Three slow glitches in the pulsar B1822–09

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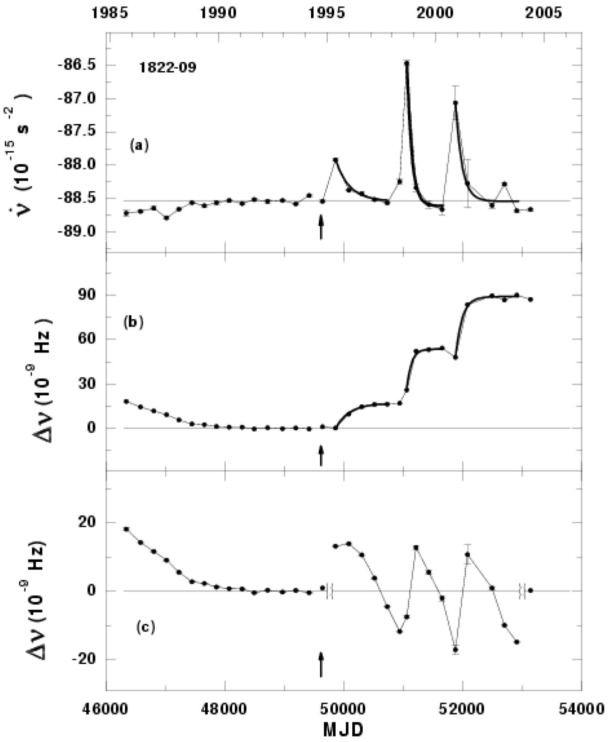

Figure 1: The frequency first derivative $\dot{\nu}$ and frequency residuals $\Delta\nu$ for the pulsar B1822–09 from 1985 to 2005 (from Ref.[3], supplemented with the new last point)

The study of the timing residuals of PSR B1822–09 at the Pushchino Observatory at frequencies 102.5 and 112 MHz allowed us to detect a new kind of variation in the pulsar rotation rate, which may be treated a slow glitch [1–3]. Fig. 1 shows that the pulsar suffered three slow glitches over the 1995–2004 interval. A characteristic feature of the slow glitches is a rapid initial decrease in the magnitude of $\dot{\nu}$ by $\sim$1–3 per cent of the initial value and subsequent exponential increase back to its initial value with a time-scale of several months (Fig. 1(a)). This causes a slow growth in the frequency residuals $\Delta\nu$ with the same time-scale as shown in Fig. 1(b), where $\Delta\nu$ are obtained relative to the data for the pre-glitch interval 1991–1994. The size of a slow glitch after a span of a few years is rather moderate, with $\Delta\nu/\nu \sim 20 \times 10^{-9}$. An obvious relaxation in frequency after a slow glitch is not observed. The residuals $\Delta\nu$ relative to a new model fit to the data for the 1995–2004 interval, where the slow glitches occurred, show oscillatory behavior with the time-scale of $\sim$1000 d (Fig. 1(c)). The reason of significant variations in $\dot{\nu}$ should be attributed to variations in braking torque. A decrease in $\dot{\nu}$ requires a corresponding decrease in torque that brakes rotation of the pulsar crust. Torque variations may be caused by changes in magnetosphere structure, e.g. variations of the polar cap size. The measured oscillatory behavior in ν on a time-scale of 1000 d reflects the oscillatory changes in torque, which suggests the existence of a long-term oscillation in the polar cap size.

References

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