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PHOTOSPHERIC ACTIVITY AMONG EARLY F–TYPE STARS

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INTRODUCTION

In the last decade stars showing variability of unclear origin have been detected among early F–type stars mainly as secondary results in the context of observational programmes devoted to the study of δ–Scuti and CP stars.

For this reason only a small number of these objects has been thoroughly studied: their positions in HR diagram is shown in fig.1.

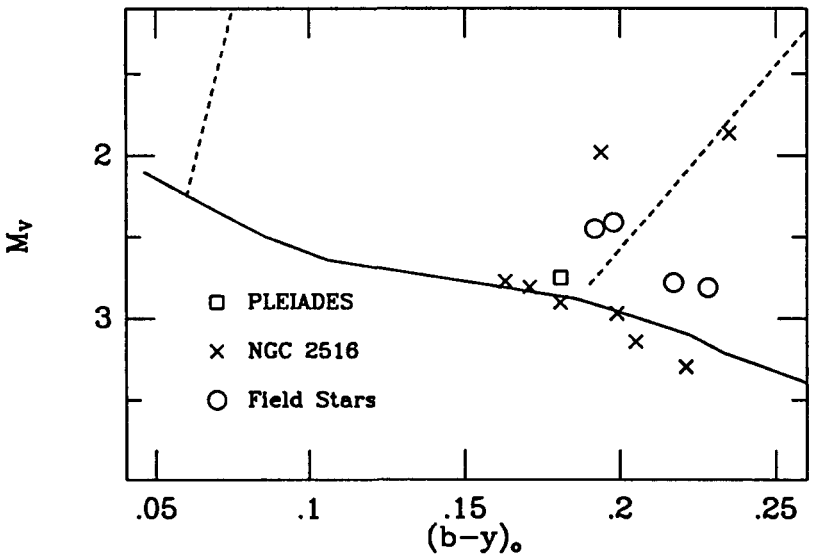

FIGURE 1: HR diagram of the observed stars.

The stars in NGC 2516 have been singled out in a survey work by Antonello and Mantegazza (1986), HD 164615 has been studied by Abt *et al.*(1983), the variability in 9 Aur has been discovered by Krisciunas *et al.*(1990,1991) and HD 23375 in Pleiades has been pointed out by Breger (1972). The solid line in Fig.1 is the ZAMS and the dashed lines are the borders of the δ–Scuti stars instability strip.

We recently discovered two objects of this type, HD 224638 and HD 224945,

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in our δ–Scuti stars observing programme, and we exploited the opportunity to investigate their behaviour (Mantegazza and Poretti 1991).

PHOTOMETRIC BEHAVIOUR

In September–October 1991 we made differential photometry of the two stars with respect to HD 225086 in the Johnson's B filter at La Silla Observatory (ESO). We collected 1000 and 985 measurements for HD 224638 and HD 224945 respectively during 20 non–consecutive nights.

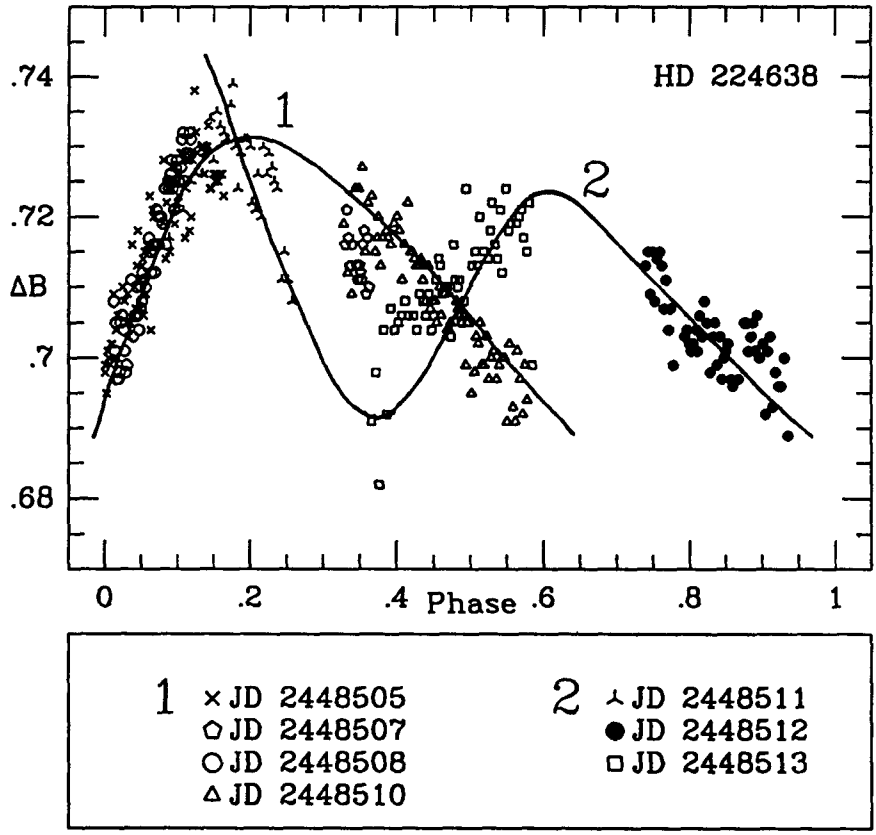

FIGURE 2: HD 224638. Phased light curve. P=1.47 d

The light curves show variations of 0.10 and 0.08 mag respectively with apparent time–scales of a few days. These values are comparable with those of the other stars in fig.1. For both stars the mean magnitude remains constant during the whole observing run.

Least squares spectra computed for both stars exhibit a complex structure confined at frequencies below 4 c/d.

Unfortunately the analysis by means of different techniques (Least squares,

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PDM and autocorrelation functions) doesn't supply reliable periods. This happens because the light curves do not repeat exactly after few cycles.

As shown in fig.2 for a few nights the light curve of HD 224638 is well phased with a 1.47 d period but suddendly a phase shift of about 0.2 p occurs at JD 2448511.

HD 164615 (Abt *et al.*1983) shows a similar, even if perhaps more regular behaviour, but this may be due to the poor sampling (159 measurements scattered over 362 nights) rather than to physical reasons.

The simplest way to explain this behaviour is to ascribe it to spots carried across the visible disk by rotation. Moreover all the available observational data regarding all the objects of our sample do not seem to support alternative models.

MODELS AND CONCLUSIONS

Rotational spotted structure is related to convection through dynamo theory. Therefore spots are expected to be present since the onset of convection at F0 (Simon 1987). Observational evidence of spots is anyway available for stars cooler than F7 only (Radick 1982;1983a;1983b)

In spite of an intense chromospheric activity revealed by their spectroscopy, the absence of spots in stars between F0 and F7 has stimulated the developement of other non–radiative models (Wolff 1987; Giampapa and Rosner 1984).

A complicated spotted structure with short lifetimes, such as that suggested by the observations discussed here, is expected in a dynamo behaviour for early F–type stars, since they possess thin convection layers (Giampapa and Rosner 1984).

Further investigations of the variability among early F–type stars could therefore resume the dynamo theory even for stars with spectral types between F0 and F7.

REFERENCES

Abt, H.A., Bollinger, G. and Burke, E.W.,jr., 1983, *Ap.J*, **272**, 196

Antonello, E. and Mantegazza, L., 1986,*A & A*, **164**, 40

Breger, M., 1972, *Ap.J*, **176**, 367

Giampapa, M.S. and Rosner R., 1984, *Ap.J*, **286**, L19

Krisciunas, K. and Guinan, E., 1990, Inf. Bull. Var. Stars n.3511

Krisciunas, K. *et al.*, 1991, Inf. Bull. Var. Stars, **3672**

Mantegazza, L. and Poretti, E., 1991, Inf. Bull. Var. Stars n.3690

Radick, R.R., *et al.*, 1982, *P.A.S.P.*, **94**, 934

Radick, R.R., *et al.*, 1983a, *P.A.S.P.*, **95**, 300

Radick, R.R., *et al.*, 1983b, *P.A.S.P.*, **95**, 631

Simon, T.,1987, in *Lectures Notes in Physics*, **291**, 265

Wolff, S.C., 1987, in *Lectures Notes in Physics*, **291**, 223

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