Public Engagement Fund Application Form

Thank you for your interest in applying to the Doctoral School's Public Engagement Fund.

Applications are invited from University of Sussex doctoral researchers and early career research staff for small grants of up to £750 per activity.

The deadline for applications is 17th November 2017

Please ensure that you have read the guidance notes before completing your application.

1. Name
[redacted]

2. Sussex e-mail address
[redacted]@sussex.ac.uk

3. Contact telephone number
[redacted]

4. School and department of lead applicant
School of Mathematical and Physical Sciences, Department of Physics and Astronomy

5. Are you a doctoral researcher or early career research staff?
Doctoral researcher

About the activity

Please tell us about the purpose of the public engagement activity.

You may select any or all of the options below. Please explain your rationale when prompted.

6. Is the purpose of your activity to inform and inspire the public?
Yes

6a. Please explain your rationale
This project will build a demonstrative model of the James Webb Space Telescope's (JWST) Near InfraRed CAMera (NIRCAM). JWST is a huge project, projected launch in spring 2019 at the cost of $10 billion. It represents a 20 year collaboration between 22 countries led by NASA, and is one of the most complicated and ambitious engineering projects ever undertaken.

The model will be made by modifying a traditional telescope, replacing the standard optics systems with a modified consumer webcam, and wheel of coloured filters in order to look at specific colours of visible light along with the infrared. The telescope will be used to hunt for clusters of LEDs of a variety of colours – including LEDs which only emit in the infrared and are thus invisible to the naked eye – which will simulate galaxies in the night sky.

This activity is a small-scale simulation of how astronomers actually search for the most distant galaxies in the Universe. Light from these galaxies is reddened in a process called redshifting: the more distant a galaxy is, the redder it appears. The most distant galaxies therefore cannot be seen in visible light, only in the infrared. The project will provide hands-on experience of this, showing how modern astronomy looks far beyond what we can see with our eyes and considers all the parts of the electromagnetic spectrum.

This activity will be inspiring because Sussex will be deeply involved in JWST astronomy. My supervisor and I have already secured a place on an early release science project, meaning we will be some of the first people to be working with JWST. Informing the public that this incredibly ambitious, expensive project has people who live in their communities is a powerful message and will inspire children interested in

science that these huge collaborations are made up of people, and it is possible to get involved if you want to.

7. Is the purpose of your activity to consult and listen to public views?
No

8. Is the purpose of your activity to collaborate with the public?
No

9. Why do you want to engage with the public? What do you hope to achieve by engaging?
Astronomy research represents a significant monetary expense, for example JWST is set to cost around $10billion. This expense is largely shouldered by the governments of the countries involved and therefore ultimately by the taxpayer. Justifying to the public why this money should be spent on pure research rather than either applied research eg. Medical research, or more immediately beneficial sectors eg. housing, seems fair when they are ultimately footing the bill. I therefore hope to impress two major points onto the general public with this project.

Firstly, astronomy is often described as a hook: children are naturally interested in space and this can be leveraged to get them interested in other Science, Technology, Engineering and Maths (STEM) subjects. Preserving the excitement for astronomy already present in younger children into their teen years can have large impacts in the numbers of students choosing STEM subjects when they reach higher education. Many students of high-school age complain that their science and mathematics and education lacks context or real-world application. Public engagement is an ideal theatre to provide this context - real scientists, engineers and mathematicians showing them how the maths and science the students are learning in the classroom is applied to do amazing things. Interacting with real scientists and doing outreach activities can let children know that even if they aren't the top students in their class, they can absolutely contribute to science, but they have to choose to stick with it.

Secondly, pure research provides a bedrock upon which applied science is built. Many of the revolutionising technologies of the past 100 years started out as a solution to a pure research problem. Just a few examples of this include PET scanners (particle physics), CCD's – which are the microchips analogous to film in all digital cameras (astronomy), or the invention of Nylon. However, the link between the pure research, and these technologies becoming widely used can be subtle, largely because it can take many years or decades between discovery and a consumer product using them. Astronomy research today will undoubtedly lead to exciting new consumer technology, however exactly what that will be is not a question that can be answered a priori.

10. What are the objectives of the activity? Please list the steps you will take to achieve these objectives.
The activity aims to:

Build an activity simulating what it is like to search for distant galaxies with a telescope. This activity will feature a modified webcam mounted inside a telescope which will be used to search for "galaxies" made from clusters of LEDs.

Take this activity to the Royal Society summer science festival in early July, followed by incorporating it into the University's Mathematical and Physical Sciences (MPS) existing outreach program as an activity taken to local schools and other large events.

Publish the plans to build the device online on the MPS outreach web-page. This project will require a solid understanding of the physics behind telescopes, engineering and computer programming so would be a perfect extended project for groups of students (eg. school technology clubs) with the right funding either in part (eg. just using a raspberry Pi to broadcast what a camera is seeing) or as a whole. These plans would

also be specifically shared with the University's partners within the South-East Physics NETwork (SEPNET) and at a wider meeting of the Institute of Physics outreach and public engagement network.

11. How will you evaluate whether you have achieved the objectives of the activity?
At the Royal Society summer science exhibition, we intend on gathering feedback by two methods. Our exhibition will include feedback cards, asking attendees to rate how much they enjoyed each activity numerically. We will also feature a “post-it wall”, which will allow visitors to give short written feedback on our exhibition if they desire.

Once the materials are then passed to the school of Mathematical and Physical Sciences (see section 12) for use in outreach events there, they use a variety of methods of obtaining feedback from their events. A combination of feedback forms, interviews with willing participants and written feedback from teachers is routinely conducted.

12. Who are your target audience/participants and how many people do you expect to engage with?
The target audience for this activity will be the general public from ages 9+.

Primarily, the telescope will debut at the Royal Society summer science festival which is taking place from 2-8 July 2018. The festival will feature 22 exhibitions, one of which will be dedicated to the James Webb Space Telescope, of which this activity will be a part. Visitor numbers to this event promise to be in the thousands based on past years.

Secondarily, the materials will be incorporated into the school of Mathematics and Physical Sciences (MPS) outreach activity suite. The materials would be available to take to local schools or to events hosted on the University campus interacting with children aged 9-18. Of the approximately 120 events MPS outreach were involved in 2016/17, over a quarter would have been suitable for this activity, each seeing an average of 60 students per event. The project would also see guaranteed use at two of the major annual events MPS outreach is involved in. Firstly, the Universities contribution to the BBC’s “Stargazing Live” event, which last year saw 650 people in a single night, including 150 students through Sussex’s Widening Participation Scheme. Secondly, the “Astronomy Masterclass” where 100-200 students are brought to Sussex campus in order to learn about all aspects of Astronomy. These events typically run twice a year and are specifically aimed one at GCSE students and one at A-level students.

13. What is the timeline of the project? Please include start and end dates, and key milestones.
The building of the project would begin immediately, with procurement of common off the shelf components and liaising with the MPS workshop in order to produce anything which needs to be built bespoke. The entire construction of the project will be done by the University, demonstrating the accessibility of the project if people wish to reproduce it.

The activity will be debuted at the Royal Society summer science festival from 2-8 July 2018, after which it will then run in perpetuity upon request by local schools as part of the MPS outreach activity suite (see section 12). The project will aim to be robust enough to last at least for the 5-year lifespan of JWST with minimal maintenance, and likely far beyond.

14. How does the suggested project relate to your own research? Please indicate how the activity will benefit yourself and your research.
My research is in the field of high-redshift Astronomy. This field involves looking for the most distant galaxies in the universe, and trying to explore how they are different to galaxies which are nearby. As mentioned in section 6a the light from these galaxies changes colour during the travel to us in a predictable way, appearing much redder than it really is - this process is called redshifting. For the most distant galaxies the light can appear so reddened that it falls out of the visible light spectrum, making them invisible to normal optical telescopes. In addition to this process, the starlight from these galaxies takes time to reach us: we are seeing them as they were in the past. In high-redshift Astronomy this idea is taken

to the extreme, searching for the reddest, and therefore the most distant and the oldest galaxies. These galaxies being so distant that we are looking at them as they were billions of years ago, looking back to when the Universe was much younger than it is today.

The James Webb Space Telescope is an infrared telescope, designed in part to peer billions of years back into the Universe's history to try to describe how it was different than it is today. It promises to be the most important leap forward in high-redshift astronomy in almost 30 years – since the Hubble Space Telescope's launch in 1990. Many astronomers – myself included – are working to develop tools so that as soon as the telescope is ready to observe, we are ready to analyse and interpret what JWST sees.

The project will benefit me directly because conducting public engagement activities provides me with experience explaining my research to people who aren't experts in astronomy. This experience will prove valuable when writing grant proposals, which are often reviewed by scientists who specialise in other areas. If I am able to communicate my research to the public in a concise and accessible way, the experience should prove invaluable for communicating it to a scientifically literate panel.

15. What is the potential legacy of the project?
The legacy of this project will be in two parts. Firstly, the physical materials produced: the model telescope will continue to see use in schools around the south-east of England through the MPS outreach programme, and other large events with which the university is already involved. The plans for the project being publish online will hopefully lead to other institutions or keen school groups such as astronomy clubs attempting to replicate the build, learning about the instrumentation side of astronomy, computer programming and engineering challenges in the process.

Secondly, the legacy of this project will be a public understanding of what JWST is hoping to achieve, and that even though it is a NASA led project, members of their local communities are actively involved in producing science from this amazing project.

16. Please outline your public engagement experience to date
During my undergraduate degree at Sussex I worked under casual employment for 5 years for Dr [redacted] as a physics and maths outreach demonstrator. This involved taking educational activities into schools, to festivals and other large events in order to engage children with physics, maths and astronomy. I averaged around 100 teaching hours per year. During this time I was involved with the development of new activities and wrote a handbook of existing activities to help train new demonstrators. This handbook was later distributed to the other 8 South East Physics Network (SEPNet) universities, being used to train their demonstrators as well. As part of this team I have helped run stands at numerous large events such as Brighton Science festival, Lewes STEMfest and the Big Bang festival.

I have also delivered numerous public talks to local astronomy societies about aspects of professional astronomy, most recently I headlined Brighton Astro's May meeting with a talk about how we measure the distance to stars and galaxies.

17. Budget

Please provide a detailed budget indicating what you would spend the funding on if you are successful in your application.

Please note that the maximum amount of funding you can apply for is £750 per activity.

Budget details

Item details	£

Telescope and mount (donated by MPS school)	£0.00
Consumer Webcam	£50.00
Raspberry Pi	£35.00
Screen/tablet for viewing	£100.00
Optical and IR filters	£50.00
Mounting equipment and paint	£100.00
MPS workshop labour (8-10 hours)	£250.00
Travel to the Royal Society	£30.00
Collapsible promotional Banner, feedback cards.	£135.00

Total: £750.00

Total requested from the Public Engagement Fund
£750.00

18. Budget code
Code to be created upon successful application

19. Supporting statement

Please submit a supporting statement (in PDF format) from your supervisor (for doctoral researchers) or the relevant Principal Investigator (for research staff).

The supervisor/PI's name, title and electronic signature should also be included in the statement you submit.

If you have any difficulty with this, please contact researcher-development@sussex.ac.uk.

Upload your supporting statement here
PublicEngagementGrant.pdf