots.

The show was delivered by two of science made simple's experienced presenters, and also taught to astronomers working in the Physics department at Cardiff University. It is hoped that these researchers will take the opportunity to present the show, or parts of it in their own outreach work, as well as being available to support future bookings through science made simple.

Evaluation

The success of the show was measured against the objectives outlined in the grant proposal as below. Most of the objectives were met and the project was delivered on time and within budget.

The impact on the students was assessed through a short questionnaire. The full results are presented in appendix 1.

Objectives

- *Develop an engaging and interactive 50 minute show that explains the science and technology of Herschel to 11-16 year olds and their teachers*

The show was produced as planned. The age range was limited to 14-16 yr olds based on the complexity of the subject content and to better link with the National Curriculum. For example the electromagnetic spectrum is key to understanding the value of Infra red astronomy, this topic studied in year ten

- *Write to 300 secondary schools in South Wales and the South West of England to let them know that the show exists as a resource they can use*

The show was marketed to schools in South Wales as planned. Since the development was largely carried out in science made simple's Norwich office, the show was also marketed to East Anglian schools.

- *Tour the show to the first 10 schools to respond during International Year of Astronomy in 2009*

The show was piloted in 2008 and a further 10 schools were visited between Dec 2008 and July 2009. A full list of schools and audience numbers is given in appendix 2

- *Offer other schools the opportunity to book the show at the standard science made simple show fee. This gives the project a sustainable life beyond the STFC funding*

The show has now joined science made simple's outreach programme and is marketed to schools across the UK. To date 5 days of shows have been booked at the normal fee.

- *Achieve at least 1 item of local press coverage about the tour*

To date no press coverage has been attained

- *Present the show at the School of Physics and Astronomy annual Christmas Lecture which attracts around 200 14-16 yr olds*

Due to maternity leave, the development of the show was switched from Cardiff to Norwich. This meant that it was not possible to present the show for the Christmas lecture in Cardiff. The show was presented instead at the University of Glamorgan as part of the Hands-on science schools programme in December 2008

- *Present the show at one professional science communication event to share best practice*

Although the show has not been presented at a science communication event a report of the project has been submitted to the British Interactive Group newsletter which is widely read by science communication professionals.

- *Make the show available for the BA festival 14-19 programme in 2009*

The show was not ready for the BA festival 2009. The show was instead offered to the International Astronautical Congress in Glasgow as part of the schools' programme. Unfortunately the offer was not taken up. The show will be offered to the BA festival 2010

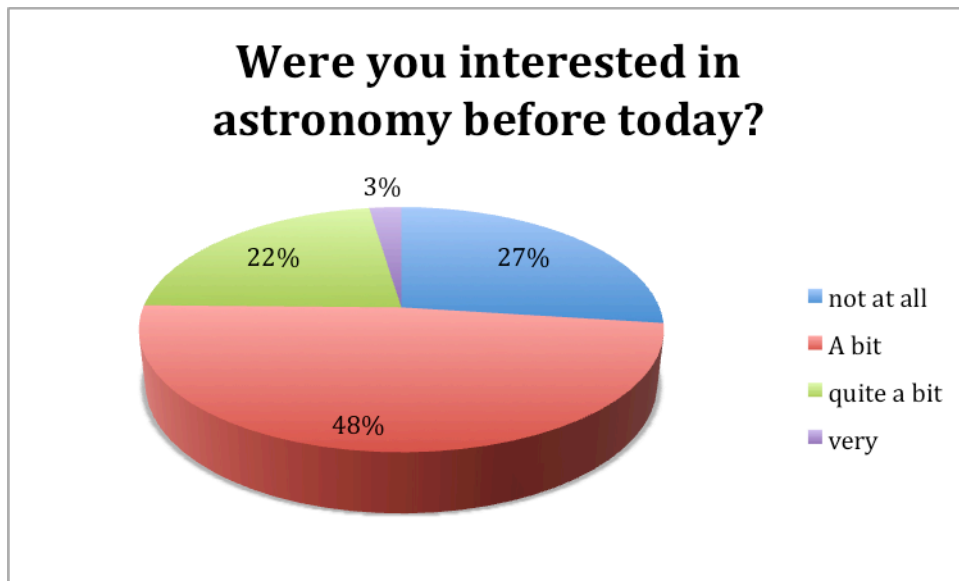
- *Produce an evaluation report on the project to publish on the 'science made simple' website*

This report will be made available though the website or on request.

Questionnaire

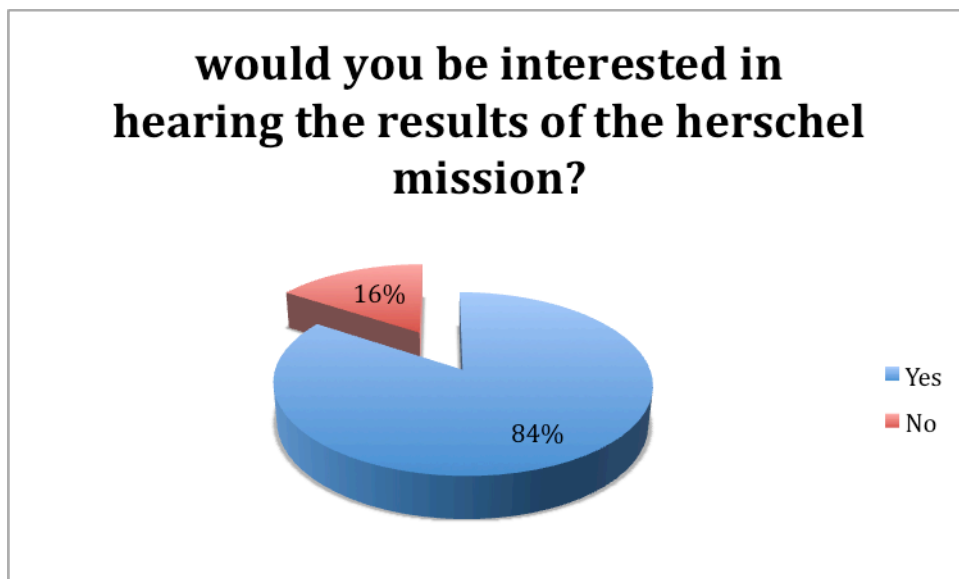
The questionnaire was designed to gather information on students' opinions on the show and astronomy in general. The survey was completed after the show and forms were collected anonymously. Students were encouraged to give their honest opinion on the show.

The first question looked at their general attitude to astronomy.



The results show that only a quarter of respondents had more than a passing interest in the topic.

The students were also asked a question to gauge their interest in the Herschel mission having seen the show.



A very large majority indicated an interest in finding out more about the mission. To aid this, all participating schools were given postcards with weblinks to the ESA and Spire sites. Posters produced by STFC were also distributed to the schools providing more information and links to site providing information on the results.

Comparing the results of these two questions it was found that of the **23** respondents who said they were “not at all” interested in astronomy before the show, **14** were interested in hearing the results of the mission.

The show included some difficult ideas and some science topics which were new to the students. The survey asked for their thoughts on the suitability of the show and their overall impression.

Asked for their overall impression 87% rated the show very good or excellent.

91% rated the show content “just right” and the length was rated “just right” by 75% with 20% wanting a longer presentation.

Pupils were also invited to make comments. Whilst only a very few took the opportunity, their responses they provide an interesting insight for further development.

“I want to see more”

“come back in 2 years to update us”

“very interesting. Where did you get the cool laser pen?”

“I think you should show the difference between the satalites (sic) and the Herschel”

“Thanks, you are well cool. We just think you should burn/blowup more things”

“Wooh great show! I like the jokes. The more experimental things are more interesting to view”

“please come again”

Conclusion

Overall we feel the project was successful in meeting its aims and objectives. However some objectives were not met and these indicate a lack of formative work which needs to be remedied on future projects.

Greater discussion earlier on would have identified the appropriate audience for the show and the objectives outlined in the proposal could have reflected this. Although press releases were issued it is apparent that a private showing for a school audience is not a media friendly event and therefore it is not surprising that no media coverage was obtained. Better linking with the publicity surrounding the Herschel launch publicity would have been an effective way of drawing media attention to the show programme.

The format of an interactive demonstration show is an effective way of introducing concepts to students. The show started with familiar concepts and drew the audience into novel ideas. The link with the Herschel project provided a real-world context for the science topics and this was important in maintaining interest and providing opportunities for self-directed further study by the students.

The show development team relished the opportunity to work with the researchers in development of the show; this collaboration could have been usefully extended with better time management. The science made simple team continue to have contact with the Herschel Outreach group and look forward to working with them on their STFC large award project, and including the results of Herschel’s observations to develop the show content over time.

An interesting development is the proposed delivery of the show by astronomers at Cardiff University. This promises to be a lasting legacy with the demonstrations and props being used to support other outreach activities run by the department.

Science made simple continue to explore projects linking active research with school shows and are grateful for the opportunity to develop this project.

Appendix 1

Results of questionnaire

1 Were you interested in astronomy before today?

not at all	23
A bit	41
quite a bit	19
very	2

2 Overall the show was...

Very Poor	0
Poor	3
Average	5
Good	2
Very good	39
Excellent	29

3 The science content was...

too easy	3
just right	78
too hard	4

4 The length of the show was....

too short	17
just right	63
too long	4

5 Would you be interested in hearing the results of the Herschel mission?

Yes	70
No	13