Stellar oscillation - a tool to determine structure parameters of δ Scuti pulsators.

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Abstract

Asteroseismology, the study of stellar pulsation, is an indispensable tool for probing stellar structure, evolution and different stellar dynamics. With the precise time series photometries from space-borne instruments like MOST, CoRoT, Kepler, BRITE and TESS, dramatic improvements have been observed in the asteroseismology of different kinds of oscillating stars. These missions have significantly shed light on the oscillations of δ Scuti stars - a special class of oscillators, particularly interesting owing to their fast rotation rates and uninterpreted pulsation patterns. However, we still lack precise measurements of their mass, metallicity, and age because it's been challenging to identify different modes in their asteroseismic spectra. But recently, Bedding et al. (2020) discovered 60 δ Scutis with highly regular pulsation patterns from TESS and Kepler. We have developed machine learning and other techniques to infer the mass, metallicity, and ages of these stars. Our results indicate that most of these stars are younger than 30 Myr, having masses around 1.6 M and metallicities below Z = 0.010. By properly identifying the dipole modes, we found that machine learning techniques can improve age determination of δ Scutis. Our study shows that the radial modes succinctly contain the information of stellar luminosity and temperature. We also noticed that the effective surface temperature has a strong impact on the inferences of all the structure parameters. With the upcoming space data from TESS and PLATO, it is possible to obtain structure inferences on a much larger ensemble of δ Scutis, which can be promising to carry out galactic archaeology.

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