

Discovery of twin kHz QPOs in the peculiar LMXB Circinus X-1

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ABSTRACT: Twin kHz quasi-periodic oscillations (QPOs) are discovered in RXTE archival data of the low-mass X-ray binary (LMXB) Circinus X-1. Their frequencies follow the Psaltis, Belloni & van der Klis (1999) relation, but extend to a previously uncovered regime. Their varying frequency ratio and deviation from 2:3 is the first evidence of an underlying neutron star since the discovery of Type-I X-ray bursts from the field (Tennant et al. (1987)). The frequency separation of the twin kHz QPOs decreases with decreasing upper kHz QPO frequency, as predicted by the relativistic precession model (Stella & Vietri 1999), a best fit of which yields a mass of $2M_{\odot}$. 69 more single kHz QPOs are discovered, with frequencies ranging from $\sim 500\text{Hz}$ down to $\sim 20\text{Hz}$, providing unique tests for models.