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Timing of the accreting millisecond pulsar IGR~J17511--3057

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{Timing analysis of Accretion-powered Millisecond Pulsars (AMPs) is a powerful tool to probe the physics of compact objects. The recently discovered \newigrj is the 12 discovered out of the 13 AMPs known. The Rossi XTE satellite provided an extensive coverage of the 25 days-long observation of the source outburst.} {Our goal is to investigate the complex interaction between the neutron star magnetic field and the accretion disk, determining the angular momentum exchange between them. The presence of a millisecond coherent flux modulation allows us to investigate such interaction from the study of pulse arrival times. In order to separate the neutron star proper spin frequency variations from other effects, a precise set of orbital ephemeris is mandatory.} {Using timing techniques, we analysed the pulse phase delays fitting differential corrections to the orbital parameters. To remove the effects of pulse phase fluctuations we applied the timing technique already successfully applied to the case of an another AMP, XTE J1807-294.} {We report a precise set of orbital ephemeris. We demonstrate that the companion star is a main sequence star. We find pulse phase delays fluctuations on the first harmonic with a characteristic amplitude of about 0.05, similar to what also observed in the case of the AMP XTE J1814-338. For the second time an AMP shows a third harmonic detected during the entire outburst. The first harmonic phase delays show a puzzling behaviour, while the second harmonic phase delays show a clear spin-up. Also the third harmonic shows a spin-up, although not highly significant (3σ c.l.). The presence of a fourth harmonic is also reported. In the hypothesis that the second harmonic is a good tracer of the spin frequency of the neutron star, we find a mean spin frequency derivative for this source of \np{1.65(18)}{-13} Hz s^{-1}.} (continue ...)

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