



Ground Support for GLAST:



Simultaneous Radio to Sub-mm Monitoring of Variability & Spectral Shape Evolution of potential GLAST Blazars

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on behalf of the
**LAT Science Working Group on Blazars and
other AGNs**



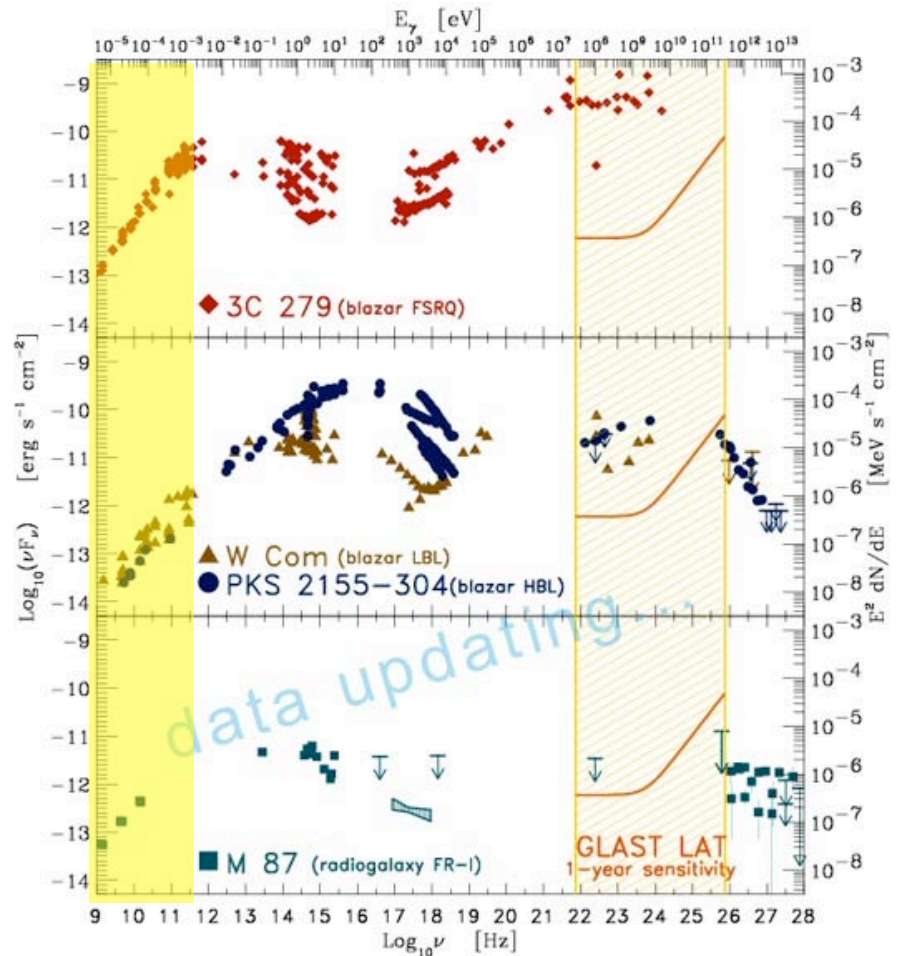
Outline

- **Multi-wavelengths (MW) activities: the ‘low-energy part’**
- **Effelsberg monitoring at cm-/mm-bands**
- **Complementary observations (planned): towards the mm-/sub-mm regime**
 - **IRAM 30m telescope**
 - **SMA**
- **Towards the optical regime**
- **Summary**



MW activities: the 'low energy' part

- ✓ GLAST will provide tremendous opportunity for future blazar studies
 - ✓ maximum science return from the offered LAT capabilities: MW studies
- ➔ **MW campaigns:** ToO/Trigger, IPCs (months) and planned long-term campaigns (> 1 year)
- ✓ cm-/mm-/sub-mm regime: 'low-energy' synchrotron part of blazar SEDs

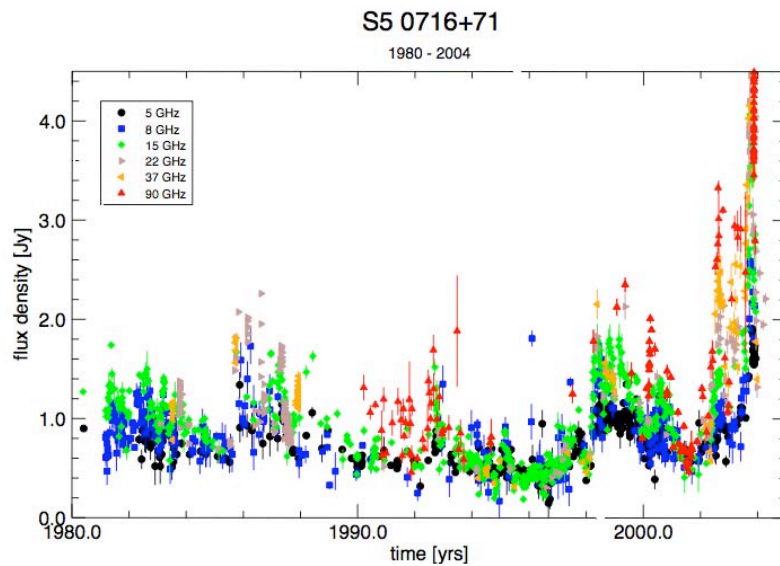


➔ GLAST dedicated simult. cm- to sub-mm monitoring in support of the MW activities

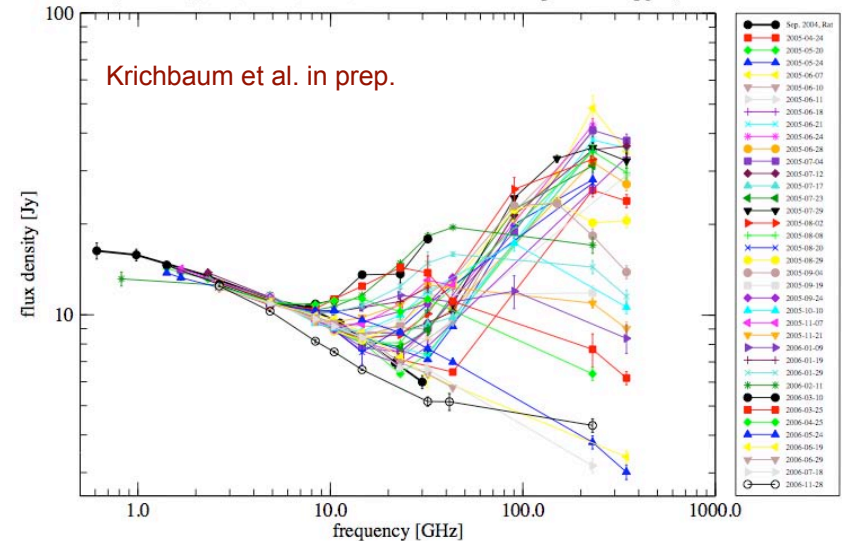


MW activities: the 'low energy' part

- ✓ here: blazars highly variable in I , P , χ plus spectral variability/evolution
- ✓ different models are discussed: e.g. shock-in-jets (e.g. Marscher & Gear 1985) or changes in the direction of forward beaming (e.g. Villata & Raiteri 1999)
- ✓ (quasi-) simultaneous, dense broad band monitoring allows to constrain variability/jet models (e.g. Tuerler et al. 2000, Lindfors et al. 2006)



Spectral Evolution of 3C454.3 after May 2005 flare
(Effelsberg, Pico, VLA, SMA, contact: tkrichbaum@mpifr-bonn.mpg.de)





Effelsberg monitoring at cm-/mm-bands

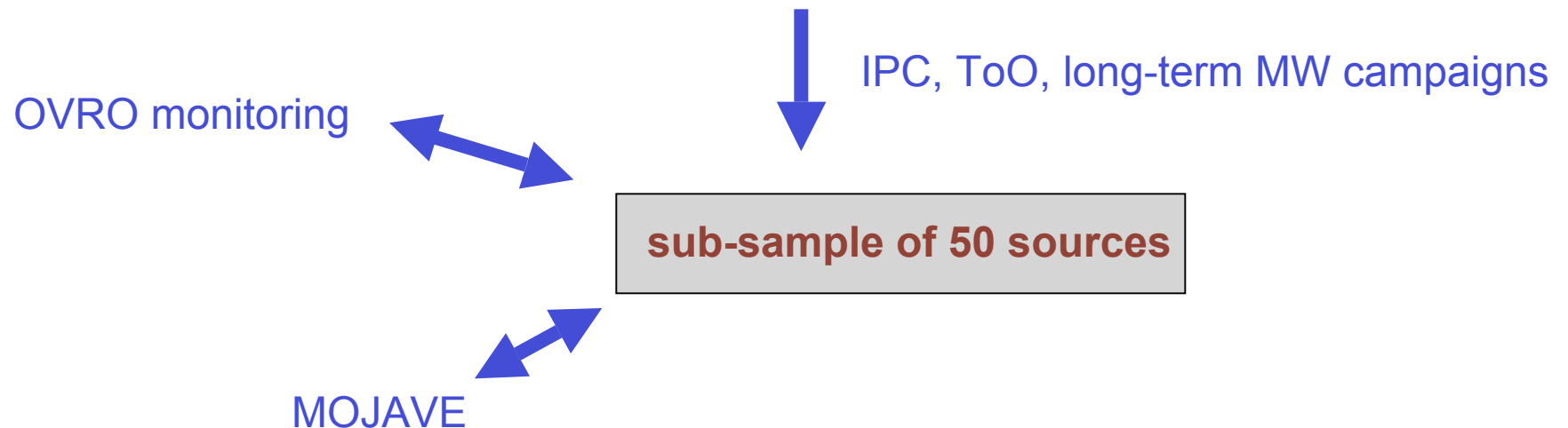
- ✓ GLAST dedicated flux-density and polarisation monitoring of a larger sample of potential GLAST blazars
- ✓ **Aim:** (quasi-) simultaneous broad band spectra (cm, mm, sub-mm, optical/IR)
- ✓ Effelsberg 100m telescope:
 - ✓ good and broad frequency coverage between 21cm and 7mm
 - ✓ full polarisation information
 - ✓ fast frequency switching capabilities (sec.) in the secondary focus
 - ✓ excellent sensitivity (new sub-reflector in 2006)
- ➔ high-precision, (quasi-) simultaneous broad band spectrum in about 35 min (~ 0.5 - 1 Jy source)





Effelsberg monitoring at cm-/mm-bands

- ✓ first (test-) epoch of ~36 hrs end of January 2007 at 110, 60, 36, 28, 20, 9, 7mm
- ✓ sampling aim: 1 epoch every 2-3 weeks over the next years
- ✓ source sample selection: 'high priority VIP' AGN/blazar list of the LAT AGN group of 150 sources





Towards the mm/sub-mm-bands

- ✓ aim: extension of the Effelsberg monitoring towards the (shorter) mm-band (3 and 1 mm)

➔ IRAM telescope: Pico Veleta 30m

- ✓ heterodyne receivers at 3 and 1 mm simultaneously
- ✓ flux-density plus polarisation
- ✓ planned proposal for a similar monitoring complementing the Effelsberg observations (March 2007)

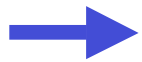




Towards the mm/sub-mm-bands



- ✓ aim: extension of the Effelsberg monitoring towards the sub-mm-band (0.8 mm)



SMA - Submillimeter Array: Mauna Kea, Hawaii

- ✓ 8 element array of 6m antennas
- ✓ sensitive, broad band SIS receivers at 1, 0.8 mm
- ✓ planned proposal for a similar monitoring complementing the Effelsberg observations for the next deadline



Towards the optical/IR regime

- ✓ aim: add the optical/IR bands
- ✓ (quasi-) simultaneous optical observations with the 1.2m Kryoneri telescope approved (V/B/R/I bands)
- ✓ Gino: REM & AIT telescopes (approved, V/R/I/H bands)



Summary

- ✓ ambitious effort as MW support for GLAST:
dense, (quasi-) simultaneous flux-density (and polarisation)
monitoring from cm-/mm-/sub-mm up to optical/IR wavelengths
of 50 potential GLAST blazars
- ✓ complementing the MW activities/campaigns of the LAT
AGN group towards 'the lowest energies' and together
with OVRO, MOJAVE and the help of the community

➔ huge broad band data base to study & understand the high energy
emission of these sources recorded by **GLAST**