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The effects of a neutron star translational and rotational motion in observable timing and evolution of radiopulsars

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The instant observed period of an isolated radiopulsar is accepted to be identical to the physical period of a neutron star rotation except for the cases of obvious strong precession. However, in the strict sense, the time interval between two successive pulses received by an observer is nothing else than the interval between successive passes of the observer through rotating pulsar beam. And this interval is not necessarily equal to the current physical period of the neutron star. Since the star is affected by an electromagnetic braking torque and is not spherical, it is liable to forced and free precessions that result in the complex rotation of pulsar beam relative to the observer. Thus the observed pulsar period becomes a slightly different from the physical one.

In our work we derive analytically and analyse corresponding "geometric" contribution to time evolution of the observed pulsar period. We show that for NS with typical parameters, even non-spherical ones, this contribution does not affect pulsar observables significantly. Instead, a slowly precessing neutron star looks like a non-precessing one with a period which systematically (and slightly) differs from a physical period of NS rotation. Thus, in particular, the nature of anomalous values of pulsars braking indices can not be merely geometrical. If NS complex rotation is indeed the trigger of braking indices high values, then one needs to postulate an existence of a some mediator mechanism.

We also derive and analyse effects of a translation motion of a NS. The observer gradually leaves pulsar beam due to systematic change of an angle between NS radius vector and spin axis caused by NS motion. We show that the timescale of this process is significantly less than typical pulsar lifetime. On the other hand, the same effect also causes the appearance of "new" kindling pulsars in the observed subset due to the observer's entrance into the beam of an initially "hidden" pulsar. And the rate of the latter process seems to be higher than the one of a pulsars physical birth. We conclude that both effects should have strong selectional impact on the observed pulsars subset.

Author: BIRYUKOV, Anton

Co-authors: Dr BESKIN, Grigory (Special Astrophysical Observatory of RAS); Dr KARPOV, Sergey (Special Astrophysical Observatory of RAS)

Presenter: BIRYUKOV, Anton

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