



- Contratto ASI-INAF
“Attività scientifiche nel campo dell’
astrofisica per la missione GLAST”

Resp. Scientifico: P. Caraveo

Durata: 03-05-2006 ----- 02-05-2008



- WP 1000 Coordinamento & PO (P. Caraveo)
- WP 2000 Software scientifico (F. Longo)
- WP 3000 Scienza galattica (P. Caraveo)
- WP 4000 Scienza extragalattica (E. Massaro)
- WP 5000 Ricerca di controparti e oss. Correlate (P. Caraveo)
- WP 6000 Supporto a rivelatori robotici (G. Tosti)
- WP 7000 Gamma ray Burst (G. Barbiellini)
- WP 8000 Materia scura (P. Caraveo)
- WP 9000 Sinergia AGILE-GLAST (M. Tavani)



WP 1000 Activities

**Coordination of INAF-ASI-INFN committee
on AGILE-GLAST synergies**

**Organization of a two-day workshop on
“Gamma-ray astronomy in Italy” (July 2-3)**

Organization of “Tutorial” on Glast
software and planning for multi $\lambda\lambda\lambda$ school

**Presentation of the Glast mission to italian
conferences**



WP 1000 -personnel

- Post Doc to LAT MOC (A. Tramacere)
- Post Doc at IASF Milano (A. Dupays)



WP 1000 activities - EPO

<http://www.iasf-milano.inaf.it> → divulgazione



WP 2000 – scientific software

- F. Longo Post Doc U.Trieste 7 mesi 14
- L.Foschini Ric.TD INAF/IASF Bo 1 mese 2
- G. Malaguti Ric. INAF/IASF Bo 1 mese 2
- F.Boffelli Dottorando U.Pavia 2 mesi 4
- S.Ciprini Ass.Ricerca U.Perugia 1 mese 2
- E.Moretti Co.Pro. U.Trieste 5 mesi 5
- M. Marelli Borsista INAF/IASF-Mi 6 mesi 6



WP 2000 Outputs

Schools and Tutorials

- GLAST SW Tutorial – Milano 30.03.06
http://www.ts.infn.it/experiments/glast/glast_analysis.html
- Perugia – Scuola su Astrofisica Gamma e Multifrequenza:
Analisi Dati e Problematiche Astroparticellari
Perugia, 3-7 Luglio 2006
<http://glastweb.pg.infn.it/school2006/index.htm>

More in preparation



WP 3000-galactic science

Patrizia Caraveo	DR	INAF/IASF Milano	
Andrew Chen Ric.	TD	CIFS	
Teresa Mineo	Ric	INAF/IASF Palermo	1 mese 2
Giancarlo Cusumano	Ric	INAF/IASF Palermo	1 mese 2
Antonino La Barbera	Ric	INAF/IASF Palermo	1 mese 2
Elena Amato Ric.		INAF O.Arcetri	2 mesi 4
Rino Bandiera AA		INAF O.Arcetri	2 mesi 4
Pasquale Blasi AA		INAF O.Arcetri	2 mesi 4
Franco Pacini PO		Uni. Firenze	1 mese 2
Marco Salvati AO		INAF O.Arcetri	1 mese 2
Pietro UbertiniDR		INAF/IASF Roma	2 mesi 4
Marco Tavani DR		INAF/IASF	1 mese 2
Giovanni Bignami	PO	Univ. Pavia	2 mesi 4
Fabio Mattana*	Dott	Univ. Milano	8 mesi 16



WP 3000-tasks

- **Pulsars**

radio observations (target list in common with Agile)

- **SNR and PWN**

evaluation of PWNe observability

- **Microquasars**

multi $\lambda\lambda$ studies

- **Diffuse emission**

- **Theoretical models**



WP 4000- Extragalactic Science

Enrico MASSARO	PA	Dip. Fisica, Un. La Sapienza	5 mesi	10
Corinne ROSSI	RIC	Dip. Fisica, Un. La Sapienza	1 mese	2
Silvia SCLAVI	Dott.	Dip. Fisica, Un. La Sapienza	8 mesi	16
Adrea TRAMACERE	Dott.	Dip. Fisica, Un. La Sapienza	8 mesi	16
Cesare PEROLA	PO	Dip. Fisica, Un. Roma Tre	1 mese	2
Sergio COLAFRANCESCO RIC	Oss.	Astron. Roma/INAF	4 mesi	8
Guido DI COCCO	DR	INAF/IASF, Bologna	1 mese	2
Mauro DADINA	RIC	INAF/IASF, Bologna	2 mesi	4
Luigi FOSCHINI	RIC	INAF/IASF, Bologna	1 mese	2
Paola GRANDI	RIC	INAF/IASF, Bologna	2 mesi	4
Giuseppe MALAGUTI	RIC	INAF/IASF, Bologna	1 mese	2
Elena PIAN	RIC	INAF/IASF, Bologna	1 mese	2
Attilio FERRARI	PO	Dip. Fisica, Un. Torino	2 mesi	4
Gianpiero TAGLIAFERRI	AA	Oss. Astron. Brera/INAF	1 mese	2
Post doc		Dip Fisica La Sapienza	11 mesi	22
fellowship		Dip Fisica La Sapienza	11 mesi	11



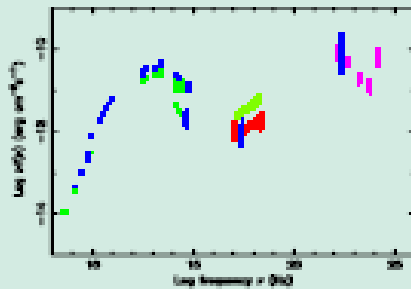
WP 4000 - TASKS

1. Blazars and AGNs (catalogs)
2. Blazars and AGNs (SED)
3. Multi $\lambda\lambda\lambda$ obs. (from space)
4. Extragalactic BKG radiation
5. Clusters of Galaxies- find candidates for GLAST
6. Theory

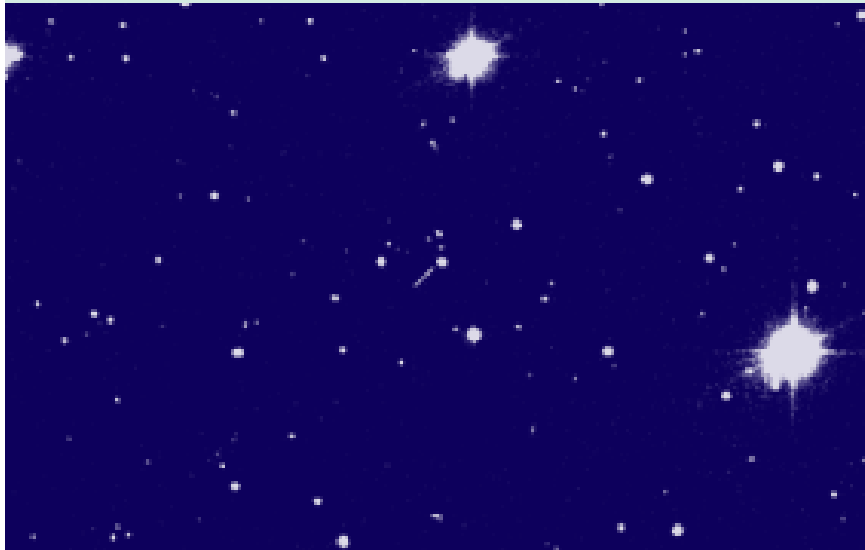


Multifrequency Catalogue of BLAZARS

Volume I (0h - 6h)

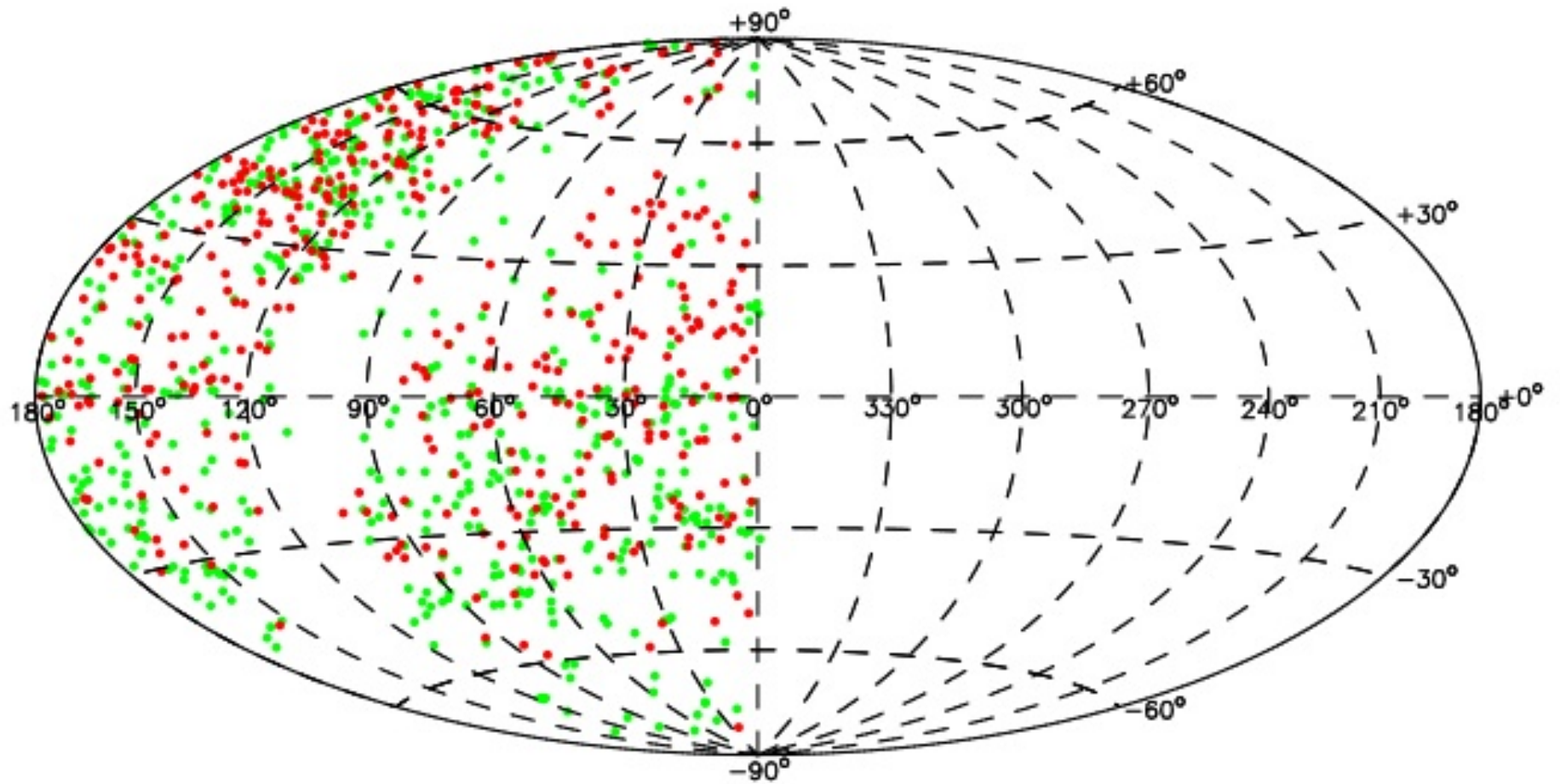


Enrico Massaro
Silvia Sciavi
Paolo Giommi
Matteo Ferri
Silvia Piranomonte



The BZ catalogue

Enrico Massaro
Phys. Department
Un. La Sapienza. Roma



IFC GLAST- Frascati- Sept. 3, 2007



Multi-frequency Catalogue of BLAZARS

E. Massaro, P. Giommi, S. Colafrancesco, C. Leto,
P. Marchegiani, A. Maselli, M. Perri, S. Piranomonte
0h-13h

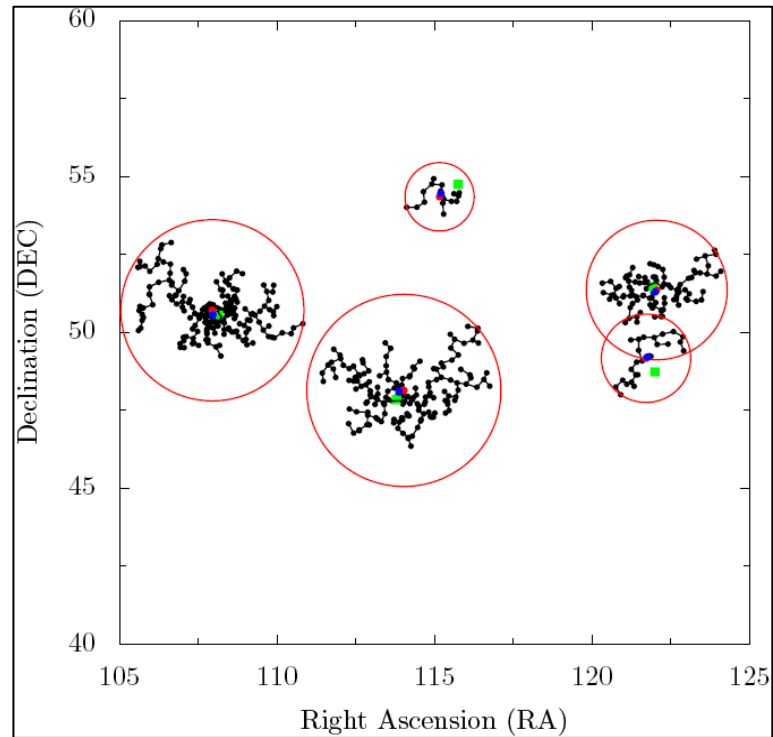
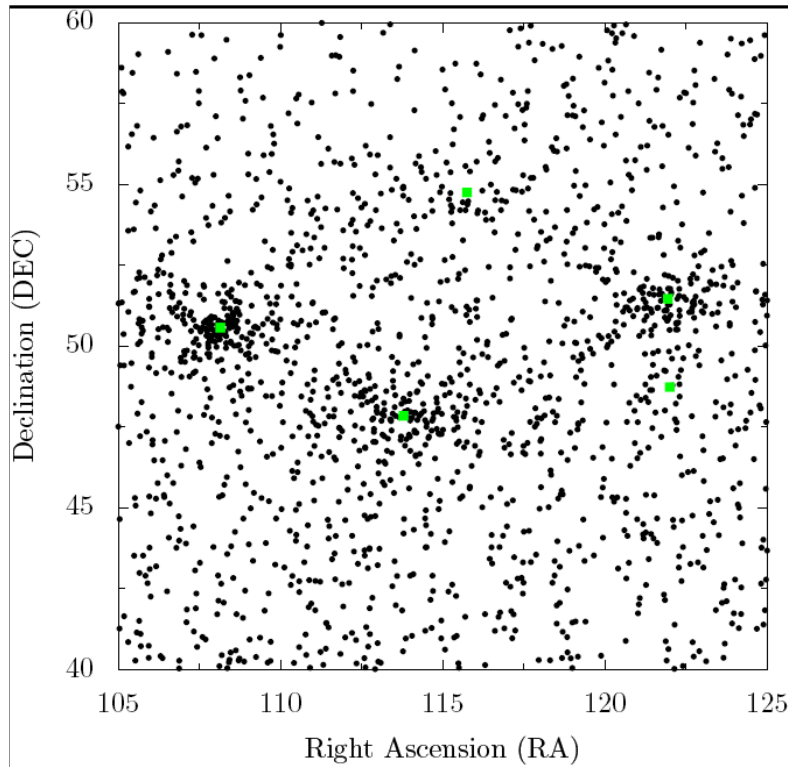
On-line

table - continuously updated

Scientific software to fit multi $\lambda\lambda\lambda$ data



• Minimal Spanning Tree

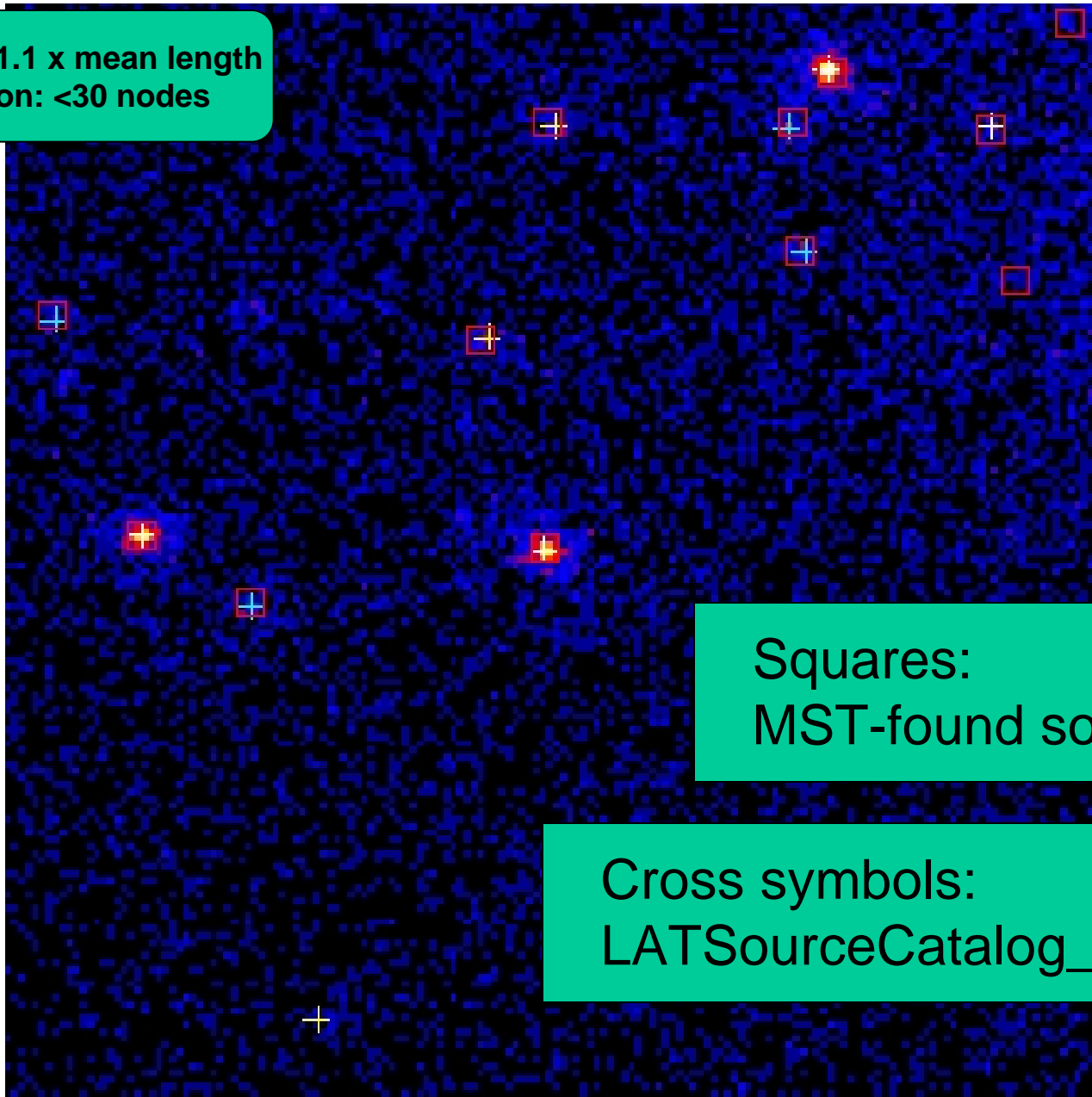


A DC2 field with 1675 detected photons, with 3 strong sources and two faint sources (green squares).

Each point is a detected photon above 100 MeV



Separation: 1.1 x mean length
Elimination: <30 nodes



Squares:
MST-found sources

Cross symbols:
LATSourceCatalog_v2

DC2 40x40 deg field above 500 MeV (RA 65 to 105; DEC -64 to -24)



WP 5000-search for counterparts

Patrizia Caraveo	PR	INAF/IASF Milano	
Niccolò D'Amico	PO	Uni. Cagliari	1 mese 2
Nicola La Palombara	Ric.	INAF/IASF Milano	1 mese 2
Andrea DeLuca*	A. R.	INAF/IASF Milano	1 mese 2
Roberto Mignani	AdF	Leicester	2 mesi 4
Massimo Villata	Ric.	INAF/Oss. Torino	1 mese 2
Claudia Maria Reiteri	Ric	INAF/Oss.Torino	1 mese 2
Angela Bazzano	PR	INAF/IASF Roma	2 mesi 4



WP 5000-tasks

•Catalog X-correlation

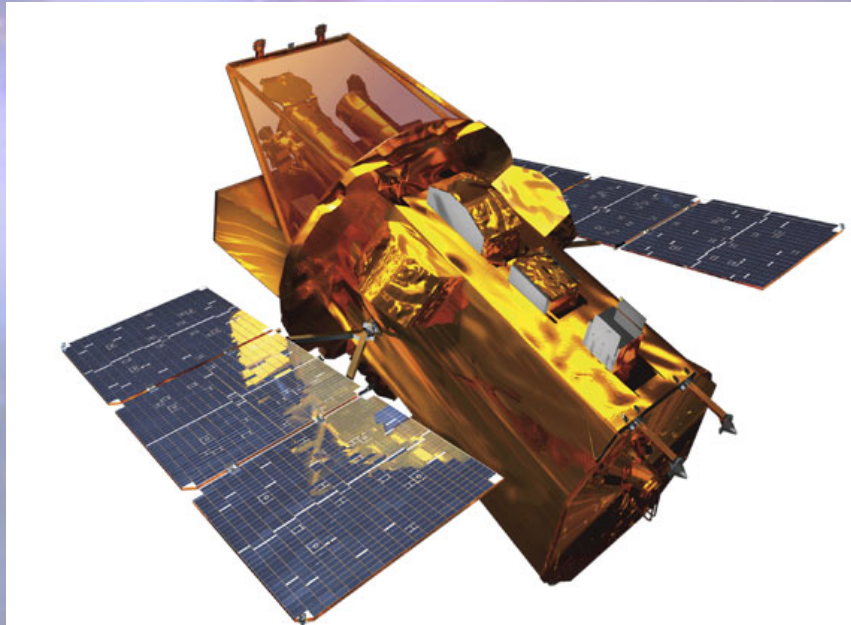
FoM approach based on

- educated guesses on chance occurrence probability
- variability,
- energetics

•FoM suggests plausible associations

From association to identification

**Multi $\lambda\lambda\lambda$ ob's of high FoM targets can
secure identifications**



e.g.:Swift filler obs time

SWIFT-GLAST

Identify new classes of sources

to start population studies



The magnitude of the problem

End 2007-mid 2008

AGILE: 50 new γ -ray sources

10 ksec x 50 sources = 500 ksec

10% of the filler programme

End 2008-mid 2009

GLAST: 500 new γ -ray sources

10 ksec x 500 sources = 5 Msec

100% of the filler programme



WP 6000 robotic telescopes

Gino Tosti	RIC	Dip. di Fisica Università di Perugia	5 mesi	10
Roberto Nesci	PA	Dip. di Fisica "La Sapienza" Roma	4 mesi	8
Molinari Emilio Carlo	RIC	INAF - Osservatorio Astronomico di Brera	2 mesi	4
Massimo Villata	RIC	INAF - Osservatorio Astronomico di Torino	2 mesi	4
Claudia Raiteri	RIC	INAF - Osservatorio Astronomico di Torino	2 mesi	4
Antonino Cucchiara	Dott	Dip. di Fisica Università di Perugia	5 mesi	10
Nucciarelli Giuliano	TEC	Dip. di Fisica Università di Perugia	5 mesi	10
Marco Bagaglia	TEC	Dip. di Fisica Università di Perugia	5 mesi	10



WP 6000 - TASKS

Selection of objects to be monitored

table of 150 "VIP" AGN/blazar targets for GLAST

<http://glastweb.pg.infn.it/blazar/>

Observations and data analysis (**on going**)

Data archiving



Bright Sources

A public web-page with a

table of 150 "VIP" AGN/blazar targets for GLAST and MW analysis:

<http://glastweb.pg.infn.it/blazar/>

- Bright AGN/blazars assembled trying to collect basic data with direct links to existing databases (avoiding duplication/obsolescence).
- This web-table can be useful to **plan long term MW campaign**, to select input sources for science **Proposals to MW facilities** (other satellites, ground-based obs.), to perform simultaneous MW analysis joint with the GLAST data, spectral-temporal analysis/comparison based on long-term historical datasets, etc.
- It might be also a starting point to develop a dedicated MW blazars database for GLAST.



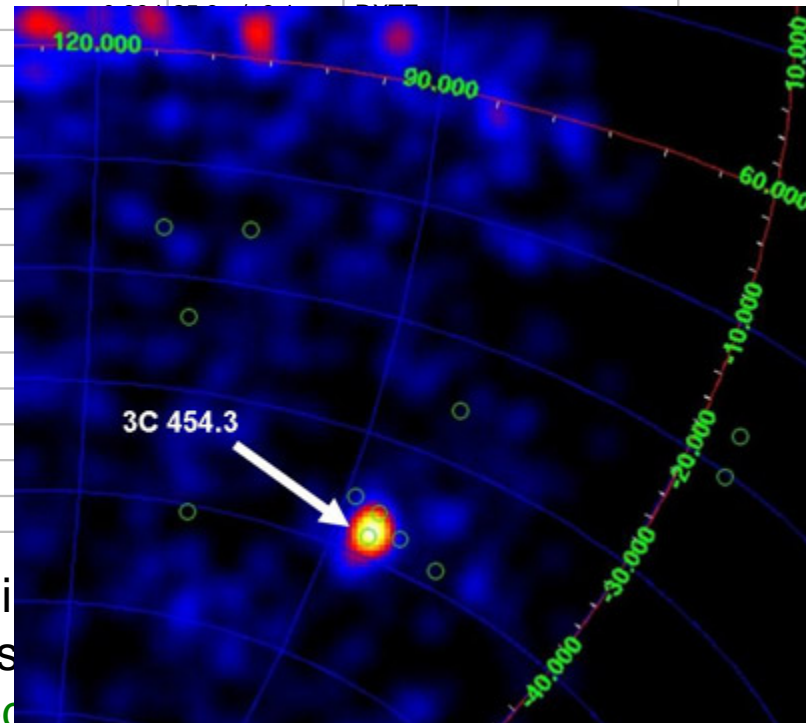
X-ray Proposals Accepted/Submitted

Facility	Lead	Sources	Period
1.	Suzaku Cycle 2	G. Madejski PKS0528+134	Jan.-Apr. 2008
2.	RXTE cycle 12	G. Tagliaferri ToO (18 EGRET blazars)	launch-03/2009
3.	RXTE cycle 12	J. Carson ToO on 3C273	launch-03/2009
4.	RXTE cycle 12	B. Giebels PKS 2155-304	launch-03/2009
5.	RXTE cycle 12	G. Tosti BL Lac	launch-03/2009
6.	RXTE cycle 12	D. Paneque Mrk 421, Mrk 501, 1ES 1959+650	launch-03/2009
7.	RXTE cycle 12	G. Madejski 3C279	launch-03/2009
8.	RXTE cycle 12	B. Lott PKS 0528+134	launch-03/2009
9.	Chandra Cycle 9	G. Madejski ToO on flaring blazar	12/2007-12/2008
10.	INTEGRAL AO-5	V. Lonjou KP Cygnus region (including BL Lac)	08/2007-08/2008
11.	INTEGRAL AO-5	W. Collmar KP Program NE region	08/2007-08/2008
12.	INTEGRAL AO-5	L. Foschini KP Galactic Center	08/2007-08/2008



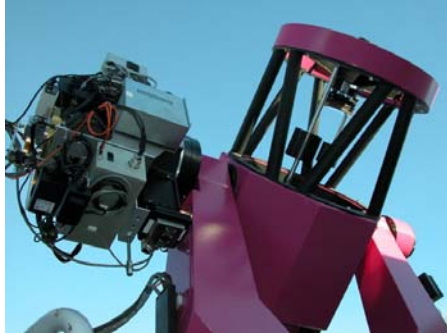
ToO Campaigns: The AGN Science Group List

Proper Name	EGRET name	class	z	F	LAT Proposals Accepted/Submitted
				10-8ph/cm2/s	
3C 66A	3EG J0222+4253	LBL	0.444	18.7 +/- 2.9	RXTE
AO 0235+16	3EG J0237+1635	LBL	0.940	65.1 +/- 8.8	RXTE, Chandra
PKS 0528+134	3EG J0530+1323	FSRQ(LP)	2.060	93.5 +/- 3.6	RXTE, Chandra
PKS 0537-441	3EG J0540-4402	LBL			
S5 0716+71	3EG J0721+7120	LBL			
PKS 0735+17	3EG J0737+1721	LBL			
OJ 248	3EG J0829+2413	FSRQ			
OJ 287	3EG J0853+1941	LBL			
S4 0954+65	3EG J0958+6533	LBL			
W Com	3EG J1222+2841	IBL			
3C 273	3EG J1229+0210	FSRQ(LP)			
3C 279	3EG J1255-0549	FSRQ(HP)			
PKS 1406-076	3EG J1409-0745	FSRQ(LP)			
PKS 1510-08	3EG J1512-0849	FSRQ			
PKS 1622-29	3EG J1625-2955	FSRQ(LP)			
BL Lac	3EG J2202+4217	LBL			
CTA 102	3EG J2232+1147	FSRQ(HP)			
3C 454.3	3EG J2254+1601	FSRQ(HP)			



These sources are also included in the EGRET catalog (but coordinated with LAT) proposals

- XMM (PI. G. Tagliaferri) **accepted**
- INTEGRAL (PI. E. Pian) **submitted**

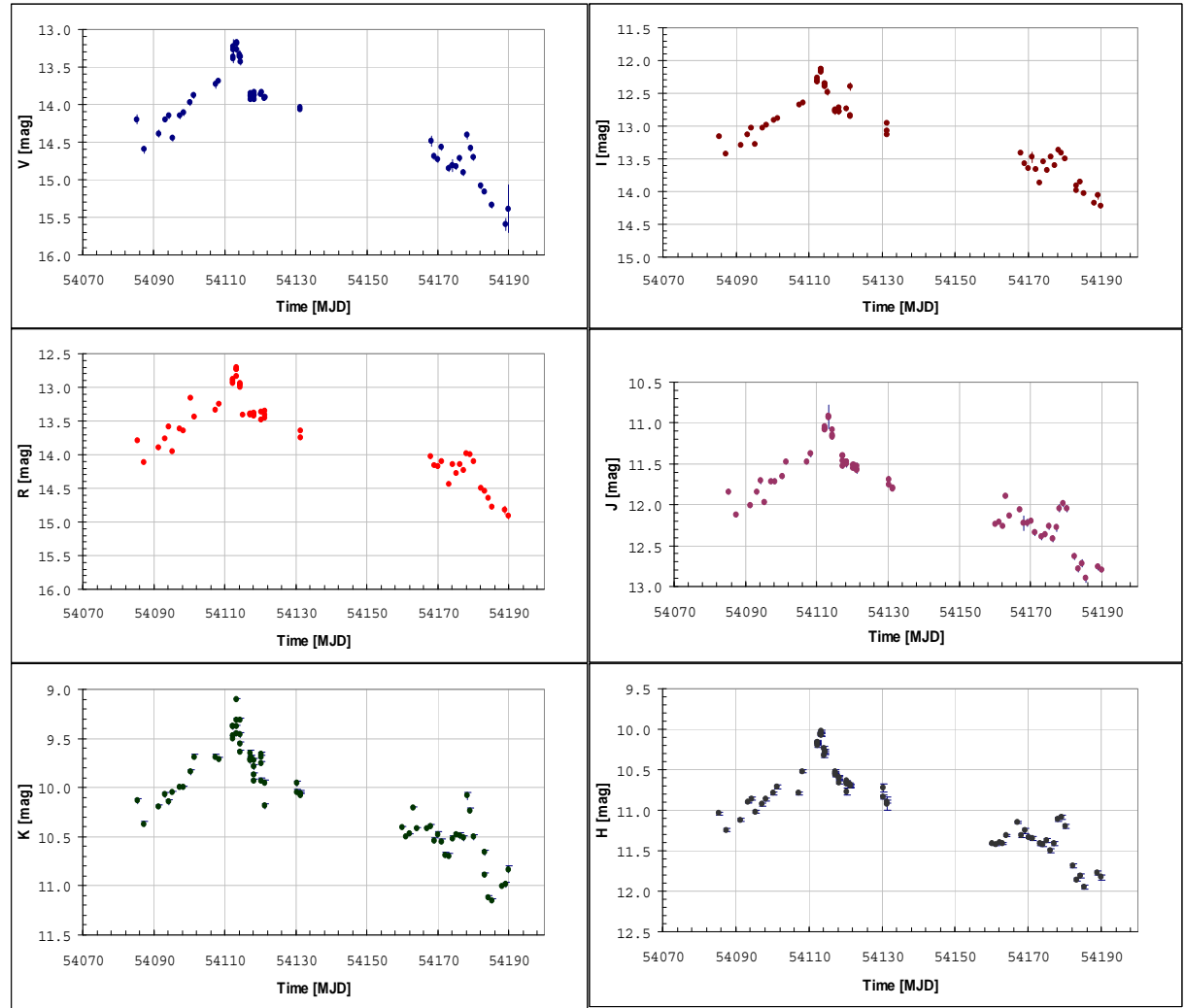
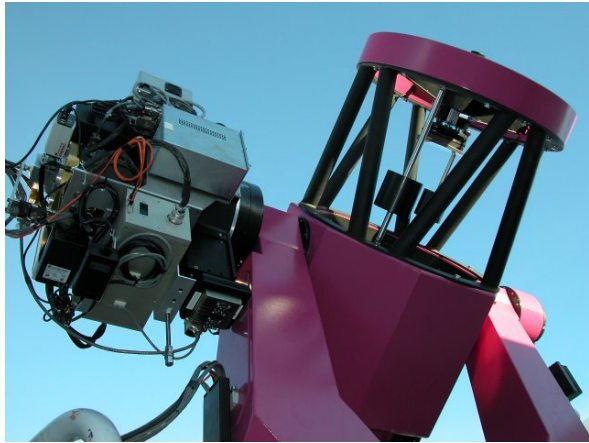


REM Robotic Telescope (La Silla- Chile)

<u>oggetto</u>		<u>periodo di osservazione</u>	<u>numero osservazioni</u>
PKS0118-272	OSSERVATO	2/23/11	15
PKS0208-512	OSSERVATO	2006-08-03 Ò 2007-03-11	436
1H0323+022	OSSERVATO	2006-08-23 Ò 2007-01-21	373
CTA26	OSSERVATO	2006-08-23 Ò 2007-01-15	302
OA129	OSSERVATO	2006-08-23 Ò 2007-01-15	300
NRAO190	OSSERVATO	2006-08-23 Ò 2007-01-14	325
PKS0537-441	<u>NON OSSERVATO</u>		
1ES0548-322	<u>NON OSSERVATO</u>		
1ES0647+250	<u>NON OSSERVATO</u>		
PKS0735+178	<u>NON OSSERVATO</u>		
OJ248	<u>NON OSSERVATO</u>		
OJ287	OSSERVATO	2006-10-31 Ò 2007-01-30	683
1H1100-230	OSSERVATO	2006-11-01 Ò 2007-04-27	299
PKS1144-379	<u>NON OSSERVATO</u>		
OM280	<u>NON OSSERVATO</u>		
PKS1206-238	OSSERVATO	2006-11-26 Ò 2007-01-30	189
1H1219+301	OSSERVATO	2007-01-17 Ò 2007-01-31	48
ON231	OSSERVATO	2007-01-09 Ò 2007-04-28	182
3C273	OSSERVATO	2006-12-16 Ò 2007-04-28	313
3C279	OSSERVATO	2006-08-22 Ò 2007-05-03	2206
1ES1255+244	OSSERVATO	2007-04-19 Ò 2007-04-28	46
PKS1313-333	OSSERVATO	2006-08-22 Ò 2007-05-02	215
1Jy1424-418	OSSERVATO	2006-08-06 Ò 2007-05-03	221
PKS1510-089	OSSERVATO	2006-08-19 Ò 2006-08-21	30
APLibrae	<u>NON OSSERVATO</u>		
OR165	OSSERVATO	2007-04-17 Ò 2007-05-02	70
1Jy1548+056	OSSERVATO	2006-08-23 Ò 2007-04-26	56
1ES1553+113	OSSERVATO	2006-08-23 Ò 2007-04-28	56
PKS1622-297	OSSERVATO	2006-08-06 Ò 2007-01-20	96
NRAO530	OSSERVATO	2006-08-23 Ò 2007-05-02	146
PMNJ1802-3940	<u>NON OSSERVATO</u>		
PKS2005-489	OSSERVATO	2006-08-23 Ò 2007-05-02	288
PKS2155-304	OSSERVATO	2006-08-03 Ò 2006-12-18	6321
3C446	OSSERVATO	2006-08-23 Ò 2006-11-30	222
1Jy2227-088	OSSERVATO	2006-08-23 Ò 2006-11-29	231
CTA102	OSSERVATO	2006-08-23 Ò 2006-11-29	216
3C454.3	<u>NON OSSERVATO</u>		
1Jy2255-282	OSSERVATO	2006-08-03 Ò 2006-12-30	260
PKS2355-534	OSSERVATO	2006-08-03 Ò 2007-01-14	314
1H2354-315	OSSERVATO	2006-08-03 Ò 2007-01-15	320



REM Robotic Telescope (La Silla- Chile)



3C 279 flares in 2007

- Agile detection in july

**A Guarantee Time Proposal on Blazar Monitoring Accepted.
2 Proposal submitted on April 22, 2007**

IFC GLAST- Frascati- Sept. 3, 2007



WEBT



The WEBT support to the GLAST observations will consist of both:

long-term monitoring

about 15 observatories 30 blazars

shorter-term campaigns

all the WEBT collaborators (typically 30–50 observatories).

(Support to AGILE will start on September)
IFC GLAST- Frascati- Sept. 3, 2007



WP 7000 GRBs

- | | | | | |
|------------------|-----------------------------|----------------|--------|---|
| • G. Barbiellini | PO | U. Trieste | 2 mesi | 4 |
| • A. Celotti | PA | SISSA | 2 mesi | 4 |
| • G. Ghirlanda | Ric | INAF/Obrera | 2 mesi | 4 |
| • L. Piro | DR | INAF/IASF Roma | 1 mese | 2 |
| • F. Longo | Post Doc | U.Trieste | 1 mese | 2 |
| • A.Galli | Dottoranda U.Roma1, INFN Ts | | 2 mesi | 4 |
| • E. Moretti | Co.Pro | U.Trieste | 5 mesi | 5 |

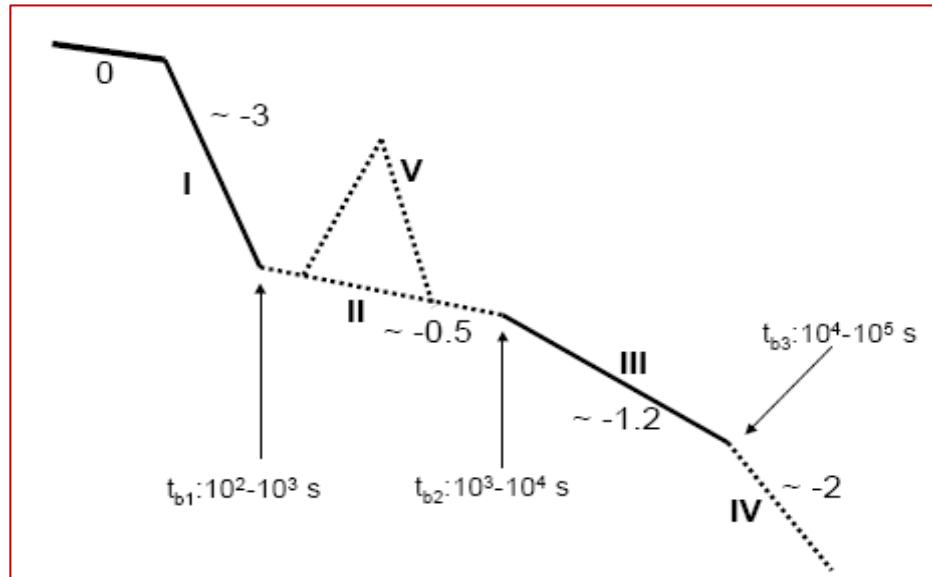


WP 7000 TASKS

- Simulation activities within th DC2 and SC.
- Development of new models on GeV flares based on Swift results
- High z GRB populations
- GRB GLAST & TeV detection



GRB X-ray flares



Prompt-to-afterglow transition characterized by initial steep decay, flattening, and flares

X-ray flares present in $\sim 40\%$ of Swift GRB sample.

- ✓ Several X-ray flares show hard-to-soft spectral evolution
⇒ **Late Internal Shock preferred** (Zhang et al. 2005, Burrows et al. 2005)
- ✓ Other flares do not show spectral evolution and have a spectrum consistent with that of the afterglow
⇒ **External Shock preferred**: clumpy medium (Dermer 2007), refreshed shock (Rees & Meszaros 1998, Guetta et al. 2006) thick shell fireball (Piro et al. 2005, Galli & Piro 2006).

-Internal Shock:

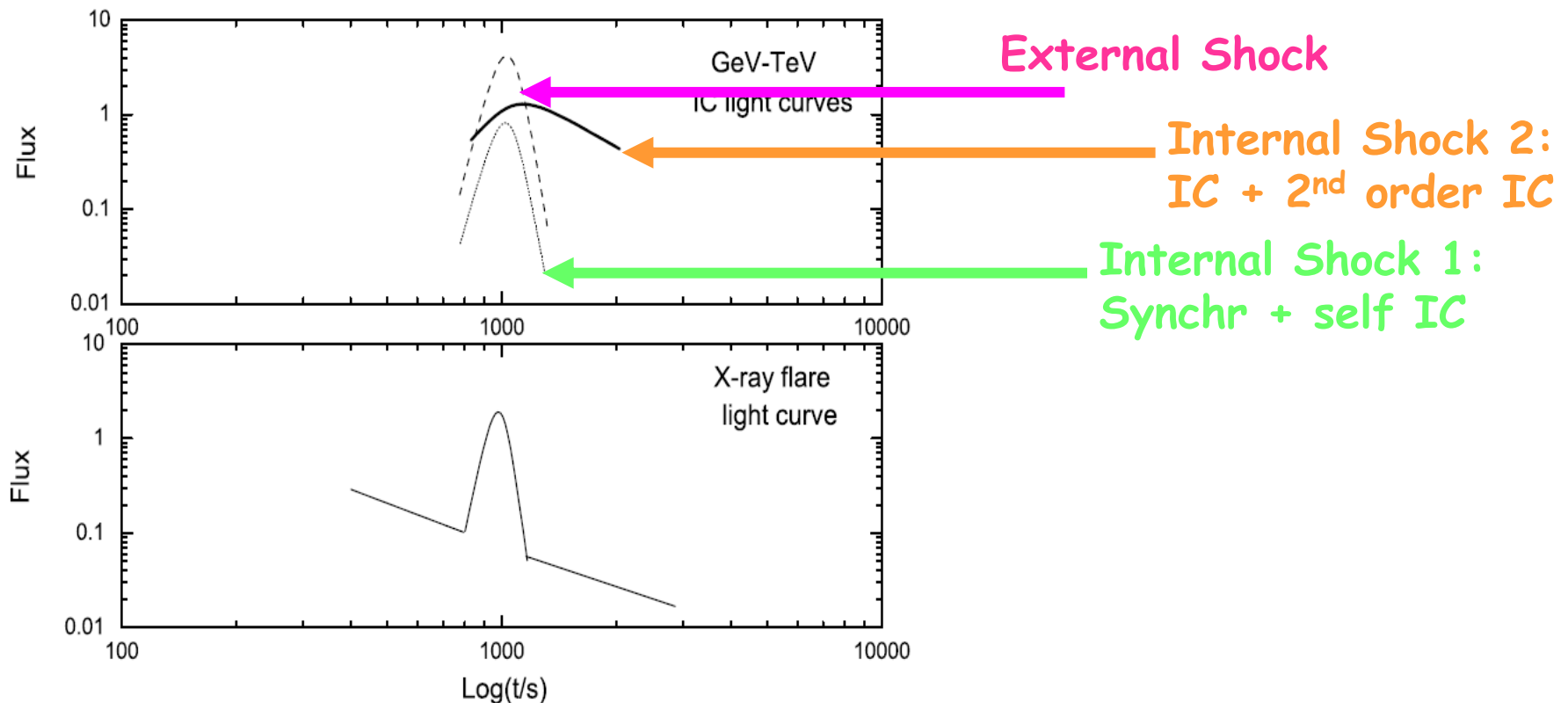
Low Lorentz factor, low Thompson cross section \Rightarrow no bright high energy flares

Different emitting regions \Rightarrow temporal dilatation

-External Shock:

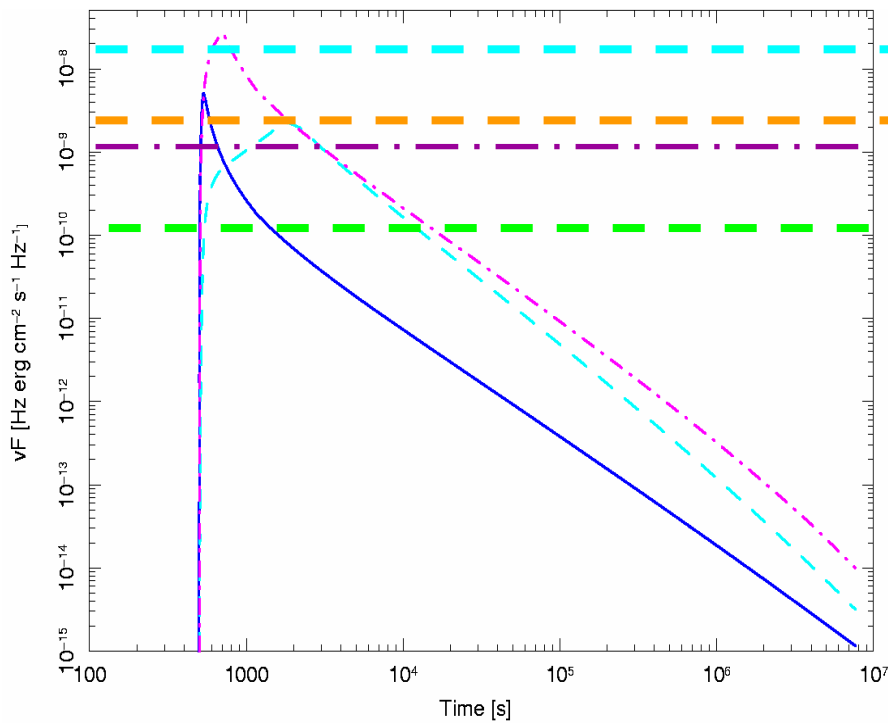
Higher Lorentz factor \Rightarrow brighter high energy flares

Same region and electrons population \Rightarrow similar temporal profiles





Predictions in the context of the External Shock

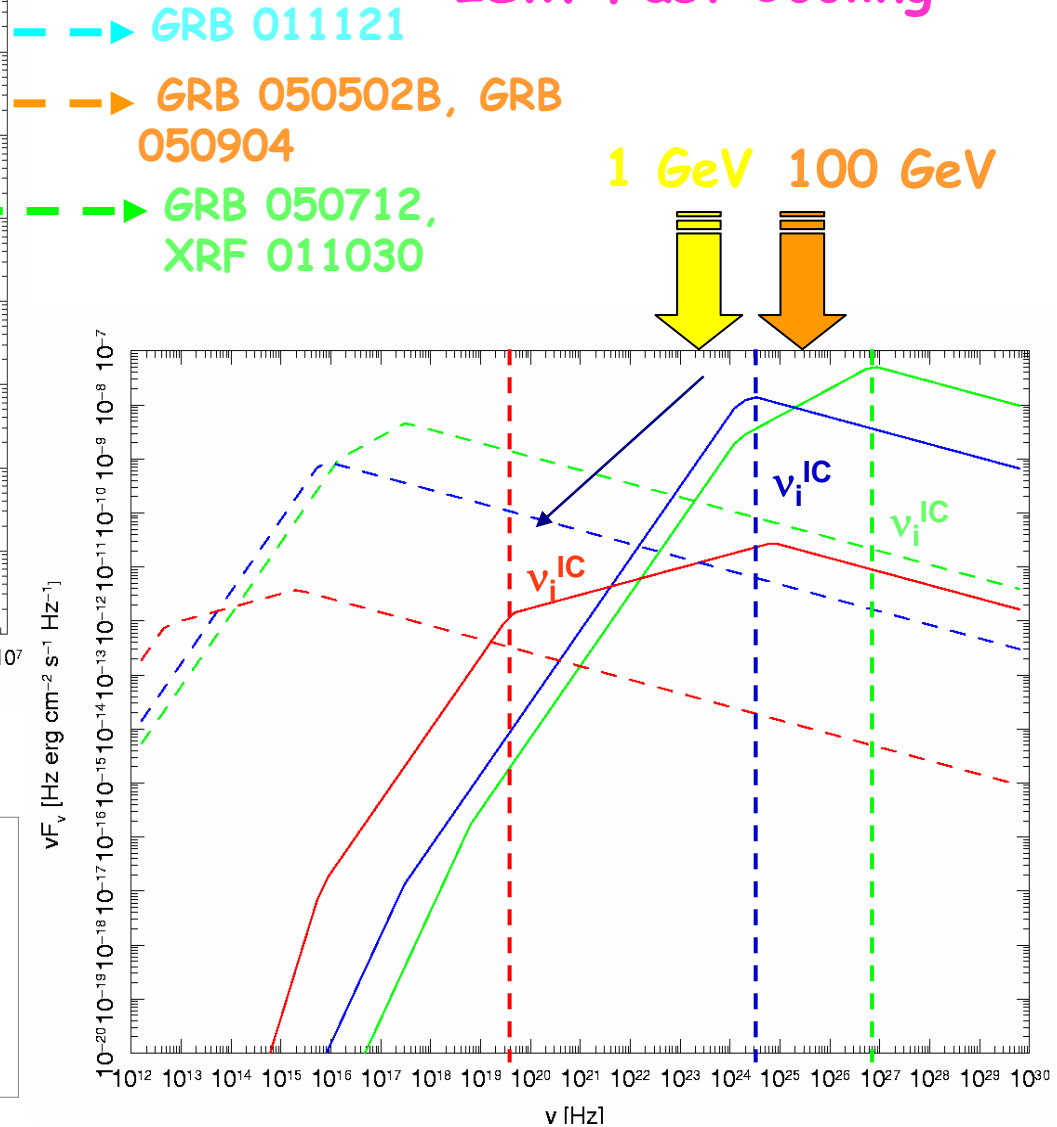


$E_{53}=5, \Gamma_0=300, n=1, \epsilon_e=0.1, \epsilon_B=10^{-4},$
 $p=2.5, z=1, t_0=500 \text{ s}$

Beginning Flare
 Top
 50000 s

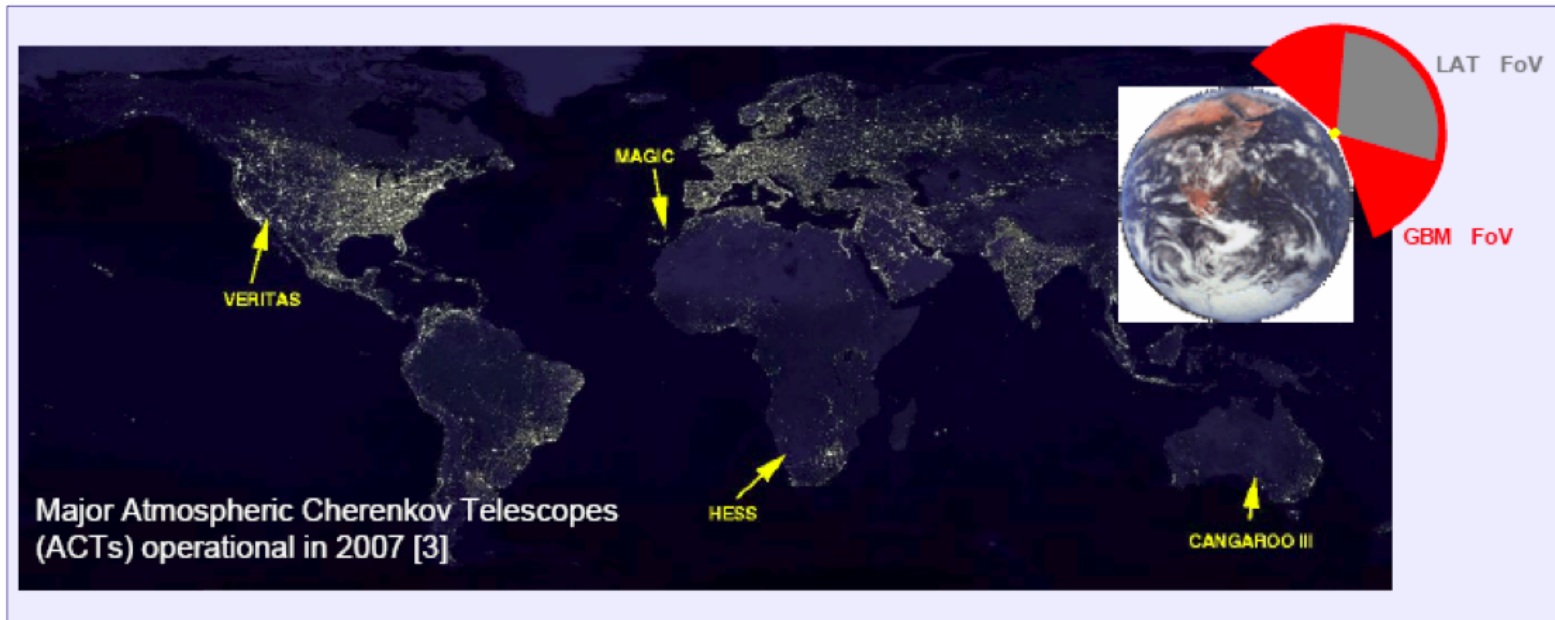
IFC GLAST- Frascati- Sep 09, 2007

ISM-Fast Cooling





GeV-TeV synergy



- ACTs: 10% duty cycle, 5° fov. Some of them can slew in few minutes (20% of the sky)
- need $\sim 1^\circ$ location accuracy (LAT only)
- Some back-of-the-envelope calculations:
 - Joint observation: Number of LAT alerts * duty cycle * sky coverage
 - ACT: $50 * 0.1 * 0.2 \sim 1$ GRB/yr suitable for combined GeV-TeV observations
 - EAS: $50 * 1 * 0.2 \sim 10$ GRB/yr suitable for combined GeV-TeV observations



WP 8000-Dark Matter

Giovanni Bignami	PO	Uni. Pavia	3 mesi 3
Andrea Lionetto	Ass Ricerca	U.Roma2	11 mesi 22
Francesco Bertola	PO	Uni.Padova	2 mesi 4
Alessandro Pizzella	Ric.	Uni.Padova	2 mesi 4
E. Corsini	Ric.	Uni. Padova	2 mesi 4
Lucio Buson	AA	INAF/O.Padova	2 mesi 4



WP 8000-tasks

- Evaluate Glast sensitivity to Kaluza Klein particles
- Evaluate how different dark matter decay modes could be observable by Glast
- Address the propagation of exotic particles interfacing Galprop and DarkSusy
- Evaluate how to detect axions with Glast

Spectrophotometrical study of a sample of Galaxies to measure the ratio dark to luminous matter (and identify promising candidates)



WP 8000-Outputs

Simulation of spectra containing lines from different decay modes

Simulation of propagation of exotic particles

Inderdiplinary day (physics-astronomy) organized by the dep. of Astronomy and Physics in Padova

Dark matter contribution to galaxies' rotation curves



WP 9000-Agile-Glast sinergies

Marco Tavani DR	INAF/IASF Roma		1 mese 2
Francesco Longo	Borsa Post Doc	U.Trieste	3 mesi 6
Stefano Vercellone*	Ric.TD	INAF/IASF Milano	
Alberto Pellizzoni*	Ric.TD	INAF/IASF Milano	
Andrea Giuliani*	Ass.Ricerca	INAF/IASF Milano	
Andrew Chen*	Ric TD	INAF/IASF Milano	



WP 9000-tasks

Share relevant info: e.g. Particle BKG in orbit

Optimizing the use of multi $\lambda\lambda\lambda$ data (pulsars, AGN monitoring)

Optimizing the Agile pointing plan to take advantage of the pointing strategy vs. the scanning one



WP 9000-Outputs

INAF-ASI-INFN WG coordinated by P. Caraveo

- Workshop for the italian community on gamma-ray astronomy
Frascati 2-3 july 2007