ICRAR & ICRAR-Pawsey Summer Studentships 2018-2019
Project Proposal

Project Details	
Project Title	How fast can neutron stars eat other stars?
Primary Supervisor	Arash Bahramian
Primary Supervisor Availability	Away Dec 17 - Jan 6 (Available via email & skype in this period)
Contact Details	arash.bahramian@curtin.edu.au
Additional Supervisors & Contact Details	Richard Plotkin (richard.plotkin@curtin.edu.au)
Additional Resources Required	N.A.
Pawsey Centre Hardware Use	N.A.
Software Required	List all software requirements here. Student Desktop Requirements: ● Anaconda Python ● HeaSoft (https://heasarc.nasa.gov/lheasoft/) ● SAO DS9 (http://ds9.si.edu/site/Home.html) Pawsey Centre software installations required: ● None
Student Location for project	ICRAR-Curtin
Project Description	X-ray binaries are binary systems containing a compact object (neutron star or a black hole) accreting matter from a companion star (typically a star like the Sun). Over time, the strong gravity of the compact object pulls matter from the surface of the donor star and strips its outer layers. Theoretical models predict that as the material falls towards the neutron star/black hole, it loses angular momentum and energy through emission (mostly in X-rays). The stars in the binary get closer as their orbital period shrinks. These predictions have made measurement of orbital period and its changes over time in X-ray binaries a direct method to test our understanding of how black holes and neutron stars devour other stars. Classically, it was thought that any observable change of orbit in X-ray binaries would require observations over centuries/millennia to be detected. However, over the past three decades, changes in orbital period have been observed in in a handful of eclipsing X-ray binaries over timescale of ~years. These findings suggest that there are more complex physical mechanisms (like the star's magnetic field) significantly impacting evolution of X-ray binaries. Thus a careful study of orbital changes in a larger sample of sample of X-ray binaries is needed to better understand evolution in these systems. In this project, the student will analyze recently obtained X-ray data with the *Swift* satellite of a well-known eclipsing X-ray binary, for which the orbital period waslast measured in the year 2000. This will allow a direct estimate of the rate at which the orbital period has changed in this system and thus constrain the evolution of this system. We anticipate that the X-ray analysis will be included in a refereed publication, with the student as a co-author, pending satisfactory completion of the project.

Student Attributes	
Academic Background	Familiarity with basic regression (e.g., fit a line to some data)
Computing Skills	Familiarity with elementary programing in python
Training Requirement	
Project Timeline	
Week 1	**Project introduction and setup**
Week 2	**Literature review (Accretion in X-ray binaries)**
Week 3	**Literature review (Evolution of X-ray binaries, history of the target of this study)**
Week 4	**Introduction: regression in python, reduction and analysis of X-ray data**
Week 5	**Data reduction (extracting light curves)**
Week 6	**Data reduction (extracting light curves)**
Week 7	**Data analysis (light curve fitting)**
Week 8	**Data analysis (light curve fitting)**
Week 9	**Finalizing analysis (estimating the ephemeris)**
Week 10	**Final Presentation and Reporting**

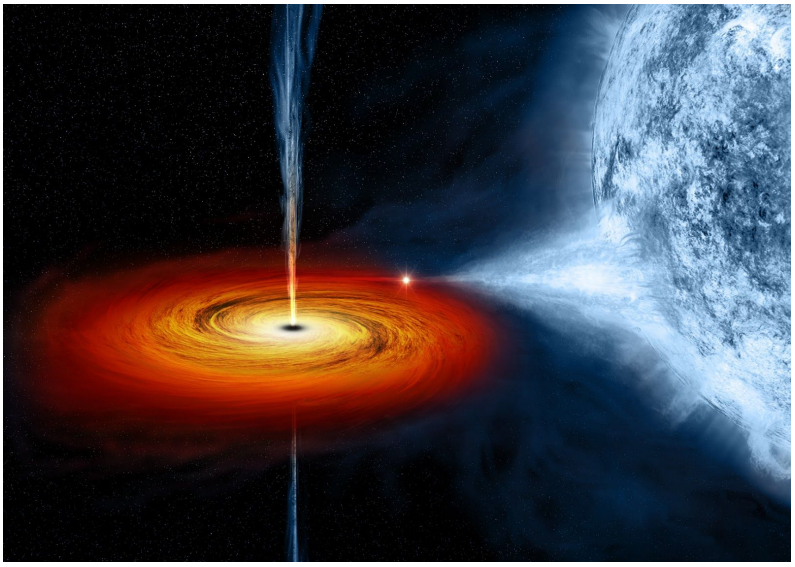

Illustration of an X-ray binary: the compact object (neutron star or black hole) slowly pulls and eats the outer layers of the companion star. In this project, we are trying to estimate how fast this process is and how long it can last for a specific system.