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Evidence for 3XMM J185246.6+003317 as a massive magnetar with a low magnetic field

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3XMM J185246.6+003317 is a transient magnetar located in the vicinity of the supernova remnant Kes\,79. So far, observations have only set upper limits to its surface magnetic field and spindown, and there is no estimate for its mass and radius. Using ray-tracing modelling and Bayesian inference for the analysis of several light curves spanning a period of around three weeks, we have found that it may be one of the most massive neutron stars to date. In addition, our analysis suggests a multipolar magnetic field structure with a subcritical field strength and a carbon atmosphere composition. Due to the time-resolution limitation of the available light curves, we estimate the surface magnetic field and the mass to be $\log_{10}(B/\mathrm{G}) = 11.89^{+0.19}_{-0.93}$ and $M = 2.09^{+0.16}_{-0.09}$~$M_\odot$ at 1σ confidence level, while the radius is estimated to be $R = 12.02^{+1.44}_{-1.42}$ km at 2σ confidence level. They were verified by simulations, i.e., data injections with known model parameters, and their subsequent recovery. The best-fitting model has three small hot spots, two of them in the southern hemisphere. These are, however, just first estimates and conclusions, based on a simple ray-tracing model with anisotropic emission; we also estimate the impact of modelling on the parameter uncertainties and the relevant phenomena on which to focus in more precise analyses. We interpret the above best-fitting results as due to accretion of supernova layers/interstellar medium onto 3XMM J185246.6+003317 leading to burying and a subsequent re-emergence of the magnetic field, and a carbon atmosphere being formed possibly due to hydrogen/helium diffusive nuclear burning. Finally, we briefly discuss some consequences of our findings for superdense matter constraints.

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