

# STELLAR WINDS FROM MASSIVE STARS: THE INFLUENCE OF X-RAYS ON THE DYNAMICS

I. Stevens<sup>1</sup>, G. Cooper<sup>2</sup> and S. Owocki<sup>2</sup>

(1) Code 665, NASA/GSFC, Greenbelt, Maryland, MD 20771

(2) Bartol Research Inst., University of Delaware, Newark, DE 19711

**ABSTRACT.** We report on a theoretical investigation of the X-rays observed from early type stars on the global wind dynamics.

## 1. Introduction

X-rays are observed from early type stars with  $L_x \sim 10^{31} - 10^{34} \text{ erg s}^{-1}$ , and are believed to be produced from shocks in the wind. The wind model of Castor *et al.* (1975, CAK), and subsequent modifications, remains the most realistic and complete description of line driven winds. Here, we use a modified CAK model which includes the effects of X-ray ionization (XRI) on the force multiplier  $M(t)$ , and some simple estimates about the distribution of X-rays in the wind to investigate the dynamical impact of the X-rays. The model has been previously used to investigate gas dynamics in MXRB's (Stevens and Kallman, 1990).

## 2. Results

- For values of  $\log_{10} P \geq 21.5$  ( $P = L_x v_\infty / \dot{M}$ ) major changes in wind dynamics can occur.
- $\dot{M}$  is largely unchanged by XRI, while  $v_\infty$  tends to be reduced; by  $\sim 50\%$  for higher values of  $P$ .
- The observed parameters suggest that for a number of early type stars XRI can alter the wind dynamics.
- Stars most likely to be dynamically affected by XRI are those with relatively high values of  $L_x/L_{bol} \sim 10^{-6}$  (Chlebowski *et al.* 1989).
- In most WR stars XRI will not significantly alter the wind dynamics.
- However, some WR stars might be affected, particularly those with higher X-ray luminosities such as HD 93162, HD 193793, and HD 104994, though in these stars it is possible other mechanisms are at work (colliding winds, wind-ISM interactions).

## References

- Castor, J., Abbott, D., and Klein, R., 1975. *Ap. J.*, **195**, 157.  
Chlebowski, T., Harnden, F., and Sciortino, S., 1989. *Ap. J.*, **341**, 427.  
Stevens, I., and Kallman, T., 1990, *Ap. J.*(submitted).