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

Project Details	
Project Title	**Modelling feedback in galaxy evolution**
Primary Supervisor	**Dr. Adam Stevens**
Primary Supervisor Availability	Away 5-15 November and for 2-3 weeks over Christmas/New Year (inclusive of the University shut down period). Otherwise available.
Contact Details	adam.stevens@uwa.edu.au +61 8 6488 7627
Additional Supervisors & Contact Details	Dr. Claudia Lagos claudia.lagos@uwa.edu.au
Resources Required	Mac desktop with preferably 4+ cores (most processing will be done locally). Access to local clusters for larger-scale processing.
Pawsey Centre Hardware Use	N/A
Software Required	• Python environment (e.g. Anaconda) • C compilers (e.g. clang) • MPI functionality (e.g. OpenMP) • LaTeX environment (e.g. MacTex) • git (GUI like SourceTree also recommended) • gsl
Student Location for project	ICRAR-UWA
Project Description	The evolution of galaxies is self-regulated by feedback processes. After stars form from the gravitational collapse of gas clouds, they inject energy back into their surroundings from stellar winds and supernovae, thereby making it harder for further stars to form. Galaxies also host supermassive black holes, which grow from the accretion of gas in the galaxy. The energy released from this accretion (often referred to as an active galactic nucleus) can potentially blow out the galaxy's gas and/or choke the supply of fresh gas to the galaxy. Understanding these processes is crucial to explaining how galaxies end up with the mass, morphology, and composition that we observe them to have. There is still scientific progress to made in this field. This project will focus on modelling either stellar or black-hole feedback in galaxy evolution. An analytic framework will first be set up to mathematically describe the process, and this will then be coded and folded into the DARK SAGE semi-analytic model of galaxy formation. The scholar will examine how the properties of galaxies respond to choices in their model, exploring the model's physical viability and freedom by comparing to observations. While many established models like DARK SAGE can describe galaxies in the local Universe well, concurrently reproducing galaxies in the early Universe (high redshift) can be challenging. An updated description of feedback should go some way towards rectifying this. There is freedom for the scholar to explore the properties of galaxies that most interest them at their favourite epoch. Contribution to the codebase will lead to co-authorship on the next DARK SAGE paper. DARK SAGE is a code written in C, which is publicly available: https://github.com/arhstevens/DarkSage

Student Attributes	
Academic Background	Ideally taken courses on galaxy evolution and cosmology at 3rd or 4th year undergraduate level.
Computing Skills	Python, C (background in other languages like Matlab should be transferable), Unix command line.
Training Requirement	Version control, Python packages like numpy & matplotlib
Project Timeline	
Week 1	**Inductions and project introduction**
Week 2	**Get DARK SAGE running, familiarise self with design of model**
Week 3	**Set up a plotting/analysis pipeline, try variations of the model.**
Week 4	**Build the analytic framework for the new feedback model**
Week 5	**Code the feedback model, run within DARK SAGE**
Week 6	**Bug fixing**
Week 7	**Reassess model design, finalise any features**
Week 8	**Calibrate DARK SAGE with new feedback model to observations**
Week 9	**Make predictions about galaxies that could be observed**
Week 10	**Final Presentation and Reporting**