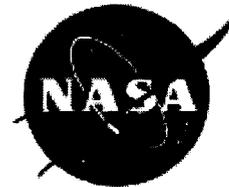


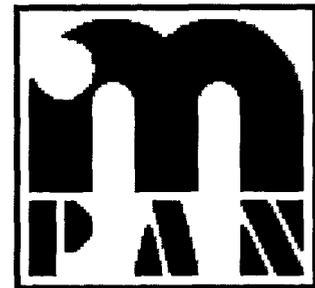
All-sky search of **EXPLORER** data for continuous sources

Jet Propulsion Laboratory
Pasadena
on leave from
Institute of Mathematics
Warsaw



National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California



25 August 2003

Warszawa 9/9/2003

All-sky Search of the EXPLORER Data

EXPLORER resonant bar detector



The EXPLORER detector is operated by Italian group called ROG currently led by Eugenio Coccia. The analysis is performed by a team consisting of Pia Astone, Kazik Borkowski, Piotr Jaranowski, Andrzej Królak, Maciej Piętka and is carried out on the basis of Memorandum of Understanding between the ROG group and Institute of Mathematics of Polish Academy of Sciences.

<http://www.astro.uni.torun.pl/~kb/AllSky/AllSky.html>

Linear parameterization of the response

For observation time of few days and a few Hz bandwidth linear representation is an adequate approximation.

$$h(t) = \sum_{j=1}^2 a_j(t) [C_j \cos \Phi(t) + D_j \sin \Phi(t)]$$

$$\Phi_s = p_0 t + p_1 t^2 + A \cos(\Omega t) + B \sin(\Omega t)$$

Maximum likelihood detection

$$F = \ln \Lambda_r = \frac{2}{S h(f) T_o} \sum_{j=1}^2 \frac{|T_j|^2}{\langle a_j^2 \rangle}$$

$$T_j = \int_0^{T_o} x(t) a_j(t) \exp[-i \Phi_{NS}(t)] \exp[-i p_o t] dt$$

$$C_j + i D_j = 2 \frac{T_{\max j}}{\langle a_j^2 \rangle}$$

Parameters of the search

- Parameters of the data:

- **The Modified Julian Date of the first**

sample: 46566.7566567

- **Length of observation time: 2 days**

- **Bandwidth of the search: 920.9992 -- 921.7598 Hz**

- Parameters of the search:

- **Spin down range: $-9.1762 \cdot 10^{-8}$ -- $+9.1762 \cdot 10^{-8}$ Hz s⁻¹**

- **No. of spin downs 2868**

- **Sky positions: All sky, no. of pointings 31915**

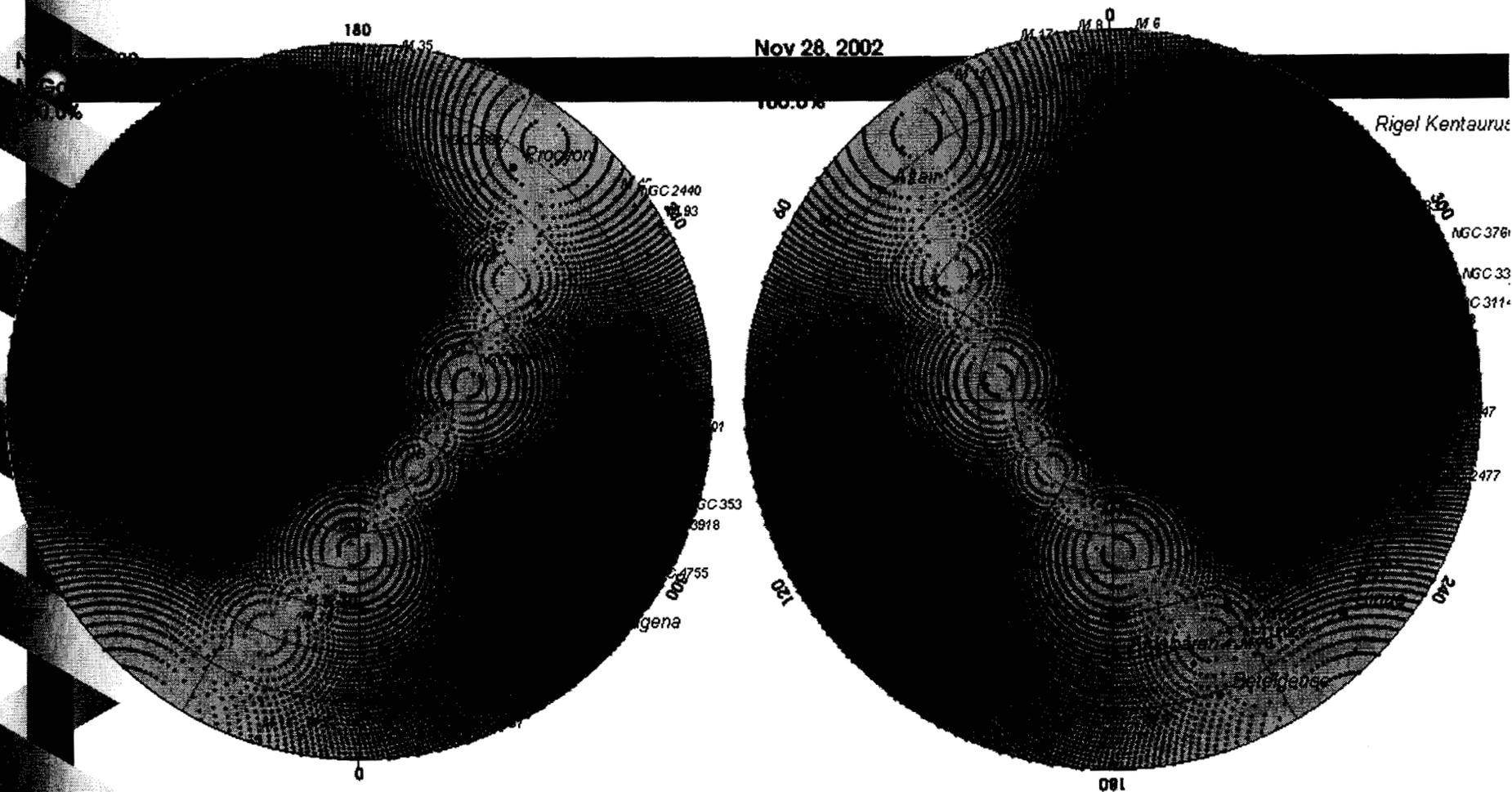
- **No. of filters = 183064440**

- **Sensitivity of the search**

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Search progress



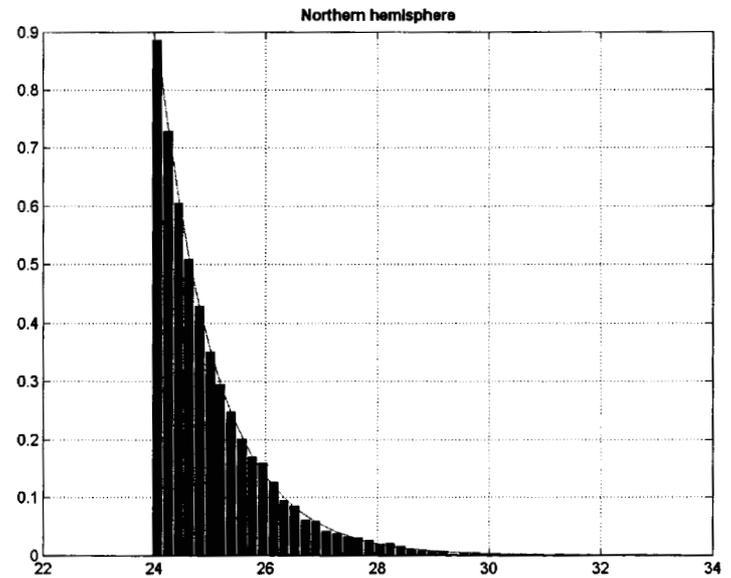
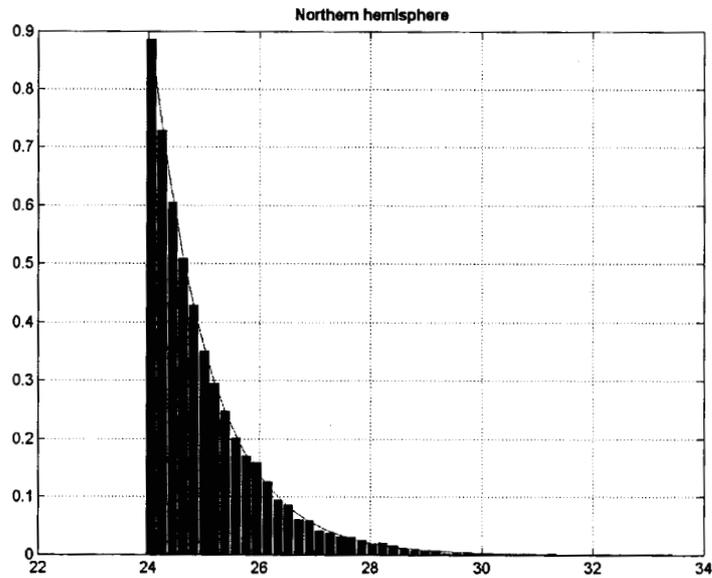
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Candidate statistics

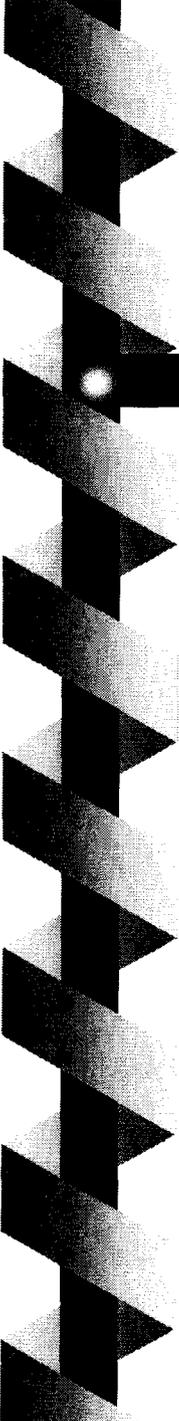
If there is no noise F has χ^2 distribution with 4 degrees of freedom.

u_{tr}



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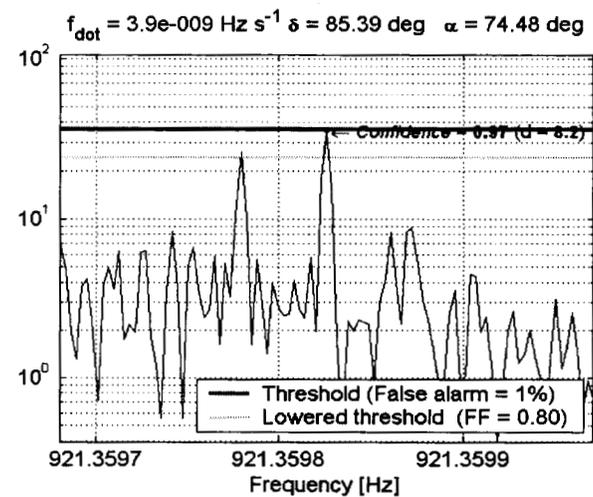
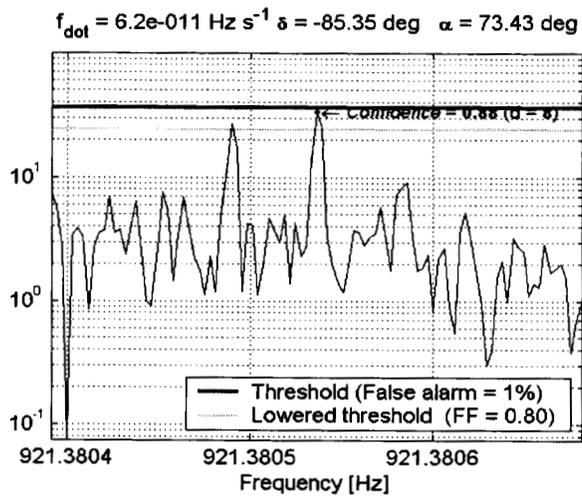
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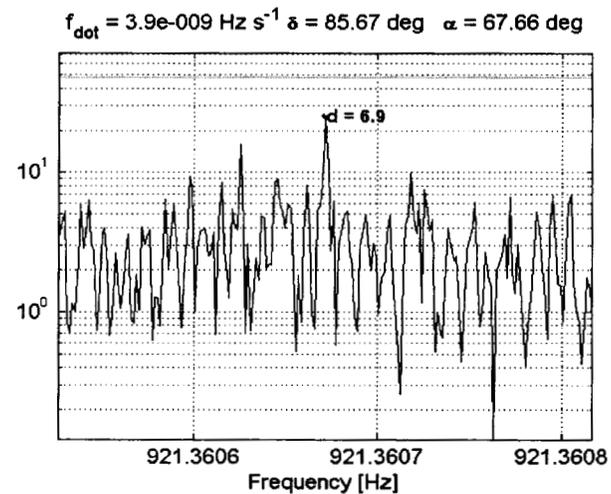
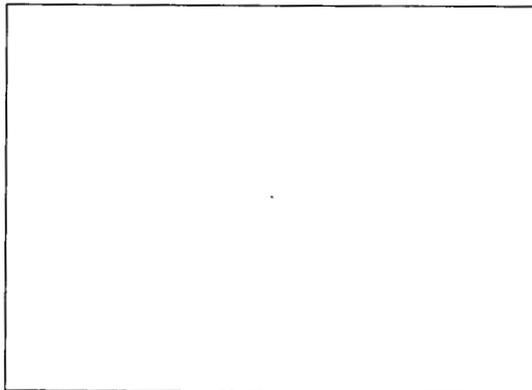
Candidate verification

- 1. Transformation from parameters (p_0, p_1, A, B) to astrophysical parameters (f, f_1, α, β) .**
- 2. Search on a small grid around astrophysical parameters.**
- 3. Search in a different 2-day stretch of data.**
- 4. Search in a 4-day stretch of data containing the original 2-day stretch.**

Candidate verification: an example



NO SIGNAL FOR DIFFERENT OBSERVATION TIME



Upper limit

$$p_1(d, F) = \frac{\sqrt{2F}}{d} I_1(d\sqrt{2F}) \exp(-F - \frac{1}{2}d^2)$$

$$p_D(d, F_0) = \int_{F_0}^{\infty} p_1(d, F) dF \quad F_{\max} = \frac{1}{2}d_{\max}^2 + 2$$

$$p_D(d_{UB}, F_{\max}) = 0.01$$

99% confidence upper limit

$$d_{UB} = 5.9 \Leftrightarrow h = 2 \times 10^{-23}$$