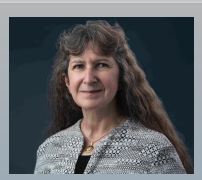

Do Metallic-Line A (Am) Stars Pulsate?
Results from TESS Cycles 1-3

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Introduction

Am stars show underabundances of Sc and Ca and enhancements of Ti and Fe-group elements in their photosphere.

These stars are not necessarily expected to show δ Sct pulsations because the diffusive processes responsible for the peculiar element abundances also should deplete helium from the pulsation driving region and inhibit pulsations. Nevertheless, some of these stars do show δ Sct pulsations (Smalley et al. 2017; Murphy et al. 2020).

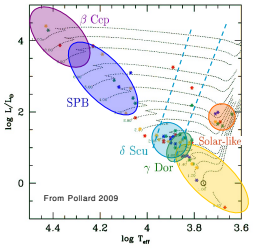
The aim of our TESS Guest Investigator programs is to observe well-characterized samples of bright (V mag ~7-8) Am stars in 2-min cadence to find out whether they pulsate and determine their pulsation frequencies.

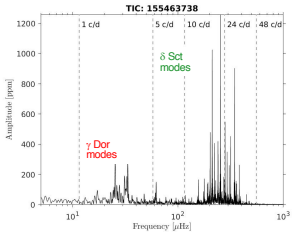
δ Scuti and γ Doradus main-sequence pulsating variables

Radial and nonradial modes

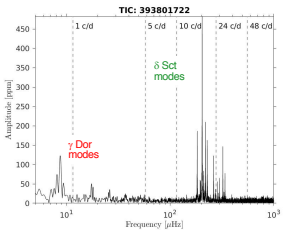
δ Sct: ~2 M_{sun}, pressure modes, periods ~2 hours

γ Dor: ~1.5 M_{sun}, gravity modes, periods ~1-3 days

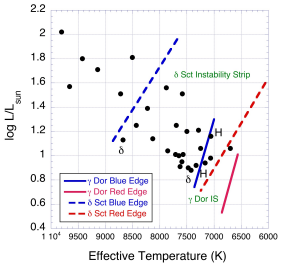




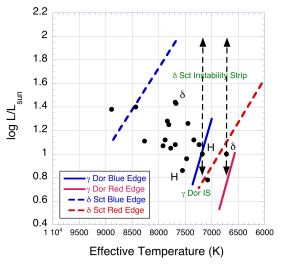
Amplitude spectrum for HD 50635, shown to be a δ Sct / γ Dor hybrid candidate from analysis of one sector of TESS data. This spectrum shows over 200 frequencies with S/N > 11.



Amplitude spectrum for HD 108449, shown to be a δ Sct / γ Dor hybrid candidate from analysis of one sector of TESS data. This spectrum shows 34 frequencies with S/N > 4.



Location in H-R diagram of 32 Am stars observed by TESS (black dots), with T_{eff} and luminosity from TESS Input Catalog v8.1 (Stassun et al. 2019). Also shown are the theoretical blue edge and observational red edge of the δ Sct instability strip (dashed lines) from Breger and Pamyatnykh (1998) and the theoretical red and blue edges of the γ Dor instability strip (solid lines) from Warner et al. (2003). The stars labeled are δ = δ Sct, H = hybrid candidate, and B = eclipsing binary, as determined from the TESS data.



H-R diagram location of 20 stars with T_{eff} < 10,000 K from Paunzen et al. (2013) sample (black dots) observed by TESS. T_{eff} and luminosity are from TESS Input Catalog v8.1 (Stassun et al. 2019). For two of the stars, the luminosity was not available, so these are plotted at log L/L_{sun} = 1 with dashed vertical arrows. The two δ Sct stars (δ) and two hybrid candidates (H) are indicated.

Conclusions

Yes, we found some pulsating Am star candidates!

Of the 32 Am stars in the Catanzaro et al. (2019) sample observed so far by TESS, we find two δ Sct stars and two δ Sct/γ Dor hybrid candidates. Of the 23 stars in the Paunzen et al. (2013) sample observed so far, we find an additional two δ Sct stars and two δ Sct/γ Dor hybrid candidates.

Confirmation of these variables is needed because of possible contamination in TESS pixels from nearby or background stars.

The frequencies observed in these stars, along with fundamental properties such as effective temperature, luminosity, and element abundances, will provide useful constraints for asteroseismic modeling to understand the origin of the pulsations.

Further information:
Characterizing Variability in Bright Metallic-Line A (Am) Stars Using Data from the NASA TESS Spacecraft, SAS 2021 conference proceedings: https://arxiv.org/abs/2107.09479

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