OPTICAL AND X-RAY STUDIES OF NEWLY-DISCOVERED FLARE STARS

By William Northey Ball

Results are presented demonstrating that selection of dMe flare stars from their EUV/optical flux ratio revealed some of the most active members from the *ROSAT Wide Field Camera* (*WFC*) and *EUVE* all-sky surveys. During a total photometric monitoring time of 121 hrs on 6 new stars, there were 54 separate optical flares recorded, including a dramatic $\Delta U = 3 \cdot 8$ magnitude flare, emitting an energy in the *U*-band of $E_U \sim 1 \times 10^{33}$ erg. Three other flares had $\Delta U \geqslant 2 \cdot 2$ magnitudes. The flaring rate of two of these new stars is shown to be comparable to that of famous flare stars.

The high-time-resolution spectra ($\lambda\lambda$3600–4200) obtained simultaneously during the large flare were analyzed and it was found that the line symmetry changed significantly within the first minute and even changed from a blue asymmetry to a red one on timescales of ~ 10 secs. These are the first such observations in a dMe star flare. Subsequent analysis, in the context of the thick-target flare model, revealed strong evidence for the existence of ~ (1–3) MeV particle beams.

Although this phenomenon has previously been reported on the Sun for Hα and X-ray lines of Ca XIX and Fe XXV, and symmetric and asymmetric broadening of the Balmer and Ca II *H* & *K* lines has also been observed at low time resolution (> 1 min) before on dMe stars, until this work, interpretation of these observations has been hampered by poor time resolution, resulting in incorrect conclusions about the plasma dynamics.

Firm evidence for coronal activity in three of the newly-discovered flare stars is presented by *ROSAT HRI* X-ray (0·2–2·0 keV) data. A large flare on one of these stars emitted energy, $E_X \sim 2 \times 10^{33}$ erg, with a loop length ~ 0·4 $R_\star$ and lasting ~ 7 hrs. This flare was modelled and found to be not inconsistent with the solar 2-ribbon scenario. — *University of Central Lancashire; accepted 1998 October*

ON THE NATURE OF THE SPECTRAL AND PHOTOMETRIC PERIOD VARIABILITY OF APPARENTLY SINGLE WOLF-RAYET STARS

By T. Morel

During the course of their evolution, massive close binaries are predicted to experience a short evolutionary phase where a Wolf-Rayet (WR) star is associated with a degenerate companion (neutron star or black hole). Apparently single WR stars displaying a cyclical pattern of variability (either in spectroscopy, photometry, and/or polarimetry) are prime candidates for such systems. However, since a number of studies have recently demonstrated the prevalence of largely aspherical winds among the OB-star population, the alternative scenario would be to consider that the periodic variability observed in these WR stars is not induced by the presence of a strongly ionizing, collapsed companion disturbing the global WR wind structure but is induced by orbital modulation of a largely anisotropic outflow.

This study presents the results of a large campaign of (generally simultaneous) spectroscopic and photometric observations attempting to infer the exact nature of apparently single WR stars with well-established (WR 6) or suspected (WR 1, WR 134, WR 136) cyclical variations.

Our study allows us to confirm the existence of a 2·3-d periodicity in WR 134. We also present arguments challenging the possible association of WR 6 and WR 134 with a collapsed companion. Alternatively, we propose that the observed cyclical variability is more likely induced, as in many O stars, by the rotation of large-scale, azimuthally extended wind structures. Although largely qualitative, this model can more easily apprehend some aspects of the variability, notably the epoch-dependent nature of the pattern of variability or the cyclical variations presented by spectral lines formed in close vicinity to the stellar core. This assertion is also supported by the deficiency of observed X-ray flux in the context of an accretion of the wind material onto a degenerate object.

If this interpretation regarding the driver of the variability in WR 6 and WR 134 is correct, these large-scale wind streams are probably induced by some kind of photospheric activity whose exact nature remains to be determined. The existence of (non)radial pulsations of the stellar core or of magnetic structures ('photospheric' or more likely of fossil origin) may, however, be at the origin of this phenomenon. — *University of Montréal; accepted 1999 March*

Interpreting the 10-μm Astronomical Silicate Feature

By Janet E. Bowey

10-μm spectra of silicate dust in the diffuse medium towards Cyg OB2 no. 12 and towards field and embedded objects in the Taurus Molecular Cloud (TMC) were obtained with *CGS3* at the *United Kingdom Infrared Telescope* (*UKIRT*). Cold molecular-cloud silicates are sampled in quiescent lines of sight towards the field stars Taurus-Elias 16 and Elias 13, whilst observations of the embedded young stellar objects HL Tau, Taurus-Elias 7 (Haro 6–10), and Elias 18 also include emission from heated dust.

To obtain the foreground silicate absorption profiles, featureless continua are estimated using smoothed astronomical and laboratory silicate emissivities. TMC field stars and Cyg OB2 no. 12 are modelled as photospheres reddened by foreground continuum and silicate extinction. Dust emission in the non-photospheric continua of HL Tau and Elias 7 (Haro 6-10) is distinguished from foreground silicate absorption using a 10-μm disc model, based on the IR-sub-mm model of T Tauri stars by Adams, Lada & Shu[1], with terms added to represent the foreground continuum and silicate extinction. The absorption profiles of HL Tau and Elias 7 are similar to that of the field star Elias 16. Fitted temperature indices of 0·43 (HL Tau) and 0·33 (Elias 7) agree with Boss'[2] theoretical models of the 200–300 K region, but are lower than those of IR-sub-mm discs (0·5–0·61; Mannings & Emerson[3]); the modelled 10-μm emission of HL Tau is optically thin, that of Elias 7 is optically thick.

A preliminary arcsecond-resolution determination of the 10-μm emissivity near θ^1 Ori D in the Trapezium region of Orion and a range of emission temperatures (225–310 K) are derived from observations by T. L. Hayward; this 'Ney-Allen' emissivity is 0·6 μm narrower than the Trapezium emissivity obtained by Forrest *et al.*[4] with a large aperture.

Published interstellar-grain models, elemental abundances, and laboratory studies of solar-system silicates (IDPs, GEMS, and meteorites), the 10-μm spectra of comets, interstellar silicates, synthetic silicates, and terrestrial minerals, and the effects of laboratory processing on the 10-μm spectra of crystalline