## N08a 3-D Structure of Colliding Winds in $\eta$ Carinae

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$\eta$ Carinae is a binary composed of a supermassive, luminous blue variable ($\eta$ Car A) and a bright companion ($\eta$ Car B). It experienced a giant eruption of mass $\sim 10 M_{\odot}$ in the 1840's, which formed the Homunculus nebula. All optical lines and X-ray light curves show variations with a 5.54 yr periodicity. In particular, the X-ray light curves exhibit interesting features, e.g., a gradual rise before periastron and a minimum that lasts for $\sim$3 months after periastron. These features are consistent with a wind-wind collision in a highly eccentric ($e \sim 0.9$) binary. However, the stars cannot be seen directly in most wavebands, being enshrouded by the dense stellar winds, which is further engulfed by the Homunculus nebula. Moreover, no 3-D colliding wind model is available because of the high eccentricity. As a result, even the viewing angle of the system has not been well constrained.

In this paper, we present the first ever 3-D dynamical model of $\eta$ Carinae, based on 3-D SPH simulations. For simplicity, we take both winds to be isothermal and coasting without any net external forces, assuming in effect that gravitational forces are effectively cancelled by radiative driving terms. For a reasonable choice of stellar, wind, and orbital parameters, we find that the lower-density, higher-velocity wind from star B makes a spiral cavity in the high-density, lower-velocity wind from star A. The cavity is transient on the periastron side, leaving only a narrow wake, whereas it occupies a large volume on the apastron side. The simulated X-ray light curve gives an excellent fit with the observed one, when the system is viewed from the inclination angle $i \sim 54^{\circ}$ and the azimuth $\phi \sim 36^{\circ}$ from apastron in the prograde direction.