

ON THE H AND K EMISSION IN DWARF STARS*

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ABSTRACT

Spectrograms of five main-sequence stars with H and K emission failed to show variations of emission-line intensity over a 5-year period, with the exception of a single spectroscopic flare of one of the stars.

This investigation consists of a search for cyclic variations in the intensity of H and K emission lines in the spectra of main-sequence stars. If such emission lines were produced to an appreciable degree in regions of prominence-like activity at the surface of a star, variations of activity would cause variations in emission-line intensity. The activity would have to be on a considerably larger scale than at the surface of the sun for the emission lines to show in the spectrum of the star as a whole. The determination of such a basic quantity as the period of variation for a number of main-sequence stars could afford a valuable clue to the fundamental cause of solar activity. There is no observational evidence for variations in H and K emission other than the occasional stellar "flares" and the statement by Joy and Wilson (1949) that "the intensity of the emission is probably variable to a considerable extent in many stars."

The stars to be observed were chosen from the list of Joy and Wilson (1949) to satisfy the following criteria: Except for the emission lines, they should be apparently normal main-sequence stars, not members of spectroscopic binary systems or associated with known dark matter. The stars should be bright enough that the region of H and K is well exposed on spectrograms of 2 hours' or less exposure with the Cassegrain spectrographs of the 60- and 100-inch telescopes, dispersions about 50 Å/mm at H and K. The emission lines should be strong enough to be visible with this dispersion. The stars should be far enough north to be observable through most of the year but not so far north ($\delta > 64^\circ$) as to be out of reach of the 100-inch.

The observations were continued as opportunity offered for a period of about 5 years (1950–1954). The observing list is given in Table 1. With the exception of HD 115953, the spectral classifications are on the MK system, 61 Cyg A and B having been used as standards. The effort was made to keep the density of exposures as nearly equal as possible from plate to plate so that moderate changes in emission-line intensity could be detected by visual inspection, although photometric standards were impressed on each plate. In order to carry out visual comparisons carefully and conveniently, a simple comparison microscope was constructed.

As previously reported (Popper 1953) and shown in Figure 1, HD 234677 showed a spectroscopic "flare" on July 21, 1953. With this single exception, visual comparison of the spectrograms shows no definite intensity changes of H and K emission; i.e., the results of the investigation are essentially negative. Photometry of the spectrograms has not been thought worthwhile because of the great amount of work involved and because of the relatively low accuracy of photographic spectrophotometry of this kind.

The conclusion to be drawn from this investigation is that H and K emission lines in the spectra of main-sequence stars near type M0 are not produced in regions of prominence-like activity or, if they are so produced, the activity is not variable to an appreciable degree.

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The lack of variation reported here is in agreement with the result of O. C. Wilson (1954), who compared H and K emission intensities in the spectra of a number of stars obtained with higher dispersion at two epochs separated by 13 years. Feast and Thackeray (1954) likewise found no variation in the K-type dwarf ϵ Ind observed over two seasons. Although the discovery of cyclic activity in stars other than the sun may be expected to lead to results of considerable importance, its detection appears to be an exceptionally difficult observational problem. Other approaches than the abortive one attempted herein might be a study of variations of frequency of flares in individual stars or of variations in "patchiness" on the surfaces of stars.

TABLE 1
STARS OBSERVED FOR VARIATION IN H AND K EMISSION

STAR	m_v	SPECTRUM	No. OF SPECTROGRAMS	
			60-Inch	100-Inch
HD 88230 = 20 C 564	6 8	K7 V	15	21
HD 115953 = ADS 8862 A	8 8	dM2	8	12
HD 234677 = GC 25394	8 3	K6 V	8	11
61 Cyg A	5 6	K5 V	10	8
61 Cyg B	6 3	K7 V	11	9

It is of interest that the spectroscopic flare occurred in the only star of the observed group that normally shows hydrogen lines in emission, H ϵ emission being observed on all spectrograms of HD 234677 and H α appearing on coudé plates. As nearly as can be determined from the literature, all late K- or M-type dwarfs that have flared show hydrogen emission in their normal spectra. Other stars with H and K emission found to have hydrogen lines also in emission are ξ Boo B, dK5 (weak H ϵ emission on coudé plates, H α in absorption), and the spectroscopic binary HD 224085, dK2 (H ϵ emission on Cassegrain spectrograms, H α emission on coudé plates).

Dr. E. C. Yowell obtained many of the spectrograms upon which this investigation is based.

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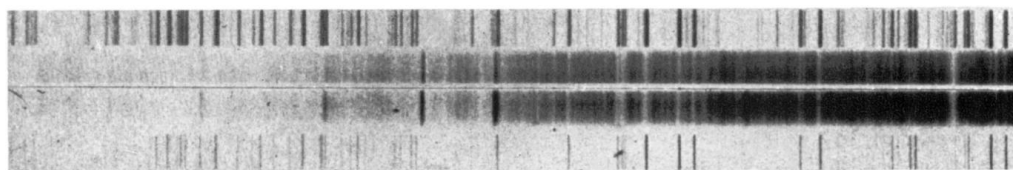


FIG. 1.—Spectrograms of HD 234677. *Above*: March 4, 1950; *below*: July 21, 1953. The spectroscopic flare occurred on the latter date.