# Pulsations and the Am Stars

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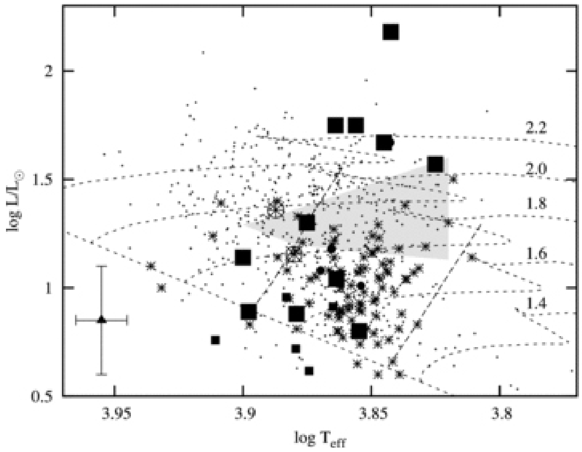
In the region of the HR Diagram where the Cepheid instability strip extends across the main sequence, there is a complex relationship between stellar pulsation and atmospheric abundance anomalies that is not fully understood. This region ranges from the early A stars to mid-F stars in spectral type, and from the zero age main sequence to the terminal age main sequence in luminosity.

Most stars in the main-sequence region of the instability strip are normal abundance δ Scuti pulsating stars with relatively high rotational velocities; usually $v \sin i > 100$ km/s. A large fraction of A stars are metallic-line (Am) stars, peaking at around 50 per cent at A8, but Am stars were believed either not to pulsate as δ Scuti stars, or may do so with much smaller amplitudes than the normal abundance δ Scuti stars. Am stars are mostly found in short period binary systems with orbital periods between 1 to 10 days, causing synchronous rotation with $v \sin i < 120$ km/s (Abt 2009, AJ, **138**, 28); a few single Am stars with similar slow rotation are known.




*Location of Am stars in the theoretical HR diagram from Balona et al. 2011, MNRAS, **414**, 792. Filled circles are Kepler pulsating Am stars and filled squares are other pulsating Am stars. The asterisks are pulsating Am stars from SuperWASP. The grey area is the predicted location of pulsating Am-star models incorporating heavy-metal diffusion. The small background points are known δ Scuti stars.*

Our physical understanding is that atomic diffusion – radiative levitation and gravitational settling – stabilises the slowly rotating Am stars so that low overtone p-modes are not excited; particularly important in this context is the gravitational settling of helium from the He II ionisation zone where the κ-mechanism drives the pulsation of δ Scuti stars. Otherwise, the more rapidly rotating stars remain mixed because of turbulence induced by meridional circulation and are excited by the κ-mechanism (Turcotte et al. 2000, A&A, **360**, 603).

Thanks to the micro-magnitude precision of *Kepler* (Balona et al. 2011, MNRAS, **414**, 792) and wide sky coverage of the ground-based SuperWASP survey (Smalley et al. 2011, A&A, **535**, A3) we now know that Am stars have low-level pulsations and that even one of them, WASP-33, is a transiting planet host star (Collier Cameron et al. 2010, MNRAS, **407**, 507). Many, *but not all*, Am stars therefore do pulsate, generally with lower amplitude than normal abundance δ Scuti stars and some even exhibit low-frequency g-modes as found in the cooler γ Doradus stars. This amplitude difference is still to be understood in terms of atomic diffusion reducing pulsation driving for the slowly rotating Am stars, but there is not a complete lack of pulsation. That has implications for turbulence in the diffusive layers and may require that the pulsation be laminar.

***By exploiting the micro-magnitude precision of K2, we will be able to further investigate the interaction between radiative diffusion and stellar pulsation.***

Only 11 Am stars were observed during the *Kepler* mission. The proposed **long-cadence** targets for Campaign 0 of the *K2* mission will increase the number of Am stars observed with micro-magnitude precision. There are 59 known Am stars within a 12-degree radius of the proposed bore sight for Campaign 0. While only a subset could be observed with selected bore sight, we estimate that number observable will be at least as great as that in the original *Kepler* mission.