Searching for Line Profile Variability in HgMn Stars

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**Abstract.** Spectra of four non-magnetic chemically peculiar late B type stars (HgMn) stars are analysed to detect periodic spectral line variations (LPVs). A procedure developed to study LPVs in Slowly Pulsating B stars has been adopted as pulsational properties of HgMn stars should be expected to be similar. In the preliminary results discussed here no conclusive evidence for periodic LPVs was uncovered. A more sensitive re-analysis of the data is under way.

**Keywords:** sample, BibrX

1. Motivation

HgMn stars are chemically peculiar stars for which periodic variability has not been found as of yet. Searches for variability have been made mostly photometrically though some studies of spectral variability have also been attempted.

Historically, several HgMn stars have been claimed to be variable but variability as yet to be confirmed in any of them (Adelman, 1998). A large number of HgMn stars were observed as part of the Hipparcos mission but no periodic variability was detected. The maximum permitted amplitude can in many cases be expected to be at most a few mmag. Recently, some spectral variability was claimed in α Andromedae which were interpreted as possible surface chemical inhomogeneities (Adelman et al., 2002). The authors argued that such variability would be the exception rather than the rule in HgMn stars.

The pursuit of elusive evidence of variability, both spectroscopically and photometrically, is motivated by several unresolved questions:

- pulsations is expected theoretically from current models, in other words confirmation of stability or the discovery of low amplitude...
Figure 1. $\log g$-$T_{\text{eff}}$ diagram showing the program stars and the theoretical limit of the SPB instability region (Pamyatnykh, 1999) along with a sample of other HgMn stars (Smith, 1993).

pulsations can provide constraints on physical processes not accounted for in the models (see Turcotte & Richard in these proceedings);

- rotational variability would provide evidence of surface inhomogeneities related to diffusion, mass loss and/or magnetism in the atmosphere of B stars;

- confirm or infirm that all HgMn stars are part of binary or multiple systems which could help answer the question as to how B stars can be slowly rotating in the absence of binarity or magnetism.

In this short paper we present preliminary results of the search of line profile variability in a substantial series of echelle spectra of four bright HgMn stars of the southern hemisphere. These observations represent an unprecedented effort to study spectroscopic variability in HgMn stars and are expected to help put stronger constraints on pulsations in these stars.

2. The Program Stars

The four program stars were the brightest southern HgMn stars visible during the periods of observation (see next section). Three of the four are within the theoretical instability region for SPB stars (HD 11753 being right on the cool edge), the fourth (HD 53244) being slightly too evolved (Figure 1).

The spectra were taken over two campaigns of several days, from September 28th to October 11th and from December 2nd to December
Table I. Summary of observations of the program stars

| HD   | name    | V     | # nights | # spectra | exposures (s) |
|------|---------|-------|----------|-----------|---------------|
| 11753 | φ Phe   | 5.11  | 26       | 105       | 600 to 1750   |
| 27376 | 41 Eri  | 3.55  | 11       | 28        | 160 to 800    |
| 53244 | γ CMa   | 4.10  | 20       | 74        | 230 to 800    |
| 221507 | β Scl  | 4.37  | 26       | 108       | 7 to 1200     |

Figure 2. The SiII doublet for the set of spectra for HD221507 used in searching for LPVs.

15th 2000, with the CORALIE spectrograph at the 1.2 m telescope at La Silla. The observations are summarized in Table I.

Due to space constraints we henceforth discuss only the star for which the better results were obtained at this point in the analysis, HD221507. The spectra selected for this star after bad data was removed are shown in Figure 2.

3. Preliminary Results

We focused on the SiII doublet at λ4128.053 and λ4130.884 Å for which the first moment was calculated, a procedure developed to study SPB stars (DeCat, 2001). The variability was studied using the PDM method. The models of HgMn stars suggest that they should pulsate in a similar way to SPB stars, if at all.

Four phase plots are shown in Figure 3. The periods shown, 0.31, 0.44, 0.78, 1.38 d were the ones which would reproduce the best approximation to a sine wave. The periods are in the range expected for SPBs. The scatter is evidently quite large in all cases and the variability, although somewhat suggestive, is far from clear.
Figure 3. Phase plots for the four best periods, 0.31, 0.44, 0.78, 1.38 d clockwise starting from the upper left, for HD221507 with a sine wave eye fitted for amplitude and phase.

The data analysis used to obtain the preceding results was not refined and we expect that significantly improved sensitivity will be achieved with forthcoming work on these data.

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