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Constraining MSP Interiors through Rotochemical Heating

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Abstract. Rotochemical heating originates in a departure from beta equilibrium in a rotating neutron star due to spin-down compression, the effect being strongest for millisecond pulsars (MSPs). The main consequence is the evolution in $\sim 10^8$ yr to a quasi-stationary state, in which the surface temperature depends only on the current spin-down power $\dot{E} = I\Omega\dot{\Omega}$. Assuming no superfluidity, we find that the surface temperature is related to the spin-down power in the form of a *power law*. Moreover, the exponent depends only on the neutrino emission process assumed. Our simulations agree well with the recent detection of possible UV thermal radiation from a millisecond pulsar (Kargaltsev, Pavlov & Romani 2004, ApJ, 602, 327).

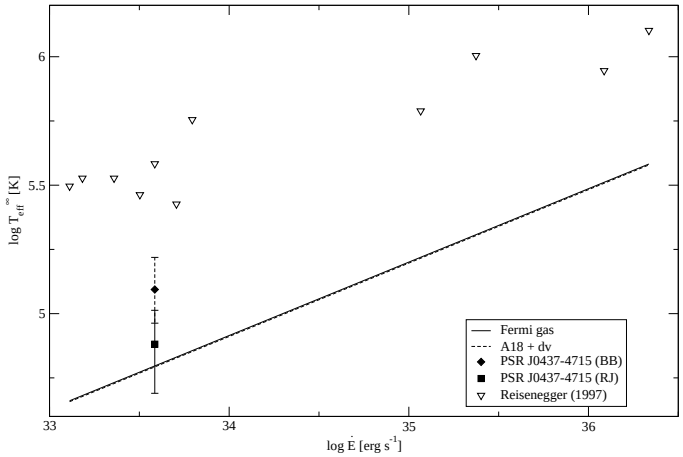

Figure 1. Surface temperatures in the quasi-stationary state as a function of spin-down power, for two different equations of state which allow standard cooling only (solid and dashed lines), with a radius $R^{\infty} = 13.8$ km. Diamond and square are the data for PSR J0437−4715 from Kargaltsev et al. (2004), assuming a blackbody and Rayleigh-Jeans fit, respectively, with the same radius. The error bars are due to the unknown interstellar reddening. Triangles are X-ray upper bounds compiled in Reisenegger (1997, ApJ, 485, 313).