

THREE POTASSIUM-FLARE STARS

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Abstract. ()*

In May 1962 D. Barbier and one of us (Barbier, Morguleff, 1962) observed a potassium flare in a dwarf star of type G 6. Two years later, in January 1964, once more we observed in a dwarf of type K 7 (Barbier, Morguleff, 1964) the same phenomenon. Finally, in June 1965, it was observed again in a dwarf star classified B 9e (Andrillat, 1965).

This «flare» shows a very bright and elusive emission of the resonance doublet of potassium (7665 - 7699 Å) on the spectra obtained with the Coudé spectrograph of the 193 cm telescope in Haute-Provence Observatory. The dispersion used was 39 Å/mm on Eastman Kodak plates IN sensitized with ammonia.

Therefore, such an «eruption» affects three dwarf stars of widely different spectral type and two of them offer some particularities. H. W. Babcock (1958) suspects the existence of a magnetic field in HD 88 230 (K 7) showing a central emission in H and K lines of Ca II according to G. Haro (1954), A. H. Joy and R. E. Wilson (1949). As for 4 Her (B 9e) its spectrum, characterized by H α emission, undergoes sometimes perceptible modifications which have been seen at the end of 1964 by Mrs. R. Herman (private communication) specially in the blue-visible region of the spectrum.

As far as we know, we have heard of no particularity concerning HD 117 043 (G 6).

Fig. 1 shows the microphotometric tracings of HD 117 043 (G 6) in the region $\lambda\lambda 7550 - 7800$ Å. The first spectrum (a) reveals two bright, wide emission lines due to the resonance doublet of potassium (7665 - 7699 Å) which completely disappeared on the second plate (b) taken the following night. HD 88 230 (K 7) was observed two nights before the «flare» *fig. 2 (a)*. The spectrum which is normal is characterized by KI as absorption lines. The «flare» is extremely bright and quite visible in (b) in spite of overexposure. Two days later, the spectrum (c) became normal again and identical to (a). Ninety-four hours elapsed between the end of (a) and the beginning of (c): the phenomenon, therefore, lasted less than 94 hours. As for 4 Her (*fig. 3*) the first tracing is that of a normal B 9e showing the triplet of OI (7772 - 7774 - 7775 Å) as absorption feature. Three nights later, the strong emission lines of KI appeared (b). They disappeared on the following night (c). The maximum duration of the «eruption» was ninety-five hours.

The three stars have since been observed many times - but no more «flare» of potassium has been noticed.

(*) This research has been published in full in the *Ann. d'Astrophysique* 29, 17, 1966.

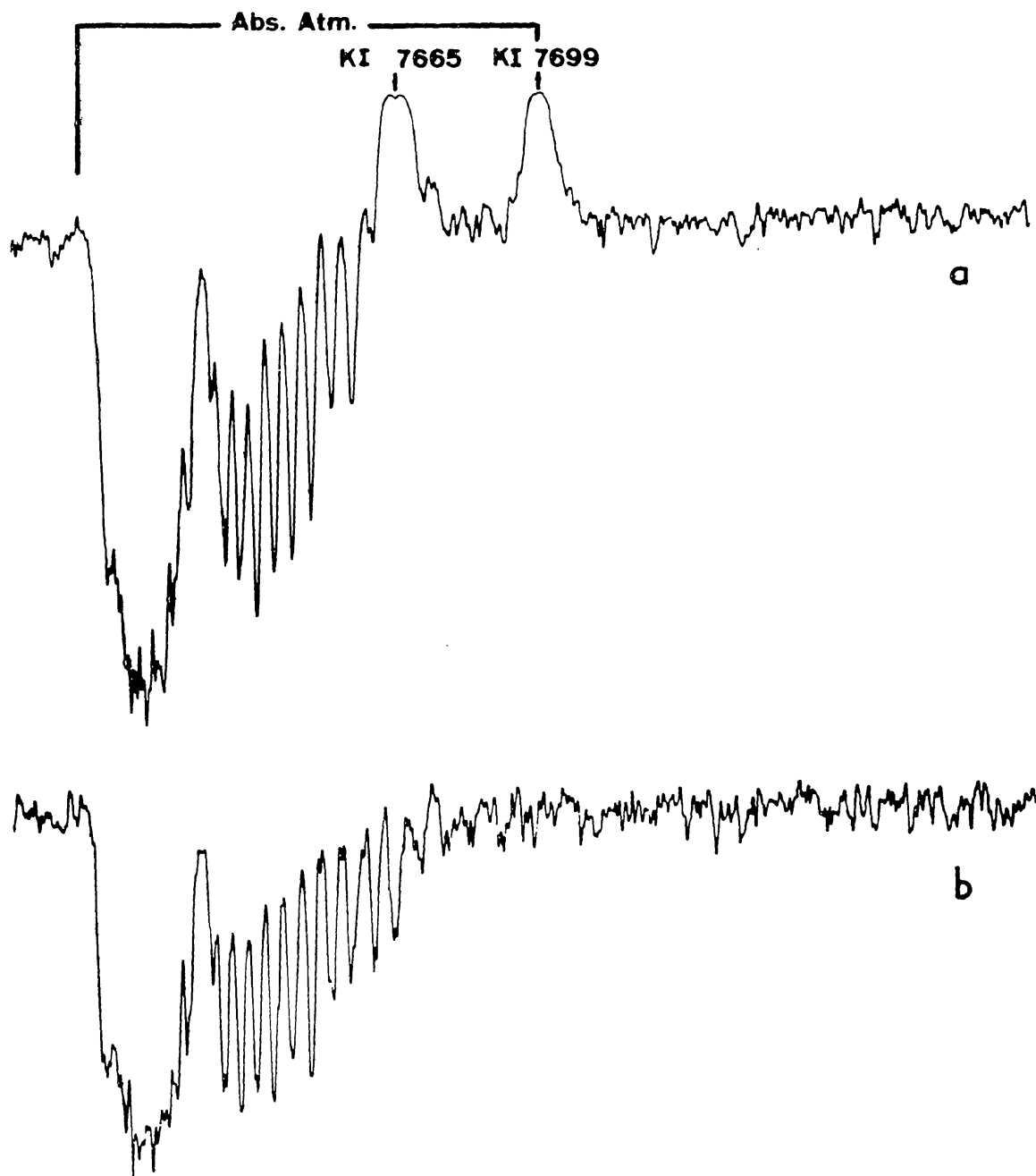


Fig. 1 — Microphotometric tracings of HD 117043 (d G 6) between 7550 and 7800 Å.
Spectra taken May 15 th (a) and May 16 th 1962 (b).

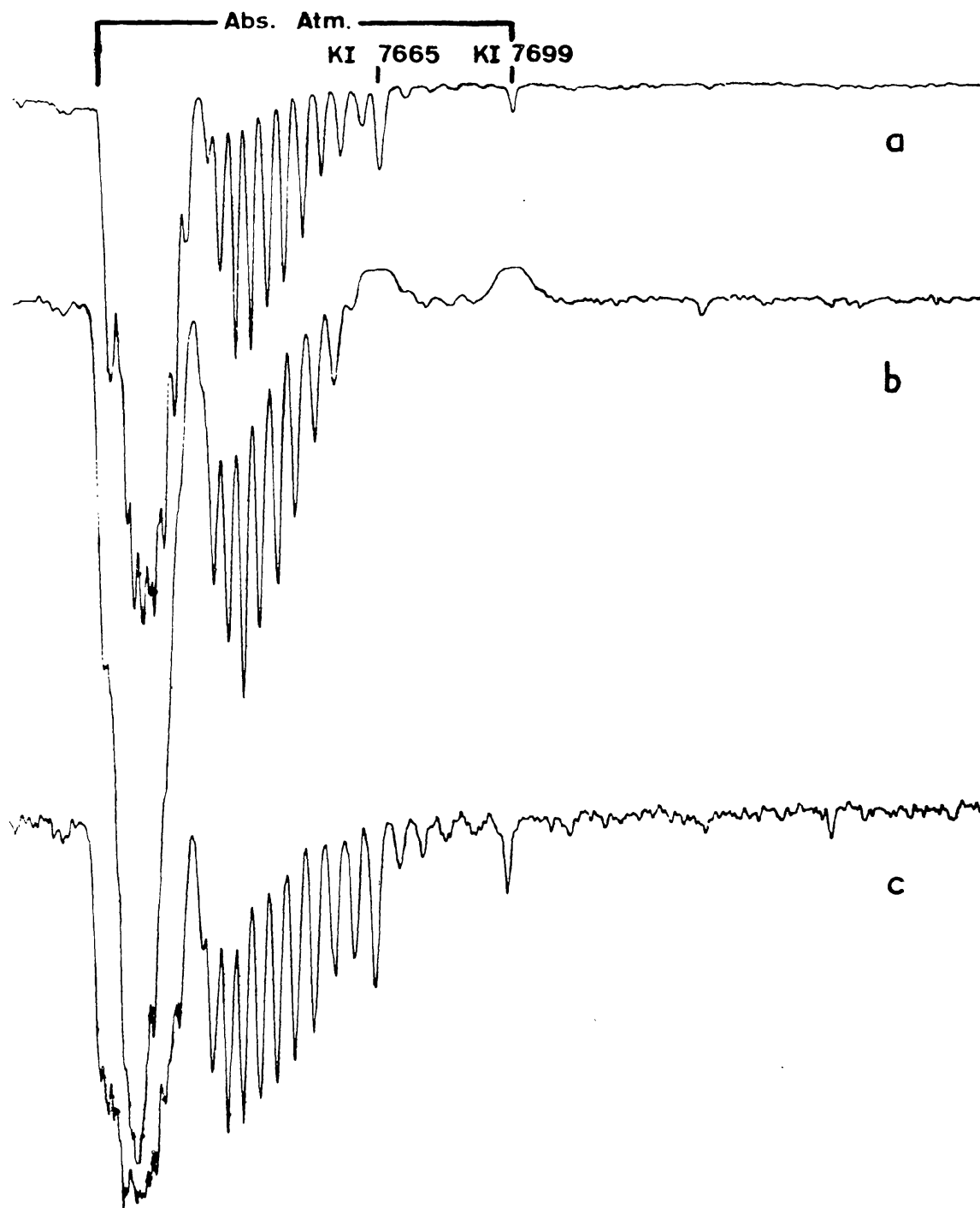


Fig. 2 — Microphotometric tracings of HD 88230 (K 7 V) between 7550 and 7800 Å. Spectra taken January 29th (a) 31st (b) and February 2nd 1964 (c).

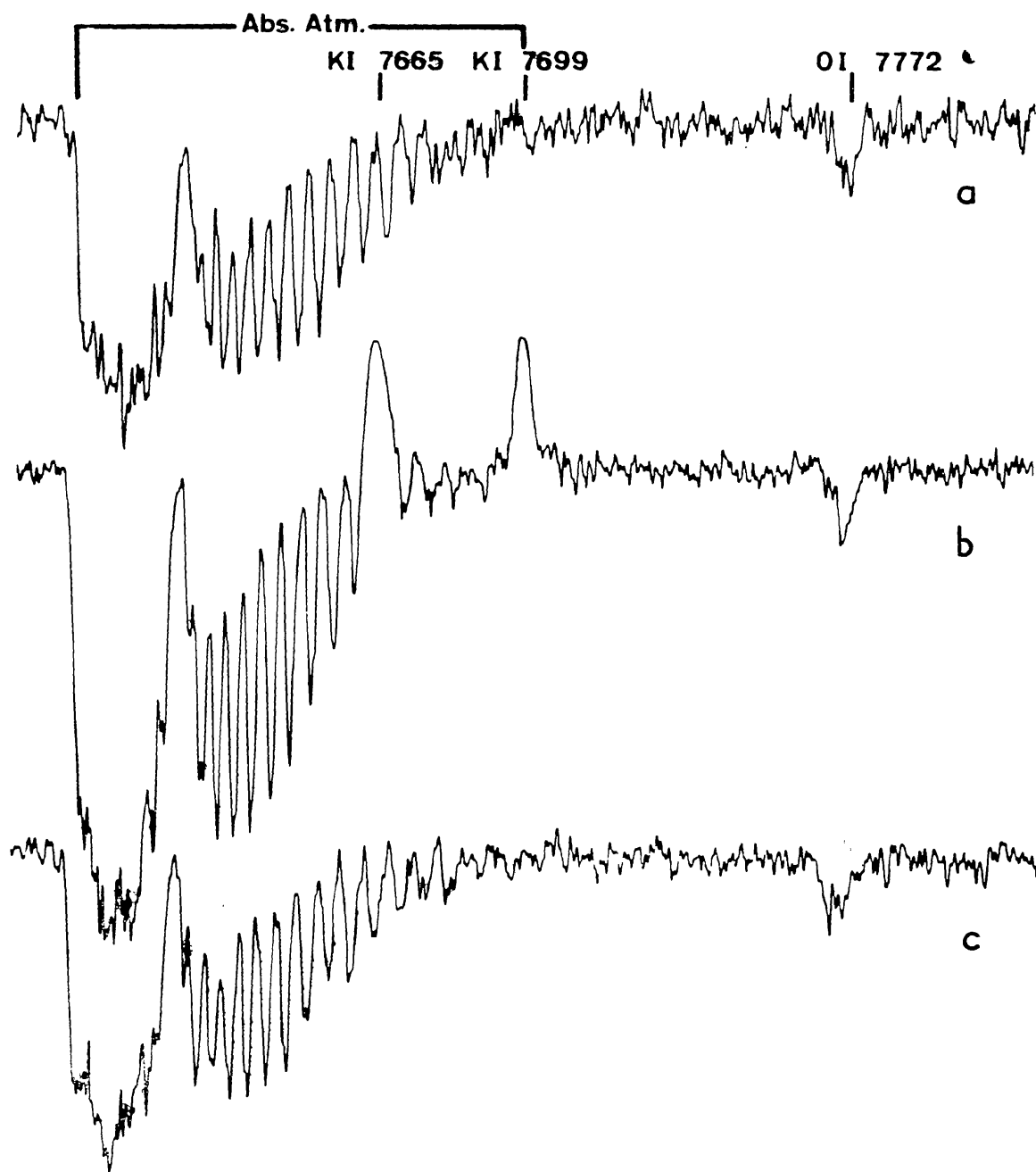


Fig. 3 — Microphotometric tracings of 4 Her (B9e) between 7550 and 7800 Å. Spectra taken June 18 th (a), 21 st (b) and 22 nd 1965 (c).

The telluric A band of O_2 ranging from $\lambda\lambda$ 7594 to 7704 Å perturbs the contours of KI lines chiefly for the component 7665 Å — and it proved impossible to derive the radial velocity. The wavelengths that we measured are different for the three stars — which seems to eliminate the hypothesis of an atmospheric origin, due either to a natural cause or to an artificial potassium cloud. This is corroborated by informations gathered from various offices; none of them mentions any experience being conducted on the corresponding dates.

Furthermore, if due to atmospheric reasons, the emission features would be sharp. On the contrary the ones observed are wide (*fig. 1, 2, 3*).

Perceptible differences appear in the equivalent width W , central intensity I_c , half-width l and base-width L (Andrillat, Morguleff, 1966). *Table I* gives a summary of the values for the component 7699 Å hardly perturbed by atmospheric band A.

TABLE I.

Star		7698,98			
		W	I_c	l	L
HD 88230	K 7 V	8,5	1,16	6,5	18,9
HD 117043	d G 6	9,6	1,83	4,3	18,5
4 Her	B 9 e	3,8	1,12	3,0	8,5

W , l , L expressed in Å.

Notice that W is clearly smaller for 4 Her than for HD 88230; in the latter the normal absorption of KI probably leads to underestimate W .

l and L seem to increase with the spectral type from B 9 to K 7.

Admitting the hypothesis of a layer in radial expansion, L gives a radial velocity of approximately 160 km/sec for 4 Her, 360 km/sec for HD 117043 and 370 km/sec for HD 88230.

It would be interesting to know the frequency of the «flares» of potassium and how long they last. A systematic research will start soon at Haute Provence Observatory by means of an objective-grating (dispersion 200 Å/mm) mounted on the Schmidt telescope.

However, since May 1965, pursuing the research initiated by D. Barbier we have been photographing continuously the solar spectrum in the region $\lambda\lambda$ 7400 - 8200 Å with a dispersion of 34 Å/mm. So far no trace of emission has been observed.

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DISCUSSION

VARDYA. Are there any plans to observe the potassium flare by photoelectric photometry, so that one can observe the development with time of the flare?

ANDRILLAT. We have no plans to observe the potassium flare by photoelectric photometry because we can observe only one star by this method and we do not know if a given star would show the potassium flare more than once.

KANDEL. I have two questions: 1) I wonder whether during the potassium flare you observed any peculiarities in the $H\alpha$ line.

2) Now of course it would be most interesting to see what happened to the Ca II H and K lines during the potassium flare, particularly in the case of the K dwarf HD 88230, which has fairly strong emission cores in those lines. I don't suppose you observed those at the same time. I wonder, however, if it would not be possible to observe the potassium resonance lines and the Ca II H and K lines simultaneously. Since you observe the spectra with a grating, could you not replace the VO2 filter (usually used to suppress the blue-uv region), with a small prism giving a dispersion perpendicular to the grating dispersion? This would yield two spectra side by side; on one side the region between, say, 3500-4500 Å, and containing Ca II H and K lines, on the other side the near IR region from 7000 to 9000 Å containing the K I resonance lines.

ANDRILLAT. 1) It seems that the $H\alpha$ line does not present any particularities during the potassium flare.

2) Surely, it is an interesting suggestion and perhaps we shall undertake some days this observation.

PAGEL. Have there been any solar flares since you began looking for potassium flares on the sun?

ANDRILLAT. No.

BUSCOMBE. Evidently they have not heard about the International Year of the Quiet Sun at Herstmonceux!

SWINGS. It would be interesting to observe the 2nd doublet of the principal series of K I. The ratio of the two — if the 2nd doublet exist — would give information on the excitation mechanism.

Note added in proof:

M. Peimbert, H. Spinrad and R. F. Wing (private communication, 31-10-1966) have found that the potassium resonance lines are very strong in the match spectrograms obtained when the match is held near the optical axis of the coudé spectrograph of the 120 inch telescope at Lick Observatory. We have also obtained match spectrograms with the coudé spectrograph of the 193 cm telescope at Haute Provence Observatory, but the emissions are only visible when the match is in a few, determined positions. Furthermore, one star was observed by an observer who never smokes but it is impossible to say that during all the exposure, nobody was smoking in the coudé room.