# Science Groups Overview

- **There are 9 LAT science working groups**

- Blazars and other AGN
  - Paolo Giommi, Benoit Lott
- Calibration and Analysis
  - Bill Atwood, Steve Ritz
- Catalog
  - Seth Digel, Isabelle Grenier
- Dark Matter and new physics
  - Elliott Bloom, Aldo Morselli
- Diffuse (Galactic and Extragalatic Seth Digel, Isabelle Grenier
- Gamma-ray Bursts
  - Jay Norris, Nicola Omodei
- Pulsars, SNRs and Plerions
  - Roger Romani, Dave Thompson
- Sources in the Solar system
  - Gerry Share
- Unidentified Sources, population studies and other galaxies
  - Patrizia Caraveo, Olaf Reimer

**Most people are members of more than one group, 188 unique names!**

# Roles of the science groups

- Make preparations for obtaining science results with the LAT
  - Science Goals: Keep abreast of new science discoveries to stay current on what GLAST can do
  - Develop analysis algorithms and software
  - Develop astrophysics simulations
  - Plan and propose for observations at other wavelengths to complement the GLAST data
  - Communicate with the rest of the scientific community about GLAST capabilities and results
    - Write papers, present GLAST contributions at conferences.
- Provide forums for LAT folks to work together on all these things
  - Meetings, mailing lists, confluence pages…

# Organisation

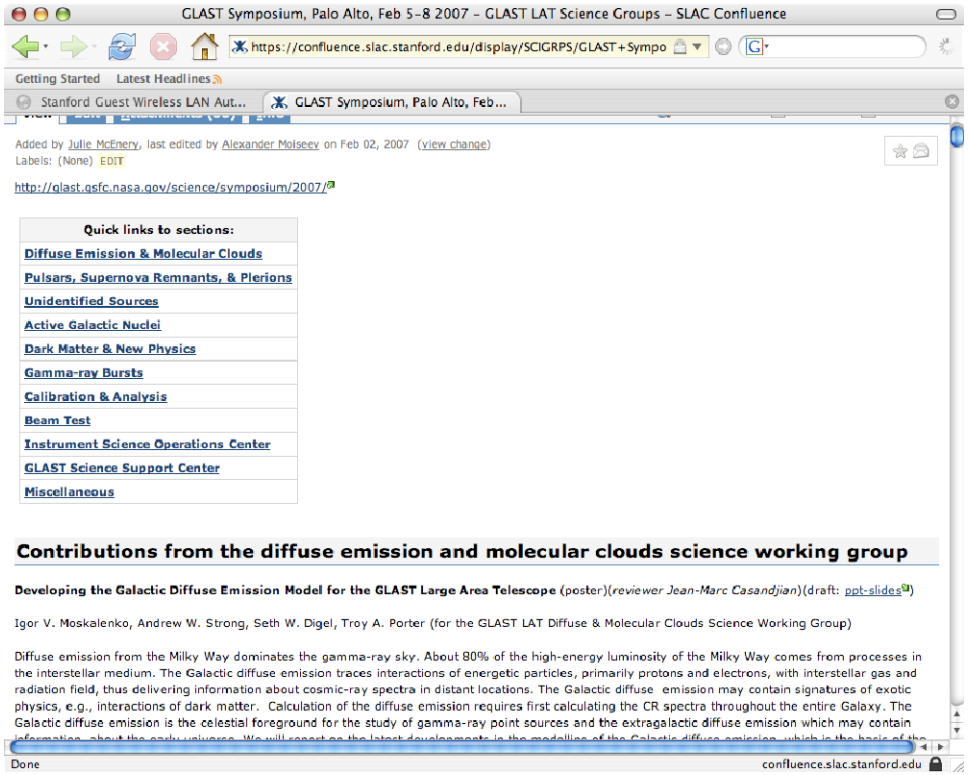
- Science group coordinators meet each month (on the first Friday of each month typically).
- The agenda, presentations and minutes from each meeting are available to all collaborators.
  - Multiwavelength report
  - Status of papers
  - Upcoming conferences
  - Discussion of simulation and analysis progress and plans
  - Coordination of collaboration and science group F2F meetings.
- Intent is that all the topics discussed at the coordinators meetings are also discussed (in more detail) in the meetings of the individual science groups.

# Conference contributions

- **Substantial LAT presence at several major meetings:**
  - **17 LAT presentations at HEAD meeting**
  - **11 LAT presentations at AAS meeting in Seattle**
  - **> 65 LAT presentations at GLAST symposium!!**
- **Many other LAT presentations at topic specific meetings**
- **Plans for LAT contributions at upcoming conferences is a regular topic in most science group meetings.**

# Conference Coordination

- **Discuss upcoming conferences in science group coordinators meetings.**
- **Encourage authors to post the titles, abstracts and slides/poster on the drafts webpage.**
- **Final talks/posters archive at the speakers bureau.**

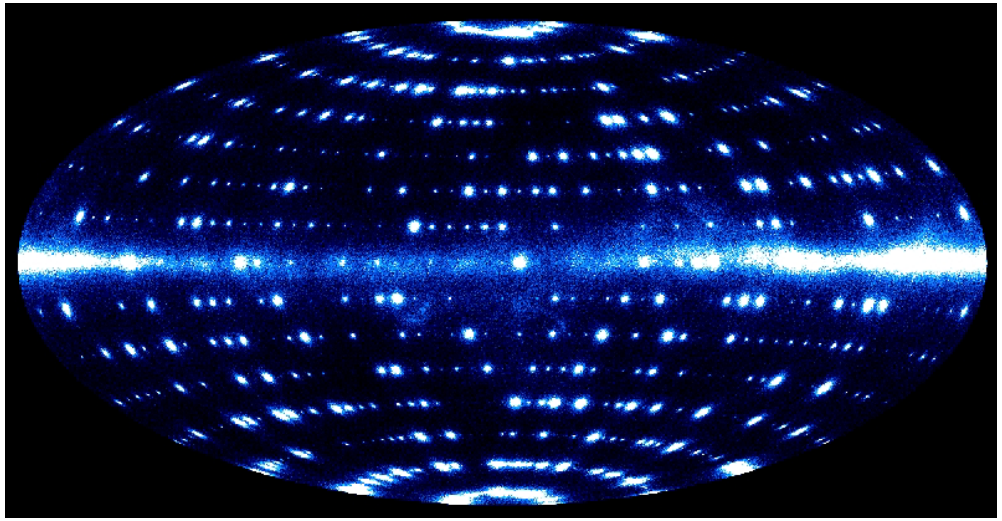


# Papers

- LAT instrument paper
  - Includes contributions from all the groups
- Calibration and Analysis group has been coordinating instrument subsystem papers
  - ACD - accepted by Astroparticle physics
  - Tkr - final draft reviewed
- Many conference proceedings

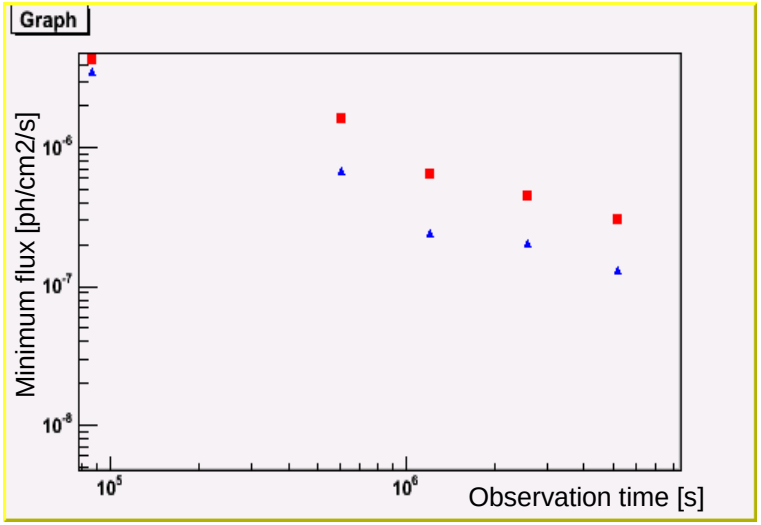
# Systematic studies: Pulsars

- Max Razzano - studying pulsar detection sensitivity
- Grid of pulsars with systematically changing flux superimposed on galactic diffuse background.



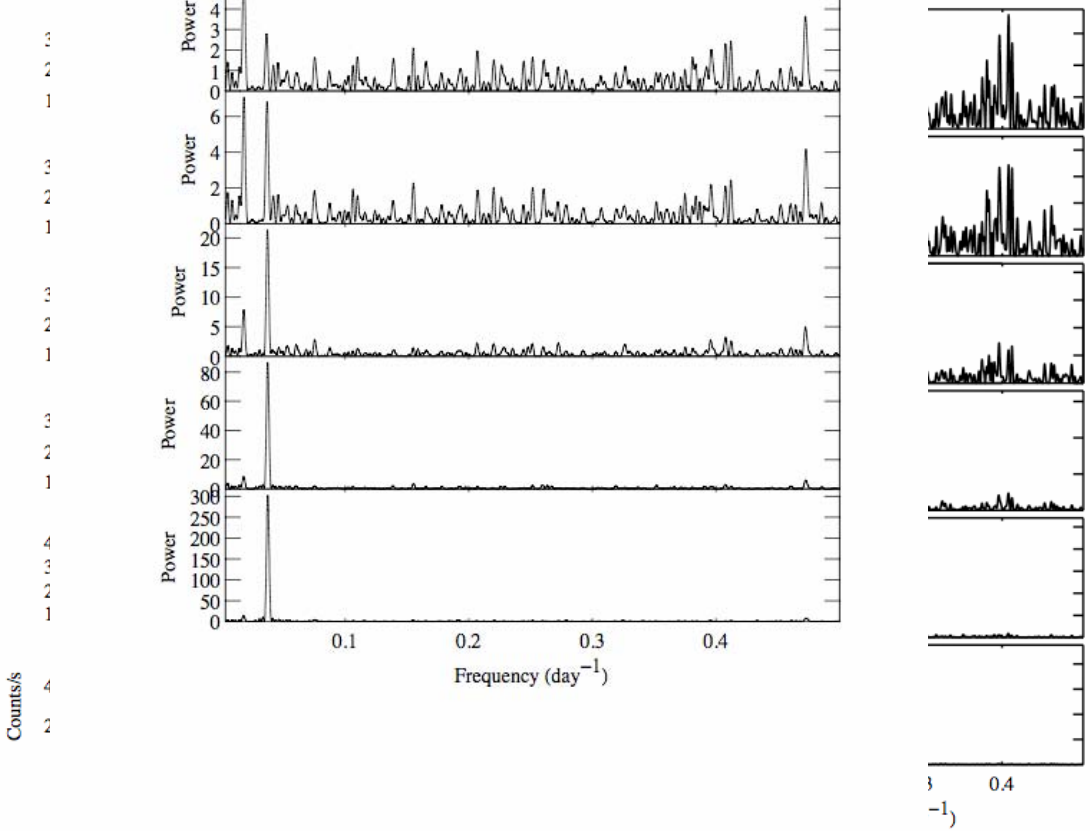
Plot of the minimum detected flux with time, for 2 different galactic latitudes. The red points are for b=0° and the blue for b=24°.

The points appear to be well fitted with a power law f(t) = 1/sqrt(t).

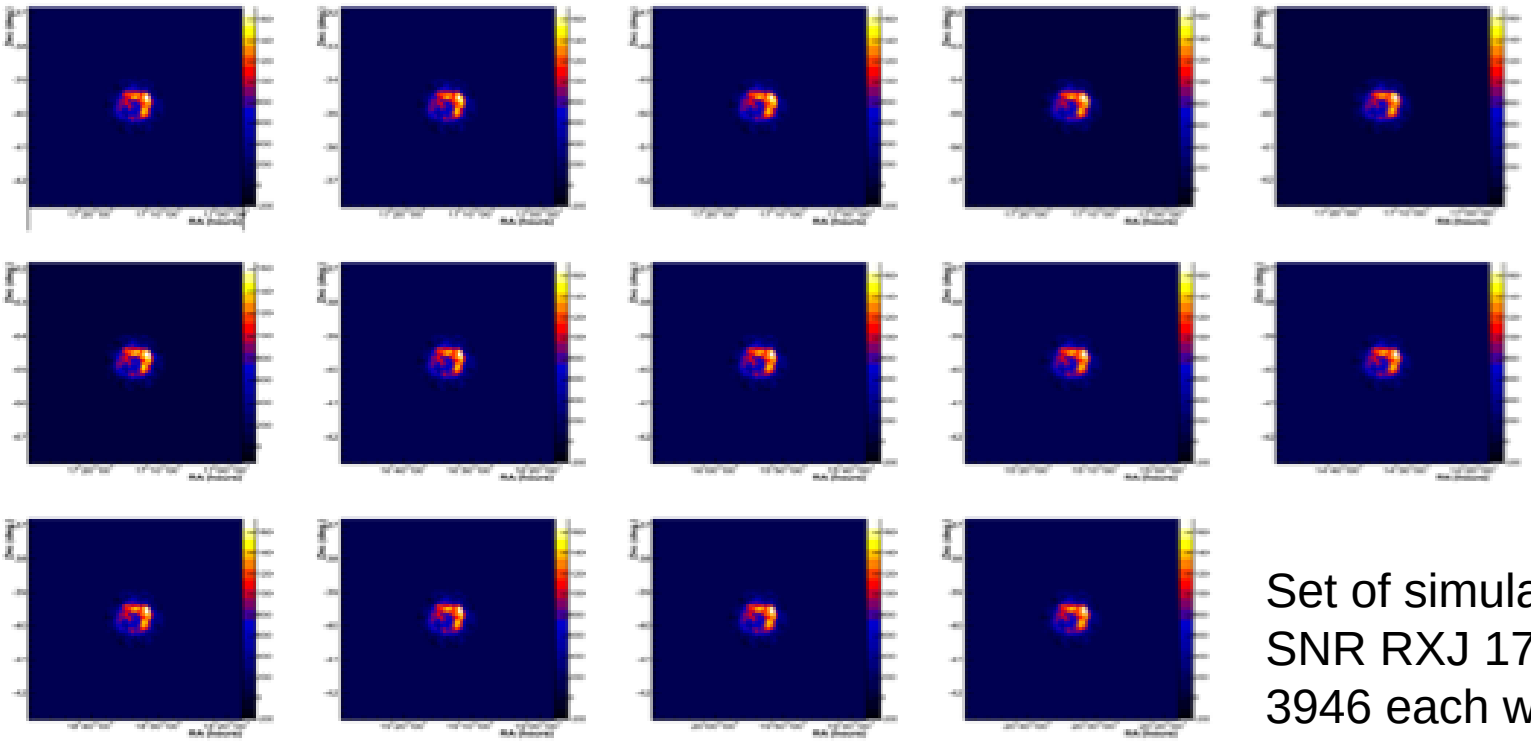


# Systematic Studies: microquasars

- **Robin Corbet a** **sequence of simulations of** **d brightness and decreasing in**
- **26 day orbit pe** **lux levels.**



# Systematic studies: SNR

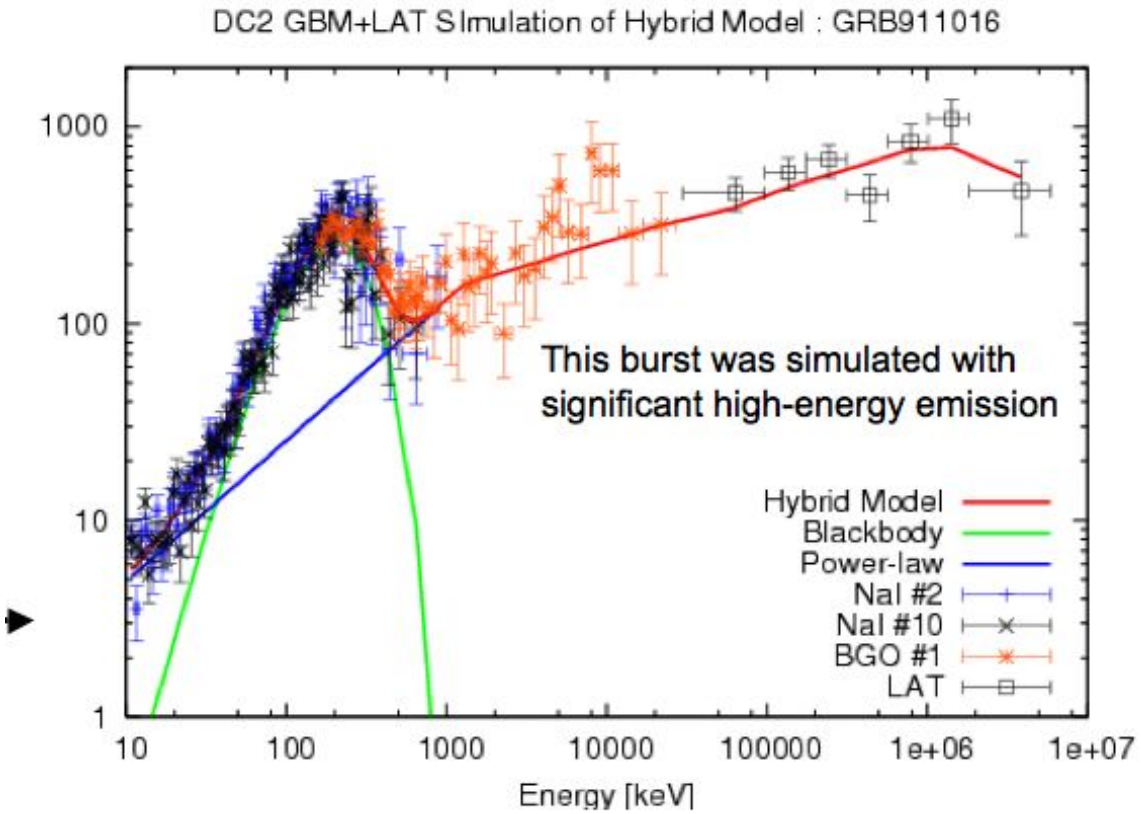


Set of simulations of SNR RXJ 1713.7-3946 each with a different spectral model (Stefan Funk)

# GRB Spectral Models

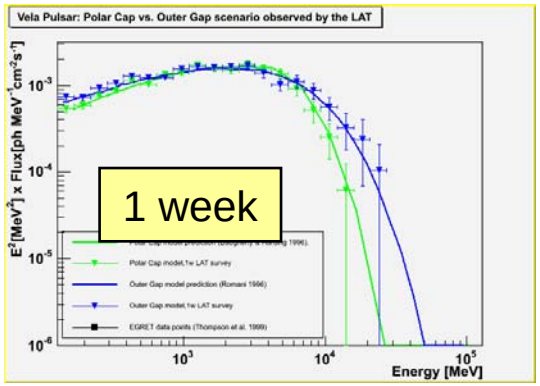
- **The GRB group is developing more sophisticated spectral models of bursts (Omodei, Battelino).**
- **Developing methods to measure spectral features and using systematic simulation studies to evaluate performance ( Nukri Komin)**

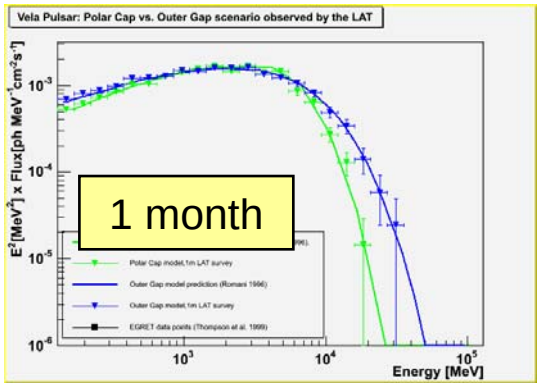
Hybrid GRB model by Milan Battelino



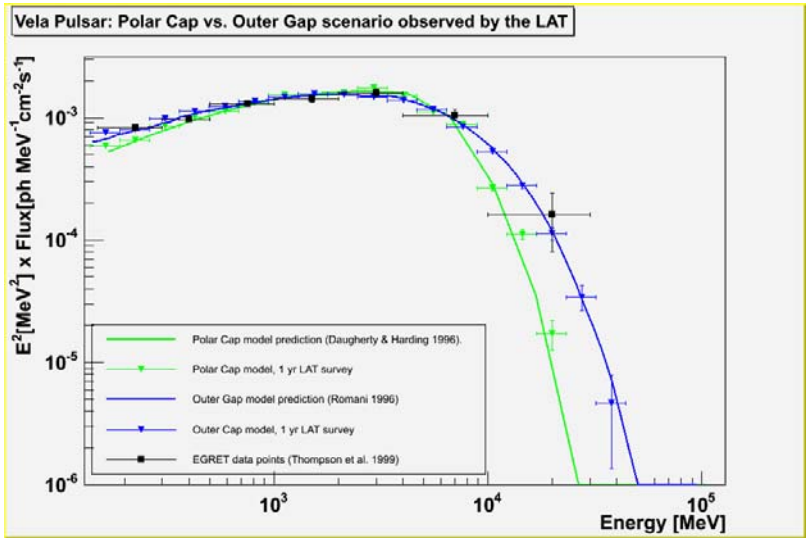
# Pulsar simulations and analysis

- Razzano and Harding - simulations to illustrate the ability of LAT observations to distinguish between pulsar emission models.
- Develop analysis methods to quantify this.
- Additional simulation improvements
  - Adding models for binary pulsars
  - Including noise and glitches



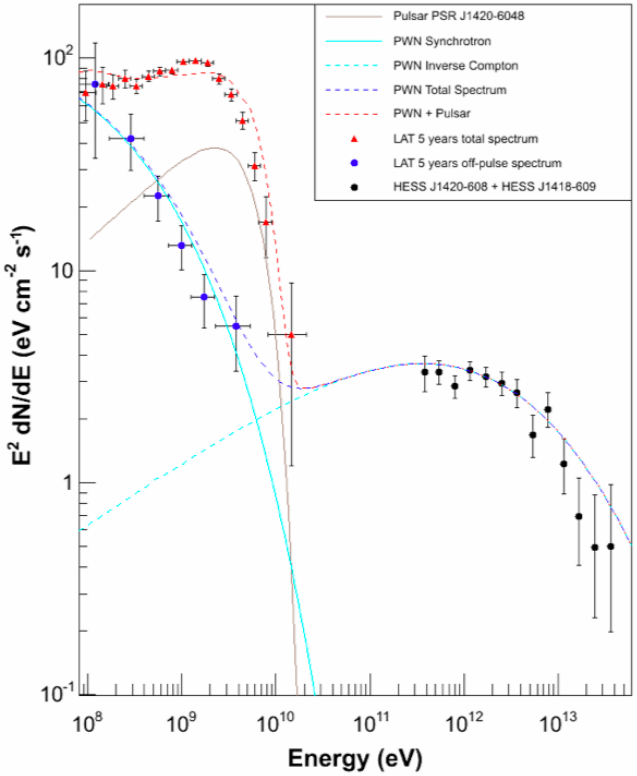



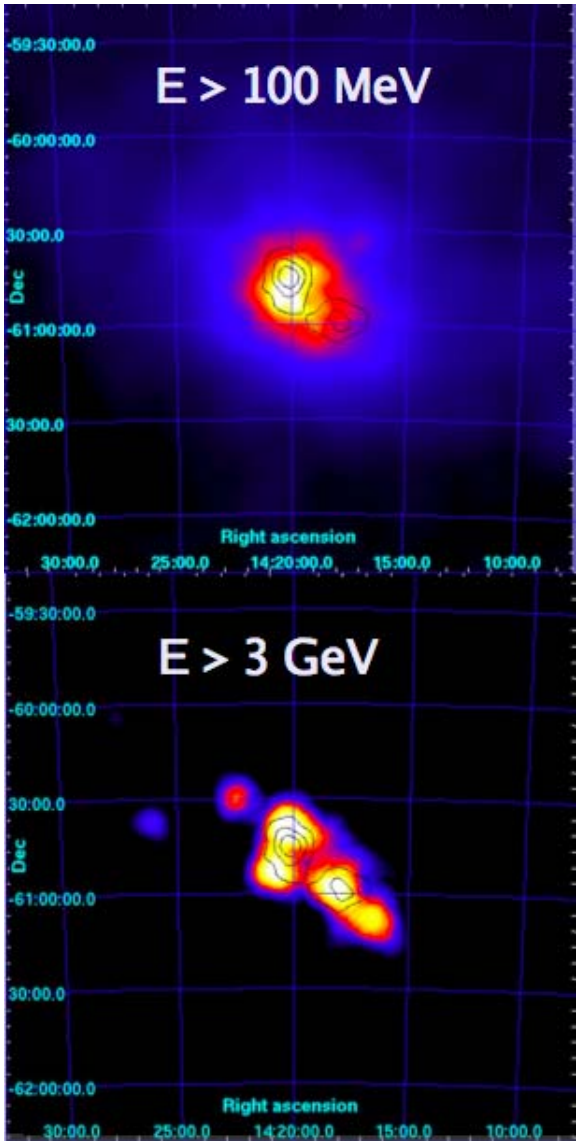

*1 week (left) and 1-month Vela observation and 1 year Vela observation.*



# Pulsar Wind Nebula Studies

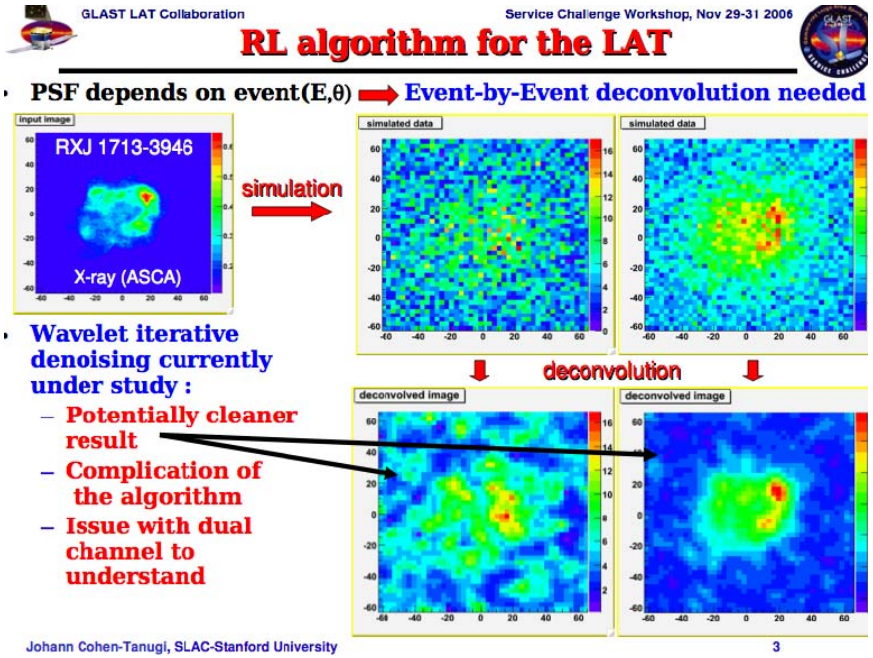
- **Simulations of the kookaburra region (Stefan Funk) which contains a pulsar and a pulsar wind nebula, illustrating how phase resolved spectral studies or energy resolved spatial studies can distinguish between the two components**



# Analysis Methods

- **Developing analysis methods to address specific science goals**



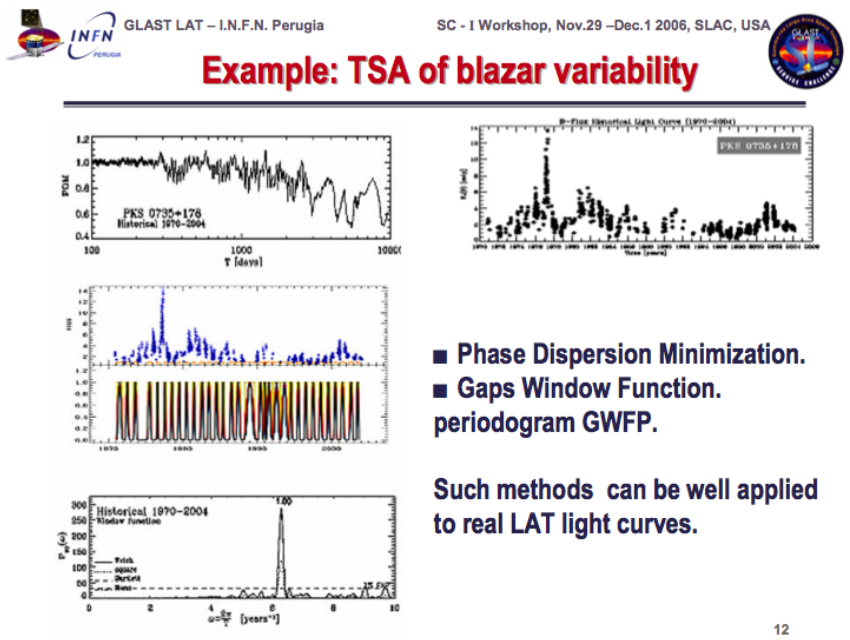



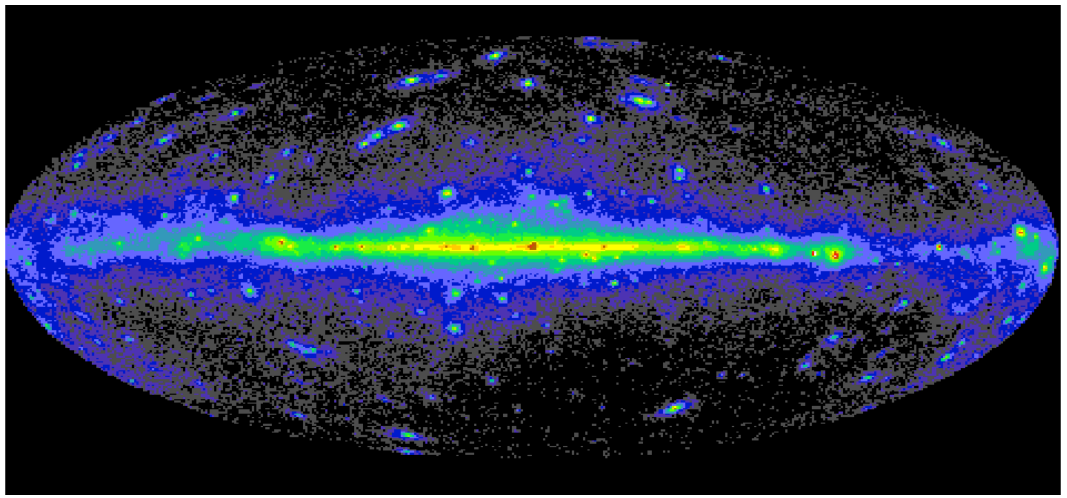

Image deconvolution methods to study extended sources (Johann Cohen-Tanugi, Hiro Tajima, Stefano Finazzi)

Time series analysis to study blazar variability (Stefano Ciprini, Gino Tosti)

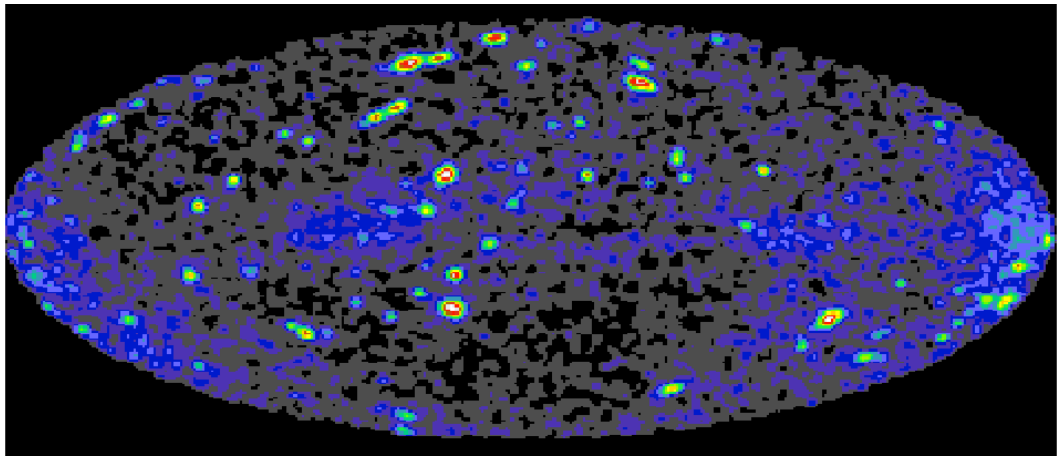
# Catalog group

- **Giommi, Gasparini and Cutini presented a method to make variability maps of the sky.**

GLAST DC2 Sky:
Normal intensity image

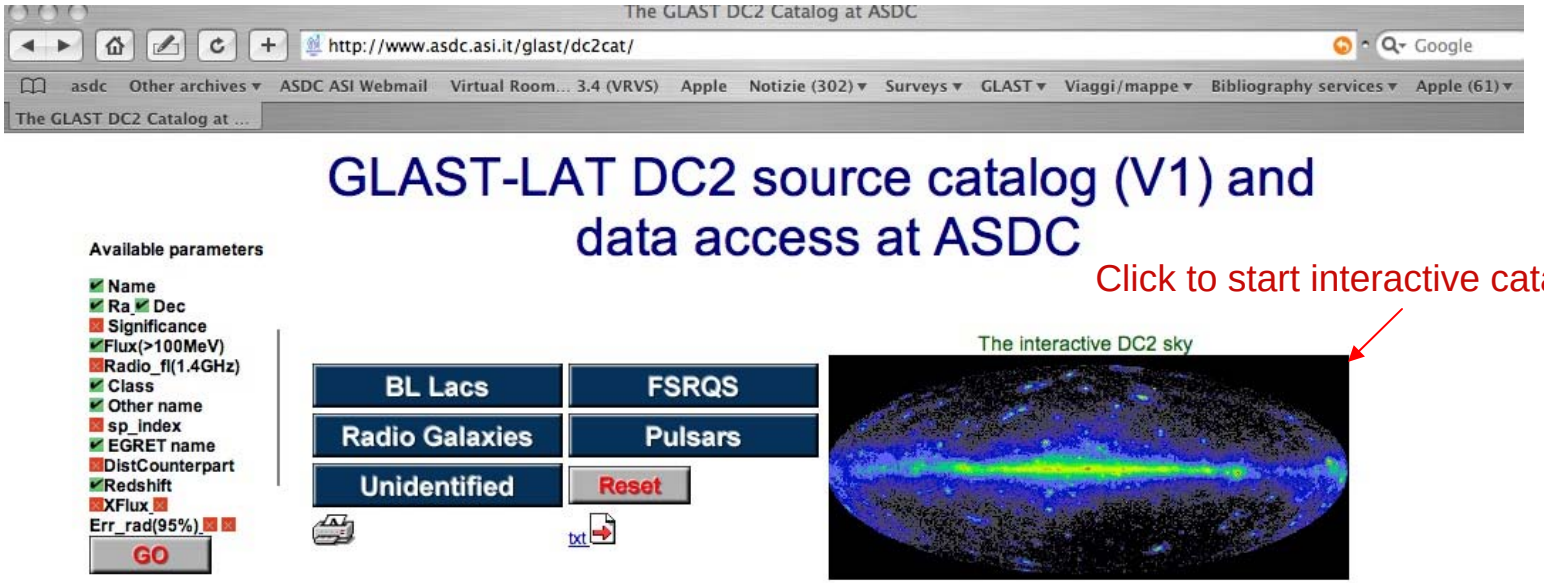


Time variability image: Image is color coded according to $\chi 2$ probability of flux variation from a KS test on each pixel (see Giommi, White & Angelini 1995 ASPC 77,117 for the method)



# ASDC catalog page

http://www.asdc.asi.it/glast/dc2cat/




Perugia Wavelet DC2 catalog at ASDC

| Entry number | | DC2 name | RA (J2000.0) hh mm ss.d | Dec (J2000.0) dd mm ss.d | Gamma flux (ph/cm2/s E>100 MeV) GLAST-DC2 | Source classification Browse Classif | Other source names | Egret name | Redshift |
|---|---|---|---|---|---|---|---|---|---|
| Subset selection mode: inclusive | | | | | Stat | | | | Stat |
| 1 Select | ASDC tools & data access | MRF0021 | 00 10 44.5 | +73 10 26.4 | 2.51e-7 | SNR | CTA1,SNR119 | 3EG J0010+73 | 0 |
| 2 Select | ASDC tools & data access | MRF0324 | 00 04 58.8 | -52 27 00.0 | 1.29e-7 | Unid. radio source | ---------- | ---------- | 0 |
| 3 Select | ASDC tools & data access | MRF0301 | 00 10 39.6 | +02 47 27.5 | 9.62e-8 | Unid. radio source | ---------- | ---------- | 0 |

# Service Challenge

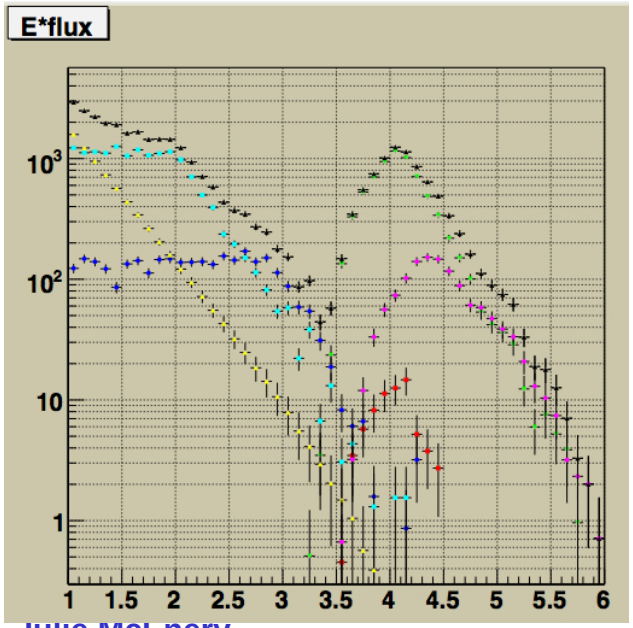
- Service challenge is the successor to the Data Challenges.
- Joint participation by ISOC and science groups.
- Sequence of simulations, of varying degrees of fidelity, to exercise our ability to extract science results from the data
- What is coming:
  - Series of 1 year quick simulation (first one in Dec 2006)
    - Astrophysical source updates: grb models, pulsars (noise, phase dependent spectra, more sophisticated XRB etc)
    - Quantify how different astrophysics models interact (e.g. blazar luminosity function on EBL studies or Galactic diffuse model on SNR studies)
    - Develop analyses requiring long datasets
    - Exercise catalog pipeline
  - 55 day full detector simulation
    - Updated sky model
    - Improved treatment of residual background in high level analysis
    - Exercise and test ASP and Catalog pipelines, flow resulting data to the GSSC.
    - Some detector/observatory imperfections - exercise ISOC monitoring and explore the effects of these on the science results (and test communication between SO and the science groups).

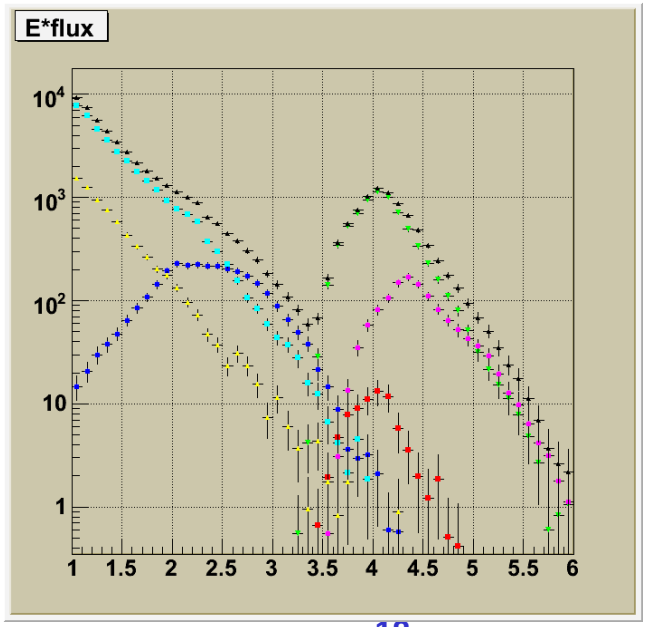
# Service Challenge

- **What is coming (cont)**
  - **Series of downlink (3hr) sized full detector sims in a variety of detector and observation configuration. Simulations produced in very low-level raw format.**
    - **Fully exercise level 1 pipeline**
    - **Exercise and develop all operations monitoring software (I.e. find and characterize instrument configurations and problems)**
    - **Practice ISOC science ops (duty scientist shifts etc)**
  - **One year full detector simulation (June 2007)**
    - **This will provide the most realistic simulation dataset to practice and develop science analysis.**
    - **Final iterations of instrument performance and IRFs.**
    - **Develop analyses that require long integration times (extragalactic and Galactic diffuse, dark matter searches etc)**
  - **In parallel with these large organized simulations, the science groups are also generating smaller sets of simulated data for specific studies**
    - **Populations of GRB, grids of point sources with systematically changing properties etc.**

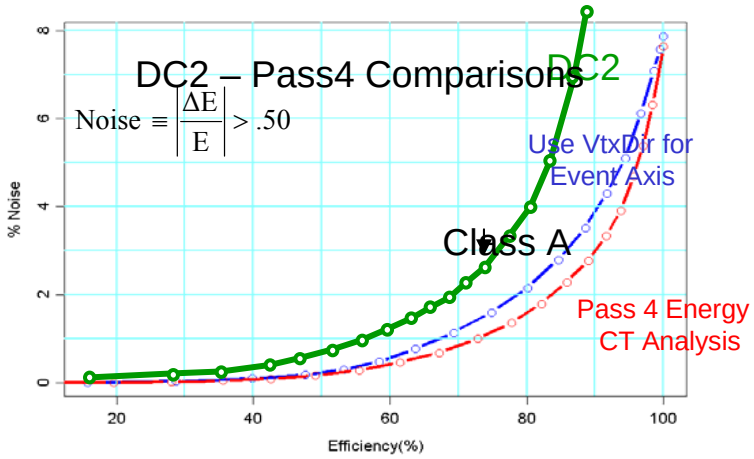
# Background model review

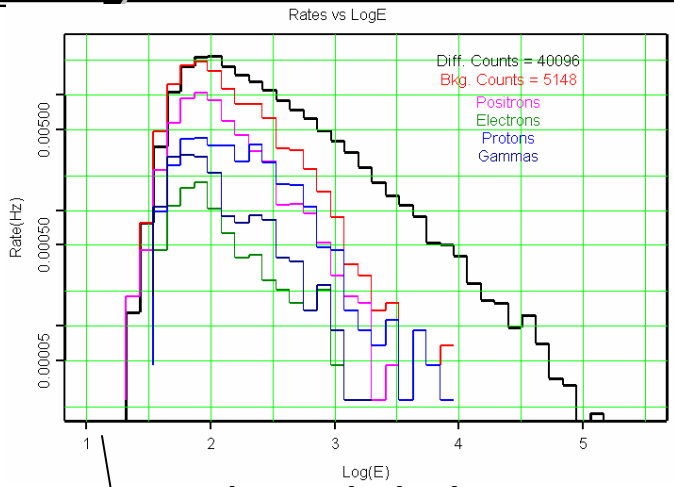
- The C&A group organised a review of the cosmic-ray background model.
- Chaired by Jonathan Ormes, implemented largely by Tsunefumi Mizuno and Toby Burnett
- Re-examined all components of the background model and compared with latest experimental measurments.
  - Updated fluxes and greatly improved detail of flux, spectral and direction distributions with orbit location.



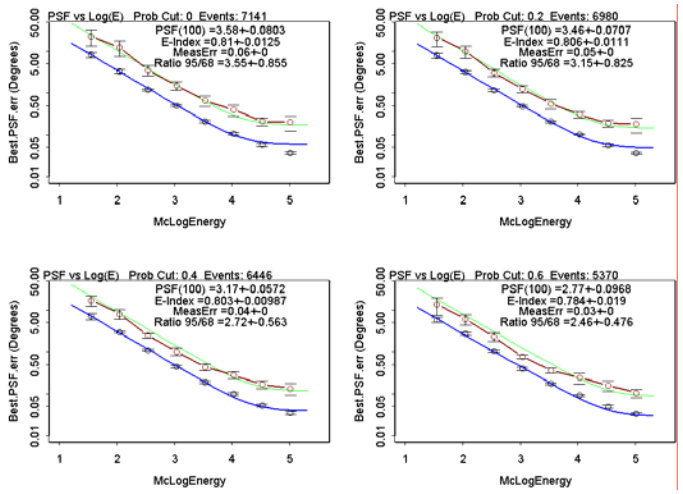
# Event Selection background rejection and sensitivity



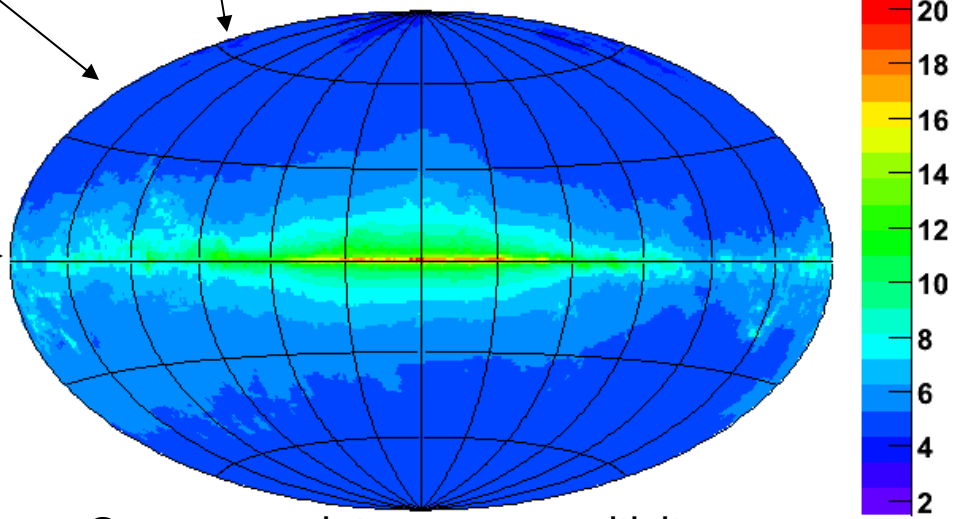




**Background rejection (Atwood)**

**Energy resolution (Atwood)**




**Psf (Atwood)**




One year point source sensitivity map (Benoit Lott)

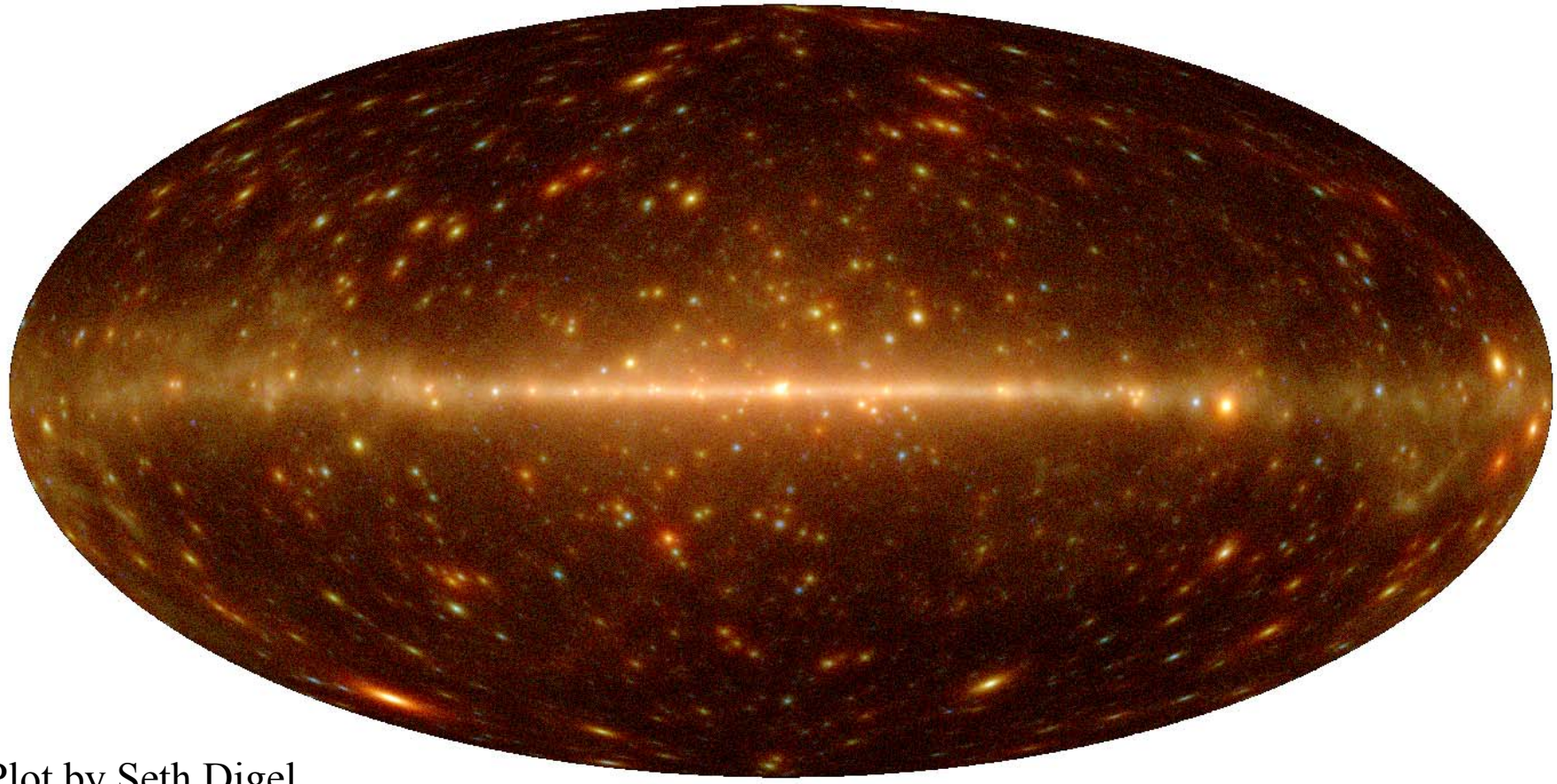
**Julie McEnery**

# Source Simulation group

- Provides the astrophysical sky model for the SC sims.
- At least one person from each science group
  - Jim Chiang
  - Seth Digel
  - Max Razzano
  - Nicola Omodei (co-Chair)
  - Alice Harding (co-Chair)
  - Stefan Funk
  - Ping Wang
  - Francesco Longo
- Coordinate science group simulations efforts and generate complete models of the sky for service challenge sims.

# 1-year obssim run

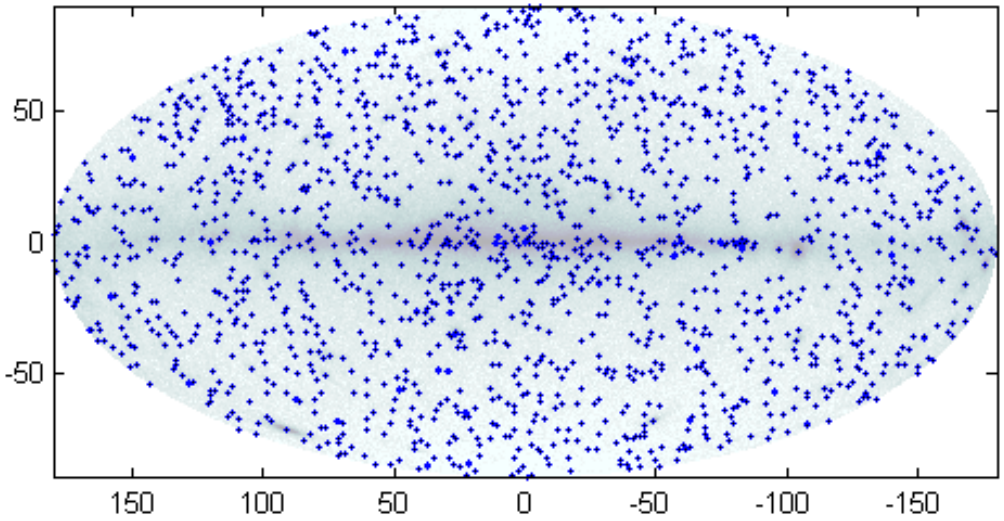
- **Putting it all together:☐**



Plot by Seth Digel

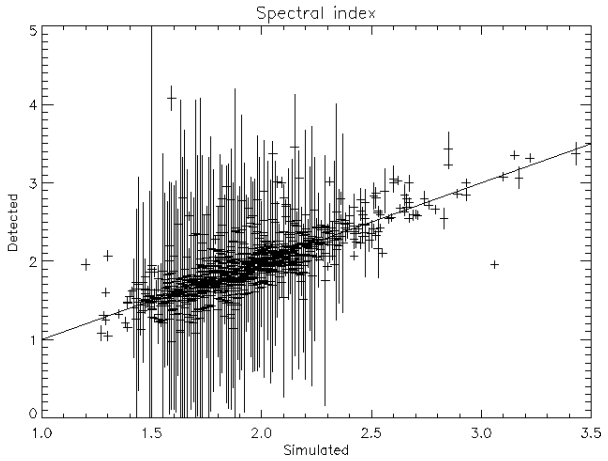
# Catalog pipeline results

- **1605 Detections, 1566 consistent with real sources (but analysis not yet complete - does not include GRB and extended sources).**



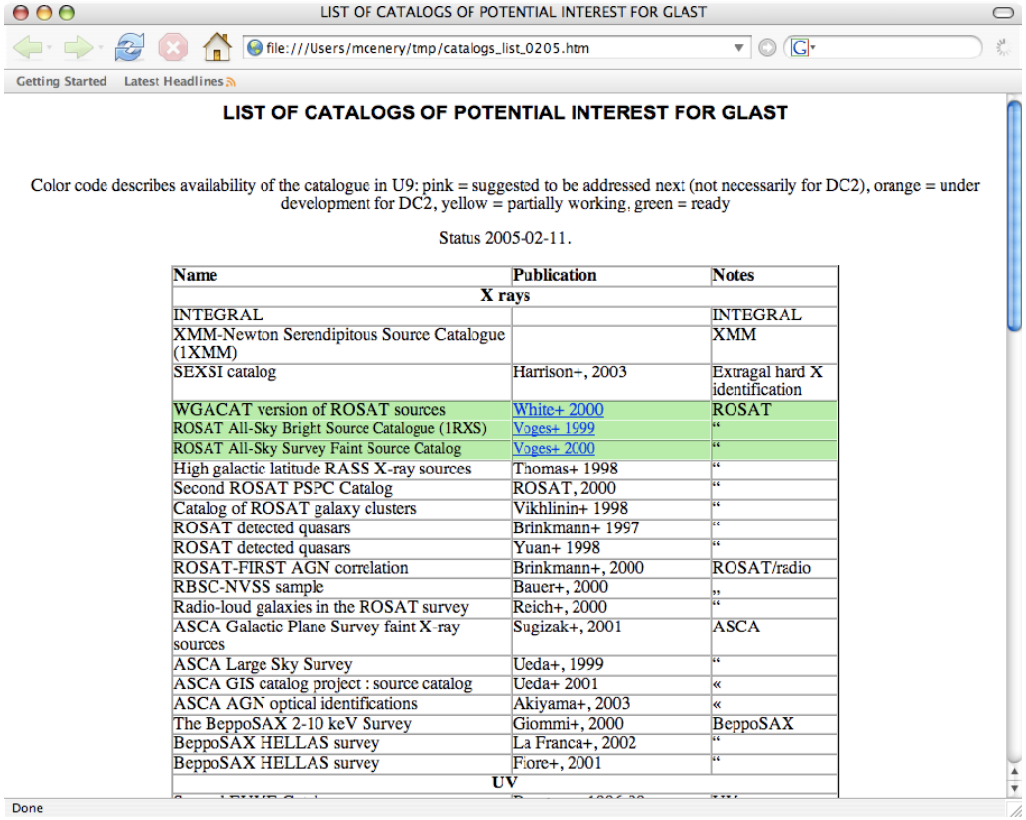

Jean Ballet and collaborators ran the catalog pipeline on the 1 year obssim run.

Work is underway to use these results to understand and quantify any systematic shifts in the fit parameters.



# Catalogs for source identification

- **Need to agreement on which catalogs to cross reference against LAT sources.**
- **Kicked off cross-group discussions, hosted/coordinated by the catalog group**



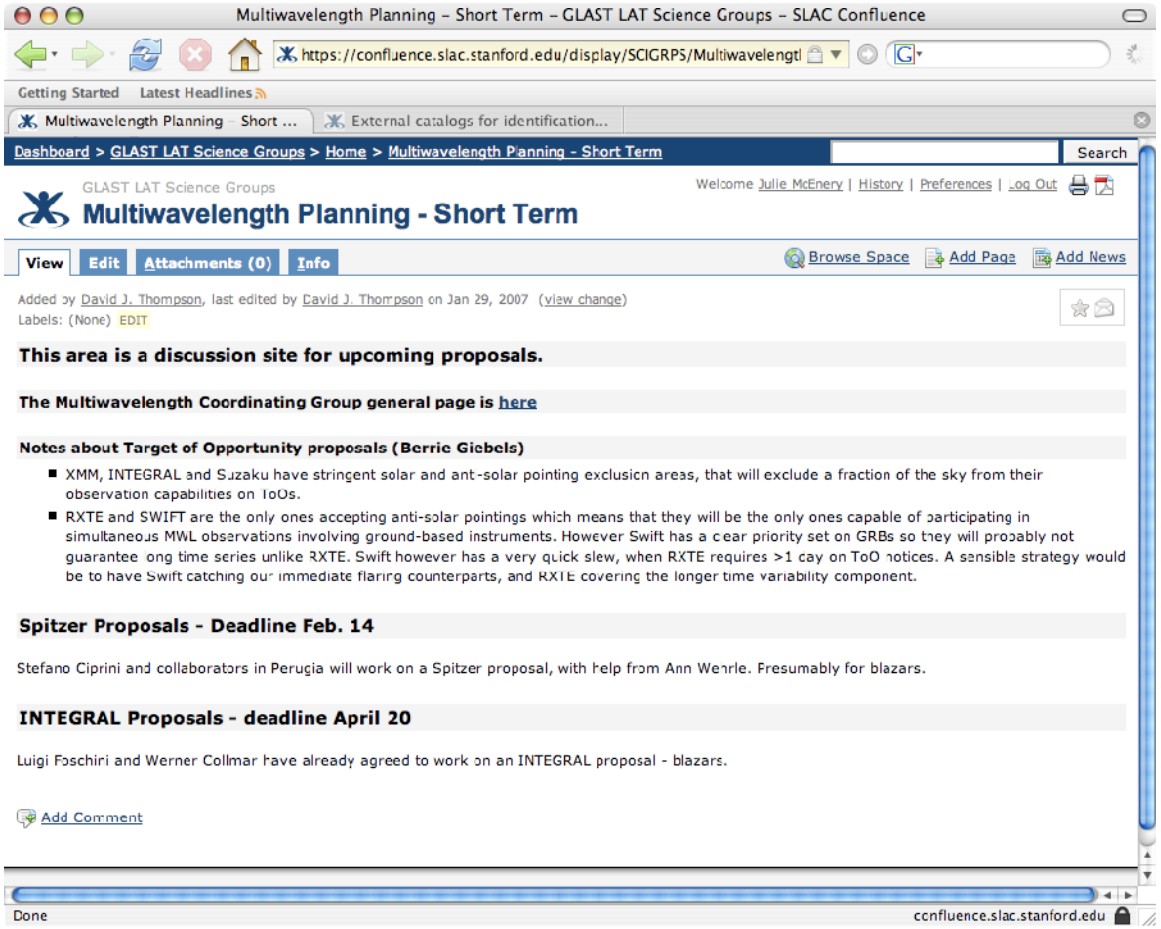

| Name | Publication | Notes |
|---|---|---|
| **X rays** | | |
| INTEGRAL | | INTEGRAL |
| XMM-Newton Serendipitous Source Catalogue (1XMM) | | XMM |
| SEXSI catalog | Harrison+, 2003 | Extragal hard X identification |
| WGACAT version of ROSAT sources | White+ 2000 | ROSAT |
| ROSAT All-Sky Bright Source Catalogue (1RXS) | Voges+ 1999 | " |
| ROSAT All-Sky Survey Faint Source Catalog | Voges+ 2000 | " |
| High galactic latitude RASS X-ray sources | Thomas+ 1998 | " |
| Second ROSAT PSPC Catalog | ROSAT, 2000 | " |
| Catalog of ROSAT galaxy clusters | Vikhlinin+ 1998 | " |
| ROSAT detected quasars | Brinkmann+ 1997 | " |
| ROSAT detected quasars | Yuan+ 1998 | " |
| ROSAT-FIRST AGN correlation | Brinkmann+, 2000 | ROSAT/radio |
| RBSC-NVSS sample | Bauer+, 2000 | " |
| Radio-loud galaxies in the ROSAT survey | Reich+, 2000 | " |
| ASCA Galactic Plane Survey faint X-ray sources | Sugizak+, 2001 | ASCA |
| ASCA Large Sky Survey | Ueda+, 1999 | " |
| ASCA GIS catalog project : source catalog | Ueda+ 2001 | « |
| ASCA AGN optical identifications | Akiyama+, 2003 | « |
| The BeppoSAX 2-10 keV Survey | Giommi+, 2000 | BeppoSAX |
| BeppoSAX HELLAS survey | La Franca+, 2002 | " |
| BeppoSAX HELLAS survey | Fiore+, 2001 | " |
| **UV** | | |

# Multiwavelength activities

- **GLAST related proposals involving at least one LAT collaborator as co-I**
  - **RXTE**
    - **7 blazar proposals**
  - **Suzaku**
    - **4 blazar proposals**
    - **Microquasar (LSI +61 303), LAT is also coordinating TeV and radio observations for this campaign.**
  - **XMM AO6**
    - **SNR (RX J1713.7-3946)**
    - **3 blazar proposals**
  - **Radio blazar observations**
    - **MOJAVE - monitor the brightest blazars with VLBA**
    - **VIPS - snapshots of large number of blazars with VLBA**
  - **Radio pulsar timing**
    - **ATNF**
    - **Nancy**

# Multiwavelength activities

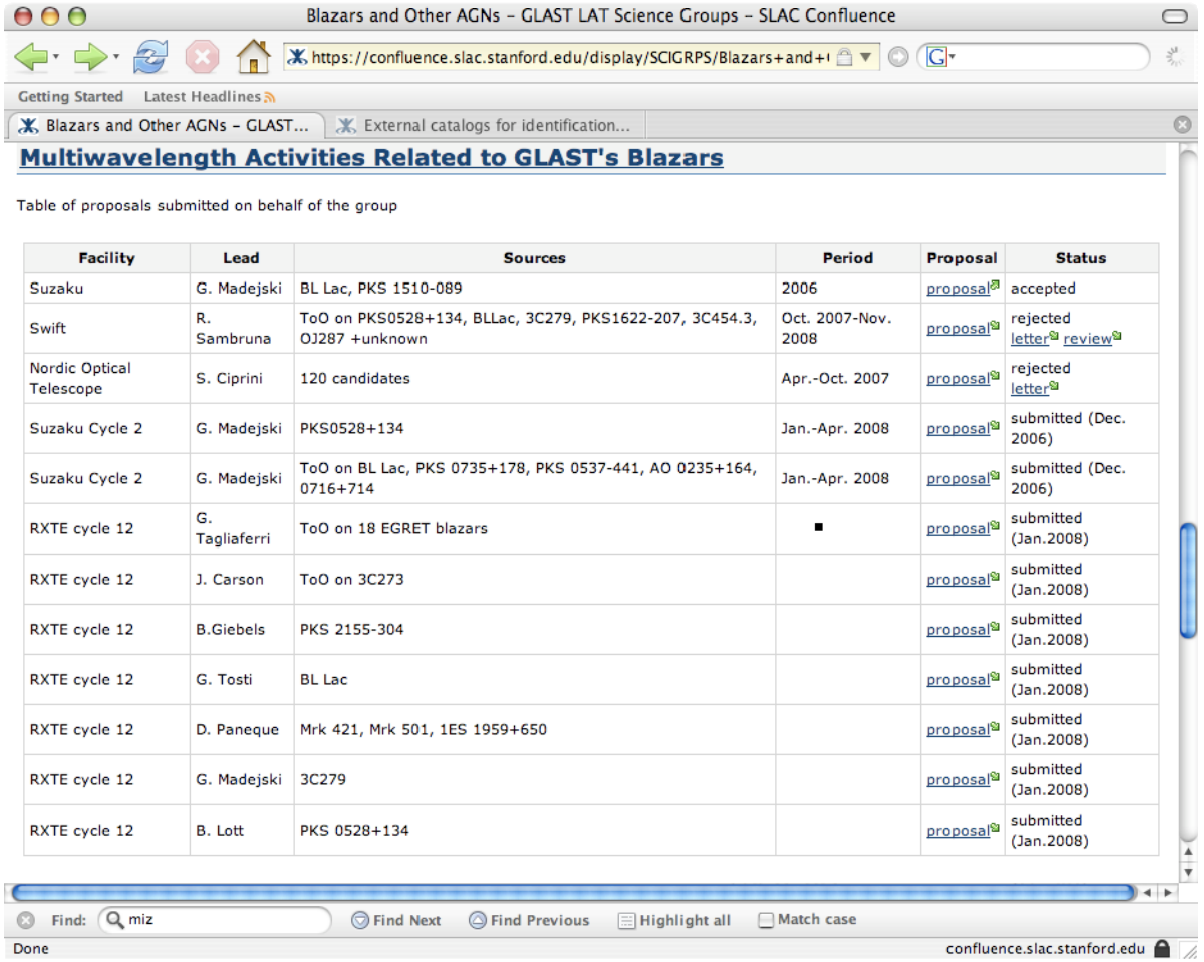
- **Communicate via a group editable webpage, to coordinate upcoming activities amongst the groups.**



# Multiwavelength activities

- **Overall coordination by the multiwavelength coordinator, but the detailed discussions happen in the science groups.**

Blazar group multiwavelength webpage



# Summary

- The groups are all working well, active and broad participation from across the collaboration
  - Good conference participation
  - Many multiwavelength proposals
  - Lots simulation and analysis development
- Future
  - Service Challenge
    - Continue to develop/refine source simulations
    - Analysis methods
    - Quantify LAT science capabilities
    - ….
  - Continue to develop multiwavelength plans
- Launch and beyond -- we really come into our own!

# Summary

- All the science groups are active and have broad participation from across the collaboration.
- Activity of all the groups is likely to increase over the next few months.
  - More people actively participating (transitioning from instrument commisioning/beamtest)
  - Multiwavelength planning and proposal writing needs to kick into high gear -- the next few months are important!
  - Many groups compiled a list of papers that could be written pre-launch, there is ~1 year left to get these done.
  - Lots of detailed source simulations and analysis
    - Infrastructure to support these studies is mature and is getting better.