

A Strawman list of Northern Hemisphere Gamma Ray Pulsar Candidates

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1. Motivation

May 2 is the deadline to request time on the Nançay radiotelescope for the 2nd half of 2006. The GLAST request will be part of a program called “high energy pulsar timing”, to group together studies for HESS (led by Yves Gallant in Montpellier), and X-ray binary studies with XMM (led by Natalie Webb in Toulouse). Ismaël Cognard and Gilles Theureau will combine the three requests into one coherent ensemble. They have asked us to provide them with target lists **one week ahead of the deadline**, that is, for **Monday, April 24**.

We no longer want a small pilot program of a dozen or so pulsars to quantify Nançay’s sensitivity. Instead we will accelerate our program and submit a list as big as GLAST’s ambitions. A look at the calendar made us pick up the pace: before Fall 2007, only a year and a half away, we’d like to be able to submit an article similar in spirit to “Timing Behavior of 96 Radio Pulsars” (Arzoumanian, Z., Nice, D.J., Taylor, J.H., and Thorsett, S.E., Ap J 422 :671-680 (1994)). And, of course, have the Science Tools D4 database of pulsar ephemerides humming and ready for launch.

This notes describes a list we’ve prepared, in the hopes that our handlers, having vastly more gamma ray pulsar experience than we, will react quickly to improve it. Note that the exercise performed for Nançay is very easily extended to the rest of the radiotelescopes and will have to be done before too long anyway.

2. The lists, and how we built them.

We work with the ATNF catalog. The files cited below can be found at <http://www.cenbg.in2p3.fr/ftp/astropart/Smith/Pulsars/>

a) the first list

Roger’s presentation at the February 21 pulsar group meeting, called *TimingTriage.pdf*, is our starting point. We re-produced his list (his slide 6). Inspired by this, we made the list in *SomePulsarCandidates.xls*, where the pulsars are sorted by

$$\sqrt{\dot{E}/d^2}, \text{ with a cut requiring } \dot{E} > 2.E34 \text{ ergs/s}$$

In addition, we require $-39 < \text{dec} < 60$ degrees, for Nançay, leaving 88 pulsars.

A nice feature of this list is the EGRET counterparts taken from a talk by Alice, and a comparison with AGILE’s targets from a paper by Pellizzoni et al. 8 of the 10 pulsars that Roger suggested for us to get the Nançay ball rolling are there: missing are J2229+6114, which is a hair too far north, and J1946+2611 which has $\dot{E} = 1.05E34$ ergs/s and so failed the cut.

a) the second list

We then dug out a list of 9 ms pulsars that Alice gave CELESTE back in 2002, that she said were candidates for 50 GeV emission. The list is on slide 25 of my talk at the February 21 pulsar group meeting, called *PSRmeet21February2006v2.pdf*. Of the 8 pulsars within Nançay’s declination reach, only one made our first list. To diversify our portfolio we amended the cuts to

$$\dot{E} > 2.E34 \text{ ergs/s} \quad \text{OR} \quad \sqrt{\dot{E}/d^2} > 1\% \text{ of the Crab value}$$

And we tightened the declination cut a hair, to $-35 < \text{dec} < 55$ degrees. 108 pulsars pass these criteria, including Alice's 8 and Roger's 8, after removing Geminga.

The list is in

BordeauxPsrCandidates.txt
BordeauxPsrCandidates.pdf

The user variable columns are as follows:

C1 is $\sqrt{\dot{E}/d^2}/k$, where $k=5.362E18$ is simply $\sqrt{\dot{E}/d^2}$ for the Crab. The list is ordered by this variable.

C2 is $\dot{E}/d^2/k$, where $k=1.2E38$ is \dot{E}/d^2 for the Crab.

C3 is B_{LC}/k , where $k=98000$ is the magnetic field at the light cylinder for the Crab. This parameter was suggested by Michel & Dermer in Nature 356 (1992) 483 (we may have that reference wrong...). Far down the $\sqrt{\dot{E}/d^2}$ list before cuts there are pulsars that have C3 of a few percent, with \dot{E} values not too far below our cut. These are millisecond pulsars... If we want to hedge our bets a little more we could add an OR on this variable too.

C4 is $(W50/P0)**3/S1400^2/k$, an estimator of the radio telescope time needed to get a good TOA measurement, with $k=2.12E7$ the value for J0205+6449, to attempt to be coherent with Roger's slides even if it is too far north for Nançay. Some of Alice's sources have shockingly large values which may be due in part to W50 not being in the ATNF database.

3. Towards better lists

This missive is going out to some very experienced pulsar people – please correct and amend our reasoning. Once we have our list, we'll also want to rough out some agreement amongst GBT, Jodrell, Nançay, and Parkes to make sure that coverage of our candidates is rational (none of the good ones lost, and not everyone doing the same ones). But one thing at a time...

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