References

1. *Wild Earth* **2**, 10 (December 1992).
2. *Nat. Areas J.* **7**, 2 (January 1987); *ibid.*, in press.

■

"Millisecond" Pulsars

In the article "A new way to rev up a fast pulsar" by Ray Jayawardhana (Research News, 18 June, p. 1720), the "new way" in the title refers to producing millisecond pulsars by accretion-induced collapse (AIC) of a white dwarf.

The general idea of AIC making neutron stars has been around for some time (*1*), and pinpointing it as perhaps *the* source of millisecond pulsars was to my knowledge first suggested by myself (*2*) and Chanmugam and Brecher (*3*) several years ago. We both noted growing evidence that pulsar magnetic fields may not actually decay away (*4*), as popularly believed, which is essential if the clever but somewhat convoluted "recycling" model is to work; the "millisecond" pulsars are actually distinguished by having magnetic fields that are orders of magnitude weaker than any previously discovered pulsar; consequently, they are born fast and stay that way.

The crucial discovery (*5*) was that of a weak-field pulsar in the globular cluster M28, because the events believed to produce strong-field pulsars (type II supernovae) are unknown in such old stellar populations (but possibly did take place when the clusters first formed). Thus, a second mechanism for making pulsars was required, which most people assumed to be recycling (and still do; almost every discovery of a new weak-field pulsar is interpreted by observers as confirming recycling). These arguments are fully reviewed in a recent book on pulsars, *Theory of Neutron Star Magnetospheres* (*6*).

F. Curtis Michel
Department of Space Physics and Astronomy
Weiss School of Natural Sciences,
Post Office Box 1892,
Rice University
Houston, TX 77251

References

1. D. J. Helfand, M. A. Ruderman, J. Shaham, *Nature* **304**, 423 (1983); R. E. Taam and E. P. J. van den Heuvel, *Astrophys. J.* **305**, 235 (1986).
2. F. C. Michel, *Nature* **329**, 310 (1987).
3. G. Chanmugam and K. Brecher, *ibid.*, p. 696.
4. W. Kundt, *Astron. Astrophys.* **98**, 207 (1981); F. C. Michel, *Phys. Today* **39** (no. 10), 9 (1986).
5. J. Middleditch *et al.*, *Int. Astron. Union Circ. No. 4401* (1987); A. G. Lyne *et al.*, *Nature* **328**, 399 (1987).
6. F. C. Michel, *Theory of Neutron Star Magnetospheres* (Univ. of Chicago Press, Chicago, IL, 1991), p. 41.