





# "Classical" definition of Blazars

Blazars are a class of active galactic nuclei (AGN) including flat spectrum radio quasars (FSRQ) and BL Lac objects.

They are characterized by

 variability over many timescales (from <1 day to years) and frequencies;

•high optical polarization;

•flat spectum and core dominant morphology in the radio;

•broad band continuum extending from radio to gamma-rays.



## Variability:What is ongoing (partial/personal view)

- Long term Monitoring
  - Perugia (http://astro.fisica.unipg.it/)
  - Colgate (http://astronomy.colgate.edu/astronomy/quasaroptical.html)
  - Turin (http://www.to.astro.it/blazars/)
  - Rome (http://astro1.phys.uniroma1.it/scae.html)
  - Tuorla (http://users.utu.fi/kani/1m/index.html)
- Mid-term Campaign on selected Sources
  - OJ 287 2005-2008 Campaign (http://www.astro.utu.fi/OJ287MMVI/)
  - REM monitoring of Blazars Observed by SWIFT
- Short-term intensive Monitoring
  - WEBT (http://www.to.astro.it/blazars/webt/)



## **Recent REM-AIT result:3C 454.3**





# WEBT

#### The Whole Earth Blazar Telescope

is an international collaboration of astronomers interested in blazar variability



About 70 telescopes from 30 to 250 cm have provided WEBT campaigns with optical and near-infrared data

The distribution in longitude of these telescopes allows the observing task to move from East to West as the Earth rotates



In principle it is possible to obtain 24 hours of continuous monitoring





## Radio telescopes collaborating to the WEBT



The radio telescopes of the University of Michigan (UMRAO, USA) and of the Metsähovi Observatory (Finland) are the historical radio arms of the WEBT

The 26 m antenna at the UMRAO

More recently, other radio telescopes have been participating in the WEBT campaigns:

The 100 m antenna in Effelsberg (Germany), the 600 m ring RATAN (Russia), and the two 32 m antennas in Medicina and Noto



# WEBT Campaign:BL Lac 2000



7 telescopes from Uzbekistan to La Palma

219 *R* final data in 10.3 hours ∆t(*R*) ~ 2.8 min

#### 0.5 mag brightness fall in ~7 h, followed by ~ 0.4 mag brightening in 1.7 h LAT Collaboration Meeting – Blazar & Other AGN WG meeting, 31 August 2005





### Example of Ground-support for the GLAST mission

### **Mid-Term Broad band monitoring of AGNs**

### P.I. Lars Fuhrmann

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University of Perugia –L. Fuhrmann, G. Tosti et al. INAF – OA Torino: U. Bach, C. M. Raiteri, M. Villata INAF – OA Teramo – M. Dolci et al. Medicina/Noto Radio Telescope: P. Leto et al.

Since December 2004:

- simultaneous radio, IR and optical monitoring of a blazar sample
- aim: multi-frequency studies
- long-term variability
- simultaneous broad band spectra and their evolution



### **Example of Ground-support for the GLAST mission**

optical: Torino and Perugia (B, V, R, I bands)

near-IR: Teramo (J, H, K bands)

Sampling: 2 times per month

Start: December 2004



Torino 1 m







### Noto/Medicina 32 m



Coloti – Perugia 0.8 m



## **Furure Plan: new ID blazars Characterization**

GLAST gamma-ray mission: several thousand new blazars expected

Charactrization of a large number of new blazar sources through radio spectra, variability, and optical polarization prior to launch will be very important.

- P. Giommi: list of ~6000 new blazar candidates
- plan/aim: source characterization of a large sub-sample with Effelsberg and/or the VLA and optical telescopes
- Collaboration with the GLAST AGN team is very welcome!!!

Università di Perugia: **L. Fuhrmann,** G. Tosti et al. ASI : P. Giommi et al. MPI Bonn: T. Krichbaum et al.





### **Example of Polarization Study (P.I. S. Ciprini)**

- •Ongoing: optical polarimetric observations of a sample of new blazar candidates selected by recent optical identification of EGRET gamma-ray point sources and by new candidates from recent radio-optical-X-rays surveys.
- Aims: to confirm or not their BL Lac or HPQ status (useful for the GLAST pre-launch catalogs) and to have optical polarization measures for the first time
- •Proposer:Perugia & Tuorla Groups
- Instrument: 2.5m Nordic Optical Telescope (La Palma, Canary Islands).
- **Starting observations:** 2 nights available at end of September (possibly 30-40 sources). Sample: possible, probable, new blazar (especially BL Lac) candidates, mag: 17-20

•Future Plan: Optical polarimetric surveys of suggested and not-confirmed BL Lac represent an independent and further tool in recognizing and select blazars for pre-launch catalogs.







## **Future development**

- Proposal submitted to ASI
  - Set up of a Network of Italian Telescope to support GLAST
    - Perugia Torino Rome +REM (La Silla)

Near/Mid-Infrared monitoring of Bright Sources from Dome C
– IRAIT project (from end of 2006)









# **Conclusion:What we need**

- Regular monitoring:
  - A catalog of selected sources
  - A "Core Group" of facilities (radio, ir, optical) able to follow the selected sources when they are both in high and low states
  - An observing strategy
  - Agreement with GTN(<u>http://gtn.sonoma.edu/public/</u>) ROBONET (http://www.astro.livjm.ac.uk/RoboNet/), and Southerm Emisphere Observer,
- Target of Opportunities
  - Agreement with WEBT, etc,

# Conclusion

- Strong GLAT Team support in preparation/submission of Proposal to Large Facilities (ESO, Hawaii, etc., Radio Tel.)
- Data policy: what can the Glast Team offer to the MW contributors?
- Do we need a communication system for alerts, data exchange (GCN?, ?,?)?
- Do we need a dedicated, object oriented, MW archive (historical data, new obs,literature, etc;e.g. each WG member could adopt a blazar)
- Discussion with the AGILE Team-AGN WG( many facilities involved to support AGILE next years, will be also involved to support GLAST).
- Support for young people

What about a dedicated Workshop on Low Frequency Monitoring of blazar to be held next Year?