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J/ApJ/810/14 Third catalog of LAT-detected AGNs (3LAC) (Ackermann+, 2015)

The third catalog of active galactic nuclei detected by the Fermi Large Area Telescope.

Ackermann M., Ajello M., Atwood W.B., Baldini L., Ballet J., Barbiellini G., Bastieri D., Becerra Gonzalez J., Bellazzini R., Bissaldi E., Blandford R.D., Bloom E.D., Bonino R., Bottacini E., Brandt T.J., Bregeon J., Britto R.J., Bruel P., Buehler R., Buson S., Caliandro G.A., Cameron R.A., Caragiulo M., Caraveo P.A., Carpenter B., Casandjian J.M., Cavazzuti E., Cecchi C., Charles E., Chekhtman A., Cheung C.C., Chiang J., Chiaro G., Ciprini S., Claus R., Cohen-Tanugi J., Cominsky L.R., Conrad J., Cutini S., D'Abrusco R., D'Ammando F., de Angelis A., Desiante R., Digel S.W., Di Venere L., Drell P.S., Favuzzi C., Fegan S.J., Ferrara E.C., Finke J., Focke W.B., Frankowski A., Fuhrmann L., Fukazawa Y., Furniss A.K., Fusco P., Gargano F., Gasparrini D., Giglietto N., Giommi P., Giordano F., Giroletti M., Glanzman T., Godfrey G., Grenier I.A., Grove J.E., Guiriec S., Hewitt J.W., Hill A.B., Horan D., Itoh R., Johannesson G., Johnson A.S., Johnson W.N., Kataoka J., Kawano T., Krauss F., Kuss M., La Mura G., Larsson S., Latronico L., Leto C., Li J., Li L., Longo F., Loparco F., Lott B., Lovellette M.N., Lubrano P., Madejski G.M., Mayer M., Mazziotta M.N., McEnery J.E., Michelson P.F., Mizuno T., Moiseev A.A., Monzani M.E., Morselli A., Moskalenko I.V., Murgia S., Nuss E., Ohno M., Ohsugi T., Ojha R., Omodei N., Orienti M., Orlando E., Paggi A., Paneque D., Perkins J.S., Pesce-Rollins M., Piron F., Pivato G., Porter T.A., Raino S., Rando R., Razzano M., Razzaque S., Reimer A., Reimer O., Romani R.W., Salvetti D., Schaal M., Schinzel F.K., Schulz A., Sgro C., Siskind E.J., Sokolovsky K.V., Spada F., Spandre G., Spinelli P., Stawarz L., Suson D.J., Takahashi H., Takahashi T., Tanaka Y., Thayer J.G., Thayer J.B., Tibaldo L., Torres D.F., Torresi E., Tosti G., Troja E., Uchiyama Y., Vianello G., Winer B.L., Wood K.S., Zimmer S.

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Keywords: BL Lacertae objects: general; galaxies: active; galaxies: jets; gamma rays: galaxies

Abstract:

The third catalog of active galactic nuclei (AGNs) detected by the Fermi-LAT (3LAC) is presented. It is based on the third Fermi-LAT catalog (3FGL) of sources detected between 100MeV and 300GeV with a Test Statistic greater than 25, between 2008 August 4 and 2012 July 31. The 3LAC includes 1591 AGNs located at high Galactic latitudes ($|b| > 10^\circ$), a 71% increase over the second catalog based on 2 years of data. There are 28 duplicate associations, thus 1563 of the 2192 high-latitude gamma-ray sources of the 3FGL catalog are AGNs. Most of them (98%) are blazars. About half of the newly detected blazars are of unknown type, i.e., they lack spectroscopic information of sufficient quality to determine the strength of their emission lines. Based on their gamma-ray spectral properties, these sources are evenly split between flat-spectrum radio quasars (FSRQs) and BL Lacs. The most abundant detected BL Lacs are of the high-synchrotron-peaked (HSP) type. About 50% of the BL Lacs have no measured redshifts. A few new rare outliers (HSP-FSRQs and high-luminosity HSP BL Lacs) are reported. The general properties of the 3LAC sample confirm previous findings from earlier catalogs. The fraction of 3LAC blazars in the total population of blazars listed in BZCAT remains non-negligible even at the faint ends of the BZCAT-blazar radio, optical, and X-ray flux distributions, which hints that even the faintest known blazars could eventually shine in gamma-rays at LAT-detection levels. The energy-flux distributions of the different blazar populations are in good agreement with extrapolation from earlier catalogs.

Description:

The gamma-ray results used in this paper were derived in the context of the 3FGL catalog (Fermi-LAT Collaboration 2015, [J/ApJ/810/23](#)). No additional analysis of the gamma-ray data was performed in the context of the present paper except for the fitting of the monthly light curves and the broadband SED fitting. The data were collected over the first 48 months of the mission, from 2008 August 4 to 2012 July 31 (MJD 54682 to 56139).

Using the Australia Telescope Compact Array (ATCA) at 5 GHz and 9 GHz, Petrov et al. (2013, [J/MNRAS/432/1294](#)) detected 424 sources in the LAT error ellipses of southern unassociated 2FGL sources. See table 2.

File Summary:

FileName	Rec1	Records	Explanations
ReadMe	80	.	This file
table2.dat	82	21	*List of ATCA blazar candidates
table4.dat	133	1591	High latitude ($ b > 10^\circ$) 3LAC full sample
table6.dat	118	182	Low-latitude ($ b < 10^\circ$) sample
table7.dat	110	107	Sources from earlier FGL catalogs missing in 3LAC

table8.dat	89	1591	3LAC sources: fluxes (high-latitude sources)
table9.dat	51	114	3LAC sources: fluxes (low-latitude sources)
table10.dat	74	55	Properties of the 3FGL very-high-energy (VHE) AGNs

Note on table2.dat: Table 2 show double-humped radio-to-gamma-ray SEDs resembling those of BCU, but they have association probabilities below threshold. More data may help secure these associations in the future.

See also:

[VII/258](#) : Quasars and Active Galactic Nuclei (13th Ed.) (Veron+ 2010)
[VII/259](#) : 6dF galaxy survey final redshift release (Jones+, 2009)
[VIII/72](#) : CLASS survey of radio sources (Myers+, 2003)
[J/A+A/579/A34](#) : 1WHSP: VHE γ -ray blazar candidates (Arsioli+, 2015)
[J/ApJS/218/23](#) : Fermi LAT third source catalog (3FGL) (Acerro+, 2015)
[J/ApJS/217/2](#) : Refined associations of Fermi/LAT sources (Massaro+, 2015)
[J/ApJ/780/73](#) : Redshifts of BL Lac objects from Fermi (Ajello+, 2014)
[J/ApJS/209/34](#) : The first Fermi-LAT $>10\text{GeV}$ catalog (1FHL) (Ackermann+, 2013)
[J/AJ/146/120](#) : MOJAVE. X. Parsec-scale kinematics of AGNs (Lister+, 2013)
[J/ApJS/207/19](#) : Hard X-ray survey from Swift-BAT 2004-2010 (Baumgartner+, 2013)
[J/MNRAS/432/1294](#) : Fermi unassociated sources ATCA observations (Petrov+, 2013)
[J/MNRAS/428/220](#) : Gamma-ray AGN type determination (Hassan+, 2013)
[J/ApJS/206/13](#) : Blazars with γ -ray counterparts. II. (Massaro+, 2013)
[J/ApJS/206/12](#) : Blazars with γ -ray counterparts. I. (D'Abrusco+, 2013)
[J/ApJ/764/135](#) : Spectroscopic redshifts of BL Lac objects (Shaw+, 2013)
[J/MNRAS/426/1750](#) : INTEGRAL/IBIS AGN catalogue (Malizia+, 2012)
[J/ApJ/758/84](#) : Relativistic jets in RRFD database II. 10yr (Piner+, 2012)
[J/A+A/541/A160](#) : Planck + X/ γ observations of blazars (Giommi+, 2012)
[J/ApJS/199/31](#) : Fermi LAT second source catalog (2FGL) (Nolan+, 2012)
[J/ApJ/748/68](#) : WISE IR colors of gamma-ray blazars (D'Abrusco+, 2012)
[J/ApJ/744/177](#) : VLBA 5GHz observations of Fermi/LAT AGNs (Linford+, 2012)
[J/ApJ/743/171](#) : The 2LAC catalog (Ackermann+, 2011)
[J/ApJ/742/66](#) : New Fermi/LAT extragalactic sources (Teng+, 2011)
[J/ApJ/742/27](#) : 15GHz and jet properties of MOJAVE blazars (Lister+, 2011)
[J/ApJ/741/30](#) : Radio/ γ -ray correlation in AGN (Ackermann+, 2011)
[J/ApJS/188/405](#) : Fermi-LAT first source catalog (1FGL) (Abdo+, 2010)
[J/ApJ/722/L7](#) : Fermi/LAT detected MOJAVE AGNs (Pushkarev+, 2010)
[J/ApJ/716/30](#) : SED of Fermi bright blazars (Abdo+, 2010)
[J/ApJ/715/429](#) : First Fermi-LAT AGN catalog (1LAC) (Abdo+, 2010)
[J/MNRAS/402/2403](#) : Australia Telescope 20GHz Survey Catalog (Murphy+, 2010)
[J/ApJS/183/46](#) : Fermi/LAT bright gamma-ray source list (0FGL) (Abdo+, 2009)
[J/ApJ/700/597](#) : FERMI LAT detected blazars (Abdo+, 2009)
[J/A+A/495/691](#) : Multifrequency catalog of blazars, Roma-BZCAT (Massaro+, 2009)
[J/ApJS/171/61](#) : All-Sky Survey of Flat-Spectrum Radio Sources (Healey+, 2007)
[J/AJ/131/114](#) : The Molonglo Southern 4Jy sample. II (Burgess+, 2006)
[J/PASP/113/10](#) : Sub-mJy radio sources complete sample (Masci+, 2001)
[J/ApJS/123/79](#) : Third EGRET catalog (3EG) (Hartman+, 1999)
[J/MNRAS/204/151](#) : Bright radio sources at 178 MHz (3CRR) (Laing+ 1983)
<http://www.isdc.unige.ch/integral/science/catalogue> : INTEGRAL source catalog
<http://tevcat.uchicago.edu/> : TeVcat online catalog

Byte-by-byte Description of file: [table2.dat](#)

Bytes	Format	Units	Label	Explanations
1- 12	A12	---	3FGL	3FGL identifier (JHHMM.m+DDMM)
14- 34	A21	---	Name	Counterpart name
36- 44	F9.5	deg	RAdeg	[15.5/344.6] Radio right ascension (J2000)
46- 54	F9.5	deg	DEdeg	[-82.8/9.8] Radio declination (J2000)
56- 62	A7	---	C1	Class count
64- 69	F6.3	[Hz]	lognuRf	[12.5/17.2]? Log frequency of rest-frame position of synchrotron peak ($\log(v_{\text{peak}}^s)$)
71- 82	A12	---	2FGL	2FGL identifier (JHHMM.m+DDMM)

Byte-by-byte Description of file: [table4.dat](#)

Bytes	Format	Units	Label	Explanations
1- 13	A13	---	3FGL	3FGL Source Name (JHHMM.m+DDMMa)
15	A1	---	C1n	Source in Clean sample: Y=Yes, N=No
17- 42	A26	---	CName	Name of the counterpart source
44- 52	F9.5	deg	RAdeg	Radio counterpart right Ascension (J2000)
54- 62	F9.5	deg	DEdeg	Radio counterpart declination (J2000)
64- 68	F5.3	deg	Sep	[0/0.4] Angular separation with counterpart source
70- 74	F5.3	deg	PosErr	[0/0.6] 95% error radius
76- 82	A7	---	SpC1	Optical class (G1)
84- 86	A3	---	SEDC1	SED class (G2)
88- 93	F6.3	[Hz]	lognu	[11.8/18.3]?=0 Log frequency of observer-frame position of synchrotron peak (NupSyn-Meas)
95-100	F6.3	[Hz]	lognuRf	[11.9/18.3]?=0 Log frequency of rest-frame position of synchrotron peak (NupSyn-Rf)
102-108	F7.5	---	z	[0.001/3.2]?=0 Redshift

110-114	F5.3	---	Prob	Bayesian probability (BayProb) (G3)
116-120	F5.3	---	LR-RG	Likelihood Ratio reliability for Radio-gamma-ray association (LR-RGProb) (G3)
122-126	F5.3	---	LR-XGP	Likelihood Ratio reliability for X-ray-gamma-ray association (LR-XGProb) (G3)
128-133	F6.3	[-]	logCpt	$[-2.5/4.5]_{?=-9.999}$ Compton Dominance in log scale

Byte-by-byte Description of file: [table6.dat](#)

Bytes	Format	Units	Label	Explanations
1- 12	A12	---	3FGL	3FGL Source Name (JHHMM.m+DDMM)
14- 34	A21	---	CName	Name of the counterpart source
36- 44	F9.5	deg	RAdeg	Radio counterpart right Ascension (J2000)
46- 54	F9.5	deg	DEdeg	Radio counterpart declination (J2000)
56- 60	F5.3	deg	Sep	$[0.003/0.4]$ Angular separation with counterpart source
62- 66	F5.3	deg	PosErr	$[0.01/0.6]$ 95% error radius
68- 74	A7	---	SpCl	Optical class (G1)
76- 78	A3	---	SEDC1	SED class (G2)
80- 85	F6.3	[Hz]	lognu	$[11.4/17.2]_{?}$ Log frequency of observer-frame position of synchrotron peak (NupSyn-Meas)
87- 92	F6.3	[Hz]	lognuRf	$[11.4/17.2]_{?}$ Log frequency of rest-frame position of synchrotron peak (NupSyn-Rf)
94-100	F7.5	---	z	$[0.01/2.7]_{?}$ Redshift
102-106	F5.3	---	Prob	$[0.8/1]_{?}$ Bayesian probability (G3)
108-112	F5.3	---	LR-RG	$[0.8/1]_{?}$ Likelihood Ratio reliability for Radio-gamma-ray association (G3)
114-118	F5.3	---	LR-XG	$[0.8/1]_{?}$ Likelihood Ratio reliability for X-ray-gamma-ray association (G3)

Byte-by-byte Description of file: [table7.dat](#)

Bytes	Format	Units	Label	Explanations
1- 24	A24	---	Name	Source Name
26- 37	F12.8	deg	RAdeg	Radio counterpart right ascension (J2000)
39- 51	F13.9	deg	DEdeg	Radio counterpart declination (J2000)
53- 61	A9	---	SpCl	Optical class (G1)
63- 65	A3	---	SEDC1	SED class (G2)
67- 74	F8.6	---	z	$[0.002/2.6]_{?}$ Redshift
76- 79	A4	---	---	[1FGL]
81- 92	A12	---	1FGL	Previous Fermi i-LAT catalogues (JHHMM.m+DDMM)
94- 97	A4	---	---	[2FGL]
99-110	A12	---	2FGL	Previous Fermi i-LAT catalogues (JHHMM.m+DDMM)

Byte-by-byte Description of file: [table8.dat](#)

Bytes	Format	Units	Label	Explanations
1- 13	A13	---	3FGL	3FGL Name (JHHMM.m+DDMMa)
15	A1	---	Cln	Source in Clean sample: Y=Yes, N=No
17- 42	A26	---	CName	Counterpart Name
44- 52	F9.2	mJy	FRad	? Radio flux
54	A1	---	n_FRad	Flag on FRad (G4)
56- 63	F8.3	10-10W/m2	FX	?=0 X-ray flux; units of $1e-13\text{erg}/\text{cm}^2/\text{s}$
65- 70	F6.3	mag	Vmag1	?=0 USNO V band magnitude
72- 77	F6.3	mag	Vmag2	?=0 SDSS V band magnitude
79- 83	F5.2	---	ARO	?=-9.99 Rest frame, broadband radio-optical spectral index
85- 89	F5.2	---	AOX	?=-9.99 Rest frame, broadband optical-X-ray spectral index

Byte-by-byte Description of file: [table9.dat](#)

Bytes	Format	Units	Label	Explanations
1- 12	A12	---	3FGL	3FGL Name (JHHMM.m+DDMM)
14- 34	A21	---	CName	Counterpart Name
36- 42	F7.2	mJy	FRad	Radio flux
44	A1	---	n_FRad	Flag on FRad (G4)
46- 51	F6.2	10-10W/m2	FX	? X-ray flux; units of $1e-13\text{erg}/\text{cm}^2/\text{s}$

Byte-by-byte Description of file: [table10.dat](#)

Bytes	Format	Units	Label	Explanations
1- 12	A12	---	3FGL	3FGL Name (JHHMM.m+DDMM)
14	A1	---	LL	Low-Latitude sources (not in 3LAC)
16- 36	A21	---	VHE	Very-High-Energy Name
38- 43	A6	---	SpCl	Optical class (G1).
45- 47	A3	---	SEDC1	SED class (G2).
49- 53	F5.3	---	z	? Redshift
55- 59	F5.3	---	alpha	Spectral Index α
61- 65	F5.3	---	e_alpha	Uncertainty in spectral index
67- 74	F8.2	---	Var	Variability Index

Global notes:**Note (G1):** Optical class as follows:

fsrq = flat-spectrum radio quasar (467 sources for $|b|>10\text{deg}$ sample;
24 sources for $|b|<10\text{deg}$ sample; 38 sources for table 7;
3 sources for table 10)

bll = BL Lac object (632 sources for $|b|>10\text{deg}$ sample;
30 sources for $|b|<10\text{deg}$ sample; 35 sources for table 7;
48 sources for table 10)

bcu I = blazar candidate of type I (57 sources for $|b|>10\text{deg}$ sample;
11 sources for $|b|<10\text{deg}$ sample)

bcu II = blazar candidate of type II (346 sources for $|b|>10\text{deg}$ sample;
85 sources for $|b|<10\text{deg}$ sample)

bcu III = blazar candidate of type III (57 sources for $|b|>10\text{deg}$ sample;
29 sources for $|b|<10\text{deg}$ sample)

bcu = blazar candidate (22 sources for table 7)

rdg = radio galaxy (14 sources for $|b|>10\text{deg}$ sample;
2 sources for $|b|<10\text{deg}$ sample; 4 sources for table 10)

nlsy1 = narrow-line Seyfert 1 (5 sources for $|b|>10\text{deg}$ sample)

agn = other active galactic nucleus (6 sources for $|b|>10\text{deg}$ sample)

css = compact steep-spectrum source (2 sources for $|b|>10\text{deg}$ sample)

ssrq = steep-spectrum radio quasar (5 sources for $|b|>10\text{deg}$ sample)

sy = Seyfert galaxy (1 source for $|b|<10\text{deg}$ sample;
1 source for table 7)

starburst = 1 source for table 7

- = not classified (5 sources for table 7)

Note (G2): SED class as follows:

LSP = low synchrotron peaked
ISP = intermediate synchrotron peaked
HSP = high synchrotron peaked
- = not classified

Note (G3): A null (blank) indicates a value below the threshold of 0.8**Note (G4):** Radio flux as follows:

N = NVSS (1.4GHz)
S = SUMSS (845MHz)
A = ATCA (20GHz)
P = PMN (4.8GHz)
F = FIRST (1.4GHz)

History:

From electronic version of the journal
* 18-Jan-2016: Insert into Vizier
* 13-Jan-2017: Table 2 added
* 24-Feb-2017: misprint in tables 4 and 8: 3FGL J1324.0-4300e;
corrected for 3FGL J1324.0-4330e

(End) Prepared by [AAS], Emmanuelle Perret [CDS] 15-Dec-2015

The document above follows the rules of the [Standard Description for Astronomical Catalogues](#); from this documentation it is possible to generate *f77* program to load files [into arrays](#) or [line by line](#)