Astrophysics > Solar and Stellar Astrophysics

Modelling pulsar glitches with realistic pinning forces: a hydrodynamical approach

Brynmor Haskell, Pierre Pizzochero, Trevor Sidery

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Although pulsars are one of the most stable clocks in the universe, many of them are observed to 'glitch', i.e. to suddenly increase their spin frequency (\nu) with fractional increases that range from \Delta\nu/\nu \approx 10^{-11} to 10^{-5}. In this paper we focus on the 'giant' glitches, i.e. glitches with fractional increases in the spin rate of the order of \Delta\nu/{\nu} \approx 10^{-6}, that are observed in a sub class of pulsars including the Vela. We show that giant glitches can be modelled with a two-fluid hydrodynamical approach. The model is based on the formalism for superfluid neutron stars of Andersson and Comer (2006) and on the realistic pinning forces of Grill and Pizzochero (2011). We show that all stages of Vela glitches, from the rise to the post-glitch relaxation, can be reproduced with a set of physically reasonable parameters and that the sizes and waiting times between giant glitches in other pulsars are also consistent with our model.

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