A curious case of the accretion-powered X-ray pulsar GX 1+4

We present detailed spectral and timing studies using a NuSTAR observation of GX 1+4 in 2015 October during an intermediate-intensity state. The measured spin period of 176.778 s is found to be one of the highest values since its discovery. In contrast to a broad sinusoidal-like pulse profile, a peculiar sharp peak is observed in profiles below ∼25 keV. The profiles at higher energies are found to be significantly phase shifted compared to the soft X-ray profiles. Broad-band energy spectra of GX 1+4, obtained from NuSTAR and Swift observations, are described with various continuum models. Among these, a two-component model consisting of a bremsstrahlung and a blackbody component is found to best fit the phase-averaged and phase-resolved spectra. Physical models are also used to investigate the emission mechanism in the pulsar, which allows us to estimate the magnetic field strength to be in ∼(5–10) × 10^{12} G range. Phase-resolved spectroscopy of NuSTAR observation shows a strong blackbody emission component in a narrow pulse phase range. This component is interpreted as the origin of the peculiar peak in the pulse profiles below ≤25 keV. The size of emitting region is calculated to be ∼400 m. The bremsstrahlung component is found to dominate in hard X-rays and explains the nature of simple profiles at high energies.

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