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Prospect of Detecting X-Ray Halos Around Middle-Aged Pulsars with eROSITA

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The detection of extended TeV γ-ray emission (dubbed "TeV halos") from Geminga and Monogem pulsars by HAWC collaboration implies that the halo-like morphologies around middle-aged pulsarsmay be common. The γ-rays above 10 TeV are thought to arise from inverse Compton (IC) scattering of relativistic electrons/positrons in the pulsar halos off cosmic microwave background photons. In themeanwhile, these electrons and positrons can produce X-ray synchrotron emission in the interstellar magnetic field, resulting in a diffuse emission in the X-ray band (namely X-ray halos). Here, we study the prospect of detecting X-ray halos with eROSITA from 10 middle-aged pulsars with characteristic age τ_c larger than tens of thousands of years in the ATNF pulsar catalog. Assuming a benchmark value (i.e., B=3μG) for the magnetic field, most of the X-ray halos are found to be bright enough to be detectable by eROSITA in the energy range of 0.5–2 keV during its four-year all-sky survey. Among these pulsar halos, three are supposed to produce X-ray fluxes above the eROSITA sensitivity of the first all-sky survey. Given the good angular resolution and the large field of view, eROSITA is expected to be able to measure the spatial distribution of the X-ray halos from sub-pc scale up to tens of pc scale. The intensity profile of the X-ray halos are very useful to constrain the magnetic field and the energy-dependence of the diffusion coefficient in the pulsar halos.

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