The 8gr8 Cygnus Survey for New Pulsars and RRATs

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ABSTRACT

We are currently undertaking a survey to search for new pulsars and the recently found Rotating RAdio Transcients (RRATs) in the Cygnus OB complex. The survey uses the Westerbrok Synthesis Radio Telescope in a unique mode wich gives it the best sensitivity of any low-frequency wide-area survey. So far we have found a few new pulsars and the routines for the detection of RRATs are starting to be implemented in the standard reduction and some preliminar results are presented here. We expect to find a few tens of new pulsars and a similar number of RRATs. This will help us to improve our knowledge about the population and properties of the latter poorly known objects as well as provide an improved knowledge of the number of young pulsars associated with the OB complexes in the Cygnus region.

The 8gr8 Cygnus Survey

This region is known as the Cygnus superbubble [1], contains a lot of OB associations and a large amount of hot gas whose origin remains unclear. It has been proposed that this hot gas was originated by a single or sequential SN explosions. If this is the case, there should be compact objects such as pulsars or black holes associated with the SN explosions [2]. These regions of high star formation are known to be areas where we would anticipate finding significant numbers of pulsars, especially young pulsars, finding them will lead us to a better understanding of the life-cycle of massive stars, their population, and to test with better statistics, the theoretical models that predict the evolution and behaviour of these systems.

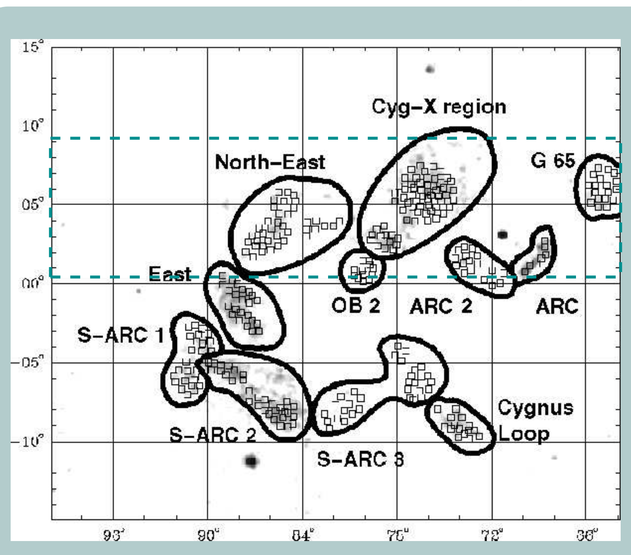

Fig.1 The Cygnus Superbubble [1]. The green box shows approximately the location of the targeted area for the 8gr8 Cygnus Survey.

The survey will:

- cover the region of the Galactic plane located between $100° < \ell < 60°$ and $0.5° < b < 8°$,
- have a coverage of $\sim$ 300 sq. degrees on the constellation of Cygnus.
- be $\sim$ 5 times more sensitivity for pulsars with P $>$ 1 s and,
- have a sensitivity of an order of magnitude for pulsars with P $<$ 1 s.

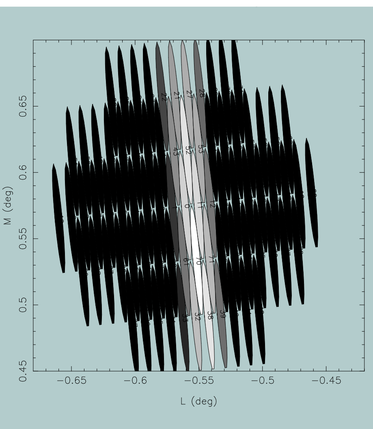

Fig. 2 Plot showing the contour and shape of the beams. The grayscale shows the beam with the highest S/N response for the candidate shown in the Fig. 3

What is the 8gr8 survey?

- Our survey is performed at 328 MHz to maximise the field-of-view/sensitivity trade off.
- The sensitivity of WRST in the 8gr8 mode allows to explore this frequency with better accuracy than other radio telescopes.
- Each observation is made using 12 WSRT telescopes which are arranged to forma grating array. The data is then combined in such a way that we end with 8 separate beams pointing at different locations in the primary beam.
- Using this combination we get the sensitivity of all 12 dishes but a beam size of just one!
- Our observations have 2^{22} samples with a sampling time of 819.2 μs and a total dwell time of 6872s.
- In total we have $\sim$ 72 points of observations, and between 900 – 1500 beams per point.
- Each pointing has at least two rounds of observations.

Reducing the Data

We reduce the data following the steps enumerated below:

1. Dedispersing the data files.
2. Combining the 8 beams into an array of N subbeams.
3. For the pulsar search, we use the standard FFT technique, with an output as the shown in Fig. 3
4. A candidate for a new pulsar should appear in all the founds of observations for that area.
5. For RRATs search we implemented an approach similar to the used by McLaughlin *et al.* [4].
6. A possible candidate for an RRATs should appear like the shown in Fig. 4, and also all the observations for that area.

What RRATs are?

Until now it is not clear what is the true nature of RRATs, and they can be related either to radio quiet X–ray populations [4] of neutron stars such as AXPs/SGRs (Magnetar candidates [5]), isolated neutron stars [6], re–activated radio pulsars [7] or giant pulses of distant Crab–like pulsars [8].

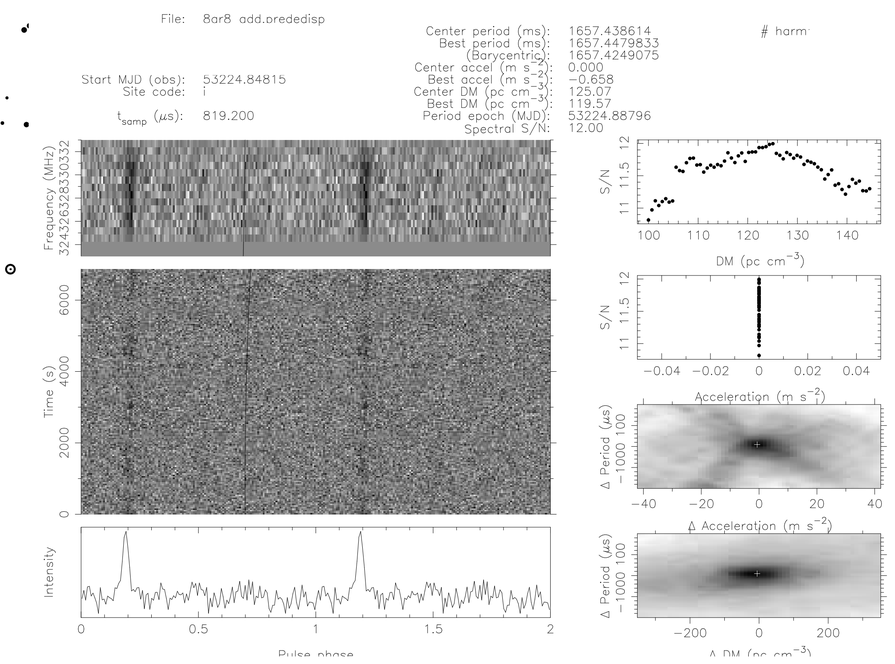

Fig. 3 Plot showing the output from a pulsar search of data, a new pulsar candiate from the 8gr8 Cygnus Survey. The plots show clearly a pulsating signal and its properties.

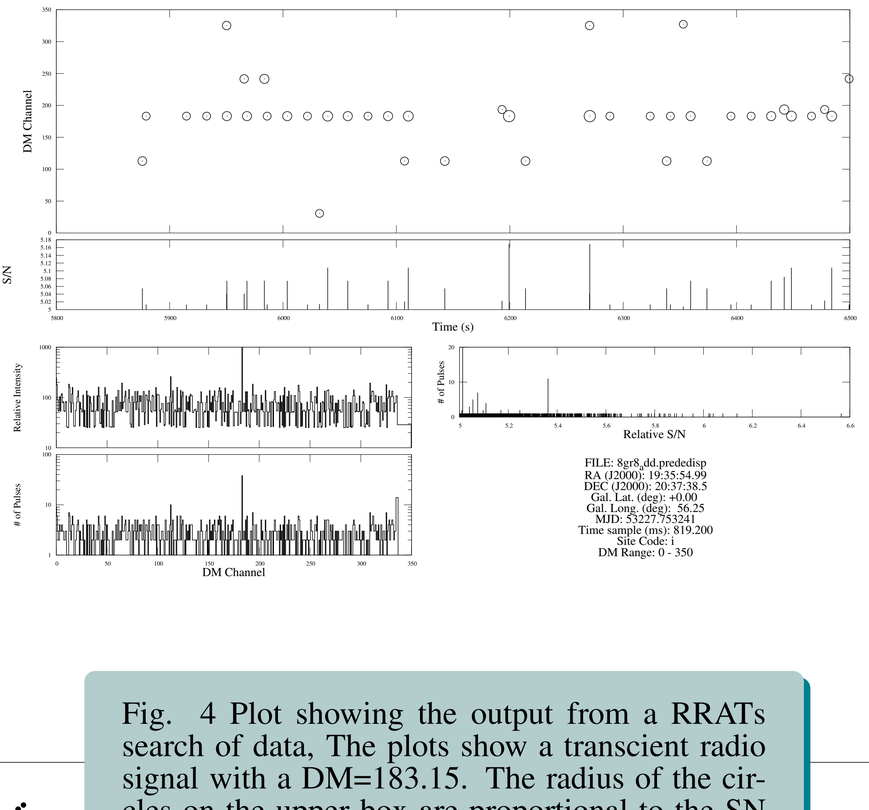

Fig. 4 Plot showing the output from a RRATs search of data, The plots show a transcient radio signal with a DM=183.15. The radius of the circles on the upper box are proportional to the SN value.

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