The evolution and fate of planets

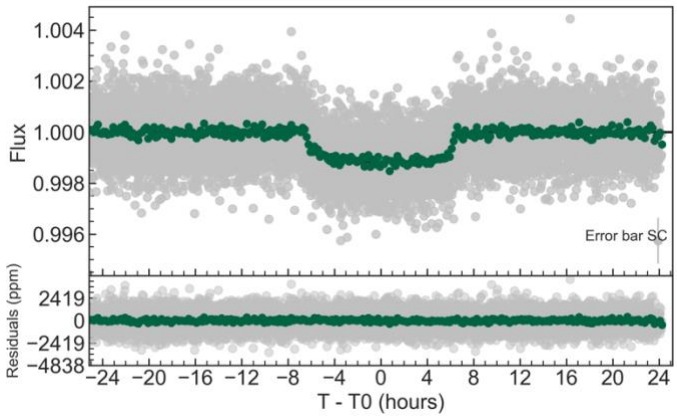
Supervisor: Dr Nora Eisner (questions to neisner@flatironinstitute.org)

What will happen to our own Solar System in the future? Can planets survive all stages of a star's life? Out of the nearly 5500 exoplanets known to date, over 97% of them exist around main-sequence stars like our Sun. The notable lack of a larger sample of planets around old (evolved) stars directly translates to a gap in our understanding of how planets evolve and eventually die.

As a star ages, it's properties change drastically which has profound effects on surrounding planetary systems. For example, the increase in stellar size and irradiation have been suspected of causing planets to inflate in size, while stellar and planetary tides are thought to be responsible for causing planets to spiral inwards towards their host stars, possibly leading to planet engulfment. In order to better understand the long-term habitability of exoplanets and the future of our own solar system we need to find and study a large sample of planets around evolved stars.

The larger radii of evolved stars, compared to their main-sequence counterparts, means that any potential transits are shallower, hindering the detection and characterisation of these planets using automated algorithms. Through large scale citizen-powered transit searches, however, we can find longer-period planets around more evolved stars. The group at QMUL leads the Planet Hunters TESS citizen science project that is carrying out a targeted search for planets at various stages of stellar evolution. This PhD project will involve using data from the Transiting Exoplanet Survey Satellite (TESS) to detect new planets around older stars and to help characterise how planets and stars interact beyond the main-sequence.

This project can be tuned to the specific interests of the student, with the possibility of a stronger focus on using citizen science and/or machine learning. If you have any questions or are interested in discussing any aspects of this project, please contact Dr Nora Eisner (neisner@flatironinstitute.org).



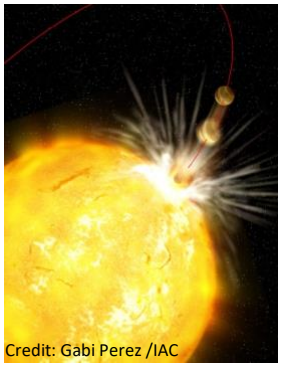


Figure. *Left panel:* example transit of a planet orbiting a post main-sequence star. This transit was identified in the TESS data via Planet Hunters TESS. *Right panel:* an artist's impression of what planet engulfment could look like. Are all planets eventually engulfed or do some survive? We can begin to address that question by finding and studying planets like the one shown in the *left panel*.

Note: This project description can be used for the "Research Proposal" part of your application.