PULSE ASYMMETRY OF MILLISECOND PULSARS

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By considering a simple model of slowly rotating neutron stars (for which the Schwartzschild metric could be used properly) whose emission is confined to circular antipolar caps, Pechenick, Ftaclas and Cohen (1983) studied the gravitational effects on the light curves. They found that for typical neutron star parameters, the light curves flattened out due to the bending of light in the neutron stellar gravity.

The results cannot, however, be directly applied to millisecond pulsars, particularly to 1937+214, because the effects of rotation are definitely not negligible.

By using the Kerr metric, we studied the effects of gravity and dragging of inertial frames on the light curves observed at infinity of fastly rotating neutron stars. When a = M (a being the stellar specific angular momentum in gravitational units) the corresponding period is 2.8 ms; when a = 2M it is 1.6 ms. (Note, that a > M poses no problem here because the Kerr metric only exists outwards of the stellar surface.) We adopted again the simple model that the emission of the neutron star is confined to circular polar caps and obtained numerical results by the Monte Carlo simulation of photon orbits.

For typical neutron star parameters, the results show that the flattening of light curves of millisecond pulsars is not as large as it is for non-rotating ones. Also, the peak is shifted to one side in an asymmetric way. It is no longer the center of the pulse or the polarization turning point. This is due to the Lorentz contraction of the polar region, while the dragging of the inertial frames produces the long tail following the peak. Therefore, if the neutron stars in galactic bulge sources are spinning fast, one cannot "smear out" their pulsation by the gravity. Furthermore, a comparison of our simulations with detailed pulse observations in 1937+214 may provide clues to the emission pattern.

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