Wind Distributed X-Ray Source Models for O Stars

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Abstract

Recent Chandra HETGS observations of O stars show that their X-ray emission lines are very broad (HWHM ranging from 400 - 1600 km s^{-1}), and in most cases, these lines show no evidence of any Doppler blue-shifted line centroids. Although the observed line broadness was expected, the lack of blue-shifted and skewed line profiles is very surprising. These results place very strong constraints on wind distributed X-ray source models (e.g., wind shocks) which are currently considered to be the most plausible explanation for the observed O star X-ray emission.

A generalized stellar wind X-ray source distribution model was developed to study a variety of symmetric and non-symmetric source distributions to determine the limitations of these models with respect to the observed X-ray line profiles. The basic inputs to the model are the structure of the stellar wind (as determined by the model being considered) and the X-ray temperature distribution of the sources (e.g., for wind shocks, the X-ray densities and temperatures are determined by the wind shock jump conditions). The X-ray radiation transfer uses standard emissivity models to determine the dependence of the emission line strengths on X-ray source densities and temperatures, and the X-ray absorption is determined by wind opacity models.

Model X-ray line profiles for a distribution of spherically symmetric shocks, sources confined in a disk, and a collection of randomly distributed sources are presented. These predicted X-ray line profiles, after folding through the HETGS instrumental response, are compared to the observed HETGS Hydrogen-like and Helium-like (fir) emission line profiles for several ions. We discuss the implications of these model line fits with regards to the validity of wind distributed X-ray source models.

CATEGORY: NORMAL STARS AND WHITE DWARFS