Timing and spectral analysis of the first variable gamma-ray pulsar, PSR J2021+4026

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We report timing and spectral analyses of the first variable gamma-ray pulsar, PSR J2021+4026. Allafort et al. (2013, ApJL, 777, 2) reported a sudden drop of the gamma-ray flux for this target, and they found a glitch occurred in 2011 October. We investigate the temporal evolution of spin-down rate (frequency time derivative) and the flux with the energy > 0.1 GeV after the glitch using the Fermi-LAT data. We find the pulsar stayed a high-spin down sate (by ~4%, comparing with the pre-glitch value) and a low gamma-ray state (by ~18%) for about three years after the glitch. After about three years (at the end of 2014), the spin down rate and gamma-ray flux retuned to the pre-glitch values within a time scale of ~month. The phase-resolved spectra and pulse profiles after the relaxation are also consistent with those in the post-glitch state.

The relaxation behavior after the glitch of PSR J2021+4026 may demonstrate an interconnection among the superfluid, crust, and global magnetosphere. A permanent-like change observed in the spin down rate and the gamma-ray flux implies that the glitch triggers a change in the structure of the global magnetosphere. We will discuss a shift of the magnetic axis or by the change of the electric current running through the magnetosphere at the glitch. PSR J2021+4026 will be an example to manifest a mode change in the radiation due to the state change of the magnetosphere.