Holly Preece

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EDUCATION

Insititute of Astronomy, University of Cambridge **Cambridge, UK**
PhD Astrophysics (PhD awarding institution) *2015 - 2019*

Armagh Observatory & Planetarium **Northern Ireland, UK**
PhD funding body - full studentship *2015 - 2019*

Royal Holloway, University of London **Egham, UK**
MSci (BSc and Integrated Masters) Physics with Astrophysics - 1st Class Honors *2011 - 2015*

KEY SKILLS

Programming Experienced programmer in Python, Bash, Fortran (77 and 90), labVIEW, C, C++, LaTeX, Mathematica, SCPI.
Numerical Methods Have written numerical methods to solve differential equations and calculate integrals and derivatives. Familiar with the Heyney method to solve non-linear PDE's.
Data Analysis Can generate and handle large heterogeneous data sets, familiar with statistical data analysis methods, automation and data visualisation.
Binary Stellar Evolution My PhD work has been focused on binary interactions, particularly tides, of hot subdwarf B stars. The hot subdwarfs are evolved, compact low-mass stars.
Problem Solving Capable of understanding complex phenomena, isolating unsolved problems and applying the appropriate methods to tackle them.
Communication Can write publishable scientific documents and reports. Comfortable explaining abstract concepts to audiences of experts and the general public both orally and via writing.

RESEARCH WORK

PhD Work - Cambridge and Armagh *2015 - 2019*

- Modified the Cambridge STARS code (Fortran 77) to include detailed calculations for tidal interactions between binary stars. Much of this work involved writing subroutines to solve second order differential equations numerically for detailed stellar models.
- Created stellar models with different masses and at different evolutionary stages using the STARS code. Considered binary and single star evolution.
- Carried out a thorough study to investigate the validity of the assumption of tidal sychnronization of hot subdwarf B stars in close binaries.
- Analysed large grids of generated stellar models by programming numerical routines and carried out statistical analysis.
- Wrote a subroutine for the STARS code to produce models in a format which can be accepted by the pulsations code GYRE.
- Developed a method to quantify the perturbation to the eigenfrequencies of stellar pulsations owing to tidal interactions for 1D stellar evolutionary models. Coded my own data visualisation routines including live plotting software which can be run at the same time as the STARS code to observe to output models as they are generated.
- Read and assessed literature in the fields of close binary stars, tidal interactions, pulsations and hot subdwarf B stars.

Masters Project - Royal Holloway *2014 - 2015*

- Carried out observations of clusters of stars using the university telescope over multiple nights and using a range optical filters and other available hardware.
- Wrote code to separate stars from background noise from the large number of images obtained with the telescope.
- Utilised statistical data techniques including maximum likelihood, parameter estimation and fitting functions to data sets to generate a H-R diagram from the obtained images. Classified the population of stars and the overall behaviour of the observed stellar cluster.
- Attended courses on general relativity and statistical data analysis.

Summer Internship at National Physical Laboratory (NPL) *2014*

- Built an acoustic thermometer from scratch using available materials. These thermometers have previously been used to make the most precise measurment of the Boltzmann constant to date. The aim of the project was to test whether the same methods could be used on larger scales for nuclear reactors.
- Automated data collection with LabVIEW and the instrument language SCPI.
- Wrote code to analyse acoustic signals received. Developed several peak finding algorithms.

CONFERENCE PARTICIPATION

Binary Stars **Cambridge, UK**
Member of LOC *July 2016*

- Member of local organising committee.

sdob8 Conference **Krakow, Poland**
Presentation at Specialist Astrophysics Conference *July 2017*

- Presented the results of my scientific research into tidal interactions between close binary stars to an audience of experts in the field.

Hydrogen Deficient Stars IV **Armagh, N. Ireland**
Member of LOC *September 2018*

- Was member of local organising committee.
- Presented a poster with the results of my scientific research into tidal interactions between close binary stars to an audience of experts in the field.

sdob9 Conference **Hendaye, France**
Presentation at Specialist Astrophysics Conference *June 2019*

- Presented the results of my scientific research into the effect of tidal distortions on the pulsations of hot subdwarf stars to an audience of experts in the field.
- Acted as chair for the close binaries presentation session.

TEACHING AND OUTREACH

- Supervised 8 students for first year mathematics at Cambridge in 2015/2016.
- Regularly participate in open evenings in the IoA (2015 - 2019).

Audiogarden - Festival of Music and Arts **Athy, Ireland**
Delivered Public Seminar on Tidal Interactions Between Close Binary Stars *September 2019*

- Introduced concepts of single star evolution from the birth to the death of an object. Considered the importance of initial mass in the overall evolution of the star.
- Discussed binary stars, which are two stars orbiting each other. The two stars can either interact with each other by exchanging mass and causing structural deformations.
- Talked about tidal interactions between the Earth and the Moon and then between close binary stars. Highlighted that the strongest tidal effects on earth are owing to the Moon, not the Sun.

Sunflowerfest - Festival of Music and Arts **Lisburn, Northern Ireland**
Delivered Public Seminar on the Role of Women in Astronomy *June 2018*

- Highlighted notable women in astronomy and their contributions to the field starting with Ancient Greek Goddess Urania and ending with Jocelyn Bell-Burnell (still alive).
- Discussed the evolution of the participation of women in astronomy and the struggles they had faced receiving formal education.
- Debated sociological theories which attempt to explain the low numbers of women including implicit bias, workplace bias, beliefs about intelligence, childhood development and influences, and 'the leaky pipeline' causing women to drop out at each level. This information was obtained by my regular attendence at events promoting diversity as well as my own further reading on the topic.

International Women's Day Event - Women in STEM **Northern Ireland**
Public Seminar and Panel Participation *March 2018*

- Gave a talk to members of the city council and participating schools about the history, evolution and sociology regarding women in physics. Similar content to that of Sunflowerfest.
- Participated as an invited panel member to talk about my personal experience as a woman in astronomy with an aim to inspire attending female school pupils to stay in STEM.
- Talked individually to many of the pupils about what it's like to do astrophysics and why it is imperative for women to persue qualifications and careers in the field.

REFEREED ACADEMIC PUBLICATIONS

- Preece, H. P., Jeffery, C. S and Tout, C. A., (2019). Asteroseismology of tidally distorted sdB stars, *Monthly Notices of the Royal Astronomical Society*, 2221 *DOI*:10.1093/mnras/stz2292.
- Preece H. P., Tout C. A., and Jeffery C. S. (2019). Convection physics and tidal synchronization of the subdwarf binary NY Virginis, *Monthly Notices of the Royal Astronomical Society*, 485:2889-2894., *DOI*: 10.1093/mnras/stz547
- Preece H. P., Tout C. A., and Jeffery C. S. (2018). Tidal Interactions of Close Hot Subdwarf Binaries., *Monthly Notices of the Royal Astronomical Society*, 481:715–726, *DOI*: 10.1093/mnras/sty2091
- Izzard Robert G., Preece Holly, Jofre Paula, Halabi Ghina M., Masseron Thomas and Tout Christopher A, (2018), Binary stars in the Galactic thick disc, *Monthly Notices of the Royal Astronomical Society*, 473:2984-2999., *DOI*: 10.1093/mnras/stx2355.
- Jeffery C. S., Baran A. S., Behara N. T., Kvammen A., Martin P., Naslim N., Østensen R. H, Preece H. P., Reed M. D. and Telting J. H., (2017). Discovery of a variable lead-rich hot subdwarf: UVO 0825+15, *Monthly Notices of the Royal Astronomical Society*, 465:3101-3124, *DOI*: 10.1093/mnras/stw2852.
- M. de Podesta, G. Sutton, G. Edwards, L. Stanger and H. Preece, (2015). Practical acoustic thermometry with twin-tube and single-tube sensors, *ANIMMA Conference Proceedings*, *DOI*: 10.1109/ANIMMA.2015.7465575.