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Spin Frequencies and Magnetic Fields of Neutron Stars: Implications of the kHz QPOs Recently Discovered in Circinus X-1 STRATOS BOUTLOUKOS, FREDERICK LAMB, University of Illinois — The paired kilohertz quasi-periodic oscillations (kHz QPOs) recently discovered in the X-ray emission of Cir X-1 are generally similar to those seen in disk-accreting neutron stars with relatively weak magnetic fields, establishing that the compact object in the Cir X-1 system is such a star. Periodic oscillations have not yet been detected from Cir X-1, so its spin rate has not yet been measured directly. In many stars that produce kHz QPOs, the frequency separation $\Delta\nu$ of the QPO pair is equal or roughly equal to the stellar spin rate ν_s or to $\nu_s/2$. The involvement of the stellar spin in producing $\Delta\nu$ indicates that the magnetic fields of these stars are dynamically important. If the mechanism that produces the kilohertz QPOs is similar in all stars, the value of $\Delta\nu$ provides a rough estimate of the star's spin rate. In Cir X-1, $\Delta\nu$ varies by 167 Hz, from $\sim$230 Hz to $\sim$500 Hz, the largest variation seen so far in any neutron star. The frequency ν_u of the upper kHz QPO in Cir X-1 is up to a factor of three smaller than is typical. The low observed values of ν_u and the large variation of $\Delta\nu$ challenge current models for the generation of kHz QPOs. We discuss the implications of the observed properties of the Cir X-1 kHz QPOs for mechanisms for generating the kHz QPOs in Cir X-1 and other accreting neutron stars. This research was supported in part by NASA grant NAG 5-12030, NSF grant AST 0709015, and funds of the Fortner Endowed Chair at Illinois.

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