Flares Detected on Some Late Giants: Are They Real?

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1 Introduction

Recently, some apparently single red giants with evidence of chromospheric activity were reported. In this work we observed those single late giants with reported flares, referenced by Pettersen (1989) and Schaefer (1989), as part of a program for investigation of the chromospheric activity in G and K giants.

According to Simon & Drake (1989), active single G and K giants may be first crossing stars that have just entered the phase of rapid spin-up as their convection zones advance upon their more rapidly rotation radiative cores. These stars are situated on the base of the red giant branch on the HR diagram. As a result they may possess dynamo driven activity at this stage of evolution.

2 Observations and Results

The aim of our research is to investigate suspected chromospherically active late giants and especially those with reported flares, using some typical indicators, accessible with our equipment, i.e. Ca II K+H, Hα and flares (Ulmschneider 1979).

For this purpose, spectroscopy and photometry were carried out for ν Oph (G9 III), τ CrB (K0 III) and V654 Her (K2 III). The 2 m telescope at the National Astronomical Observatory at Rozhen, equipped with a Coude spectrograph and CCD detector was used along with two 60 cm telescopes equipped with single-channel photon-counting photometers and a U-filter. The integration time was 1 sec.

High-resolution spectra were obtained for each star on more than one night with S/N>100 at Hα and S/N>50 at Ca II K+H. No evidence of chromospheric activity, such as emission cores in Ca II K+H were observed (Fig. 1). Hα was in absorption and seems not to be filled-in (Fig. 2). Hα spectra of OP And, an apparently single, chromospherically active K1 giant, were obtained with the same equipment. Its Hα absorption is partially filled-in and, according to Strassmeier et al. (1990), it also exhibits strong Ca II K+H emission.

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V654 Her is too faint for us to obtain a spectrum in Ca II K+H, so we used those presented in Tsvetkov & Pettersen (1985). Their low-dispersion spectrum shows no emission cores.

$17^h52^m34^s$ total monitoring time was obtained for V654 Her and $13^h53^m44^s$ for τ CrB. No flares were detected. ν Oph was too bright to be observed with our photometric equipment.

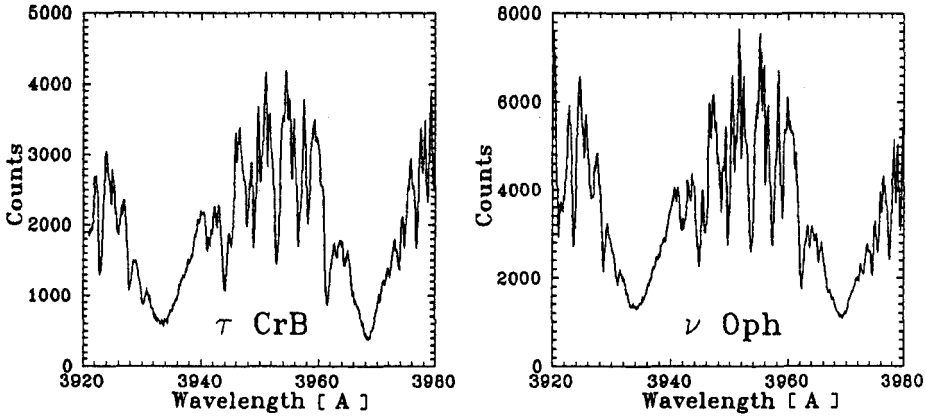

Fig. 1. Spectra of ν Oph and τ CrB in the region of Ca II K+H.

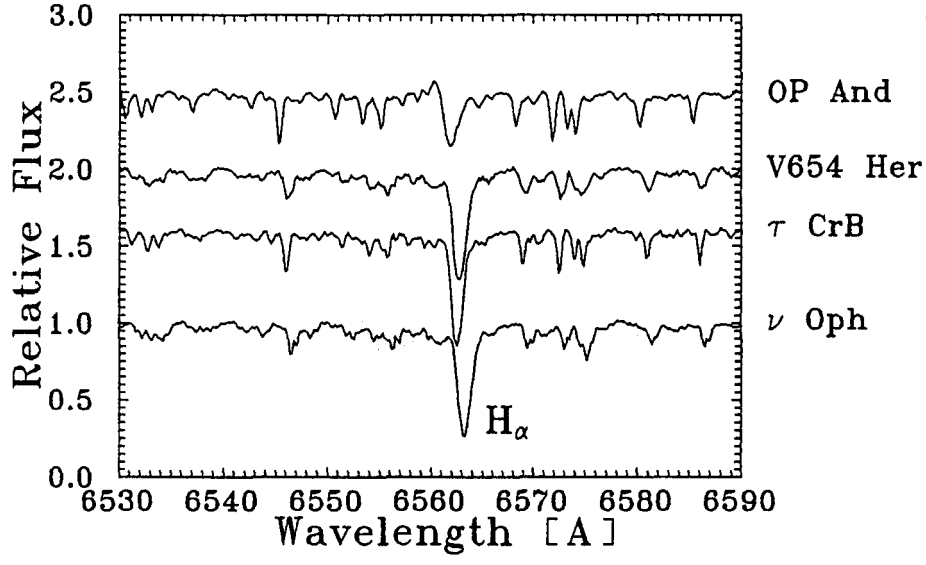

Fig. 2. Hα spectra of the stars investigated. OP And is also presented for comparison.

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3 Discussion

Our work revealed a lack of typical chromospheric activity indicators in all three stars. In Fig. 3 we show a HR diagram derived using the evolutionary tracks of Schaller et al. (1992) for solar abundance and M_{bol} and T_{eff} from Allen (1973).

M_V and $B - V$ for ν Oph and τ CrB were taken from Wilson (1976). The M_V of τ CrB differs significantly from other K0 giants and so we took its M_V, obtained from DDO photometry by Brown et al. (1989). For V654 Her we used $B - V$ value obtained by us (a mean value from 8 nights of observation at the Belogradchik Observatory) and M_V was derived using standard models from Allen (1973). The stars are situated high above the base of the giant branch and thus are inconsistent with Simon & Drake's (1989) hypothesis.

These stars seem to be normal giants and cannot be considered as chromospherically active. The nature of the events reported in Pettersen and Schaefer and presented in Table 1 remains a puzzle. We point out that the so-called flares were detected only once, and no other have been observed since.

If we analyze the reported flares we come to the following conclusions:

1. The event, detected on τ CrB visually, may have been due to a satellite glint, meteor or other sky effect.
2. The same might be possible in a lesser degree for the flare on ν Oph.
3. The nature of the so-called flare, detected photometrically on V654 Her, is unclear. We consider the star as chromospherically inactive. But we don't know artificial causes which might simulate a flare. Since the event seems not to be due to chromospheric activity, its nature remains unknown.

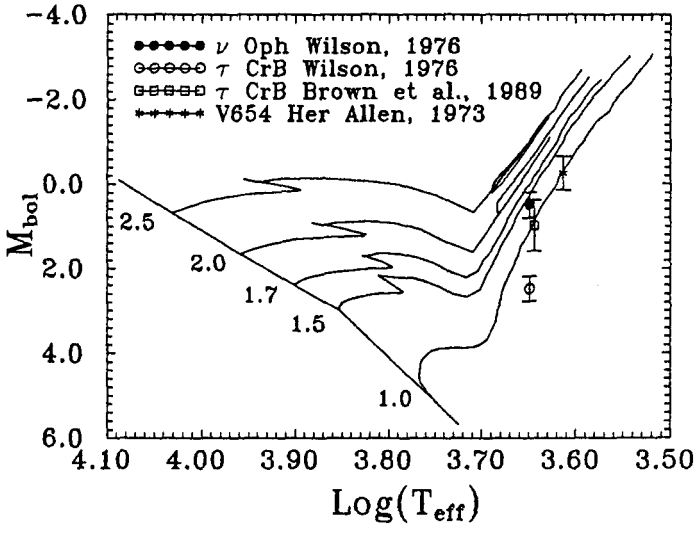

Fig. 3. Positions of the investigated stars in the HR diagram.

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Table 1. The table is taken from Schaefer (1989), where: Δm is the amplitude of the event; t is the minimum e-folding rise or fall time; D is the total event duration; N is the number of independent measurements which confirm the existence of an anomaly; and q is the angular resolution of the detector.

Star	Sp. Type	m_V	Δm	t(sec)	D(sec)	N	q(")	Detector
ν Oph	G9 III	3.3	7	10	>80	10	300	visual
τ CrB	K0 III	4.7	1.7	<0.25	0.5	1	300	visual
V654 Her	K2 III	10.0	0.15	140	300	50	10	photometer

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P.B. Byrne: The closest analogy to active giants are the RS CVn stars. There, optical flares are rare. So, is 14−18 hours monitoring sufficient to rule out optical flares?

R. Konstantinova-Antova: Of course, more observations are required, because the giants are more luminous than the dwarf flare stars. Also, we don't know whether the dynamo mechanism, suspected to operate on them is with a comparable efficiency as on the active dwarfs. But for the three giants I reported, there are no other evidences for chromospheric activity than the fact that they exhibited (in two of the cases under suspect) such flashes. In the light of our investigations (including spectral ones) I cannot say that they are due to chromospheric activity.