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V368 Cep - A POST T Tau SPOTTED SINGLE STAR

The star HD 220140 = SAO 10697 has been identified with an X-ray source by Pravdo, White and Giommi (1985). Joy and Wilson (1949) assigned to it the dKO spectral type and noticed strong CaII H and K emission lines in its spectrum. Moore and Paddock (1950) estimated its spectral type as G9V. Poretti, Mante-gazza and Antonello (1985) have found light variations of HD 220140 with the amplitude of 0.04^m and the period of 0.5767^d and classified it as a spotted star. However the photometric period of 2.75^d of this star is reported by Heckert et al. (1990). In the 69-th name list of variable stars Kholopov et al. (1989) have given to this star the designation V368 Cep.

We observed V368 Cep photometrically in October 1990 - March 1991 with the UBVRi photoelectric photometer attached to the 125-cm telescope. Spectroscopic observations were done in November-December 1990 with the coude spectrograph of the 2.6-m telescope which operates with a CCD-device. The following wave-length intervals were covered: 5873-5903 Å, 6546-6576 Å, and 6700-6730 Å. Here we report characteristics of the evolutionary status of the star, namely period and velocity of rotation, space velocity vector and lithium content.

The period 0.5767^d does not fit our photometric observations but the period 2.75^d fits them rather well. However a better representation of them is also obtained with the "satellite" period of $1/(1/2.75 - 1) = -1.571428^d$. The spectra we have obtained yield the projected velocity of rotation $v \sin i = 25$ km/s. Using the relation $R \gg v \sin i P/2\pi$ in which periods of rotation are $P=2.75^d$ or $P=1.57^d$ we have derived lower limits of the star radius $R \gg 1.36 R_{\odot}$ or $R \gg 0.78 R_{\odot}$. The latter value corresponds to the normal main-sequence K0 star but the former one is about twice larger. According to our computations HD 220140 is at a distance of 21 pc or 42 pc if its luminosity corresponds to the spectral type G9V or the luminosity is 4 times larger (i.e. the radius is 2 times larger). Pravdo, White and Giommi (1985) have concluded that HD 220140 is at a distance of 30 pc if it is a main-sequence dwarf but their X-ray observations indicate that the interstellar absorption in the direction of this star is 10^{20}H cm^{-2} which gives a distance of ~ 70 pc. Probably there are differences in values of the luminosity and apparent brightness adopted by Pravdo, White and Giommi and us which result in different distances. However both investigations indicate independently that the luminosity of HD 220140 may be larger as compared with the luminosity of a main sequence star.

The most probable value of the radial velocity is -15.6 km/s although several lines (HI, FeI, NaI) give values differing from it by -2 km/s to -4 km/s. The radial velocity of -15.6 km/s differs only slightly from the published radial velocity of -15.1 ± 1.3 km/s according to MtWilson observations (Abt, Biggs 1972) but according to the Lick Observatory the radial velocity is -19 ± 0.9 km/s (Moore, Paddock 1950). We note also the absence of night-to-night radial velocity variations demonstrated by our as well as published observations. Thus it seems highly likely that HD 220140=V368 Cep is a single star. Using values of radial velocity -15 km/s, components of proper motion (published in the SAO Catalogue) $\mu_{\alpha}=0.0731^{\text{S}}$, $\mu_{\delta}=0.087^{\text{S}}$ and distance of 30 pc we obtain the following components of the space velocity vector (km/s) $U=-22$, $V=-28$, $W=-4$. This space motion is quite similar to that of the Pleiades Group for which according to Eggen (1975) $U=-11 \pm 9$, $V=-25$, $W=-8 \pm 8$.

Our spectroscopic observations of HD 220140 show that the LiI 6707 line is stronger than the CaI 6717 line. Using the equivalent width of the LiI 6707 line $W_{\lambda}=0.288 \text{ \AA}$ and curves of growth given by Duncan (1981) we have estimated the Li abundance $\log N(\text{Li})=3.0 \pm 0.1$ which is quite near to the primordial value $\log N(\text{Li})=3.3 \pm 0.1$ (Duncan 1981).

We believe that V368 Cep belongs to the group of single spotted stars with the ages not exceeding $5 \cdot 10^7$ y. Properties of about 20 solar vicinity stars constituting this group have been discussed by Chugainov (1991). Spatial motions of these stars are similar to those of Pleiades group, Tau-Aur and Sco-Cen associations. High lithium abundances were found in several stars of this group. The evolutionary status of these stars is that they probably are in the post-T Tau stage and show the fast axial rotation which is believed to be the spinning-up phase of a short duration. The member of this group LQ Hya and V368 Cep are very similar by their spectral types, photometric periods and high lithium abundances (see Fekel et al. 1986).

P.F.CHUGAINOV, M.N.LOVKAYA, P.P.PETROV
Crimean Astrophysical Observatory, U.S.S.R. Academy of Sciences

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