



2016-2017: ASTRO: Hierarchical Bayesian Modeling of Exoplanet Population
October 17-28, 2016

Lecture: *Detecting Planets: Jointly Modeling Radial Velocity and Stellar Activity Time Series*

Speaker: David Jones

Abstract:

The radial velocity technique is one of the two main approaches for detecting planets outside our solar system, or exoplanets as they are known in astronomy. The method works by detecting the Doppler shift resulting from the motion of a host star caused by an orbiting planet. Unfortunately, this Doppler signal is typically contaminated by various “stellar activity” phenomena, such as dark spots on the star surface. A principled approach to recovering the Doppler signal was proposed by Rajpaul et al. (2015), and involves the use of dependent Gaussian processes to jointly model the corrupted Doppler signal and multiple proxies for the stellar activity.

During the SAMSI ASTRO program, we aim to extend this work by (i) proposing more informative stellar activity proxies, (ii) adapting the model to incorporate a wider variety of proxies, and (iii) utilizing the new model to optimally schedule telescope observations. In my talk, I will introduce the problem and present a more general model that allows, for example, a lag between the current stellar activity and subsequent effects on the Doppler time series. I will then discuss potential scheduling methods and conclude.

References:

Rajpaul, V., Aigrain, S., Osborne, M. A., Reece, S., & Roberts, S. (2015). A Gaussian process framework for modelling stellar activity signals in radial velocity data. *Monthly Notices of the Royal Astronomical Society*, 452(3), 2269-2291.
<https://arxiv.org/abs/1506.07304>

Boyle, P., & Frean, M. (2004). Dependent Gaussian processes. In *Advances in neural information processing systems*, 217-224. <http://papers.nips.cc/paper/2561-dependent-gaussian-processes.pdf>