MACROSCOPIC AND MICROSCOPIC BEHAVIOR FOLLOWING FOUR LARGE JUMPS IN THE VELA PULSAR (PSR 0833-45)

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Eleven years of arrival time data for PSR 0833-45 collected at Goldstone, CA were analysed by fitting a simple model of the pulse period to the data in a least-squares sense. Four large jumps ΔP in period P of $\Delta P/P \sim -2 \times 10^{-6}$ have occurred in which $\dot{P}$ increases up to 2% of its pre-jump value. Then $\dot{P}$ decays nearly exponentially with a time scale of 40 to 80 days to $(1.2471 \pm 5) \times 10^{-13}\ ss^{-1}$, regardless of the size of the jump. Q values for the jumps are about 6.5%. Further decay of $\dot{P}$ is at the constant rate (within an interjump era) of $-5 \times 10^{-24} < \ddot{P} < -9 \times 10^{-24}\ ss^{-2}$. The observable effects of random fluctuations in P or $\dot{P}$ are an order of magnitude smaller than the systematic effects evident in $\dot{P}$.

The approach here was to measure $\dot{P}$ just before a jump and work backwards in time until the post-jump decay became effective. The results appearing in Figure 1 show that $\dot{P}$ decays rapidly in tens of days, and that the decay in $\dot{P}$ is linear beyond about 200 days past the jump epoch. Small perturbations in $\dot{P}$ do not persist, so a general value of $\ddot{P}$ does prevail throughout the interjump era. A small jump (2'), wherein $\Delta P/P \sim -10^{-8}$, occurs 120 days after jump 2 and causes the interruption labeled 2' in Figure 1.

The analysis was pursued further by fitting a period model to only a few months of data just following the short-term decay, and computing the arrival time residuals for the entire interjump era. Differentiating the residuals with respect to the pulse number, one obtains the deviation P_d in period from that assumed in the model. The long-term drift of P_d over many months never exceeds 4 nsec. On the other hand, integration of $\dot{P}$ in Figure 1 yields systematic changes in P of 30 to 50 nsec, so perturbations in P caused by random fluctuations in P or $\dot{P}$ are 10 times less than those caused by systematic variations. This is consistent with the uniformity of the short and long-term decays in Figure 1.

See Downs (1981) for a thorough analysis and discussion of this data.

W. Sieber and R. Wielebinski (eds.), Pulsars, 277–278.

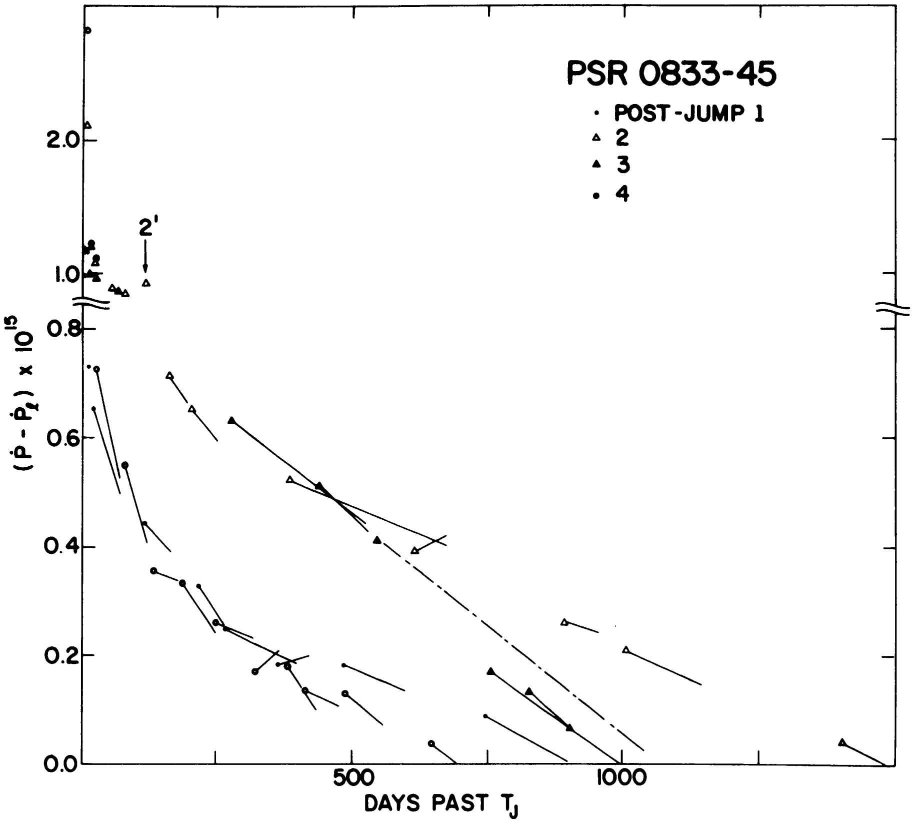

Figure 1: $\dot{P}$ versus the number of days past the jump epoch T_J. $\dot{P}$ is relative to $\dot{P}_\ell$, the last value of $\dot{P}$ before the next jump. Symbols represent $\dot{P}$ at a particular epoch. The slope of the trailing line indicates the solution for $\ddot{P}$, and the end points of the line define the data span used in the fit. The dashed line is an extension of post-jump 3 behavior prior to a temporary disturbance in $\dot{P}$.

REFERENCE

Downs, G.S.: 1981, submitted to the Astrophysical Journal.