The Radio Pulsar - Magnetar Connection

Neutron stars are the final states of the evolution of stars which have main-sequence masses more than ten times that of the Sun. These are the most compact objects in the Universe that give rise to many unusual physical phenomenon in and around them. There exist many observational classes of neutron stars which are understood to be connected through various evolutionary processes. The aim of our project is to look for possible connections between the high magnetic radio pulsars and the magnetars (the extreme magnetic field neutron stars).

The radio pulsars, belonging to the class of Rotation Powered Pulsars (RPP), are powered by the loss of rotational energy due to magnetic braking. Magnetars are thought to be young, isolated neutron stars, that manifest themselves as soft gamma ray repeaters (SGR) and anomalous X-ray pulsars (AXP). It is believed that the main energy source of these objects is the decay of their super-strong magnetic fields.

In recent years, there have been observational indications for the existence of evolutionary pathways linking different classes of isolated neutron stars. There is a clear overlap between the high magnetic field (B$ > 4 \times 10^{13}$~G) radio pulsars and the magnetars in the B-P diagram (magnetic field - spin period diagram). The magnetar-like X-ray burst exhibited by some radio pulsars have reinforced the suggestion that such high field radio pulsars are quiescent magnetars.

To understand the possible connection between these two different observational classes, we shall consider three separate approaches.

A. Compare the intrinsic parameter space (spin period, magnetic field) of these two populations.

B. Undertake literature survey to find examples of certain radio pulsars showing magnetar behaviour, and vice-versa.

C. Write simple numerical programs to see how these two populations are expected to evolve in time (and whether, under any circumstance one could evolve into the other).

If you wish to work on this project, please do the following.

01. Please watch the short video posted on the IAU-OAD site describing this project.

02. Send me a mail (unless you have already done so).

03. Familiarise yourself with the following public databases.
    a. http://www.atnf.csiro.au/
    b. http://www.physics.mcgill.ca/~
    c. http://astro.phys.wvu.edu/

04. Please go through the following article to understand the context of this work.

https://ui.adsabs.harvard.edu/
