DUST FORMATION EVENTS IN COLLIDING WINDS: AN APPLICATION TO ETA CAR

D. Falceta-Gonçalves,¹ V. Jatenco-Pereira,¹ and Z. Abraham¹

Recent IR observations indicate that many massive binary systems present dust formation episodes in regions close to the stars during the periastron passage. These systems are known to be high-energy sources, and it is believed that wind collisions are the origin of the emission. In this work we show that wind collisions not only increase the X-ray emission but also allow dust formation. As an application we study η Car, which presents, near periastron, an increase in the X-ray emission followed by a sudden decrease that lasts for about a month. We reproduce this feature calculating the optical depth due to dust formation along the orbital period.

Individual massive stars emit, in general, about 10³³ erg s⁻¹ in X-rays, but binary systems are known to emit roughly 100 times more in this band. This discrepancy indicates that a large amount of this energy comes from a non-stellar source. Usov (1992) developed an X-ray emission model for colliding winds in massive binary systems in which the gas becomes denser and hotter (about 10⁸ K) in the shocked region, increasing the free-free emission in the X-ray band. However, some systems, such as η Car, present anomalous light curves, with sudden decreases in flux, which rises again after some period of low emission (Ishibashi et al. 1999). Many massive binary systems also present high IR emission (e.g., Monnier, Tuthill, & Danchi 2001), which is associated with dust formed close to the stars mainly during the periastron passage.

Shocks between winds will be occurring during the whole orbital period, but near periastron they will be stronger. The resulting hot and dense shocked gas will emit large amounts of energy, cooling on a short time scale (∼ few hours) from 10⁸ K to just 10⁴ K. As the gas cools it also becomes denser, generating an optically thick screen to the ionizing photons around the system. The neutral region behind the screen becomes even cooler (∼ 10³ K).

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¹Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, Rua do Matão, 1226, 05508-090 São Paulo, Brazil (diego@astro.iag.usp.br).