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Gappers and Clumpers, cont'd (NAG5-3190: EUVE Guest Investigator Program)

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FINAL REPORT

SUMMARY.– EUVE Program: "GAPPERS AND CLUMPERS, CONT'D"—Objective was deep exposures of two key EUV sources, 31 Comae (G0 III) and μ Vel (G5 III), to assess their coronal emission spectra in the 80–360 Å interval, and any temporal variations detected in the Deep Survey telescope.

The following is a final report on an *EUVE* cycle 3 program to record spectra and lightcurves of the bright EUV sources 31 Comae and μ Velorum, G giants in and near the Hertzsprung gap. Unfortunately, only the former ultimately was observed, in a 245 ks pointing beginning 17 April 1995.

The *EUVE* spectra were part of a larger multispectral program involving previous *ROSAT, EUVE,* and *HST* observations to measure X-ray and ultraviolet emissions of moderate mass ($\sim$2–3$M_\odot$) giants in the Hertzsprung gap (spectral types early F–mid G) and the post helium flash "clump" ($\sim$G8–K0). Our motivation was to document the evolution of hot coronae ($T > 10^6$ K) along the post Main Sequence trajectories travelled by such stars; to gain insight concerning the "X-ray deficiency" of the F–G0 giants, and the strong braking of stellar rotation at the red edge of the Hertzsprung gap.

With few exceptions, Hertzsprung gap and clump giants observed by *ROSAT*/PSPC show hot ($T \sim 10^7$ K) coronal energy distributions, regardless of any X-ray deficiency. The *EUVE* spectra of the gap star 31 Com (G0 III) indicated a broad coronal emission measure hump at $\sim 10^{7.2}$ K, while the active clump giant β Ceti (K0 III) displayed a sharp peak at $\sim 10^{6.8}$ K, as seen previously in the mixed Clump/gap binary Capella (α Aur: G8 III + G0 III). The gap giants υ Peg (F8 III) and 24 UMa (G4 III) have EUV emissions of intermediate temperature ($\sim 10^{7.0}$ K).

We used the *ROSAT* X-ray photometry and *EUVE* high-excitation line strengths to constrain physical models of the stellar outer atmospheres. Quasistatic magnetic loops can simulate the empirical coronal emission measures of the giant stars, but the inferred pressures for sensible loop lengths conflict with direct measurements of subcoronal densities. Furthermore, the high rate of emission at $\sim 10^5$ K cannot be explained by thermal conduction down the legs of hot quasistatic loops.

On the other hand, the possible existence of elongated ($l \sim R_\star$) emission structures on the gap giants led to a speculative scenario to explain the X-ray deficiency. It was based on the increased importance of the dynamical filling phase ("explosive evaporation") of the loop lifecycle; conductive cooling—yielding TZ emissions at the footpoints—when the heating is interrupted; and the possibility for transitions between "hot" and "cool" energy balance solutions owing to dynamical suspension and centrifugal trapping of the cooling gas. The long loops might represent a vestigial global "magnetosphere" inherited from the MS phase, which ultimately is disrupted near ~G0 by the deepening convective envelope and growth of a more solar-like dynamo. Coronal emissions might be boosted temporarily as the X-ray deficiency is removed; but soon would be quenched by wind braking previously inhibited by the magnetospheric "dead zone."

The major multispectral paper was submitted to ApJ on 31 December 1996, was revised in June, and we currently are awaiting the referee's second response.

The *EUVE* observations also have appeared in several poster papers and invited reviews.

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