



Lecture 30 : Millisecond Pulsars

A neutron star spinning 642 times a second was discovered in 1982! Although it was a 'solitary pulsar', a bold conjecture was made that it must be a "recycled pulsar" - like the Hulse-Taylor pulsar - spun-up in a low-mass binary, which somehow 'got rid' of its binary companion. This scenario led to the prediction that its magnetic field must be more than 10,000 times weaker than that of the Crab pulsar. Later observations confirmed this prediction. Forty years later, nearly 150 such "Millisecond Pulsars" have been discovered, all with very nearly the same magnetic field. Millisecond Pulsars are remarkable objects for several reasons. As "clocks", they are more stable than even "atomic clocks" which define the 'standard of time'. They spin fast enough for the next generation terrestrial detectors to detect gravitational waves emitted by them. Plans are also underway to use an "array" of such pulsars as a 'detector' of low frequency gravitational waves.

If one tries to describe the development of our understanding of *Millisecond Pulsars*, it would look very much like the work report of the Astrophysics Group of Raman Research Institute in the 1980s-'90s. The group was headed by Prof. G. Srinivasan at that time, and it was he took the main initiative in this activity. In fact, great strides were made from this group in the overall area of the evolution of Neutron Stars and there is no better way to catch the drift of the progress than to go to the original articles listed below.

- G. Srinivasan & E. P. J. van den Heuvel; 1982, A&A, 108, 143
Some constraints on the evolutionary history of the binary pulsar PSR1913+16
- V. Radhakrishnan & G. Srinivasan; 1982, CSci., 51, 1096
On the origin of the recently discovered ultra-rapid pulsar
- G. Srinivasan, D. Bhattacharya, K. S. Dwarakanath; 1984, JApA, 5, 403
On the supernova remnants produced by pulsars
- D. Bhattacharya & G. Srinivasan; 1986, CSci., 55, 327
On the implication of the recently discovered 5 millisecond binary pulsar PSR 1855+09
- G. Srinivasan; 1989, A&ARv, 1, 209
Pulsars: their origin and evolution
- G. Srinivasan, D. Bhattacharya, A. G. Muslimov & A. J. Tsygan; 1990, CSci., 59, 31
A novel mechanism for the decay of neutron star magnetic fields
- D. Bhattacharya & G. Srinivasan; 1991, JApJ, 12, 17
Gamma rays from millisecond pulsars

Going ahead, the two following volumes are of interest. The first one is a status summary of Neutron Star research in the 1990s (a symposium organised by Prof. Srinivasan). The second one, with a similar overview two decades down the line, is in essence a tribute to Prof. Srinivasan's work by his contemporaries and the younger generation.

- G. Srinivasan (ed.), 1995, **Pulsars** (*Proceedings of the Diamond Jubilee Symposium*), Indian Academy of Sciences
- D. Bhattacharya, K. S. Dwarakanath & S. Konar (eds.), 2017, *Journal of Astrophysics & Astronomy* (**Special Issue**), Indian Academy of Sciences

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