A Hard X-Ray Power-Law Spectral Cutoff in Centaurus X-4 - DTU Orbit (28/01/2019)

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The low-mass X-ray binary Cen X-4 is the brightest and closest (<1.2 kpc) quiescent neutron star transient. Previous 0.5-10 keV X-ray observations of Cen X-4 in quiescence identified two spectral components: soft thermal emission from the neutron star atmosphere and a hard power-law tail of unknown origin. We report here on a simultaneous observation of Cen X-4 with NuSTAR (3-79 keV) and XMM-Newton (0.3-10 keV) in 2013 January, providing the first sensitive hard X-ray spectrum of a quiescent neutron star transient. The 0.3-79 keV luminosity was 1.1 x 10^33 erg/s (for D=1kpc), with around 60 percent in the thermal component. We clearly detect a cutoff of the hard spectral tail above 10 keV, the first time such a feature has been detected in this source class. Comptonization and synchrotron shock origins for the hard X-ray emission are ruled out on physical grounds. However, the hard X-ray spectrum is well fit by a thermal bremsstrahlung model with an 18 keV electron temperature, which can be understood as arising in a radiatively-inefficient accretion flow (RIAF) if only a small fraction of the mass flow reaches the neutron star. We suggest that most of the accretion flow is centrifugally inhibited by the magnetic propeller effect. The power-law cutoff energy is set by the degree of Compton cooling of the RIAF electrons by thermal seed photons from the neutron star atmosphere. Lower thermal luminosities should lead to higher (possibly undetectable) cutoff energies. We compare Cen~X-4's behavior with PSR J1023+0038, IGR J18245-2452, and XSS J12270-4859, which have shown transitions between LMXB and radio pulsar modes at a similar X-ray luminosity.

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