

## **A SEARCH FOR HYBRID GAMMA DORADUS/DELTA SCUTI PULSATING VARIABLES--IMPROVING THE STATISTICS**

Joyce Guzik

Los Alamos National Laboratory/University of California

GO20015

The delta Scuti and gamma Doradus pulsating variables are main-sequence (core hydrogen-burning) stars with masses somewhat larger than the sun (1.2 to 2.5 solar masses). The lower-mass gamma Dor stars are pulsating in nonradial gravity modes with periods of near one day, whereas the delta Scuti stars are radial and nonradial p-mode (acoustic mode) pulsators with periods of order two hours. Because of the near one-day periods of gamma Dor stars, it is very difficult to discover these stars and determine their pulsation frequency spectrum from ground-based photometry due to the 1 cycle/day alias, whereas Kepler observations have been able to detect them easily with one or two quarters of monitoring. Hybrid gamma Dor/delta Sct stars are among the most interesting targets for asteroseismology because the two types of modes (pressure and gravity) probe different regions of the star and are sensitive to the details of the two different driving mechanisms. Because the pulsations are driven by two different, and somewhat mutually exclusive, mechanisms, hybrid stars exhibiting both types of pulsations are expected to exist only in a small overlapping region of temperature-luminosity space in the Hertzsprung-Russell diagram. Before the advent of the Kepler and CoRoT missions, only four hybrid gamma Dor/delta Scuti pulsators had been discovered. Now the first analysis by the Kepler Asteroseismic Consortium (KASC) of 234 targets showing pulsations of either type has revealed hybrid behavior in essentially all of them! (Grigahcencu et al., ApJL in press, astro-ph 1001.0747) The existence and properties of these hybrids raise a number of questions: Why are hybrids much more common than predicted by theory? Why do some hybrid stars show frequencies in the gap predicted by theory between the gamma Dor and delta Sct frequency range? Are unknown pulsation mechanisms at work? We hope to answer these questions by improving the statistics on the occurrence and properties of hybrids among the gamma Dor and delta Sct stars using Kepler observations. We propose to supplement the KASC search by observing an additional 187 stars from the Kepler Guest Observer Input Catalog that lie in or near the gamma Dor and delta Sct instability strips. Note that we are only requesting long-cadence data, and we are proposing to observe stars that have not yet been observed by Kepler. It is imperative that we not miss this opportunity to observe these stars with Kepler, as it is nearly impossible to discover and monitor the gamma Dor stars with pulsation periods of order one day from the ground. Analysis of Kepler data to date has shown that the long cadence data is also capable of detecting delta Sct frequencies that are more than 1 hour; the properties of the short frequencies can be refined later by short-cadence data later, or by ground-based photometry. We also will perform follow-up observations of the promising hybrid candidates with ground-based spectroscopic observations using the New Mexico State University 1 meter or 3.5 m Apache Peak telescopes to obtain accurate effective temperatures and surface gravities, constrain rotation rates, detect abundance peculiarities, and rule out binarity or star spots as a cause of periodicities. A larger survey of these stars with the high-precision photometry provided by Kepler is essential to help resolve the mysteries surrounding the theoretical model predictions and to realize the potential for asteroseismology of these stars.