COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5589

Konkoly Observatory
Budapest
7 January 2005

HU ISSN 0374 – 0676

δ SCUTI LIKE PULSATION OF H254 USING ROTSE3D CCD OBSERVATIONS

KIZILOĞLU, Ü.[1]; KIZILOĞLU, N.[1,2]; BAYKAL, A.[1,3]

[1] Physics Dept., Middle East Technical University, Ankara 06531, Turkey, e-mail: umk@astroa.physics.metu.edu.tr

[2] e-mail: nil@astroa.physics.metu.edu.tr

[3] e-mail: altan@astroa.physics.metu.edu.tr

H254 is a pre-main sequence F0 spectral type star with T_{eff}= 7200 K and L_{bol}=31.4 $L_{\odot}$ (Luhman et al. 1998) in the young cluster IC 348. Ripepi et al. (2002) identified four frequencies for this source by using their eleven days observations. One of these frequencies was at 7.406 d^{-1} which is typical of δ Scuti type pulsators. They reported that the other three frequencies result from the long term behavior associated with a daily variation of H254 and partially with the similar variability in the comparison star H20.

We attempted to detect the light variations of H254 in our 95 days of observation span obtained with ROTSE3d telescope located at Bakırlıtepe, Turkey. ROTSE3 systems were described in detail in Akerlof et al. (2003). It operates without filters and has a wide passband which peaks at 550 nm. It is equipped with a CCD, 2048×2048 pixel, the pixel scale is 3.3 arcsec per pixel for a total field of view $1\overset{\circ}{.}85\times1\overset{\circ}{.}85$.

The observations were obtained between the nights MJD 53232 (August) and MJD 53327 (November). We were able to obtain 3 to 40 frames for IC 348 at each night, because of the other scheduled observations. The exposure time was 5 seconds. A total of about 1600 CCD frames were analysed. Aperture photometry by SExtractor (Bertin&Arnouts, 1996) were applied to the observed CCD frames to obtain the instrumental magnitudes. Then, ROTSE magnitudes were calculated by comparing all the field stars to the USNO A2.0 R-band catalog. All the processes were done in sequential automated mode. Barycentric corrections were made to the times of each observation by using JPL DE200 ephemerides. As a comparison star we chose H261 which is at a distance of $4'$from H254. Its spectral type (F2) is not too different from the spectral type of H254.

Fig.1 shows ROTSE3d light curve (δm_{ROTSE}= $m_{ROTSE}{}^{254}$- $m_{ROTSE}{}^{261}$) obtained from CCD observations.

A Fourier analysis of data led to the detection of a signal for a frequency 7.406 d^{-1}. We used a period search programme written by M. Sperl (Period98: available at `www.astro.univie.ac.at/~dsn/`). Fig.2 (upper panel) shows the power spectrum of H254 which displays the frequency 7.406 d^{-1} with one day alias pattern. When this frequency is removed from the spectrum no other significant frequency is seen.

We also employed the method of Scargle (Scargle, 1982) for period search in order to evaluate the confidence levels of oscillations (see Fig.2 lower panel). We estimated the

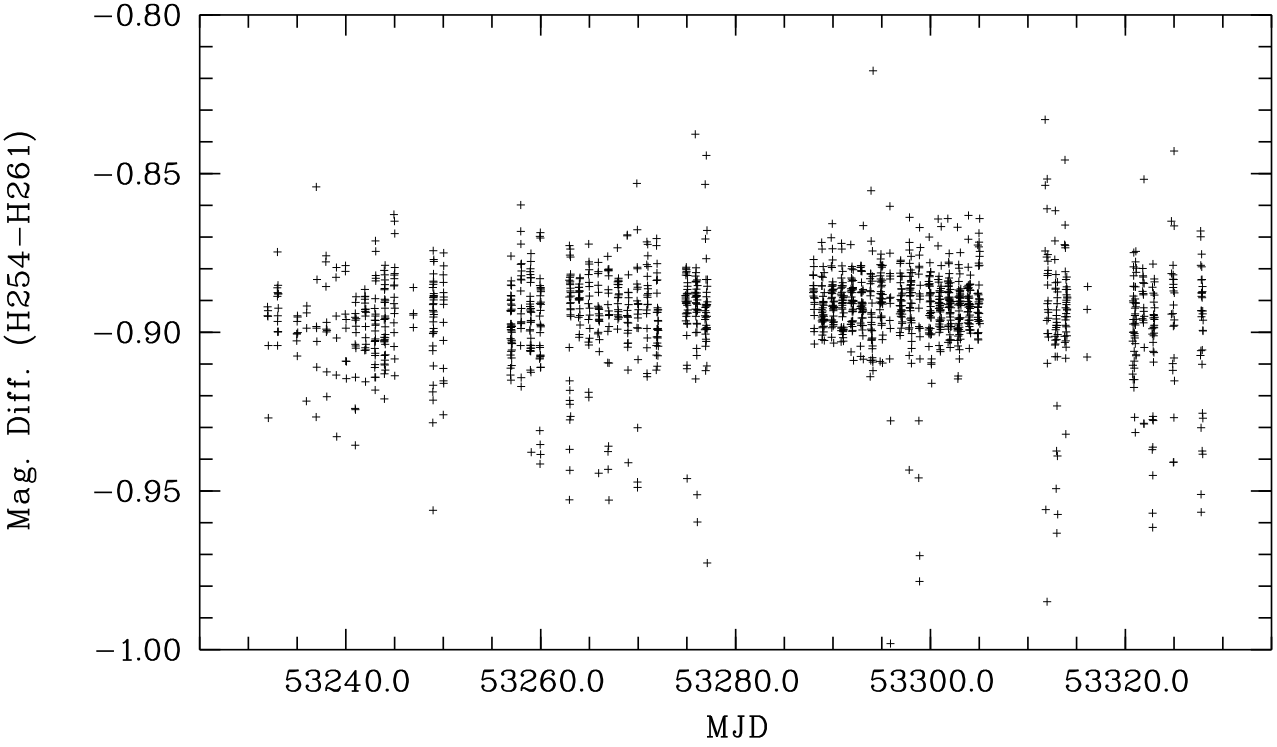

Figure 1. ROTSE3d light curve

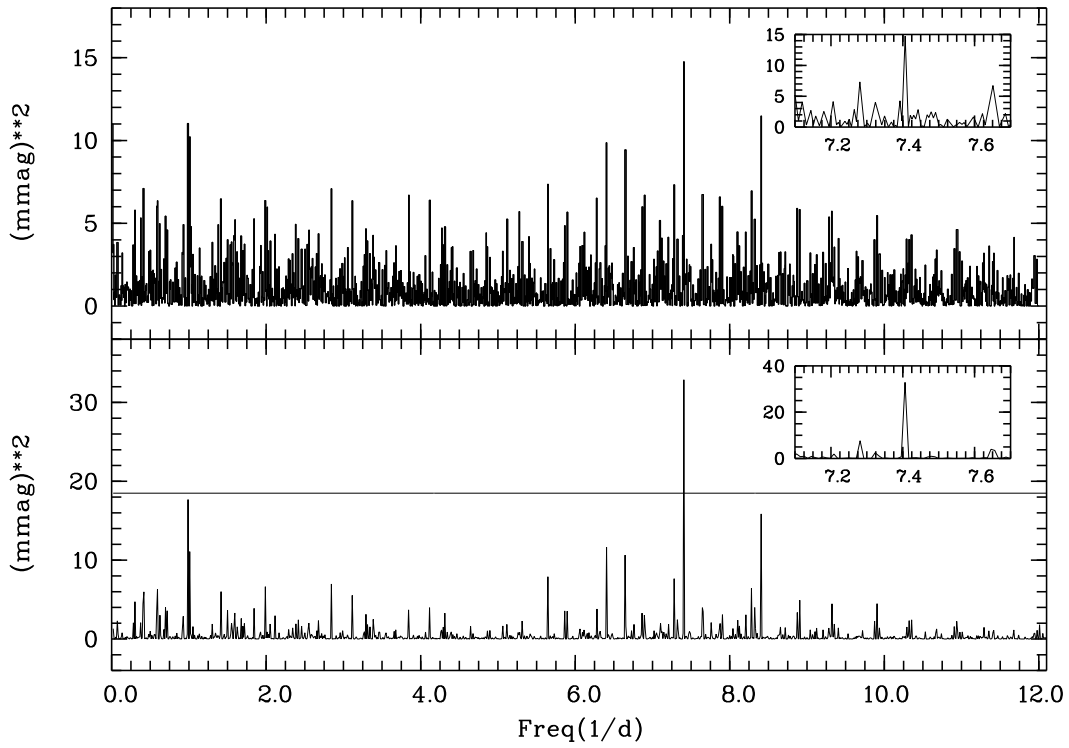

Figure 2. Power spectra for H254 (upper panel: Period98, lower panel: Scargle algorithm, MJD = JD − 2400000.5). Solid line represents 2σ confidence level.

noise level of periodogram by fitting a constant line. The probability of a signal above this level has an exponential probability distribution which is essentially a χ^2 distribution for two degrees of freedom (Scargle 1982). For given parameters, the confidence level of the signal for the maximum power at 7.406 d^{-1} is ~ 0.997. This confidence level is close to the $\sim 5\sigma$ level signal detection. As seen from Fig.2 all other detected powers are below the 2σ detection level which indicate that 0.157, 0.283 and 0.931 d^{-1} frequencies detected by Ripepi et al. (2002) are not present in our light curve.

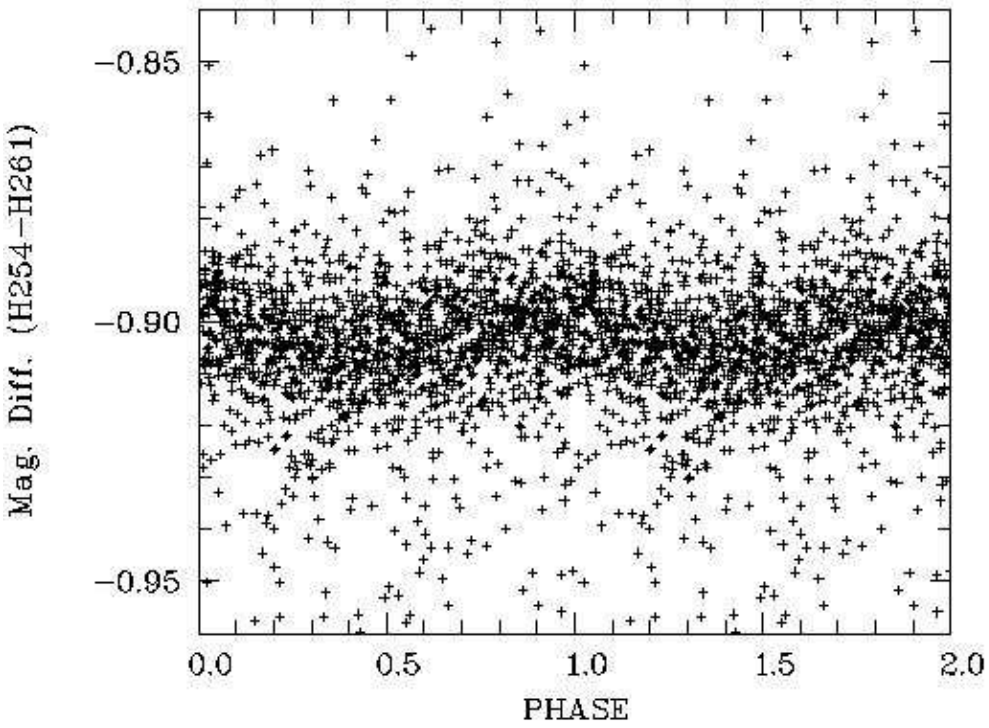

Figure 3. Light curve phased with the frequency 7.406 d^{-1}

Fig.3 shows the light curve phased with the frequency 7.406 d^{-1}.

As a conclusion, ROTSE3d data allowed us to identify the frequency 7.406 d^{-1}. No other significant frequency was detected.

Acknowledgements:

This study was supported by TUG (Turkish National Observatory), TUBITAK (Turkish Scientific and Research Councile).

References:

Akerlof, C.W., Kehoe, R.L., McKay, T.A., Rykoff, E.S., Smith, D.A., et al., 2003, *PASP*, **115**, 132

Bertin, E., Arnauts, S., 1996, *A&AS*, **117**, 393

Luhman, K.L., Rieke, G.H., Lada, C.J., Lada, E.A., 1998, *ApJ*, **508**, 347

Ripepi, V., Palla, F., Marconi, M., Bernabei, S., Arellano Ferro, A., Terranegra, L., Alcalá, J. M., 2002, *A&A*, **391**, 587

Scargle, J.D., 1982, *ApJ*, **263**, 835