

## Astrophysics &gt; High Energy Astrophysical Phenomena

# Internal Heating of Old Neutron Stars: Contrasting Different Mechanisms

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The thermal emission detected from the millisecond pulsar J0437-4715 is not explained by standard cooling models of neutron stars without a heating mechanism. We investigated three heating mechanisms controlled by the rotational braking of the pulsar: breaking of the solid crust, superfluid vortex creep, and non-equilibrium reactions ('rotochemical heating'). We find that the crust cracking mechanism does not produce detectable heating. Given the dependence of the heating mechanisms on spin-down parameters, which leads to different temperatures for different pulsars, we study the thermal evolution for two types of pulsars: young, slowly rotating 'classical' pulsars and old, fast rotating millisecond pulsars (MSPs). We find that the rotochemical heating and vortex creep mechanism can be important both for classical pulsars and MSPs.

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