1993BASI...21..375R

Bull. Astr. Soc. India (1993) **21**, 375-376

Spectroscopic binary orbits and MK morphological studies of some Am stars

S. Sreedhar Rao
Department of Astronomy, Osmania University, Hyderabad 500 007

1. Motivation

The metallic-line A type stars (Am) on the main sequence are known to be largely the members of binary systems and therefore yield periods. Due to their small equatorial radial velocities, they display sharp spectral lines which facilitate an easy and accurate measurement of their Doppler displacements as well as line profile studies. Their slow rotation ($v \sin i <$ 100 km/s) also causes surface abundance anomalies which are often represented by the distinct spectral characteristic Sp (K) < Sp (H) < Sp (ml). Such spectra require a third dimension specifying the metallic-line type for classification. Although, Am stars are cooler extensions of Ap stars, they are hitherto known to be exclusive to each other with respect to their magnetic fields and hence in the degree of display of abundance anomalies and associated spectrum variability. Therefore we have obtained well widened spectra of several Am stars with the Meinel spectrograph at the Nasmyth focus of the 1.2m telescope of the Japal-Rangapur Observatory with the aim to study :

(i) Spectroscopic orbits (HD 434, HR 3040, HR 903, 37 ε Ser and 41 Sex A at 33 Å mm^{-1})
(ii) MK Morphology (28 Am stars and 39 MK standards at 66 Å mm^{-1})
(iii) Spectrum line variability (41 Sex A at 33 and 66 Å mm^{-1}).

2. Spectroscopic orbits

Among the four Am designates selected for investigating their binary nature, HD 434 had turned out to be a new single line spectroscopic binary, although contemporaneous observations of Hube & Gulliver were combined with 33 of ours to obtain vastly improved elements for the system, especially with respect to it's mass function. The study of HR 3040, which may show variable radial velocity, and that of others would however be presented elsewhere after analysing sufficient data. 41 Sex A (A3Vm), a known single line spectroscopic binary with orbit, has been observed (70 spectra) and a combined solution is presented to confirm its orbital elements. Their orbital scenario suggests that these are detached systems on the main sequence, the former being more evolved than the later (Sreedhar Rao & Abhyankar 1992, MNRAS, 258, 819).

© Astronomical Society of India • Provided by the NASA Astrophysics Data System

1993BASI...21..375R

3. MK morphology

The pseudo-luminosity effects exhibited by the spectra of Am stars is an astrophysical enigma. Our new morphological classification of a random sample of 28 Am stars unfolds many a phenomenon hitherto unknown in Am stars as shown below (Sreedhar Rao & Abhyankar 1991, JAA, 12, 133) :

(i) The weak Ca II K feature corresponds to a dwarf in almost all the stars of our sample.

(ii) The 'm 43' (λλ 4260-4400 Å) corresponds to an F type supergiant or a dwarf. λ 4315 Å and λλ 4383-86 Å features are also found to be luminosity class discriminants besides those in the G-band area.

(iii) The 'm 39' (λλ 3850-4100 Å) corresponds to an F giant or even a supergiant.

(iv) The Sr II λ 4077 Å feature corresponds to a higher luminosity class than the rest of the spectrum in two-thirds of our sample. The magnitude of this difference apparently determines whether the spectral lines vary.

(v) The weak-line Am stars do not exhibit the pseudo-luminosity effects and their spectra almost conform to those in the boxes of MK system. They comprise about 20% in our sample and some of these might have been wrongly classified. Also some of these could be Am-δ Del transition class stars placed between weak Am and δ Del stars with δ Scuti type pulsation.

(vi) Am-shell features are identified in some of the spectra which resemble those in the extreme A-shell spectrum of the MK standard HD 41511, illustrated in the 1978 MAT Atlas. Especially, the entire metallic line spectrum of HD 76756 resembles that of HD 41511 (JD 244 7131.38) except for Sr II λ 4077 Å feature.

4. Spectrum variability

HD 93903, 41 Sex A (A3 Vm), is found to exhibit phase modulated spectrum line variation. It's spectral morphology shows that the metallic line spectrum resembles a normal A type at one phase and at another, it resembles an Am with greatly enhanced Sr II λ 4077 Å line. It shows moderate Ap characteristics in exhibiting probable abundance patches formatted by the surface magnetic field geometry. An estimated field of 2 kG in the hot Am star o Peg (Mathys & Lanz, 1990, A&A, 230, L21) support our observations. We conclude that it is the first observed transition object between the Ap and Am stars which are known to be mutually exclusive with respect to their magnetic fields and surface abundance anomalies (Sreedhar Rao, Abhyankar & Nagar 1990, ApJ, 365, 336).

5. Future work

It is necessary to observe more Am stars, binary (only 77 orbits are known) as well as single stars, to improve our classification resolution, to study the signature of the circumstellar envelopes and their contribution, if present, to the observed anomalies and to verify the spectrum line variability for a better understanding of Am phenomena and the evolution of these enigmatic stars.

© Astronomical Society of India • Provided by the NASA Astrophysics Data System