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ASTRONOMY AT THE EPOCH OF MULTIMESSENGER STUDIES

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The influence of small-scale magnetic field on the heating of J0250+5854 polar cap

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Radio pulsar J0250+5854 is the slowest pulsar among rotation powered pulsars. It is an old pulsar with spin-down age $\tau = 13.7 \cdot 10^6$ years, which rotates with period $P = 23.54$ s, the strength of dipolar magnetic field at pole estimated by pulsar spin-down rate is $B_{dip} = 5.1 \cdot 10^{13}$ G [1]. Such pulsars lie beyond conventional pulsar "death line" and its existence is usually explained by the presence of surface small-scale magnetic field (see, for example, [2]). The other explanation is presented by [3]. In this paper the influence of surface small-scale magnetic field on the heating of PSR J0250+5854 polar cap is considered with assumption that the pulsar is close to aligned, i.e. the inclination angle is $\chi \lesssim 30^\circ$. It is assumed that the polar cap is heated only by reverse positrons accelerated in pulsar diode. It is supposed that pulsar diode is located near the star surface (polar cap model) and operates in the steady state space charge-limited flow regime. The reverse positron current is calculated in the framework of two models: rapid and gradually screening. To calculate the production rate of electron-positron pairs we take into account only the curvature radiation of primary electrons and its absorption in magnetic field. It is assumed that some fraction of electron-positron pairs may be created in bound state that can later be photoionized by thermal photons from star surface. We do not take into account the influence of polarization of curvature radiation on pair generation. Also we do not taken into account positronium decay. It is shown that under this assumptions almost all electron-positron pairs are produced in bound state and the multiplicity of photoionized pairs may exceed $10-10^2$ per primary electron.

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