Extragalactic Jets from the TANAMI Sample as Seen by Fermi/LAT

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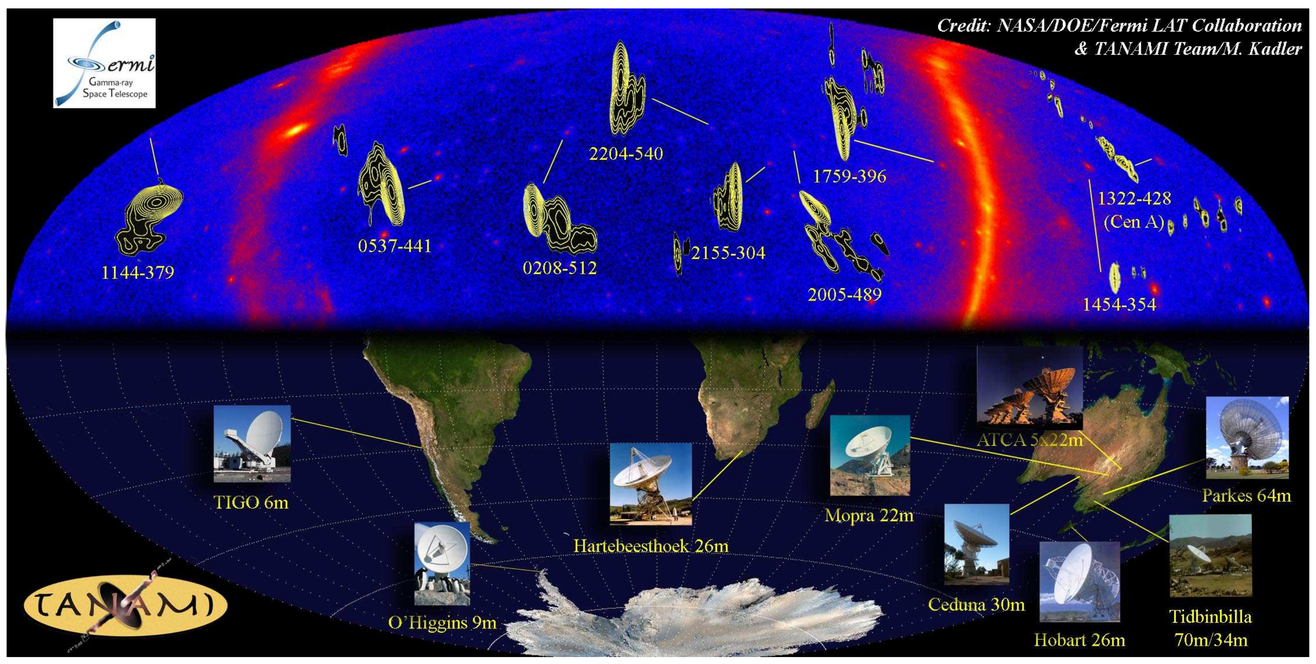
Summary: We discuss the γ-ray properties of extragalactic jets from the TANAMI AGN sample.

Abstract

The TANAMI program has been monitoring the parsec-scale radio jets of Southern γ-ray bright AGN with VLBI techniques simultaneously with Fermi/LAT monitoring of their γ-ray emission. Here we present the γ properties of the TANAMI sources based on an analysis of the preliminary 1st year LAT source list. We compare the radio and γ-ray characteristics of the AGN jets and present upper limits on the γ-ray flux for LAT-undetected TANAMI sources.



Collage showing the Southern *Fermi*/LAT γ-ray sky in the top half of this Aitoff projection and the Earth's Southern Hemisphere in the bottom with the positions of the radio telescopes of the TANAMI array indicated. Overlayed on the *Fermi* sky image are TANAMI radio images of the brightest extragalactic γ-ray sources. Note that South is up in the *Fermi* γ-ray image and that the scale of the radio jets is enhanced by a factor of ~ 1000. More information on the TANAMI project can be found on poster P1-51 (Müller et al.).

γ-Properties of the AGN from the TANAMI Sample

45 out of 65 AGN from the TANAMI sample can be associated with γ-ray sources from the year-1 catalog under development by the LAT team. A distribution of the flux of these sources is shown in Fig. 1. The distribution of spectral indices is presented in Fig. 2. The sources in our sample are classified according to the Véron-Véron 12th edition catalog. For the not associated sources we performed a maximum likelihood analysis (e.g., Cash, 1979) to obtain upper limits on the flux. The results are shown in Table 1.

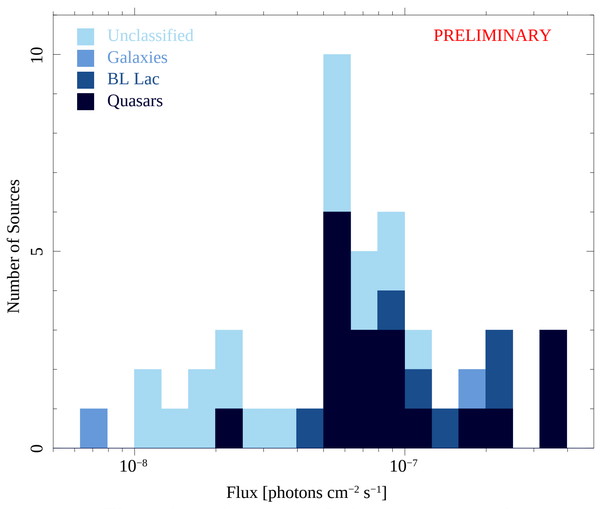


Figure 1: Flux distribution of the associated sources.

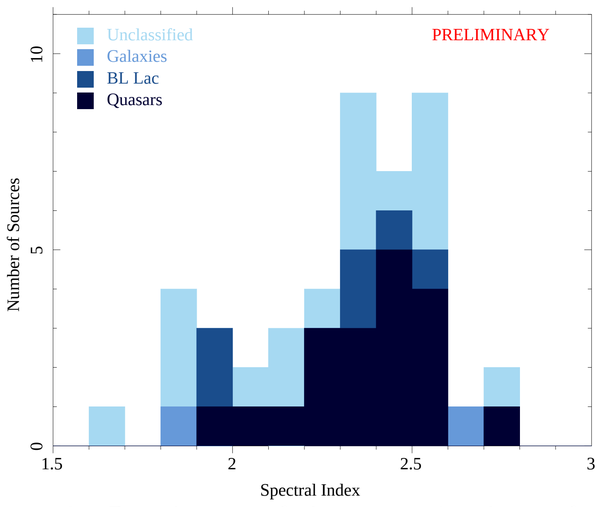


Figure 2: Distribution of the spectral indices of the associated sources.

The calculation of upper limits on the γ-ray flux for the unassociated AGN from the TANAMI sample revealed in several cases a relatively high test statistic (TS)[a]. We modeled sources with $\mathrm{TS} > 25$, while upper limits are presented for the other sources. The resulting parameters are shown below.

Table 1: γ-ray flux and upper limits of the unassociated AGN from the sample:

Name	ID[b]	Test Statistic	Flux[c]	Spectral Index	pointlike TS
1505-496	U	51.64	6.2 ± 1.5	2.61 ± 0.13	5.4
2149-306	Q	31.00	4.2 ± 0.9	3.1 ± 0.2	5.7
0438-436	Q	0.01	< 3.79	—	0.6
0518-458	G	9.18	< 4.0	—	6.6
0527-359	U	0.00	< 0.30	—	0.0
1104-445	Q	3.65	< 3.1	—	0.7
1257-326	Q	0.00	< 0.23	—	3.3
1333-337	G	0.00	< 0.14	—	0.0
1549-790	G	2.04	< 9.0	—	0.0
1716-771	U	0.00	< 1.44	—	1.9
1718-649	G	14.00	< 2.4	—	8.8
1733-565	G	0.00	< 1.73	—	0.0
1804-502	Q	18.32	< 8.0	—	7.0
1814-637	G	1.56	< 5.0	—	1.8
1934-638	G	0.00	< 0.15	—	0.0
2027-308	G	14.29	< 3.5	—	2.0
2106-413	Q	0.00	< 0.13	—	0.0
2152-699	G	20.32	< 5.8	—	6.7
2326-477	Q	17.56	< 3.7	—	1.1
2355-534	Q	15.03	< 8.0	—	1.6

[a] $\sqrt{\mathrm{TS}}$ is comparable to the significance in sigma.
[b] The optical counterpart, denoted as follows: (Q) quasar, (B) BL Lac object, (G) galaxy, (U) unclassified
[c] Flux in the energy band from 100 MeV to 100 GeV in units of $[\times 10^{-8}$ photons cm^{-2} s$^{-1}]$

Discussion of Tentative Detections

For several of the unassociated sources (Table 1) the maximum likelihood analysis indicated a tentative detection. As the significance of these sources is quite low and some of them are close to bright sources or not far away from the Galactic plane, we calculated the pointlike TS and TS maps in addition. The TS results (Table 1) are qualitatively similar but in most cases there is a significant difference in the absolute TS values. TS maps for sources where a localized peak is found and the corresponding counts maps are presented in Fig. 3.
It is worth noting that models for the tentative detections (Table 1) have softer spectra than expected from the distribution in Fig. 1. Due to the energy dependence of the PSF of LAT weak soft sources are more difficult to locate than ones with harder spectra. Further analysis is required to determine if the asymmetric distribution of spectral indices is a property of the sample.

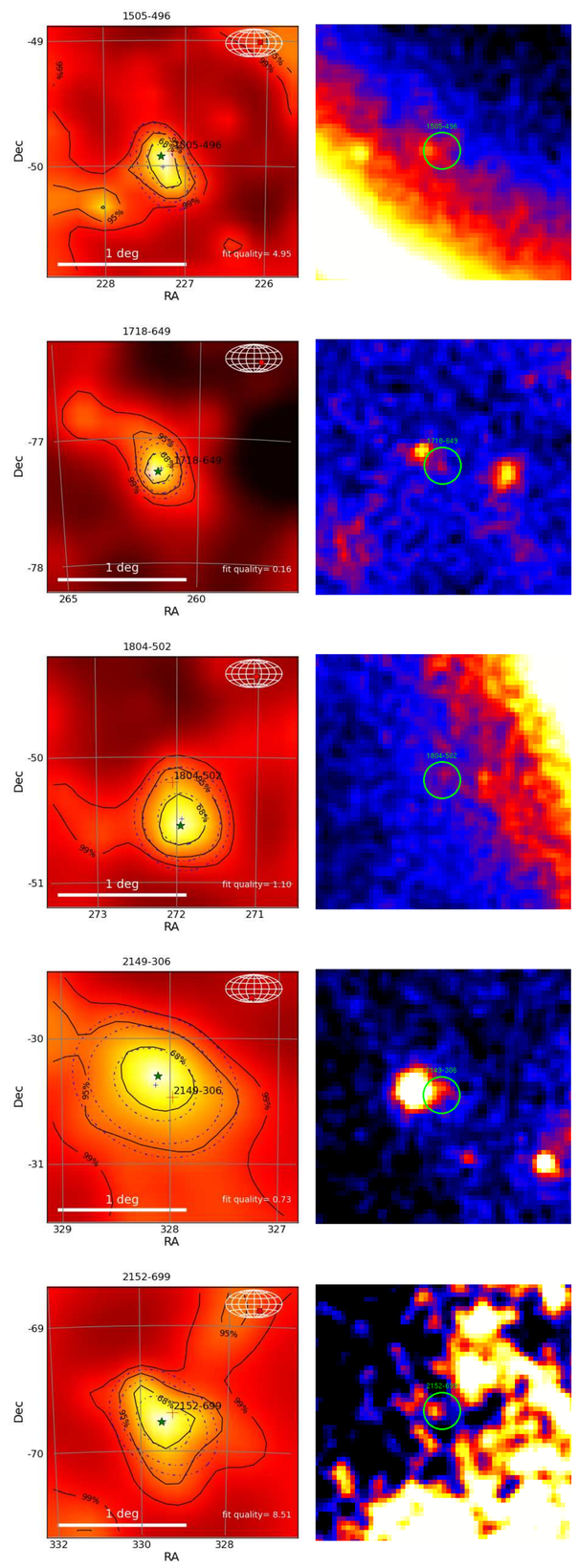


Figure 3: For possible new detections the TS maps are shown on the left and the corresponding counts maps on the right. The diameter of green circle in the count maps, which indicates the position of the analyzed source, is 2°.

References

Cash W. 1979, ApJ 228, 939
Véron-Cetty M.P., Véron P., 2006, Vizier Online Data Catalog 7248, 0

Information on the TANAMI program can be found here:
`http://pulsar.sternwarte.uni-erlangen.de/tanami/`

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If you have any questions or comments, feel free to speak to me →

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