



TANAMI: Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry

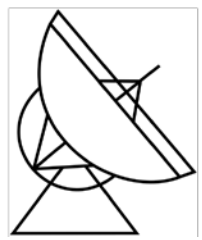
Roopesh Ojha

NVI/ U. S. Naval Observatory

On behalf of the TANAMI team



June 22nd, 2010



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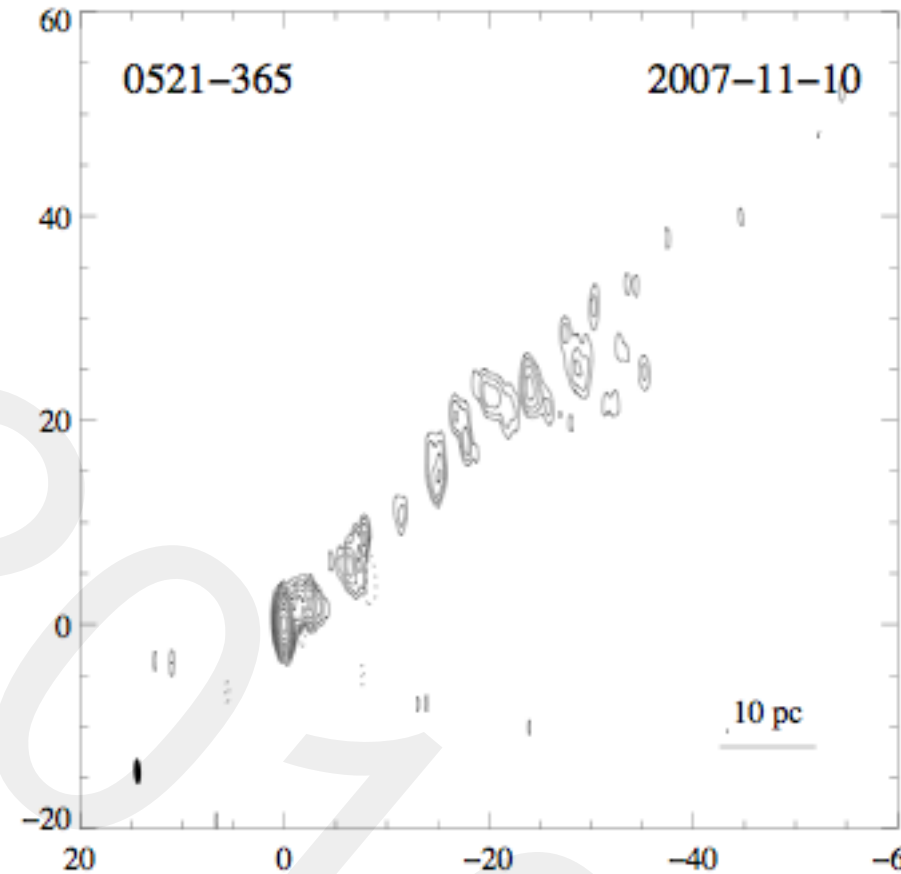
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in collaboration with the
LAT AGN Science Working Group

Outline

- TANAMI
- Supporting programs
- General results/ First epoch results
- SEDs
- Some specific results: gamma-ray properties, PKS 0537-441, and Cen A
- Immediate Future

What VLBI brings to the table

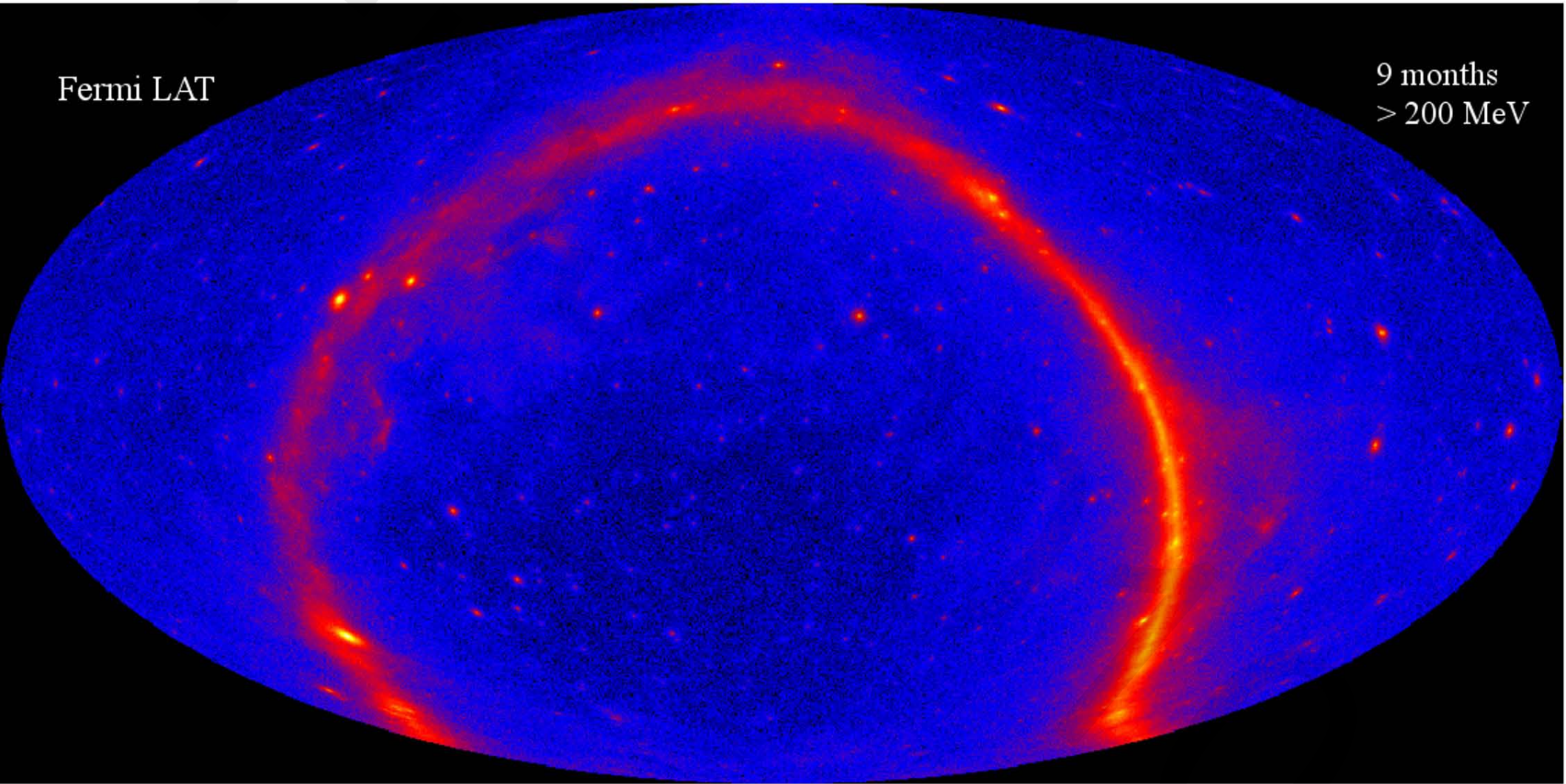
- direct imaging of jets
- only direct measure of intrinsic jet parameters
 - speed
 - Doppler factor
 - inclination
 - opening angle
- identify location and extent of emission regions
- under what conditions do blazars and non-blazars emit gamma rays



Fermi All Sky Map

Fermi LAT

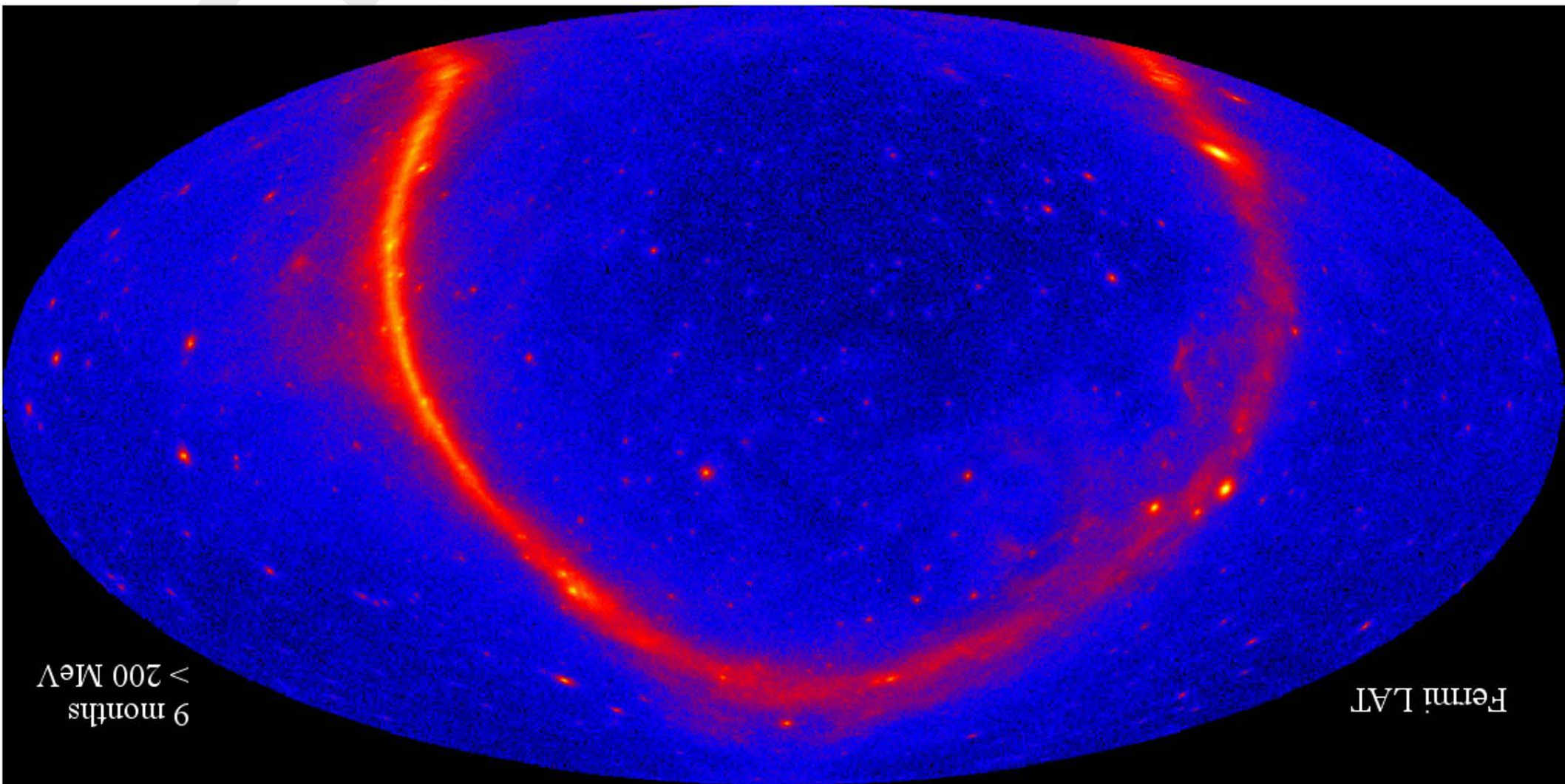
9 months
> 200 MeV



Equatorial coordinates

NASA/DOE International LAT Team

Fermi All Sky Map (Austral View)

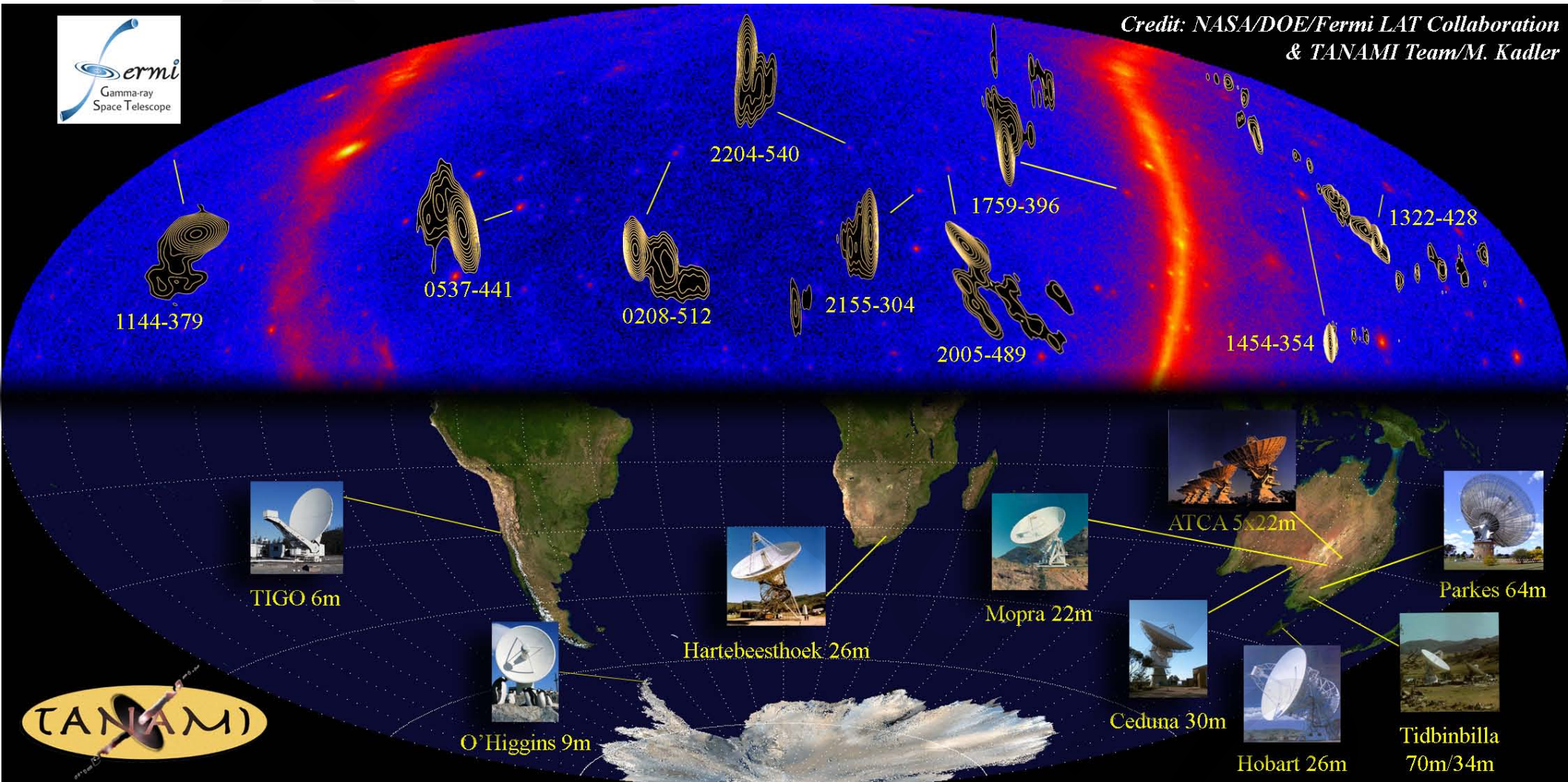


NASA/DOE International LAT Team

TANAMI!



Credit: NASA/DOE/Fermi LAT Collaboration
& TANAMI Team/M. Kadler



Southern Fermi/LAT sky in top half. South on top. Radio images scaled up ~1000

The Australian Long Baseline Array (LBA)+

- ~ 1 hour per source
- 6 scans
- typical angular resolution 1.5×0.7 mas
- dual frequency
- attempting ~ 2 month cadence
- scheduling
- uv-coverage

LBA++

New telescopes:

Auckland (New Zealand) available

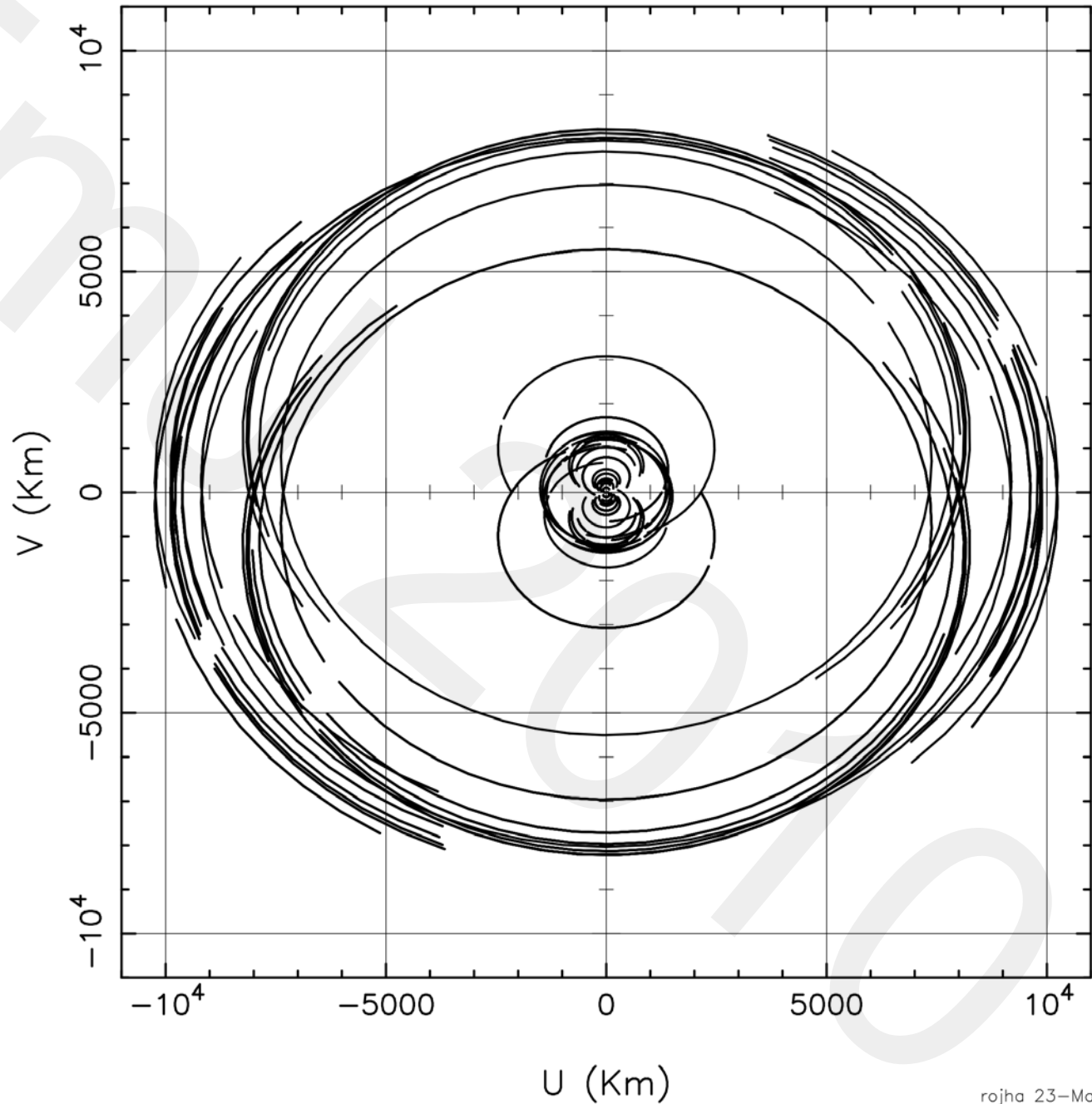
Yarragadee (Western Australia) and Katherine (Northern Territory) to be available in ~2 years (AUSCOPE VLBI Array).

If access is arranged it will mitigate uv-coverage problems. But only 12m diameter.

UV Coverage for PLAN

PARKES
ATCA
MOPRA
HOBART
CEDUNA
TID70_S2
TIGOCONC
OHIGGINS

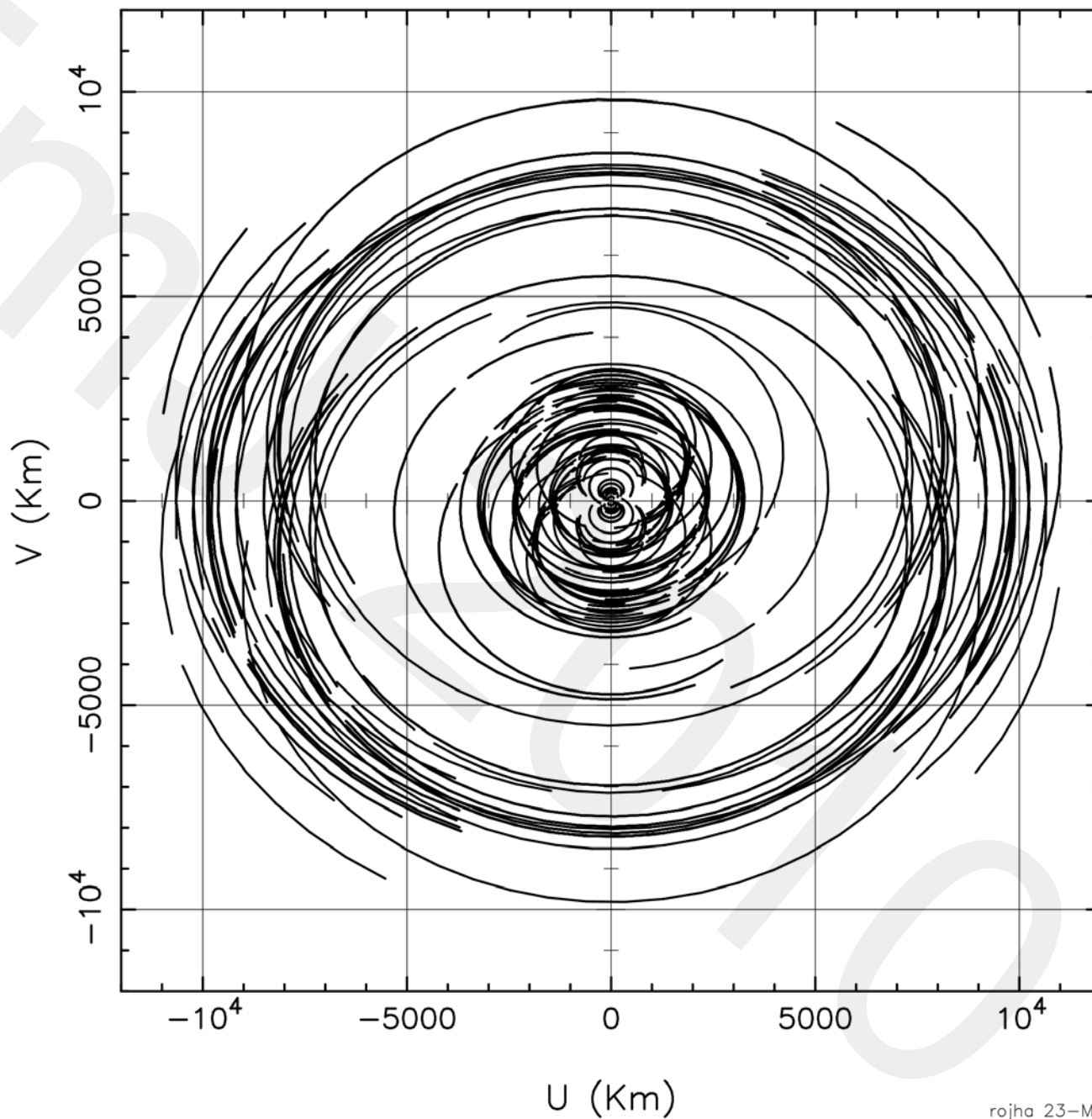
0047-579



UV Coverage for PLAN

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OHIGGINS
TIGOCONC
YARRAGAD
KATHERIN
WARKWORT

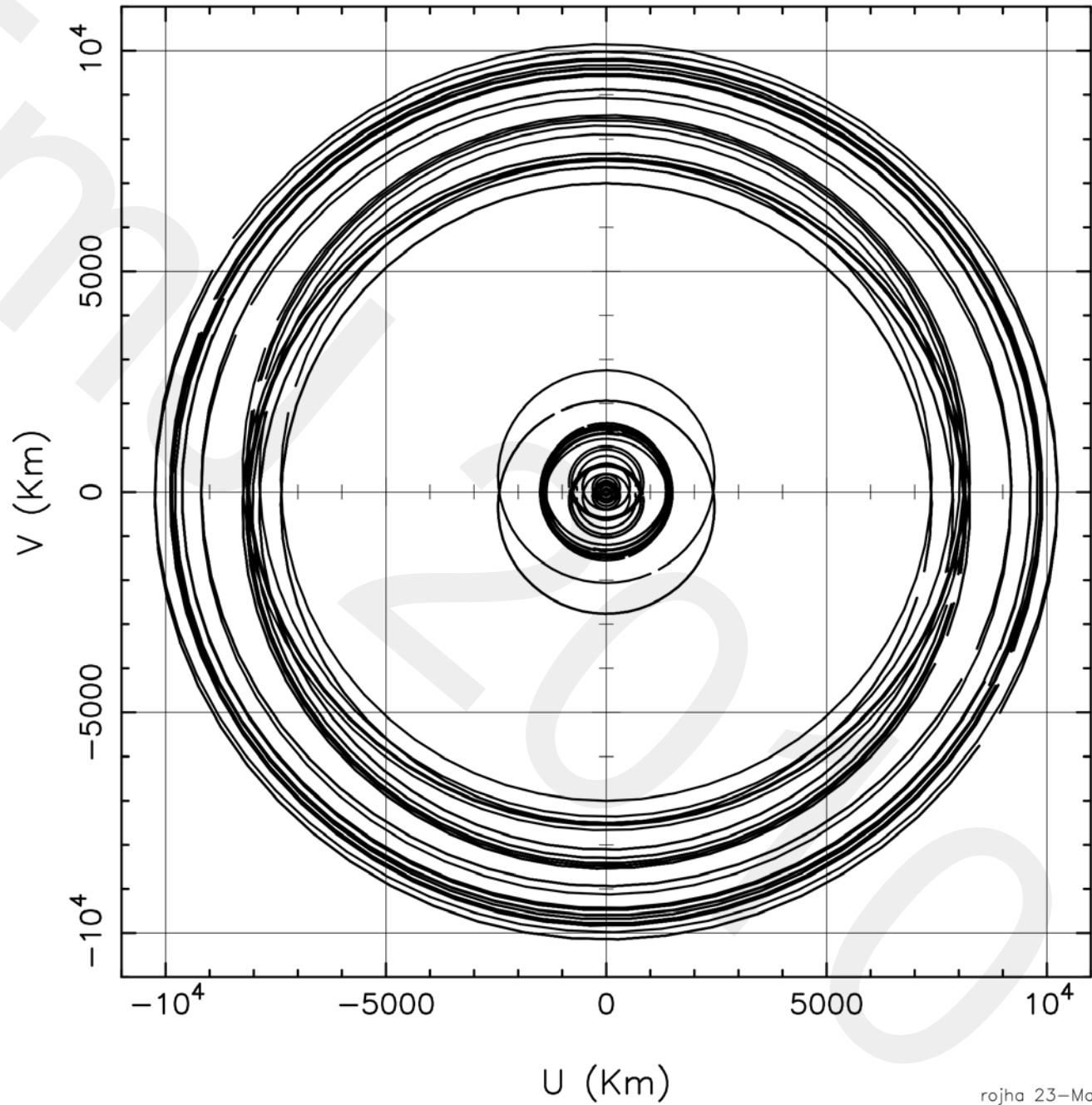
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UV Coverage for PLAN

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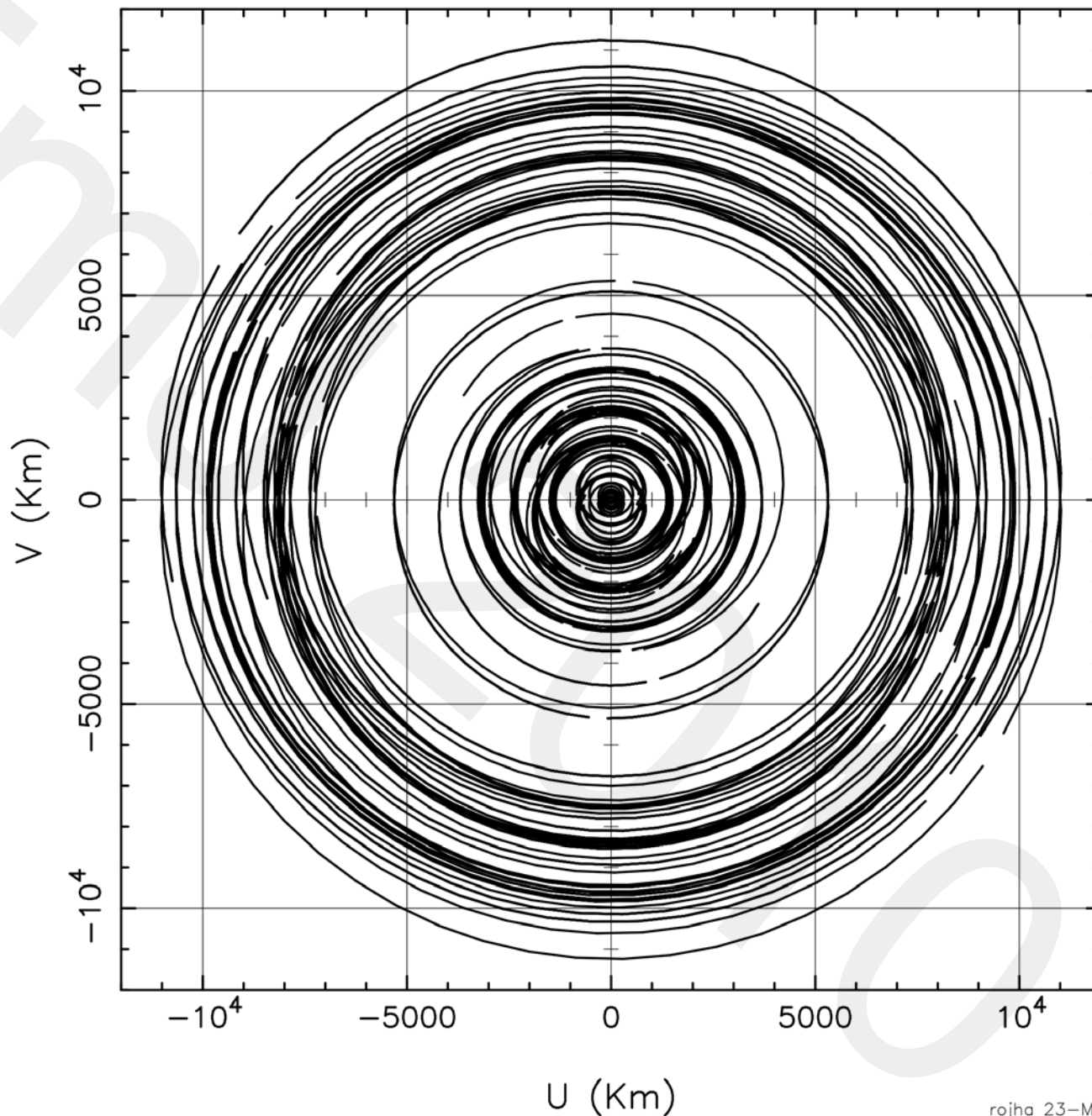
1549-790



UV Coverage for PLAN

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YARRAGAD
KATHERIN
WARKWORT

1549-790



Supporting Radio Observations

Lovell: Single-dish monitoring, 2.3 and 8.4 GHz at Hobart 26m and 6.7 GHz at the Ceduna 30m

Lovell: Ceduna Hobart Interferometer (~1700km)

Tingay: ATCA monitoring 6 frequencies (4.8 to 40 GHz)



Hybrid radio and gamma-ray
selected sample south of -30 deg
declination

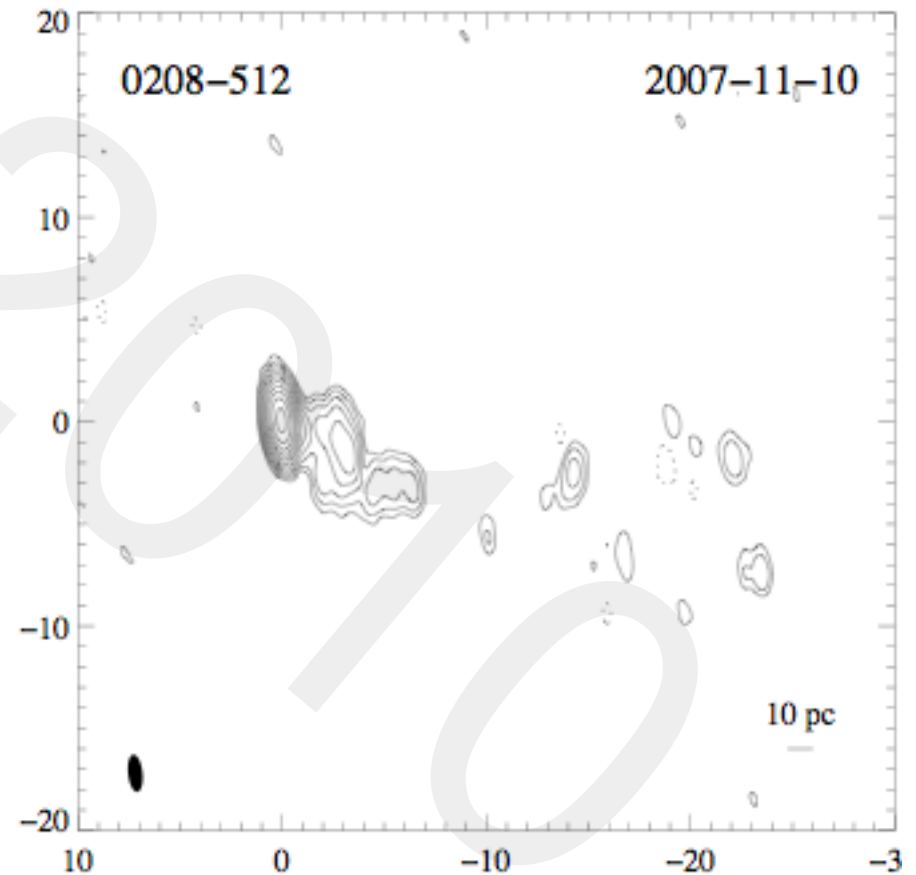
1) Flat spectrum sources with
 $S_{5\text{GHz}} > 2 \text{ Jy}$

2) EGRET detections

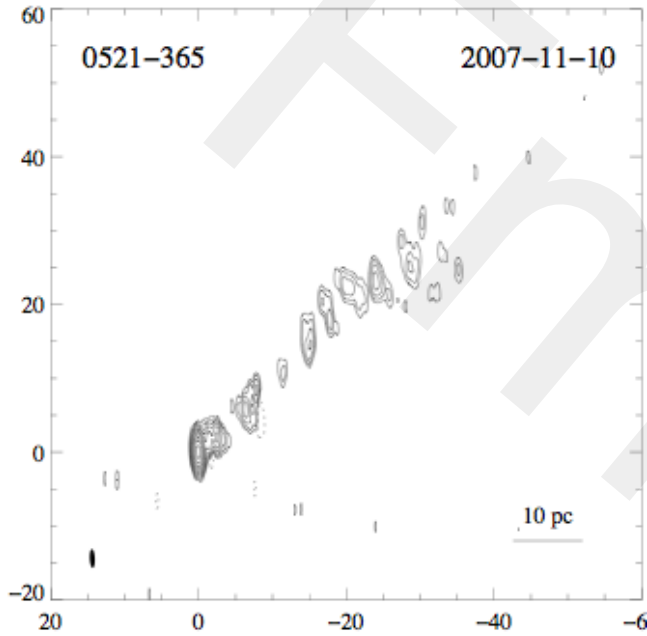
3) Typical sources of a class
4 IDVs
GPS source
galaxies

Initially 43 sources. Now adding
Fermi-detected gamma-loud AGN
(mostly without previous VLBI
observations)

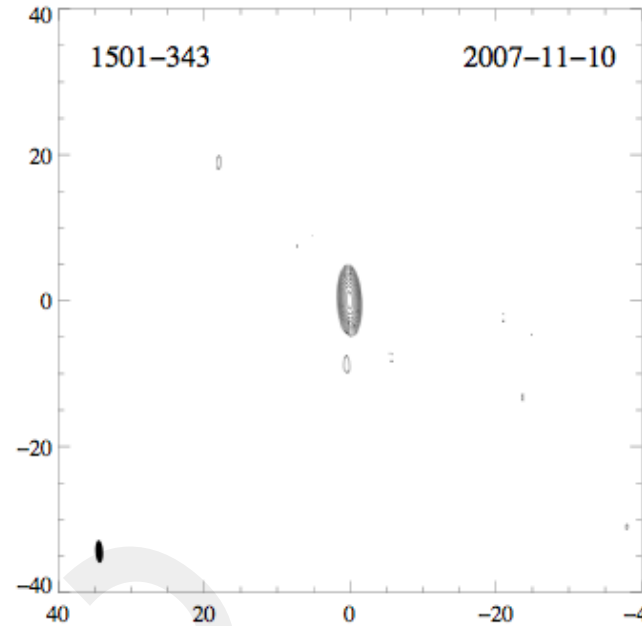
Sample Selection



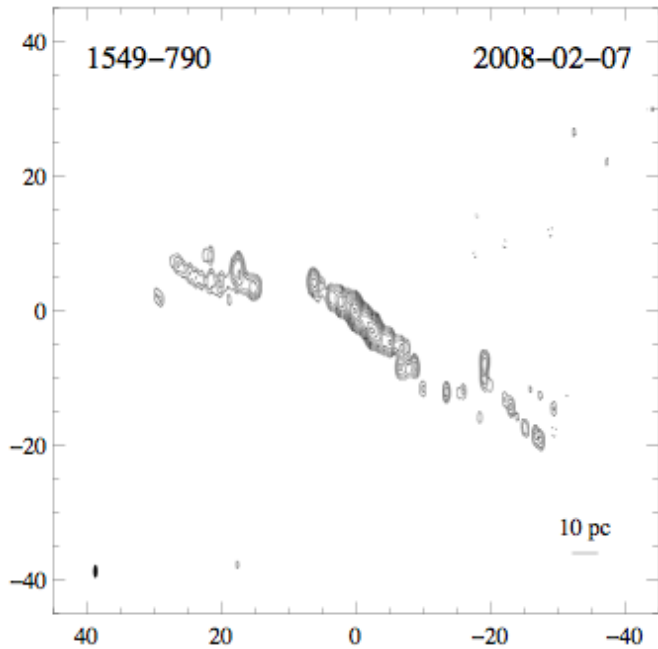
First Epoch Results: Morphology



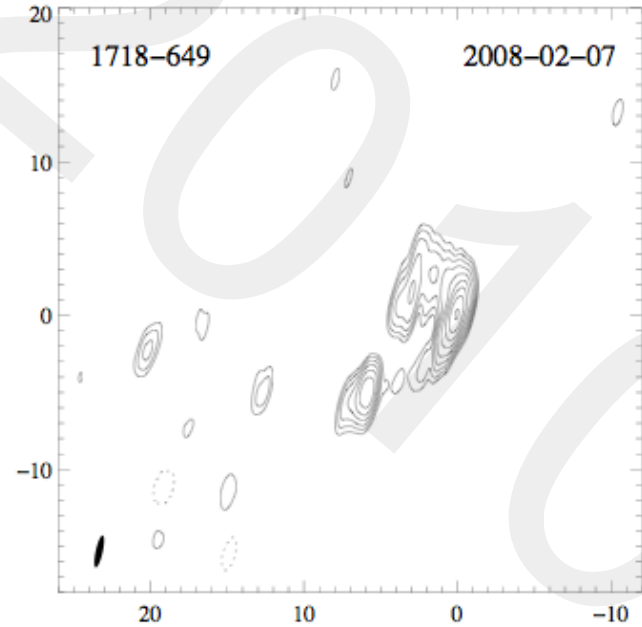
Single
Sided (SS)
- 36



Compact
(C) - 1



Double
Sided
(DS) - 5



Irregular
(Irr) - 1

First Epoch Results

Ojha et al. A &A in press, arXiv 1005.4432

Redshift:

- Distribution of the quasars and BLLacs in the TANAMI sample is similar to those for the LBAS and EGRET blazars
- No difference in the radio- and gamma-ray selected subsamples

Luminosity:

- Core and total luminosity calculated assuming isotropic emission
- No significant difference between LBAS and non-LBAS sources
- Galaxies, BLLacs quasars average luminosity sequence

First Epoch Results

Brightness Temperature:

- High end dominated by quasars and low end by BLLacs/galaxies
- No significant difference between LBAS and non-LBAS sources
- 14 below equipartition, 30 below inverse Compton limit, putting about a third of the values above this limit. (Doppler boosting, exotic mechanisms, non-simple geometries)

First Epoch Results

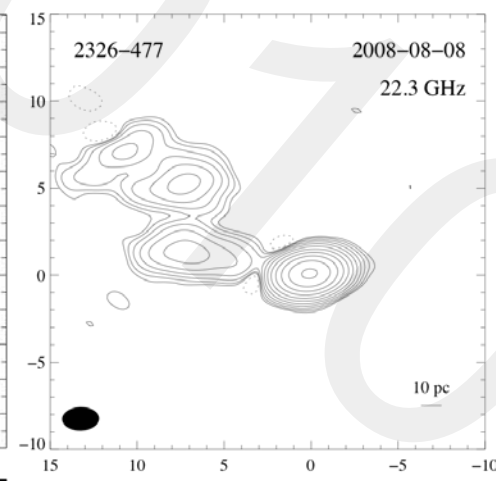
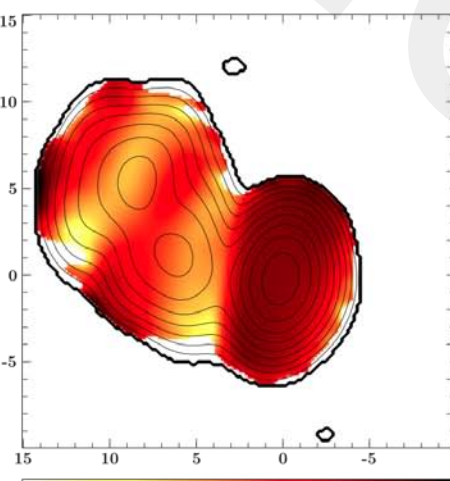
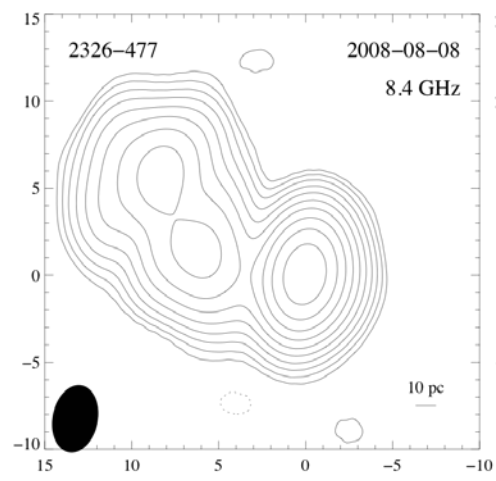
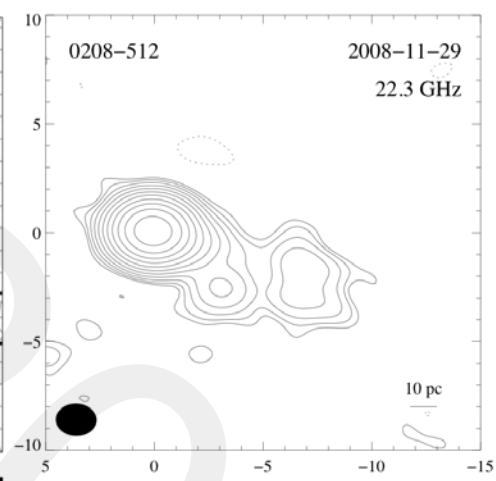
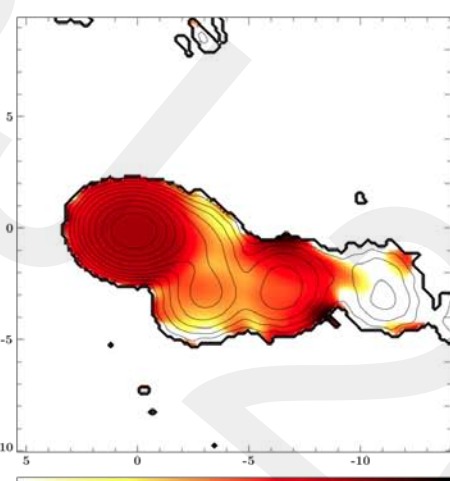
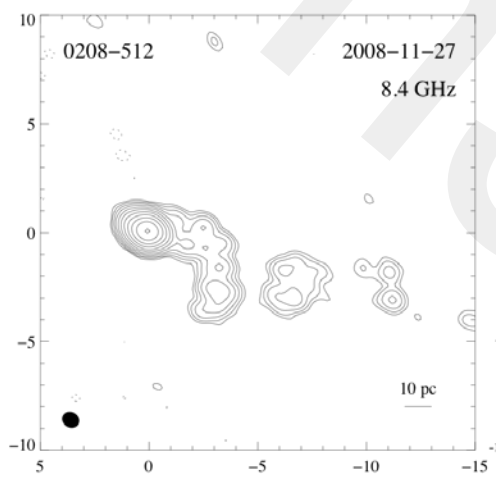
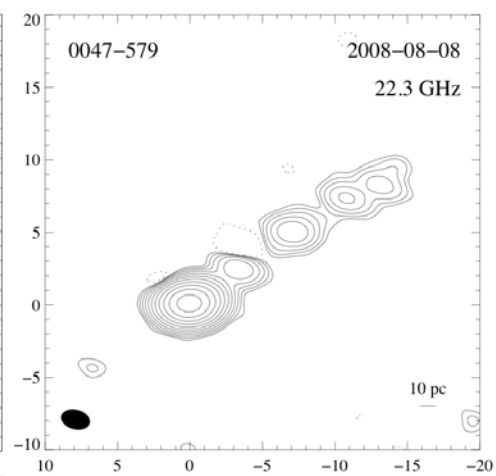
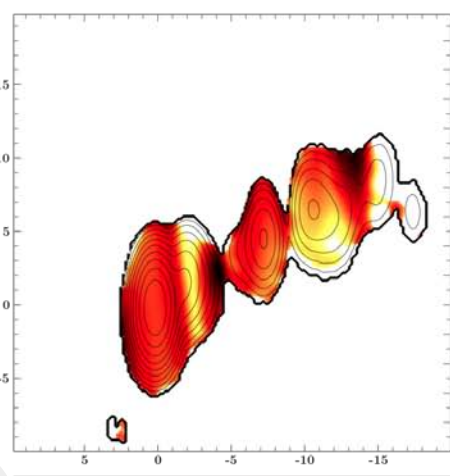
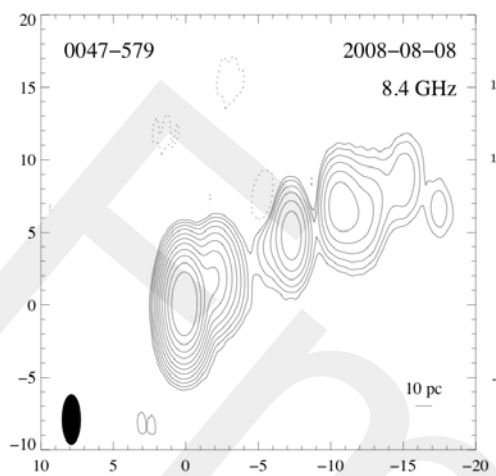
Are opening angles correlated with gamma-luminosity?

78% of LAT AGN Bright Sample (LBAS) sources have opening angle > 30 deg. Only 27% of non-LBAS sources do. (Small number alert!)

Either 1) LBAS jets have smaller Lorentz factors (beaming cone $\sim 1/\text{Lorentz factor}$)

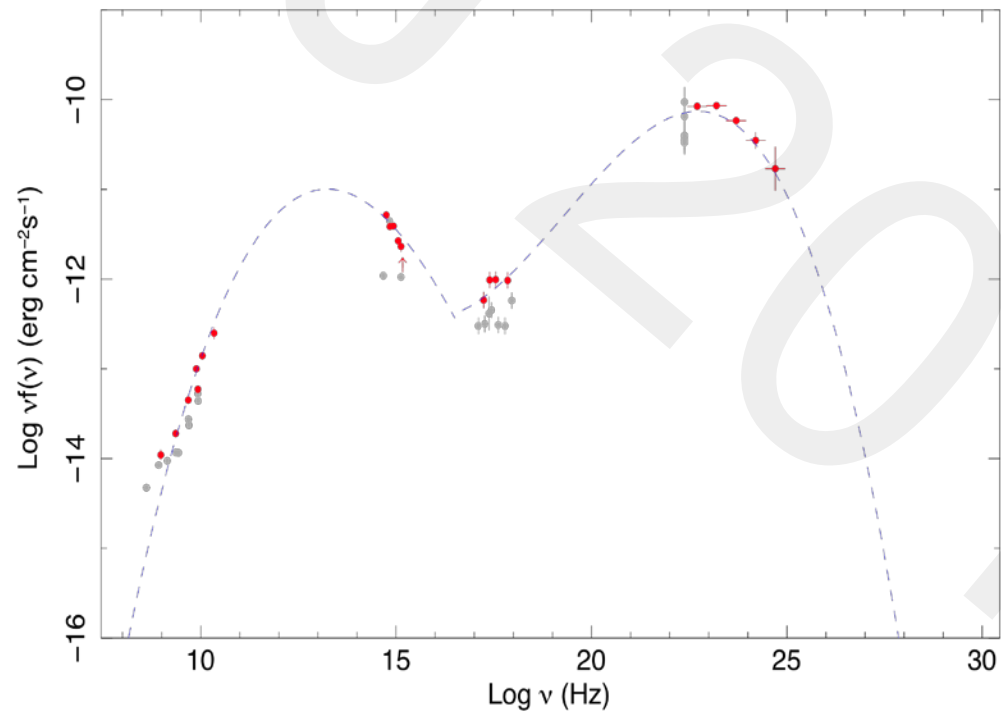
2) LBAS jets are pointed closer to line of sight

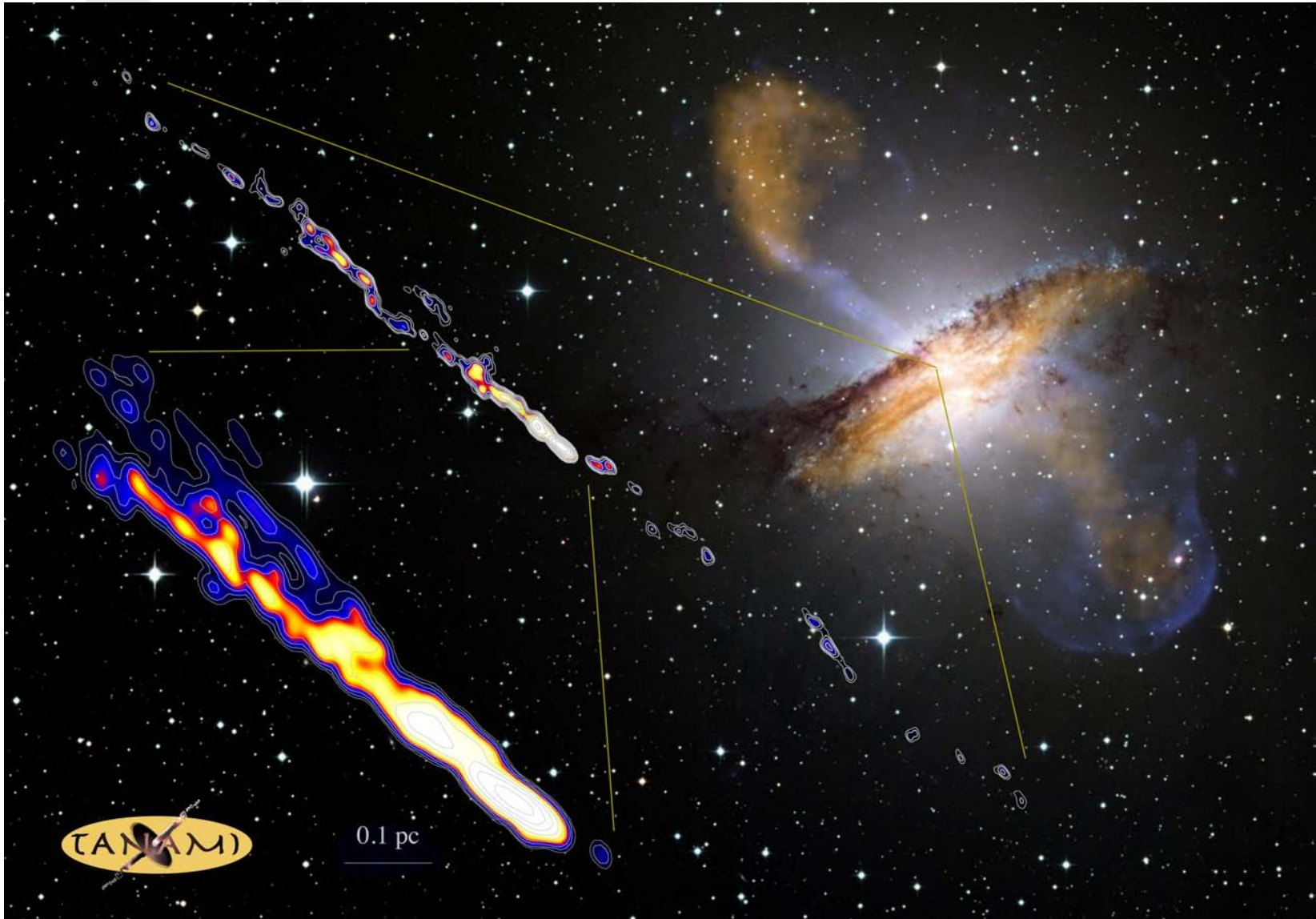
See Pushkarev et al. 2009, A & A, 507, L33



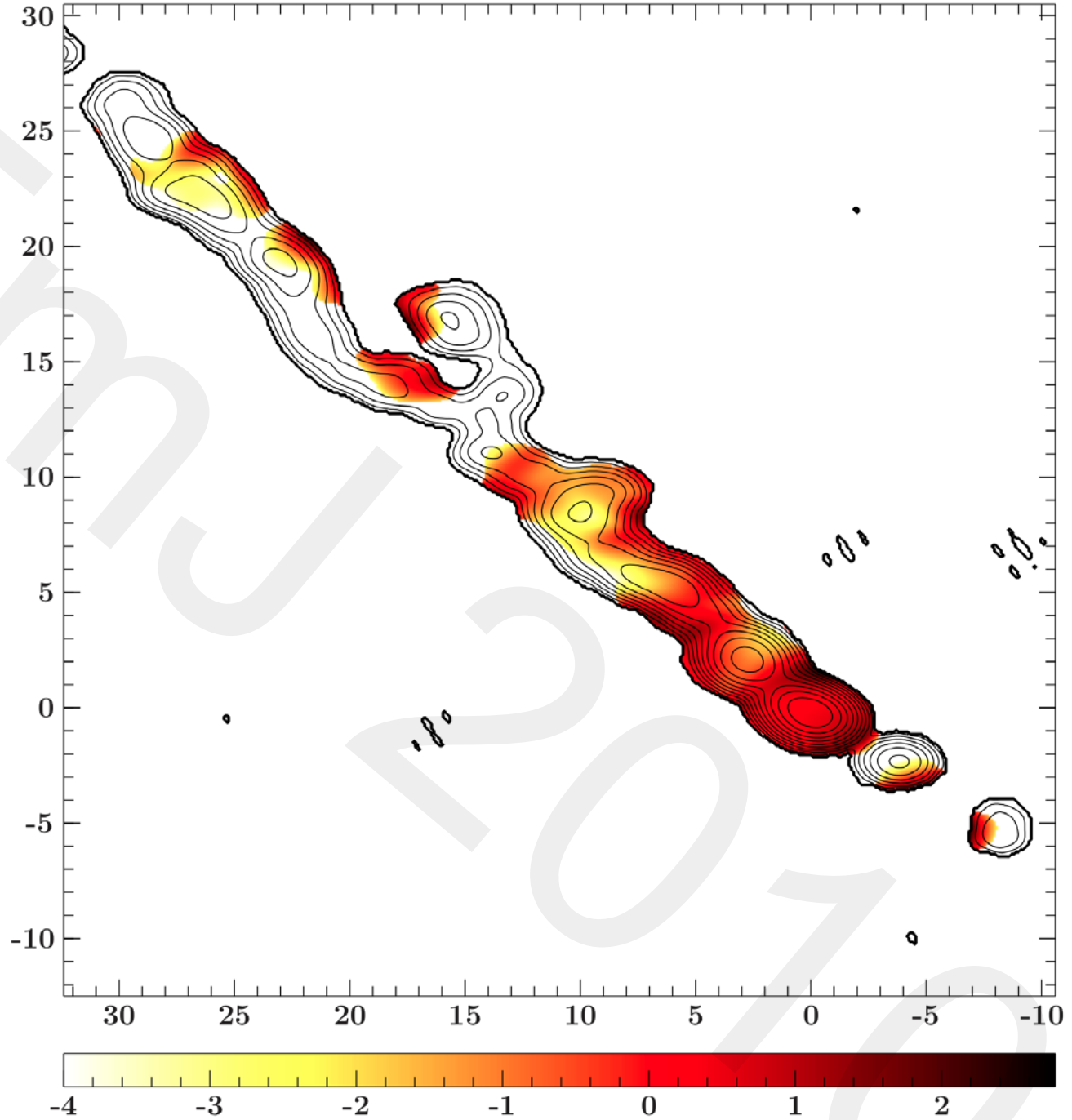
Broadband SEDs

- PKS 1454-354 (below)
- SEDs of LBAS blazars

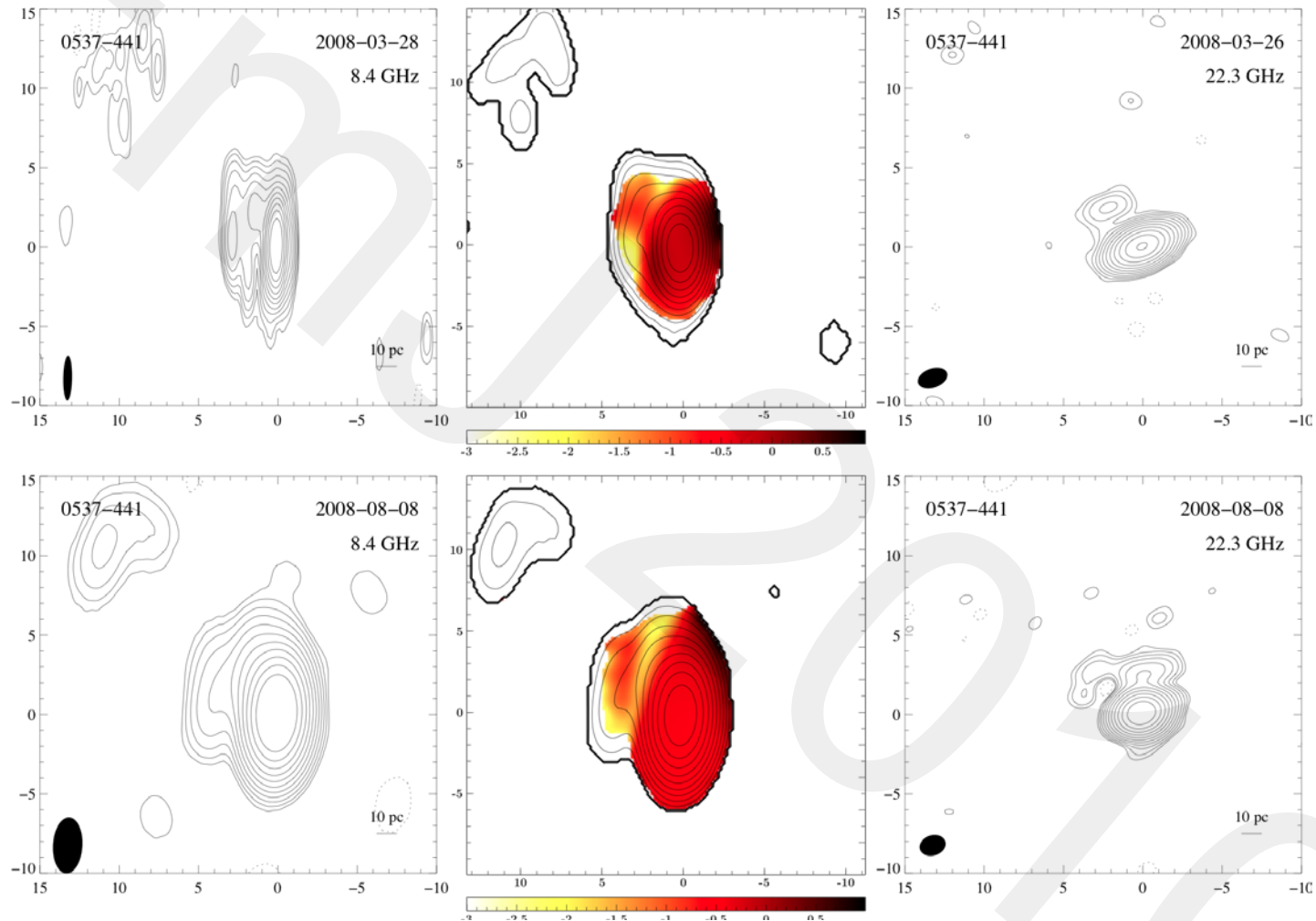




Mueller
et al.
P18

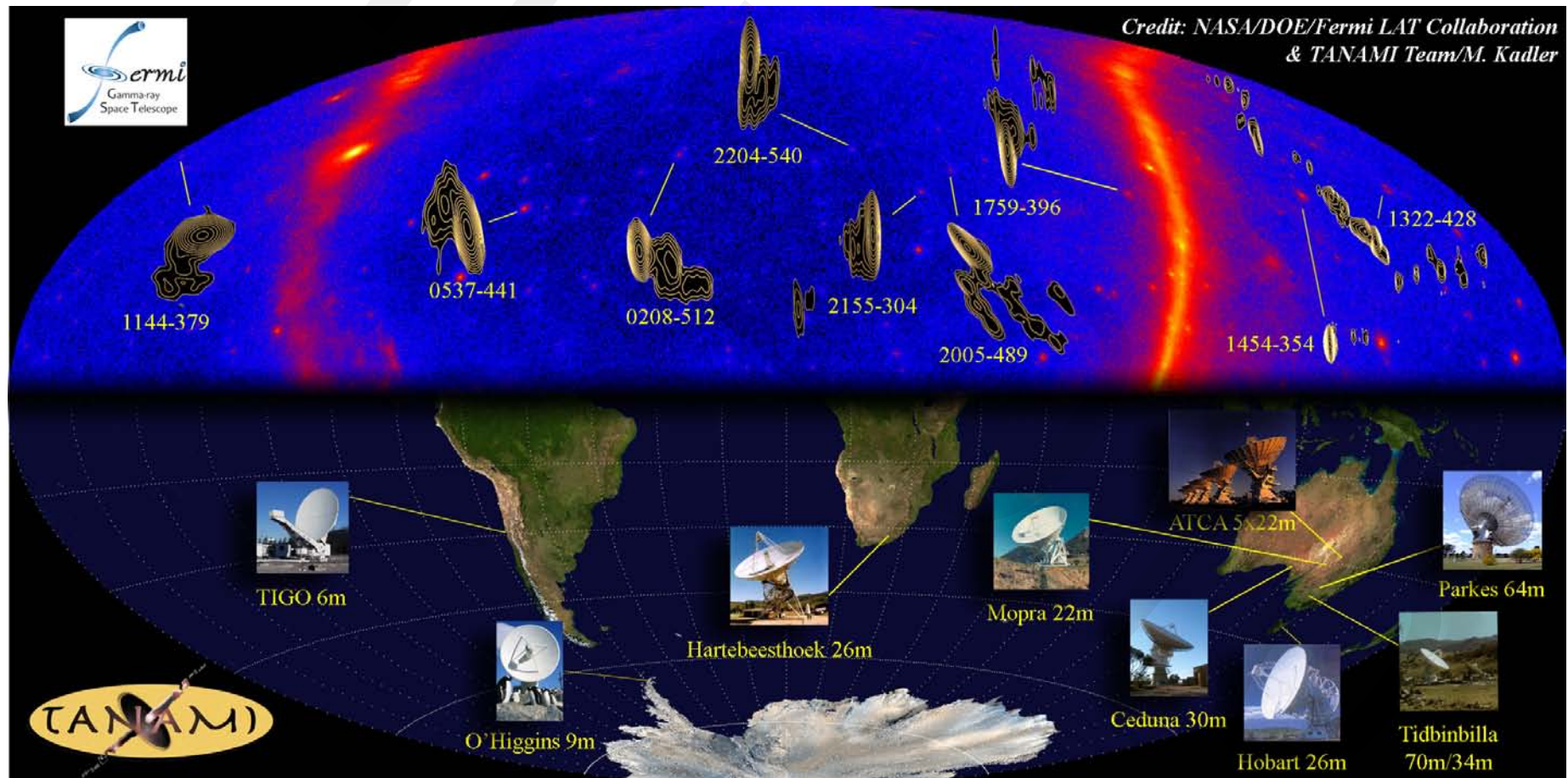


PKS 0537-441: Hungwe et al. P15



Gamma-ray Properties: Boeck et al. P1

- 53 of 75 objects associated with bright gamma-ray sources
- all 10 BL Lacs and 24/32 quasars
- BL Lacs have harder photon indices than quasars agreeing with findings for gamma-ray selected sample.



Talk to us

- Unique VLBI, Interferometric & Single Dish Radio Monitoring in Place
- Potential to chase ToOs very quickly
- Access to data



TANAMI - Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry

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[The TANAMI Team](#)

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TANAMI

TANAMI (Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry) is a new program to image and monitor the parsec-scale structures of relativistic jets in active galactic nuclei (AGN) of the Southern Hemisphere with the LBA. Complementary to existing programs in the Northern Hemisphere (e.g., MOJAVE), TANAMI is tracking the jets of sources south of -30 degrees declination with milliarcsecond resolution at 8.4GHz and 22GHz. TANAMI observations are being conducted every two months which started in November 2007 providing dense sampling of fast superluminal moving jet features. This sampling rate allows us to observe 40 sources through 2008 and to add up to 80 additional sources at optimized observing cadences in subsequent years. Moreover, it enables us to react quickly to transient events and to begin follow-up observations of sources of special interest, in particular blazars found by GLAST to be flaring at gamma-rays.

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Last Modified: Wed, 2008 Jun 25

Summary

- Southern sky
- 8.4 and 22 GHz images
- Spectral Index Maps
- Results contributed (SEDs)
- First Epoch results
- Work in progress
- Proper motion, new telescopes?

Website: <http://pulsar.sternwarte.uni-erlangen.de/tanami/>

All Things Fermi: <http://glast.gsfc.nasa.gov/>

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Danke!