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Diagnosing the particle transport mechanism in the Geminga's pulsar halo via X-ray observation

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Extended TeV gamma-ray emission, which is also referred to as the TeV halo, has been discovered around the Geminga pulsar and a few other middle-aged pulsars. It is believed that the gamma-ray pulsar halo arises from the inverse Compton radiation of relativistic electrons escaping from the pulsar wind nebula. Therefore, the transport mechanism of these escaping electrons is crucial to understand the origin of the pulsar halo. So far, three kinds of models have been suggested to explain the measured feature of the TeV halo: (1) isotropic diffusion with low diffusion coefficient; (2) isotropic diffusion with the standard diffusion coefficient considering the transition from the quasi-ballistic to the diffusive transport regime; (3) anisotropic diffusion with the standard diffusion coefficient in the interstellar medium and a mean magnetic field direction approximately aligned with observer's line of sight. On the other hand, the synchrotron radiation of the same population electrons are mostly in the X-ray band. We show the expected X-ray intensity profiles of the pulsar halo under these three models. Since X-ray instruments generally have better angular resolution, their measurement on the inner region of the Geminga's pulsar halo can be used to distinguish among different models.

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