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Using 3D Dynamic Models to Reproduce X-ray Properties of Colliding Wind Binaries

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The massive-star-plus-massive-star systems known as colliding wind binaries (CWBs) are unique laboratories for X-ray astrophysics. Given that massive stars have strong and fast (radiatively driven) stellar winds, the wind-wind collisions of CWBs produce hard X-rays (up to ∼10 keV) that have been monitored extensively by several X-ray telescopes, such as *RXTE*, *XMM*, and *Chandra*. To interpret these X-ray light curves and spectra, we model the wind-wind interaction using 3D smoothed particle hydrodynamics (SPH), and then solve the 3D formal solution of radiative transfer to synthesize the model X-ray properties. The results for the multi-year-period, highly eccentric CWBs η Carinae and WR 140 match well the 2-10 keV *RXTE* light curve, hardness ratio, and dynamic spectra, as well as *XMM* and *Chandra* spectra. This includes η Car's ∼3-month-long X-ray minimum associated with the 1998.0 and 2003.5 periastron passages, suggesting the previously inferred primary mass loss rate of $\sim 10^{-3}\,M_\odot$/yr (11 orders of magnitude greater than the Sun!). We also model the short-period (2.67 day) CWB HD 150136, which harbors the nearest O3 star. The imbalance of the wind strengths suggests a 'wind-star' collision as the primary wind reaches the secondary star's surface, the model of which matches the X-ray eclipse at superior conjunction very well. This contributed to obtaining full phase coverage of HD 150136 with *Chandra*, and thus we will present our efforts to model the full light curve and dynamic spectra.