STUDENT RESEARCH ASSISTANT

Advisors: *Dr. Regner Trampedach (SSI), Dr. Savita Mathur (IAC)*

Supervisor*: Dr. Ralph Shuping (SSI)*

Title: *Studying the convection parameters of Kepler main-sequence to red-giant stars as a function of metallicity*

Abstract:

With spectra of stars, we can get a good handle on their effective temperatures and a fair idea of their surface gravities, but no constraint on their radii (and therefore also not on their masses). Helio- and astero-seismology are very powerful tools as they allow us to probe the deep interiors of the Sun and the stars, which combined with spectroscopic observations, can give us mass, radius, and age for individual stars (as opposed to stars in clusters) with a better precision than with classical observations. The Kepler space telescope, which observed hundreds of thousands of stars (from main sequence to giants) with unprecedented accuracy for months and years, has revolutionized the field of asteroseismology. While enabling the study of solar-like oscillations, these observations also revealed a signal of granulation, the surface manifestation of the convective envelopes of stars. This signal can teach us about convection, but it can also be used as a diagnostic tool for determining both surface gravity (from a characteristic timescale of the signal) and stellar radii (from its amplitude).

The student will work on the analysis of the convective background of solar-like stars on the main-sequence, sub-giant, and red-giant stars to look for correlation with metallicities based on spectra from the APOGEE survey of the Kepler field. A Bayesian code has been developed to fit the convective background and the summer student will apply it to tens of thousands of stars, to ~15,000 red giants with detected solar-like oscillations and with APOGEE spectra (for accurate determination of atmospheric parameters). This analysis will provide constraints on the variation with radii and atmospheric parameters of convective time scales and amplitudes. These will be compared to results of a grid of 3D simulations of convection developed by Dr. Regner Trampedach, who will co-supervise the summer student. The simulations may help guide our interpretation of the observations, and in turn, the observations may point to improvements that can be made to the simulations.

Short List of Goals:

- Analysis of the convective background for 15,000 red giants observed by the Kepler mission to extract timescale and amplitude of granulation using the existing Bayesian code “apollinaire”
- Consolidate the stellar parameters (from seismology and APOGEE)
- Look for multidimensional correlations of the granulation parameters with the stellar parameters, specifically to explore the effects of metallicity
- Comparison with 3D simulations of convective stellar atmospheres
- Interpret the Kepler observations based on the simulations and understand any differences between observations and simulation predictions.

About the Position

Requirements: Graduate student with undergraduate degree in astrophysics, physics or other related area; and Python, MacOS and Linux experience.

Desired skills: IDL, experience with statistical analysis, GitHub.

Schedule: **Desired start early June-** -Flexible **–** Full or part-time preferably during summer months.

Compensation: $20 - $25 per hour based on applicable knowledge and background.

To apply: Please submit resume (or CV), cover letter, and contact information for 2 or 3 references to Jobs@spacescience.org.

Note: Position is open until filled.