



Science and
Technology
Facilities Council

Project application under the Gravitational-wave Excellence through Alliance Training (GrEAT) Network with China

Lead(s) and collaborator (s): name(s) and institution(s)
Lead: Yi-Ming Hu: TianQin Research Center for Gravitational Physics and School of Physics and Astronomy, Sun Yat-sen University Collaborator: Ian Harry: Institute of Cosmology and Gravitation (ICG), University of Portsmouth, Portsmouth, UK.
Student name(s) to work in project if applicable: name(s) and institution(s)
Han Wang, TianQin Research Center for Gravitational Physics and School of Physics and Astronomy, Sun Yat-sen University Connor Weaving, ICG, Portsmouth. (Only if you think naming students on both sides is useful?)
Where will the activity be hosted?
TianQin Research Center for Gravitational Physics, Sun Yat-sen University (Zhuhai Campus), Zhuhai 519082, People's Republic of China

Title of activity and description of the project (~100 word summary - suitable for reporting to STFC)
Archival multi-band searches for stellar-mass binary black holes using PyCBC We expect many thousands of observations of binary-black hole mergers with 3 rd generation ground-based gravitational-wave observatories. Some of these signals will be directly observable with space-based observatories such as TianQin and LISA, but most will not be significant compared to the noise background of the space-based observatories. However, if we use data from later ground-based observations, we can go back to the archived TianQin and LISA data and observe such subthreshold signals. This would allow us to acquire significant additional information about the physical parameters of the system and the population of high-mass stellar binary black holes. In this project we will apply the PyCBC toolkit to demonstrate the capability of such archival searches, explore the feasibility of performing such searches in the future and investigate the scientific payoff that such a search would allow.

What would success look like and what are the follow on steps? How will you monitor the project? 50-100 word summary
Success in this project would represent a scientific paper (or papers) describing the results of our study and exploring the scientific payoff of archival multi-band gravitational wave searches. In addition, we will incorporate the code we develop during this project into the PyCBC repository and publish the exact specifications and configurations that we used in our paper to allow easy reproducibility of our results. We will monitor this project by comparing progress against the following milestones: <ul style="list-style-type: none"> • Modify the PyCBC code to make it suitable for space observatories • Simulate binary black hole observations in 3rd generation ground based observatories. • Estimate the SNR distribution of such signals in space-based observatories. • Construct a pipeline to search archival space-based observatory data for known, sub-threshold binary black hole mergers.

For questions/comments and submission please contact Prof. Ik Siong Heng (ik.heng@glasgow.ac.uk) Dr. Mariela Masso Reid (Mariela.MassoReid@glasgow.ac.uk) and Prof. Zong-Hong Zhu (zhuzh@bnu.edu.cn).