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Testing the Impact of Surface Temperature Inhomogeneities on Quiescent Neutron Star Mass/Radius Determinations

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Spectral analyses of quiescent neutron stars in X-ray binaries have been used to constrain the mass and radius of the neutron stars. A question not yet explored is the effect of undetected hot spots on the spectrum, and thus on the inferred mass and radius of a quiescent neutron star. We simulate light curves for hydrogen atmosphere neutron stars with hot spots, performing Monte Carlo simulations to infer the range of likely pulsation amplitudes detectable for given choices of hot spot temperature and radius. We search for pulsations in the deepest observations of quiescent neutron stars done so far, X7 and X5 in the 800-ks Chandra HRC observations of 47 Tuc, finding 3-sigma upper limits on the pulsed fraction of 17.5% and 18.9% respectively for spin periods as low as 1.5 ms, and including acceleration searches. We will use these limits to constrain the size and/or temperature of any hot spots on these quiescent neutron stars. Finally, we plan to use these constraints to study the effects on the X-ray spectrum, and thus on the inferred mass and radius, that these possible hot spots might produce.

Primary author: Mr ELSHAMOUTY, Khaled (University of Alberta)

Co-authors: Dr HEINKE, Craig (University of Alberta); Dr MORSINK, Sharon (University of Alberta); Dr BOGDANOV, Slavko (Columbia Astrophysics Laboratory); Ms ABIGAIL, Stevens (University of Alberta, University of Amsterdam)

Presenter: Mr ELSHAMOUTY, Khaled (University of Alberta)

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