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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.

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    Morselli A., Moskalenko I.V., Murgia S., Nuss E., Ohno M., Ohsugi T.,
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    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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    =2015ApJ...810...14A   (SIMBAD/NED BibCode)

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°), 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/ApJS/218/23). 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	Lrecl	Records	Explanations
ReadMe	80	.	This file
table2.dat	82	21	*List of ATCA blazar candidates
table4.dat	133	1591	High latitude (|b|>10deg) 3LAC full sample
table6.dat	118	182	Low-latitude (|b|<10deg) sample
table7.dat	110	107	Sources from earlier FGL catalogs missing in 3LAC

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) (Acero+, 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 >10GeV 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 RRFID 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	---	Cl	Class count
64- 69	F6.3	[Hz]	lognuRf	[12.5/17.2]? Log frequency of rest-frame position of synchrotron peak $(\log(\nu^S_{peak}))$
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	---	Cln	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	---	SpCl	Optical class (G1)
84- 86	A3	---	SEDCl	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     ---   SEDCl  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     ---     SEDCl   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-13erg/cm2/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-13erg/cm2/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	---	SEDCl	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|>10deg sample;
               24 sources for |b|<10deg sample; 38 sources for table7;
               3 sources for table 10)
    bll      = BL Lac object (632 sources for |b|>10deg sample;
               30 sources for |b|<10deg sample; 35 sources for table 7;
               48 sources for table 10)
    bcu I    = blazar candidate of type I (57 sources for |b|>10deg sample;
               11 sources for |b|<10deg sample)
    bcu II   = blazar candidate of type II (346 sources for |b|>10deg sample;
               85 sources for |b|<10deg sample)
    bcu III  = blazar candidate of type III (57 sources for |b|>10deg sample;
               29 sources for |b|<10deg sample)
    bcu      = blazar candidate (22 sources for table 7)
    rdg      = radio galaxy (14 sources for |b|>10deg sample;
               2 sources for |b|<10deg sample; 4 sources for table 10)
    nlsy1    = narrow-line Seyfert 1 (5 sources for |b|>10deg sample)
    agn      = other active galactic nucleus (6 sources for |b|>10deg sample)
    css      = compact steep-spectrum source (2 sources for |b|>10deg sample)
    ssrq     = steep-spectrum radio quasar (5 sources for |b|>10deg sample)
    sy       = Seyfert galaxy (1 source for |b|<10deg 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 ƒ77 program to load files into arrays or line by line