

Hydrodynamic Interaction between the Be Star and the Pulsar in the TeV Binary PSR B1259-63/LS 2883

Atsuo T. Okazaki (1), Shigehiro Nagataki (2), Tsuguya Naito (3), Akiko Kawachi (4), Kimitake Hayasaki (5), Stanley P. Owocki (6), and Jumpei Takata (7)

(1) Hokkai-Gakuen University, Japan (2) Yukawa Institute for Theoretical Physics, Japan (3) Yamanashi Gakuin University, Japan (4) Tokai University, Japan (5) Kyoto University, Japan (6) University of Delaware, USA (7) University of Hong Kong, China

We study the interaction between the Be star and the pulsar in the TeV binary PSR B1259-63/LS 2883, using 3-D SPH simulations of the tidal and wind interactions in this Be-pulsar system. We first run a simulation without pulsar wind nor Be wind, taking into account only the gravitational effect of the pulsar on the Be disk. In this simulation, the gas particles are ejected at a constant rate from the equatorial surface of the Be star, which is tilted in a direction consistent with multi-waveband observations. We run the simulation until the Be disk is fully developed and starts to repeat a regular tidal interaction with the pulsar. Then, we turn on the pulsar wind and the Be wind. We run two simulations with different wind mass-loss rates for the Be star, one for a B2V type and the other for a significantly earlier spectral type. Although the global shape of the interaction surface between the pulsar wind and the Be wind agrees with the analytical solution, the effect of the pulsar wind on the Be disk is profound. The pulsar wind strips off an outer part of the Be disk, truncating the disk at a radius significantly smaller than the pulsar orbit. Our results, therefore, rule out the idea that the pulsar passes through the Be disk around periastron, which has been assumed in the previous studies. It also turns out that the location of the contact discontinuity can be significantly different between phases when the pulsar wind directly hits the Be disk and those when the pulsar wind collides with the Be wind. It is thus important to adequately take into account the circumstellar environment of the Be star, in order to construct a satisfactory model for this prototypical TeV binary.

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Email: okazaki@elsa.hokkai-s-u.ac.jp