CORONAL WINDS FROM GIANTS AND SUPERGIANTS

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ABSTRACT The H I Lyα emission of the archetype “hybrid” bright
giant α Trianguli Australis (K2 II-III) is strongly red-asymmetric. It
suggests that the stellar wind has a fast, high-excitation component in
addition to the well-known low-speed (~80 km s⁻¹) outflow seen in Mg II.

INTRODUCTION

A recent study of the H I Lyα emission of Capella (α Aur: G8 III + G0 III;
Ayres et al. 1993) revealed a surprisingly variable blueward asymmetry in the
secondary’s emission core which most naturally could be explained by a high-
speed (~200 km/s), high-excitation (≥ 10⁵ K) wind. While the inferred mass-loss
rate is modest, the drain of angular momentum could be quite substantial. It
possibly could inspire the rapid spin-down of moderate-mass G0 giants crossing
the Hertzsprung gap towards later types. The example of Capella has motivated
a search for other instances of “coronal” winds from evolved stars. We report
here a new – and intriguing – case: the archetype “hybrid chromosphere” bright
giant α TrA (K2 II-III: Hartmann, Dupree, & Raymond 1980).

OBSERVATIONS

We dearchived six IUE SWP-HI spectra of α TrA taken between 1980 and 1985,
ranging in exposure time from 480 to 1135 minutes. We processed the spectra
using the techniques developed for the Capella program. A novel photometric
linearization suppressed fixed pattern noise, while an “Optimal” weighted slit
extraction maximized the S/N in the background-dominated H I orders (m =
113, 114). We coadded the six echellograms to yield a time-averaged spectrum
of improved S/N, as shown in Fig. I.

MODELING

The Lyα emission of α TrA is strikingly asymmetric. We simulated the H I
absorption profile due to the interstellar medium and the known low-excitation
wind (at \(-80 \text{ km s}^{-1}\)) using the algorithm developed for the Capella work. We estimated the hydrogen columns based on the distance and direction of \(\alpha\) TrA for the ISM absorption; and on the total \(N_H\) determined from the ROSAT PSPC pulse height spectra of Kashyap et al. (1993). The result is illustrated in Fig. IIA. No sensible combination of the two known components can depress the blueward emission peak to the observed levels. However, addition of a broad mildly optically thick absorption at high velocities (\(-400 \text{ km s}^{-1}\)) can successfully suppress the blue peak, as illustrated in Figure IIb.

**DISCUSSION**

The broad absorption could represent low-excitation material accelerating through a range of velocities; or high-excitation “coronal” gas at a narrower range of velocities (here, the broadening would be purely thermal). Although the column of neutral hydrogen required to explain the absorption is not great, it could represent a considerable amount of material if the outflow truly is coronal (the neutral fraction is very small – but not negligible – at 10^6 K). The “wind” might be analogous to the class of Alfven-wave driven flows described by Hartmann & MacGregor 1980; or it might arise by a superposition of “Coronal Mass Ejections” associated with flare activity (like that reported by Kashyap et al. in their deep ROSAT pointing). Finally, the outflow potentially could represent a substantial drain of angular momentum, and thus might significantly affect the coronal evolution of such objects, if their activity derives from an analog of solar-like Dynamo action.

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FIGURE II  (a) Simulation of ISM + low-excitation wind absorption components. Diamonds represent an assumed intrinsic profile (scaled from Mg II). The thin solid line is the total absorption (individual contributions are dotted), the thick profile is the attenuated model, and the shaded profile is the observed line shape; (b) with addition of high-speed coronal wind contribution.

REFERENCES