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Energy transformations in the birth of neutron stars

Monday 24 March 2014 18:00 (15 minutes)

Millisecond pulsars, radio pulsars, and magnetars are distinct classes of neutron stars that currently exhibit different periods, magnetic fields and space velocities. In my talk, I speculate with the idea that these current properties of neutron stars could have had similar values during the birth of these stars. I develop a relatively simple model based on the assumption that neutron stars experienced three abrupt physical changes at the end of their birth, which could have been originated in birth magneto-rotational instabilities: an increase in period from the initial value to the current value, implying a change of rotational energy; an exponential decay of its magnetic field from the initial value to the current surface value, implying a change of radiative energy; and finally, an increase of space velocity from the initial value to the current value, implying a change of kinetic energy. These birth energy changes are assumed to be connected by an energy conversion in which a radiation loss and an increase of kinetic energy occur at the expense of a rotational energy loss. According to this model, If the assumed energy conversion occurs in times of order 10ˆ(-4) s then neutron stars are born with magnetic fields in the range of 10ˆ(15)-10ˆ(16) G and initial periods in range 1-20 ms. This means that neutron stars are born with magnetic fields typical of magnetars and periods typical of millisecond pulsars.

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