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Modelling interaction of relativistic and non-relativistic winds in binary system PSR B1259-63/SS2883 - II. Impact of magnetization and anisotropy of the pulsar wind

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In this paper, we present a numerical study of the properties of the flow produced by the collision of a magnetized anisotropic pulsar wind with its environment in binary system. We compare the impact of both the magnetic field and the wind anisotropy to the benchmark case of a purely hydrodynamical (HD) interaction of isotropic winds, which has been studied in detail by Bogovalov et al. (2008). We consider the interaction in axisymmetric approximation, i.e. the pulsar rotation axis is assumed to be oriented along the line between the pulsar and the optical star and the effects related to the pulsar orbiting are neglected. The impact of the magnetic field is studied for the case of weak magnetization (with magnetization parameter $\sigma<0.1 $), which is consistent with conventional models of pulsar winds. The effects related to anisotropy in pulsar winds are modeled assuming that the kinetic energy flux in a non-magnetized pulsar wind is strongly anisotropic, with the minimum at the pulsar rotation axis and the maximum in the perpendicular direction. We show that, although both considered effects change the shape of the region occupied by the terminated pulsar wind, their impact appears to be small. In particular, for the magnetization of the pulsar wind below 0.1, the magnetic field pressure remains well below the plasma pressure in the post-shock region. Thus, in the case of interaction of a pulsar with the stellar wind environment (opposite to the case of plerions, i.e. the pulsar interaction with the interstellar medium, when the magnetic field becomes dynamically important independently on the wind magnetization) the HD approach represents a feasible approximation for numerical modelling.

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