

DC2 source identification with *gtsrcid*

Vincent Lonjou, Romain Dicostanzo & Jürgen Knödseder

Outline

- DC2 source identification with *gtsrcid*
 - method
 - extra-galactic sources
 - galactic sources
 - high energy sources
 - summary
- *gtsrcid* associated tools
 - display
 - tutorial
- Conclusion

DC2 source identification : method

- **Extra galactic sources :**

- Blazar identification "à la *Mattox et al., 2001*"
- BL Lac catalogs (*Veron-Cetty et al., 2003*), Blazars (*Sowards-Emmerd et al., 2003*)
- Seyfert (*Lipovetsky V.A. et al., 1988*)
- AGN (*Veron-Cetty et al., 2003*), QSO (*Veron-Cetty et al., 2003*)

- **Galactic sources**

- pulsars (ATNF catalog)
- SNR (*Green., 2001*)
- LMXB & HMXB (*Liu et al., 2001*), microquasars (*Paredes, 2004*)

- **Correlation with others HE-THE experiment catalogs**

- EGRET catalog (*Hartman et al., 1999*)
- HESS catalog (http://www.mpihd.mpg.de/hfm/HESS/public/HESS_catalog.htm)

Method

Probability method : POSITION

angular distance between
source and counterpart

$$P_{\text{pos}} = \exp\left(\frac{-\varphi}{\sqrt{\theta_{\text{src}}^2 + \theta_{\text{cpt}}^2}}\right)$$

error on the
source position

error on the
counterpart position

User defined probability : SNR

- Green catalog (2001), 231 SNR
- SNR are extended sources
 - $1.2' < \text{extension} < 310'$ in Green catalog
 - select extension $< 60'$

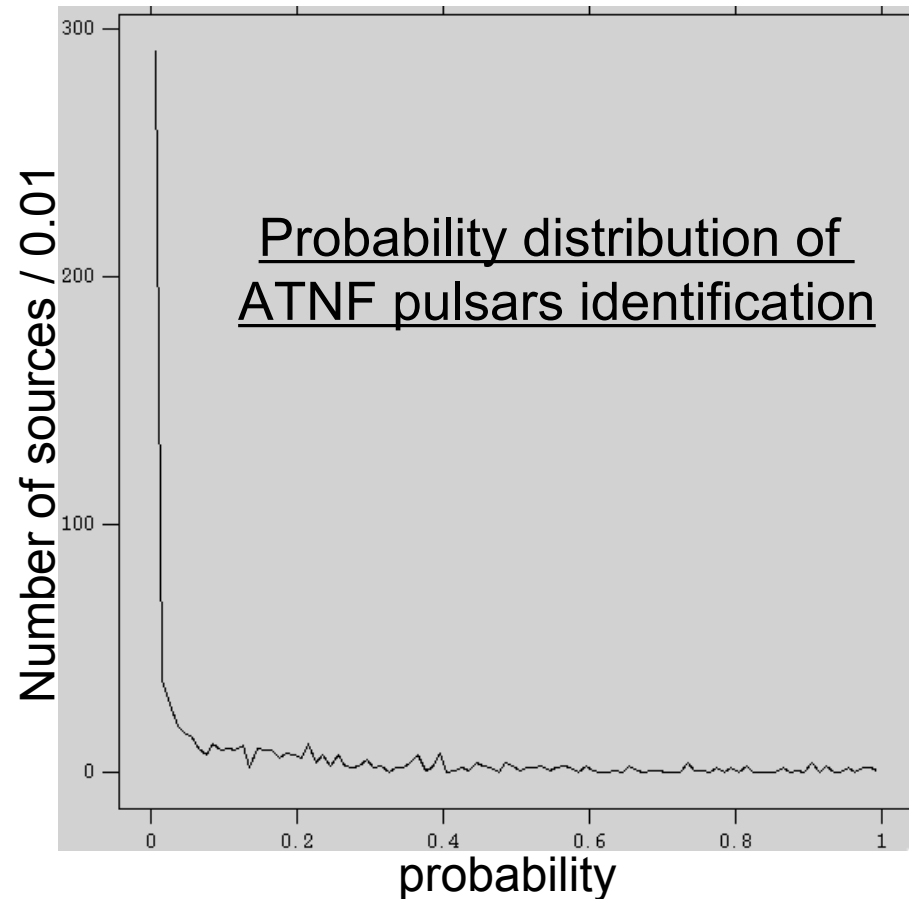
$$P_{\text{pos}} = \exp\left(\frac{-\varphi}{\sqrt{\theta_{\text{src}}^2 + \theta_{\text{cpt}}^2}}\right)$$

error on the
source position

spatial extension of
the SNR

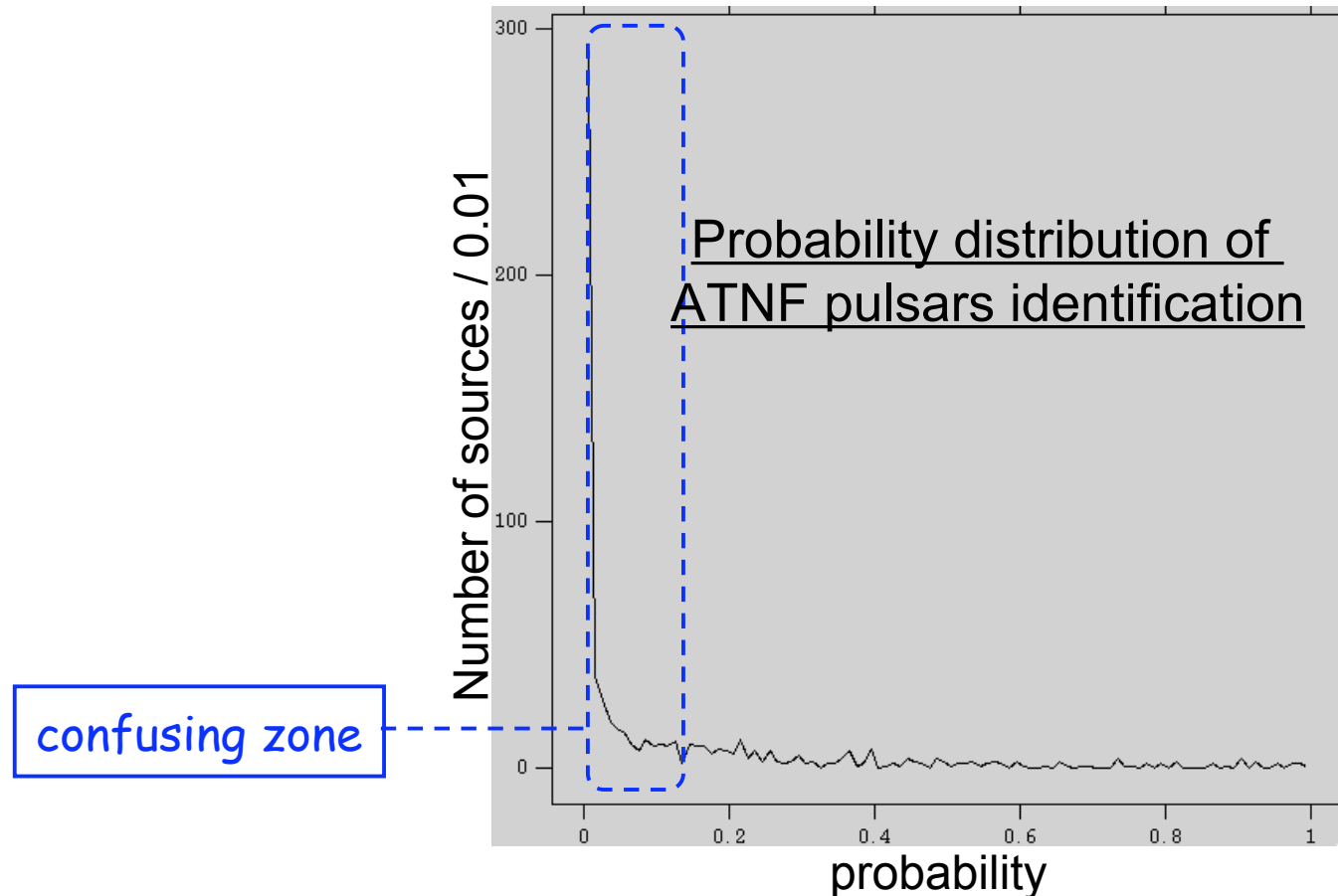
Method : probability distribution

a tool to get a realistic value for the probability threshold



Method : probability distribution

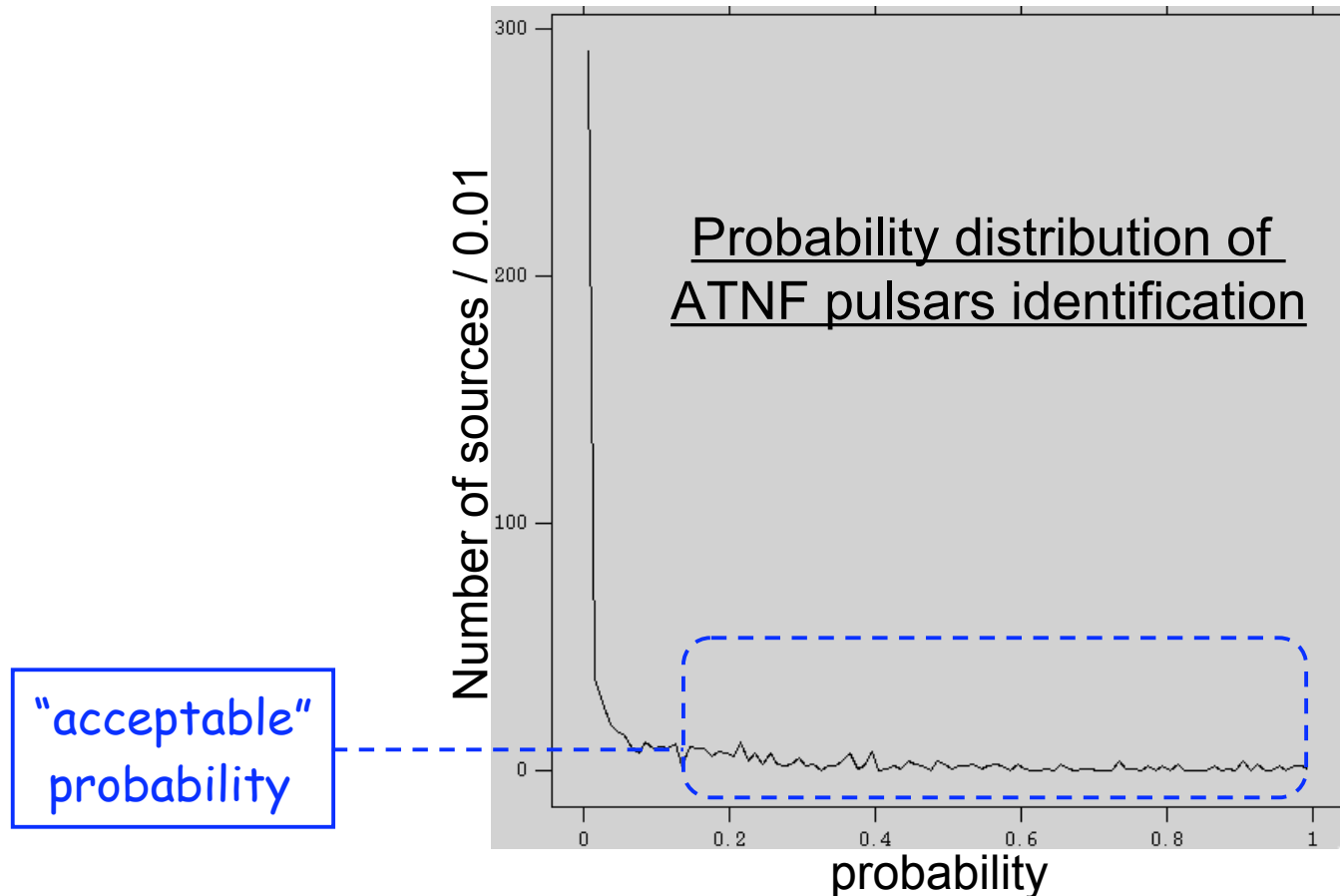
a tool to get a realistic value for the probability threshold



Angular distance between source and counterpart > mean angular distance in the counterpart catalog

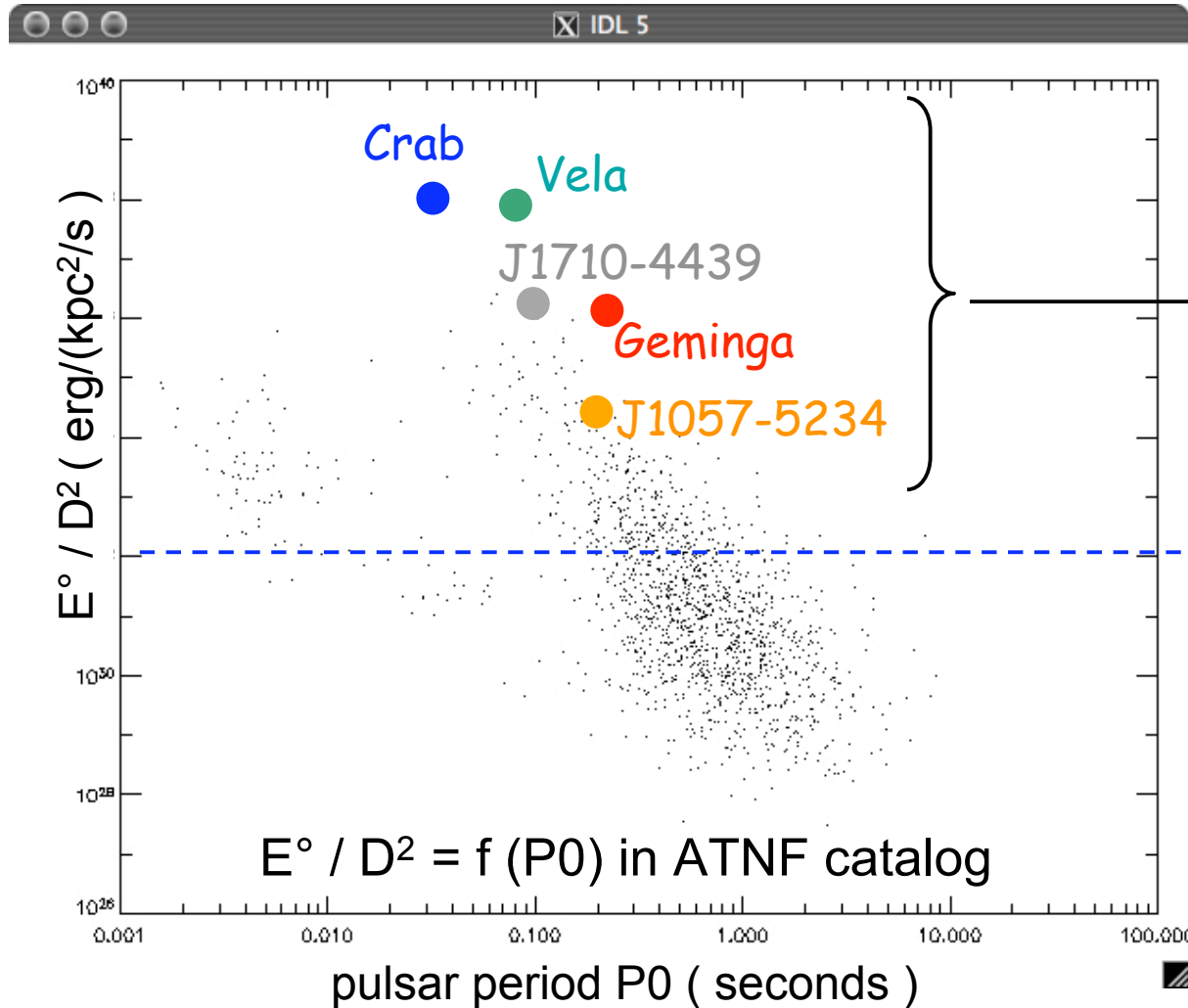
Method : probability distribution

a tool to get a realistic value for the probability threshold



The number of identified sources still depends on the probability threshold

Method : add some physics...



ATNF & pulsars

5 EGRET pulsars

selection criteria
 $\sim 10^{32}$
 $\sim 1\%$ J1057-5234

suppress 72% of
the candidates

Method : final results

Create a fits file with 2 columns (cpt name+prob) per LAT sources

Select	proba_AGN	blac	proba_blac	blazars	proba_blazars	QSO	proba_QSO	Seyfert	proba_Seyfert
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15A25	11A25	15A25	11A25	15A25	11A25	15A25	11A25	15A25	15A25
<input type="checkbox"/> All									
<input type="button" value="Invert"/>									
118	0.0000000	unknown	0.0000000	J0633+1751	0.80516800	Q0630+180	0.59843900	unknown	0.0000000
119	0.0000000	unknown	0.0000000	J0628+1847	0.82502100	unknown	0.0000000	unknown	0.0000000
120	0.0000000	unknown	0.0000000	J0617+2238	0.52333700	unknown	0.0000000	unknown	0.0000000
121	0.0000000	unknown	0.0000000	unknown	0.0000000	unknown	0.0000000	unknown	0.0000000

Then, select a unique counterpart :

Select	Number_of_counterparts	Most_Probable
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30A25	30A25	
<input type="checkbox"/> All		
<input type="button" value="Invert"/>		
81	1	QSO=TEX2032+117, 0.9459820
82	3	AGN=3C66.0B, 0.92504900
83	1	QSO=PKS1936-15, 0.92303000
84	0	none
85	2	Mattox=J1924-2914, 0.99998
86	1	blazars=J2046+0933, 0.8857
87	0	none
88	1	QSO=3EGJ0422+1741, 0.89680
89	1	blazars=J2352+3752, 0.9270

Extra galactic

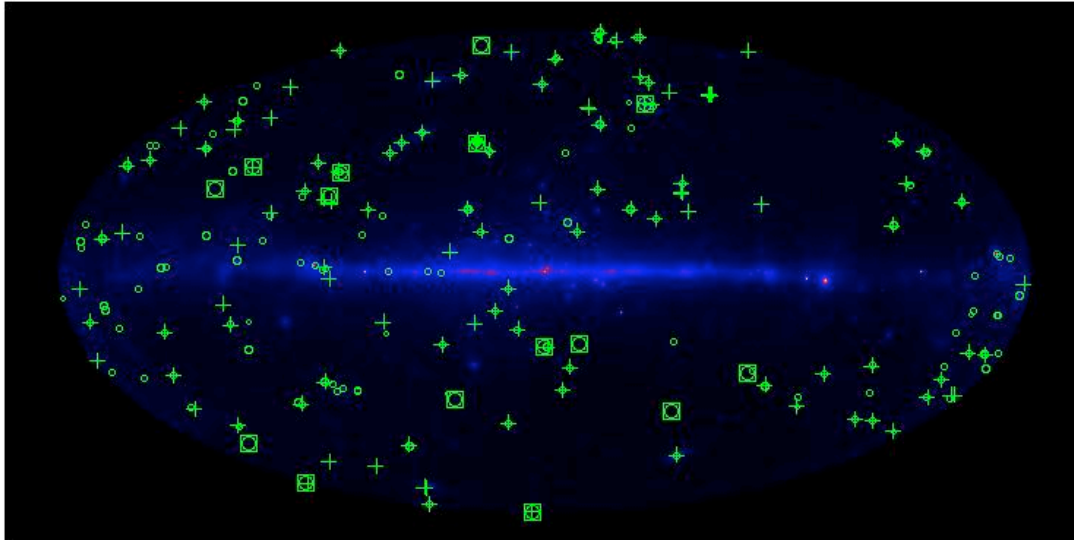
- blazars
- Seyfert
- AGN & QSO



Galactic

- pulsars
- microquasars
- binaries
- SNR

Extra-galactic sources



Extra-galactic sources :

Blazars

• Mattox et al. ○ 85(114) 85

• catalog ○ 74 49

Seyfert □ 15 9

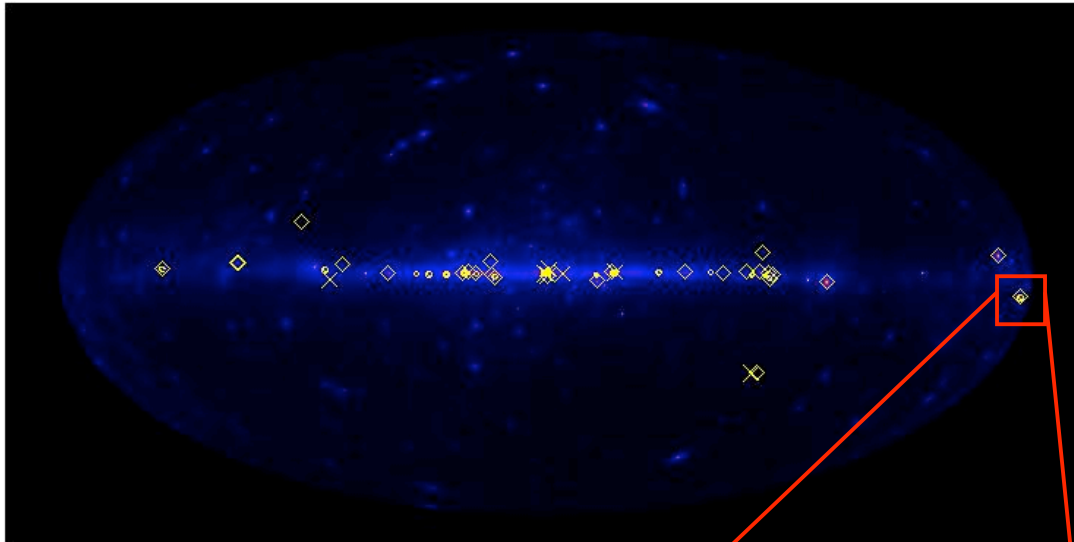
AGN & QSO ✦ 117 26

Total number of AGN 169

Raw number for each class

Number after suppression of cross-talk
between different classes

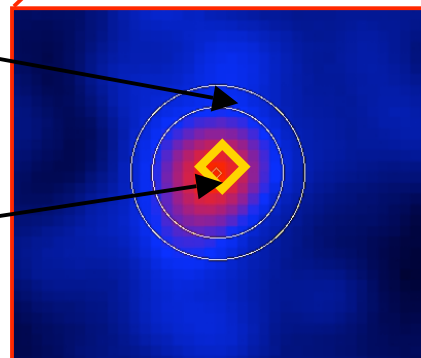
Galactic sources



Galactic sources :

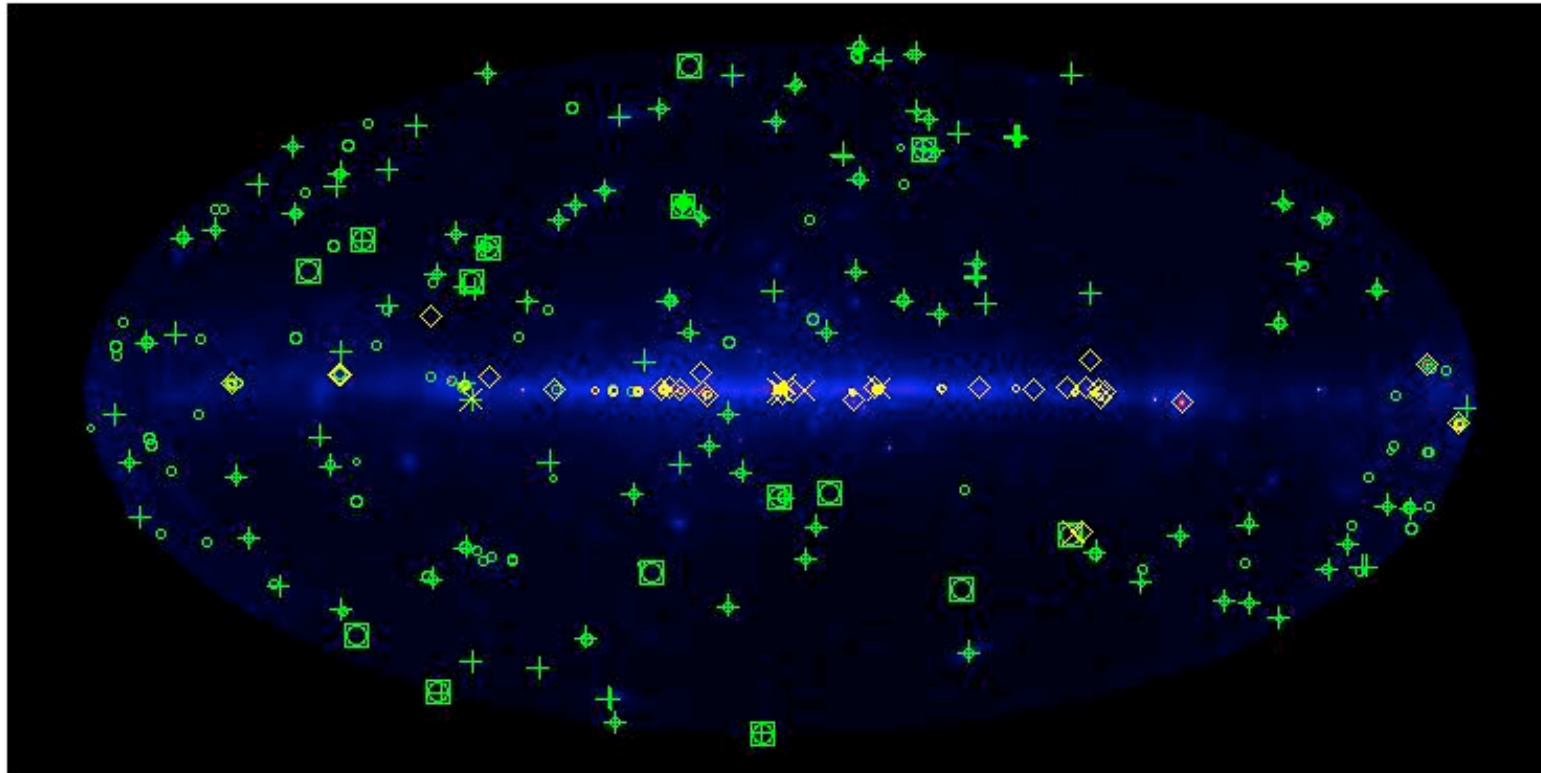
Pulsar	◇	22	22
microquasars	×	2	1
LMXB/HMXB	○	17	12
SNR	◎	11	4
Total number			39

Pulsar + SNR :



Crab region

DC2 source identification : summary



Extra-galactic sources

169



Galactic sources

39



Identified sources

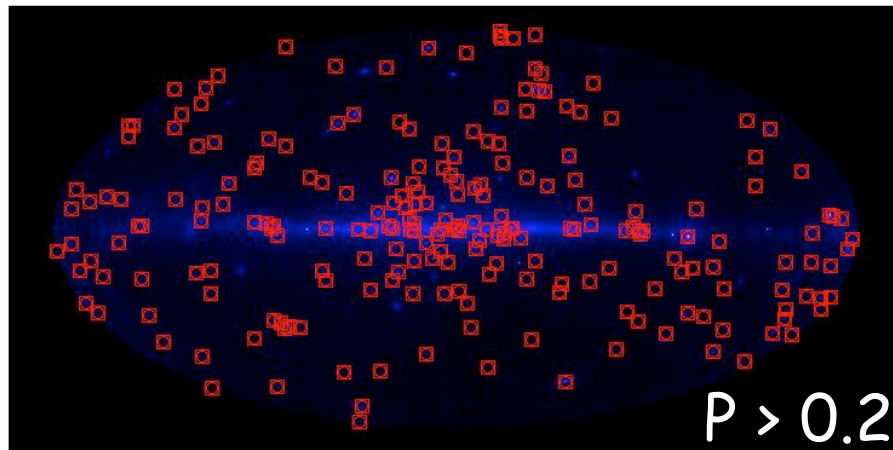
55 %

= f (probability threshold)

EGRET & HESS sources

EGRET sources

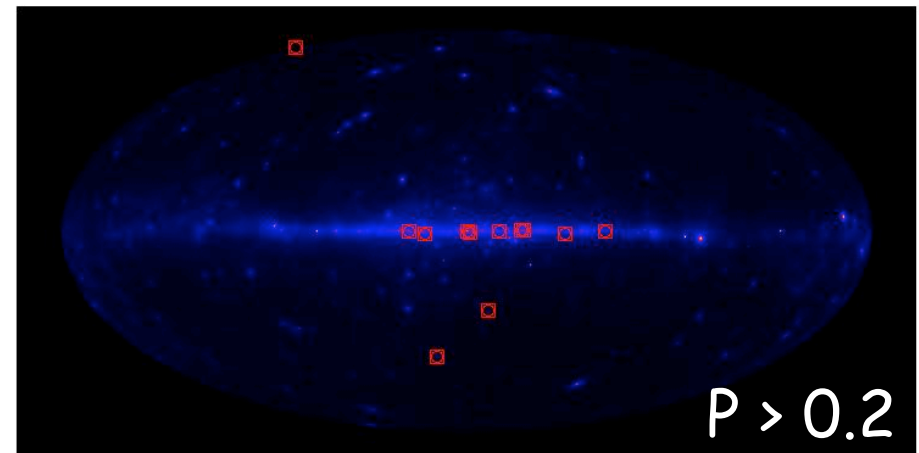
3EG (Hartman et al., 1999), 271 sources



- Probability < 0.2 confusing
- Probability > 0.2 221 sources
- Probability > 0.5 172 sources
- Probability > 0.8 98 sources

HESS sources

HESS catalog (web site), 25 sources



- Probability < 0.2 confusing
- Probability > 0.2 12 sources
- Probability > 0.5 8 sources
- Probability > 0.8 2 sources

gtsrcid associated tools : display

Generation of *.reg file for DS9

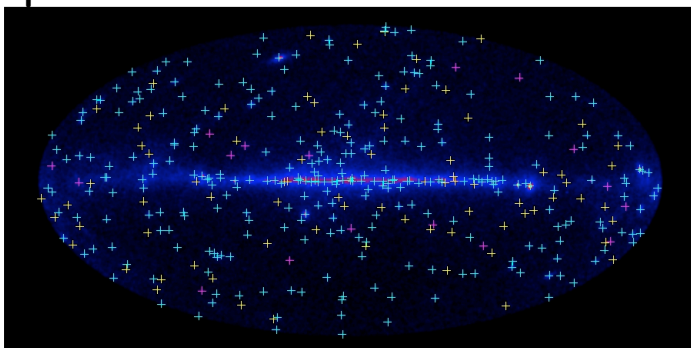
- Why ?

Display *gtsrcid* output

- How ?

IDL code which read *gtsrcid* output fits file, generation of *.reg file

- Output :



Implementation of a visualization routine in *gtsrcid*

- Why ?

Instantaneous and systematic check of *gtsrcid* output

- How ?

New C++ routine in *gtsrcid*, generate a *.ps file

On-going...

*.reg ?

gtsrcid associated tools : tutorial

http://www.cesr.fr/~lonjou/gtsrcid_DC2_tutorial/index.html

gtsrcid DC2 Tutorial

Purpose:

Explain how to use *gtsrcid* with some examples of use :

- [1-How to cross-correlate DC2 LAT catalog and 3EG](#)
- [2-How to reproduce the Mattox et al. 2001 method on DC2 LAT catalog](#)
- [3-How to cross-correlate DC2 LAT catalog and the ATNF pulsar catalog](#)

Provide a catalog data base:

- [catalog data base](#)

References, links:

- *gtsrcid* tutorial on [the SAS web page](#)
- Jürgen Knödliseder "DC2 kick off" presentation, [ppt](#), [pdf](#)
- Vincent Lonjou "DC2 kick off" presentation, [ppt](#), [pdf](#)
- Mattox et al. 2001, APJS, Volume 135, Issue 2, p. 155-175, [ADS](#)

Requirements : what do you need to use *gtsrcid*

- the Sciences Tools (v7r0p2) : [get the DC2 version of the Science Tools](#)
- one of the following packages:
 - [DC2 LATSourceCatalog v1-3EG tutorial.tar.gz](#)
 - [DC2 LATSourceCatalog v1-Mattox tutorial.tar.gz](#)
 - [DC2 LATSourceCatalog V1-ATNF tutorial.tar.gz](#)
- **Warning:** You must install Science Tools v7r0p2 because there are problems of compatibility between *gtsrcid* and the LAT catalog with older versions.

Provides methods with examples of use

Provides catalogs

SOON... provides *gtsrcid* associated tools

...ideas and wishes are welcome

Conclusion

- DC2 source identification
 - 55% of identified sources
 - 169 extra-galactic sources (85 blazars)
 - 39 galactic sources (22 pulsars)
- *gtsrcid* evolution
 - DC2 feedback
 - Comparison with others groups results
 - Work on methods accordingly