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ORIGINAL ARTICLE

Plasma magnetosphere and spin down of rotating magnetized strange stars in general relativity

B.J. Ahmedov · A.A. Abdujabbarov · D.B. Fayzullaev

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Abstract It has been found that in general relativity slow down due to the energy losses through charged particles outflow in plasma magnetosphere strongly depends on star's compactness parameter and is more faster for the neutron star with comparison to that for the strange star of the same mass. Comparison with astrophysical observations on pulsars spin down precise data may provide important information about star's compactness parameter and consequently an evidence for the strange star existence and, thus, serve as a test for distinguishing it from the neutron star.

Keywords Strange star · General relativity · Spin down · Plasma magnetosphere

Among astrophysical objects which can be useful in investigating the physics under the extreme conditions particular place belongs to radio pulsars (see, for example, Lorimer and Kramer (2005)). According to the magnetospheric models radio pulsars are rotating highly magnetized neutron stars, producing radio emission above the small area of its surface called polar cap. Goldreich and Julian (1969) proved that such a rotating highly magnetized star cannot be surrounded by vacuum due to generation of strong electric field pulling out charged particles from the surface of the star. They proposed first model of the pulsar magnetosphere containing two distinct regions: the region of closed magnetic field lines, where plasma corotates with the star as a solid body, and the region of open magnetic field lines, where radial electric field is not completely screened with plasma particles and plasma may leave the neutron star along magnetic field lines. Radio emission is generated due to continuous cascade generation of electron-positron pairs in the magnetosphere above the polar cap. Thorough research on structure and physical processes in pulsar magnetosphere can be found in works of Goldreich and Julian (1969), Sturrock (1971), Mestel (1971), Ruderman and Sutherland (1975), Arons and Scharlemann (1979), Muslimov and Harding (1997). Although a self-consistent pulsar magnetosphere theory is yet to be developed, the analysis of plasma properties in the pulsar magnetosphere based on the above-mentioned papers provides firm ground for the construction of such a model.

It was shown by a number of authors that effects of general relativity play very important role in physics of pulsars. The effect of general relativistic frame dragging effect in the plasma magnetosphere was investigated in Beskin (1990, 2009), Muslimov and Tsygan (1992), Muslimov and Harding (1997), Mofiz and Ahmedov (2000), and many others, and proved to be crucial for the conditions of particle acceleration in the magnetosphere and, therefore, for generation of radio emission. The effect of the stellar oscillations on plasma magnetosphere in general relativity is recently discussed in Abdikamalov et al. (2009a), Morozova et al. (2010, 2012), Zanotti et al. (2012). From the above mentioned papers it is seen that the general relativistic ef-

B.J. Ahmedov · A.A. Abdujabbarov (✉)
Institute of Nuclear Physics, Ulughbek, Tashkent 100214, Uzbekistan
e-mail: ahmadjon@astrin.uz

B.J. Ahmedov · A.A. Abdujabbarov
Ulugh Begh Astronomical Institute, Astronomicheskaya 33, Tashkent 100052, Uzbekistan

B.J. Ahmedov
International Centre for Theoretical Physics, Strada Costiera 11, 34151 Trieste, Italy

D.B. Fayzullaev
National University of Uzbekistan, Tashkent 100174, Uzbekistan