Identifying TeV sources candidates among Fermi -LAT unclassified blazars with Artificial Neural Network

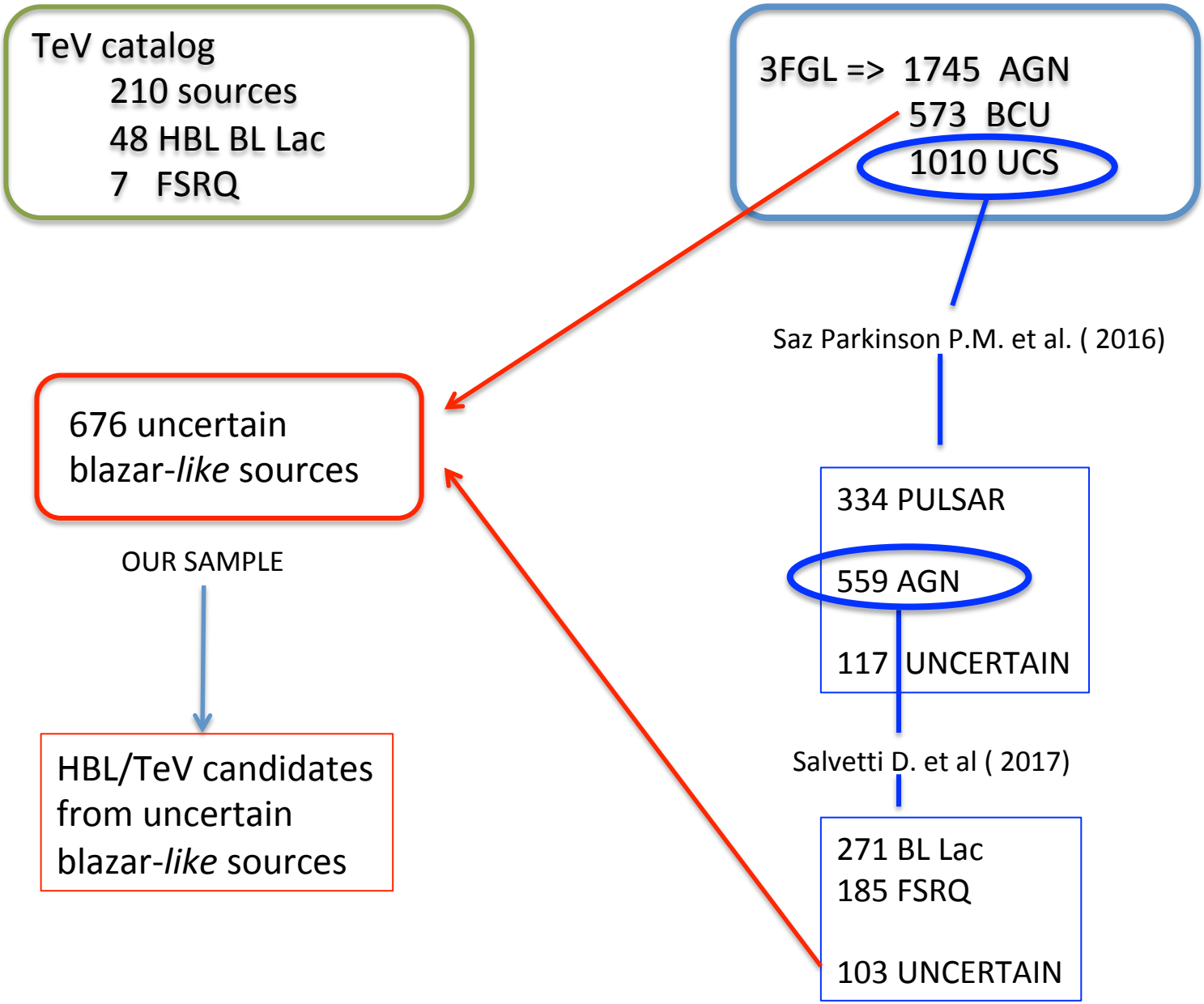
Graziano Chiaro Manuel Meyer Mattia Di Mauro,
Giovanni La Mura David Salvetti David J Thompson

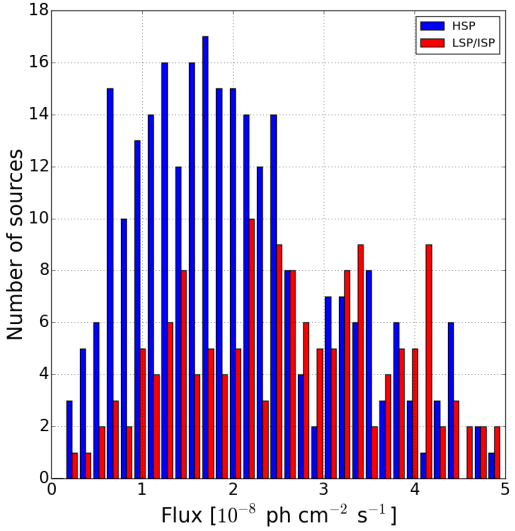
on behalf of Fermi LAT Collaboration

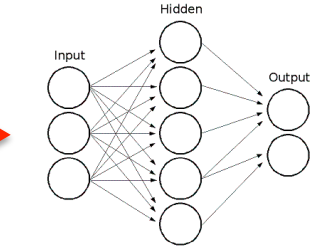
June 2018

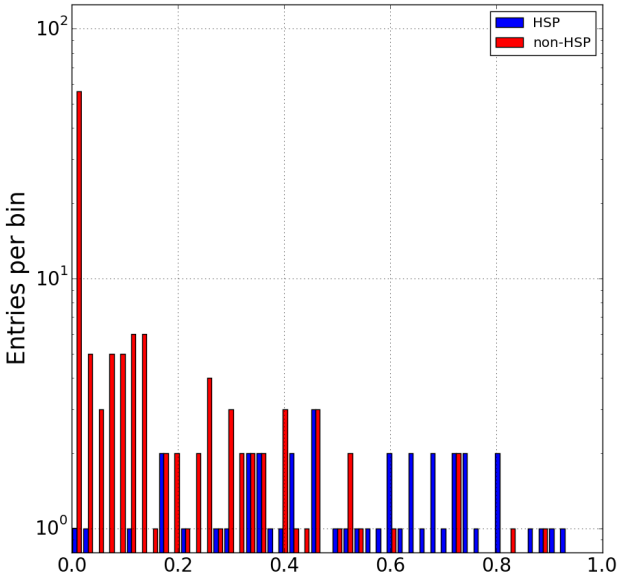
IACTs are the most sensitive detectors of VHE rays but their observation time is limited by their small field of view (FoV), and by many science cases to study.

The aim of this study is to search unclassfied blazars that are likely detectable with Cherenkov telescopes within reasonable observation times using an artificial neural network algorithm, in order to save observing time and consequently to increase the number of detections.

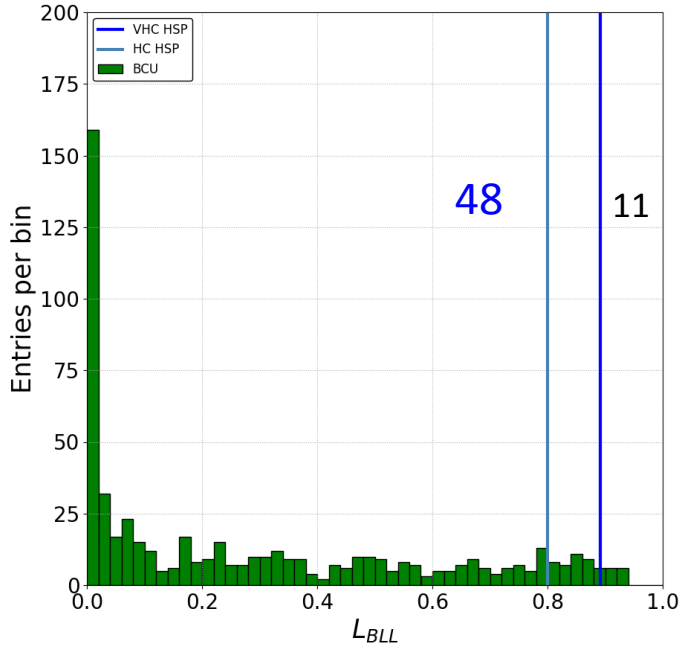

TeV catalog
210 sources
48 HBL BL Lac
7 FSRQ
3FGL => 1745 AGN
573 BCU
1010 UCS
Saz Parkinson P.M. et al. (2016)
676 uncertain blazar-*like* sources
OUR SAMPLE
334 PULSAR
559 AGN
117 UNCERTAIN
Salvetti D. et al (2017)
271 BL Lac
185 FSRQ
103 UNCERTAIN
HBL/TeV candidates from uncertain blazar-*like* sources

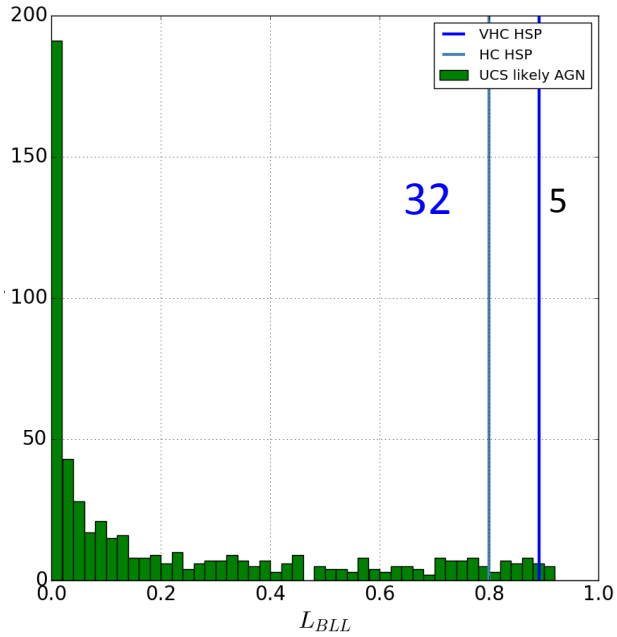






3FGL





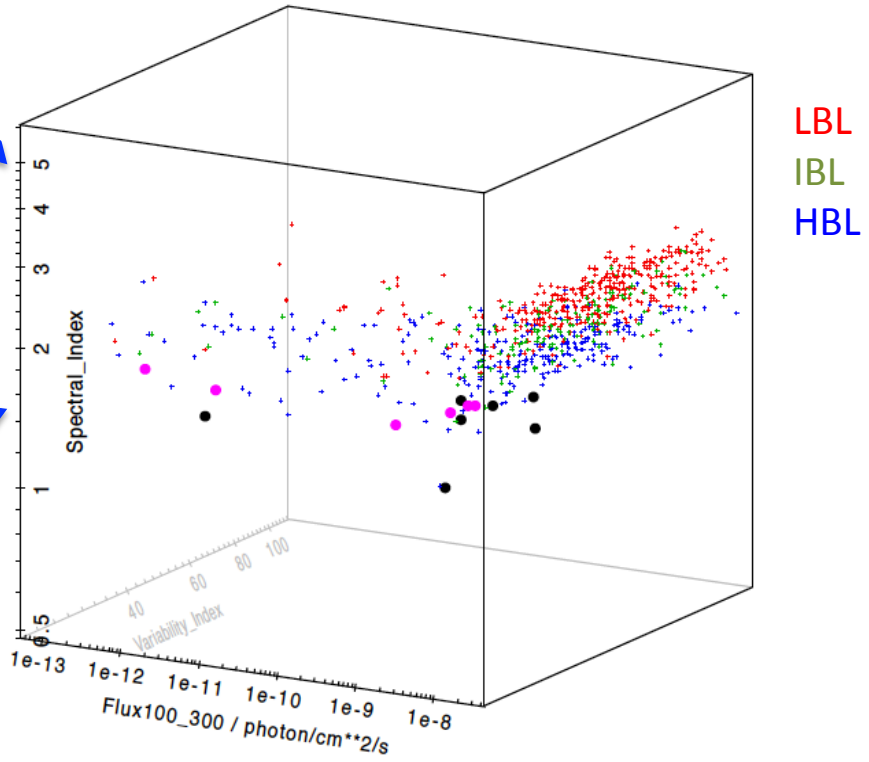
OUR SAMPLE

Table 1. Full list of BCU HBL candidates. Col.3) TS that represents the detection significance over the 100MeV 300 GeV band, Col.4) Spectral Index , Col.5) TS_{VAR} that represents the variability significance. Col.6) HBL Likelihood, Col. 9, 10, 11) the observability at the IACT site. On the top of the list the HC sources (L_{HBL} > 0.89) .

3FGL name	Association	2WHSP	TS	Sp.Index	TS_{VAR}	L_{HBL}	RAJ2000	DecJ2000	HESS	VERITAS	MAGIC
3FGL J0047.9+3447	1RXS J004754.5+344758	◇	56.73	1.57	11.70	0.92	12.0196048	34.8078403	◇	◇	◇
3FGL J1155.4-3417	NVSS J115520-341718	◇	147.32	1.64	16.24	0.92	178.8740215	-34.3364279	◇	◇	◇
3FGL J1434.6+6640	1RXS J143442.0+664031	◇	73.90	1.58	16.78	0.92	218.7228604	66.6708133	◇	◇	◇
3FGL J0921.0-2258	NVSS J092057-225721	◇	62.51	1.73	10.50	0.91	140.2437051	-22.9484594	◇	◇	◇
3FGL J0648.1+1606	1RXS J064814.1+160708	◇	40.10	1.81	13.91	0.9	102.0277929	16.0891409	◇	◇	◇
3FGL J1711.6+8846	1RXS J171643.8+884414	◇	44.30	1.83	12.40	0.9	258.6700448	88.7077331	◇	◇	◇
3FGL J1714.1-2029	1RXS J171405.2-202747	◇	73.8	1.44	18.16	0.9	258.5155102	-20.4759692	◇	◇	◇
3FGL J1910.8+2855	1RXS J191053.2+285622	◇	102.25	1.62	15.16	0.9	287.7132869	28.9403618	◇	◇	◇
3FGL J0153.4+7114	TXS 0149+710	◇	80.86	1.81	19.72	0.89	28.4286335	71.2551089	◇	◇	◇
3FGL J0506.9-5435	1ES 0505-546	◇	455.43	1.49	29.82	0.89	76.7570493	-54.5983993	◇	◇	
3FGL J1944.1-4523	1RXS J194422.6-452336	◇	100.09	1.63	11.11	0.89	296.1113217	-45.3896215	◇		
3FGL J0742.4-8133c	SUMSS J074220-813139		32.29	2.03	11.80	0.92	115.4463662	-81.5382983			
3FGL J0040.3+4049	B3 0037+405	◇	75.94	1.93	12.02	0.90	10.08708372	40.83295536			
3FGL J0043.7-1117	1RXS J004349.3-111612	◇	60.40	1.91	12.51	0.88	10.93797337	-11.31276512			
3FGL J1824.4+4310	1RXS J182418.7+430954	◇	80.91	1.82	19.74	0.88	276.1228226	43.17807155			
3FGL J0528.3+1815	1RXS J052829.6+181657		35.69	1.67	14.66	0.87	82.11283303	18.27306451			
3FGL J0646.4-5452	PMN J0646-5451		190.34	1.46	17.37	0.87	101.6181351	-54.91863251			
3FGL J1959.8-4725	SUMSS J195945-472519	◇	923.79	1.51	94.31	0.87	299.9397253	-47.4290142			
3FGL J2108.6-8619	1RXS J210905.5-861853	◇	91.04	1.66	10.72	0.87	316.9856579	-86.3066386			
3FGL J0039.0-2218	PMN J0039-2220	◇	89.34	1.66	11.61	0.86	9.76909807	-22.31500028			
3FGL J0305.2-1607	PKS 0302-16		147.60	1.60	22.94	0.86	46.23075836	-16.14465306			
3FGL J1040.8+1342	1RXS J104057.7+134216	◇	69.15	1.70	11.06	0.86	160.2564773	13.71799631			
3FGL J2312.9-6923	SUMSS J231347-692332	◇	35.32	1.72	16.13	0.86	348.4026935	-69.39020448			
3FGL J0515.5-0123	NVSS J051536-012427		45.66	1.79	11.76	0.85	78.87455087	-1.41946214			
3FGL	RX J0620.6+2644	◇	92.02	1.53	15.10	0.85	95.17349572	26.74390304			
3FGL			174.15	1.52	14.44	0.85	100.0137646	-12.90013415			
3FGL						0.85	113.3491751	51.86215575			
3FGL								68.0872362			

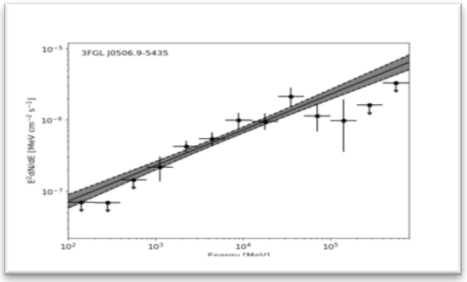
Table 2. Full list of BCU HBL candidates. Col.2) TS that represents the detection significance over the 100MeV 300 GeV band, Col.3) Spectral Index , Col.4) TS_{VAR} that represents the variability significance. Col.5) HBL Likelihood, Col. 8, 9, 10) the observability at the IACT site. On the top of the list the HC sources (L_{HBL}<0.89).

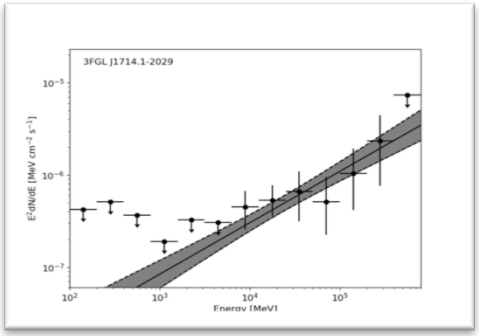
3FGL name	2WHSP	TS	Sp.Index	TS_{VAR}	L_{HBL}	RAJ2000	DecJ2000	HESS	VERITAS	MAGIC
3FGL J1349.9-3044	◇	64.26	1.6	10.10	0.919	◇		◇		
◇3FGL J2142.6-2029		36.07	1.68	8.19	0.914	325.6571 89	-20.4955455	◇	◇	◇
◇3FGL J2321.6-1619		34.14	1.73	45.13	0.911	350.3965092	-16.3171 1884	◇	◇	◇
◇3FGL J2145.5+1007		52.53	1.7	19.90	0.906	326.3814678	10.1295875	◇	◇	◇
◇3FGL J2300.0+4053	◇	174.53	1.64	6.97	0.904	345.0583034	40.87503 1575	◇	◇	
3FGL J1155.3-1112										
3FGL J2224.4+0351		29.50	1.93	9.53	0.89	336.102	3.859			
3FGL J1525.8-0834	◇	59.52	1.92	23.258	0.89	231.47	-8.579			
3FGL J1619.1+7538		107.12	1.86	14.91	0.88	244.961	75.673			
3FGL J0251.1-1829		104.26	1.58	10.203	0.88	42.797	-18.486			
3FGL J0020.9+0323		60.66	2.09	22.501	0.88	5.231	3.395			
3FGL J0813.5-0356		57.02	1.71	13.154	0.88	123.387	-3.589			
3FGL J1234.7-0437		51.54	2	29.762	0.87	188.697	-4.622			
3FGL J1922.2+2313		80.83	2.22	22.632	0.87	290.566	23.226			
3FGL J2043.6+0001		48.48	2.01	24.427	0.87	310.901	0.029			
3FGL J0312.7-2222		177.14	1.84	18.274	0.87	48.176	-22.371			
3FGL J1513.3-3719	◇	54.74	1.91	18.061	0.87	228.329	-37.319			
3FGL J0524.5-6937		94.15	2.05	18.366	0.86	81.128	-69.629			
3FGL J1225.4-3448		22.27	1.74	7.006	0.86	186.356	-34.807			
3FGL J1222.7+7952		43.83	2.12	14.79	0.86	185.9965	79.8921			
3FGL J2309.0+5428	◇	77.06	1.75	17.677	0.85	347.252	54.476			
3FGL J2015.3-1431	◇	17.42	1.81	14.63	0.85	303.8543	-14.5344			
3FGL J2053.9+2922		359.63	1.76	43.971	0.85	313.476	29.374			
3FGL J0234.2-0629		90.70	2	20.73	0.84	38.564	-6.105			
3FGL J1545.0-0641		150.10	1.59	11.852	0.84	236.265	-66.6997			
3FGL J0731.8-3010		37.07	1.96	12.914	0.84	112.974	-30.177			
3FGL J0952.8+0711		50.96	1.91	14.122	0.84	148.217	7.199			
3FGL J0527.3+6647		51.89	1.9	14.781	0.83	81.9	66.7767			
3FGL J1528.1-2904		26.28	1.8	11.717	0.83	232.086	-29.068			
3FGL J0049.0+4224	◇	36.95	1.8	16.583	0.82	12.253	42.413			
3FGL J1057.6-4061	◇	40.23	1.71	15.543	0.82	164.409	-40.862			
3FGL J0928.3-5255		98.75	2.09	26.678	0.80	142.03	-52.868			

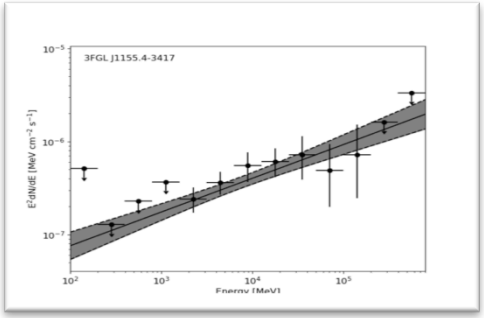


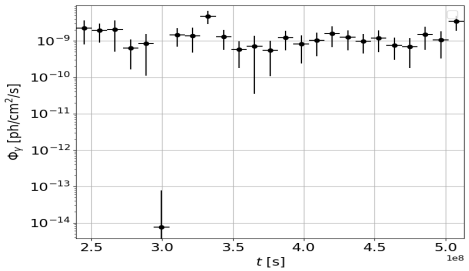
FERMI – LAT ANALYSIS

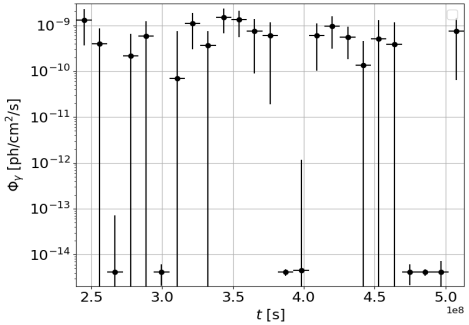
104 months Pass 8 / 16°x16°ROI /Fermi.py Ajello et al.(2017)

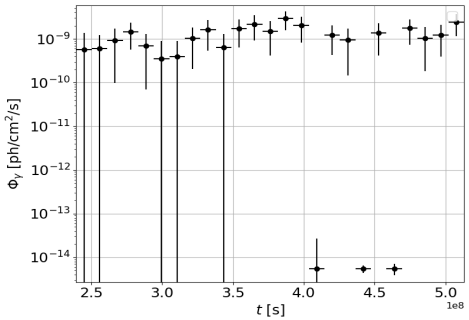


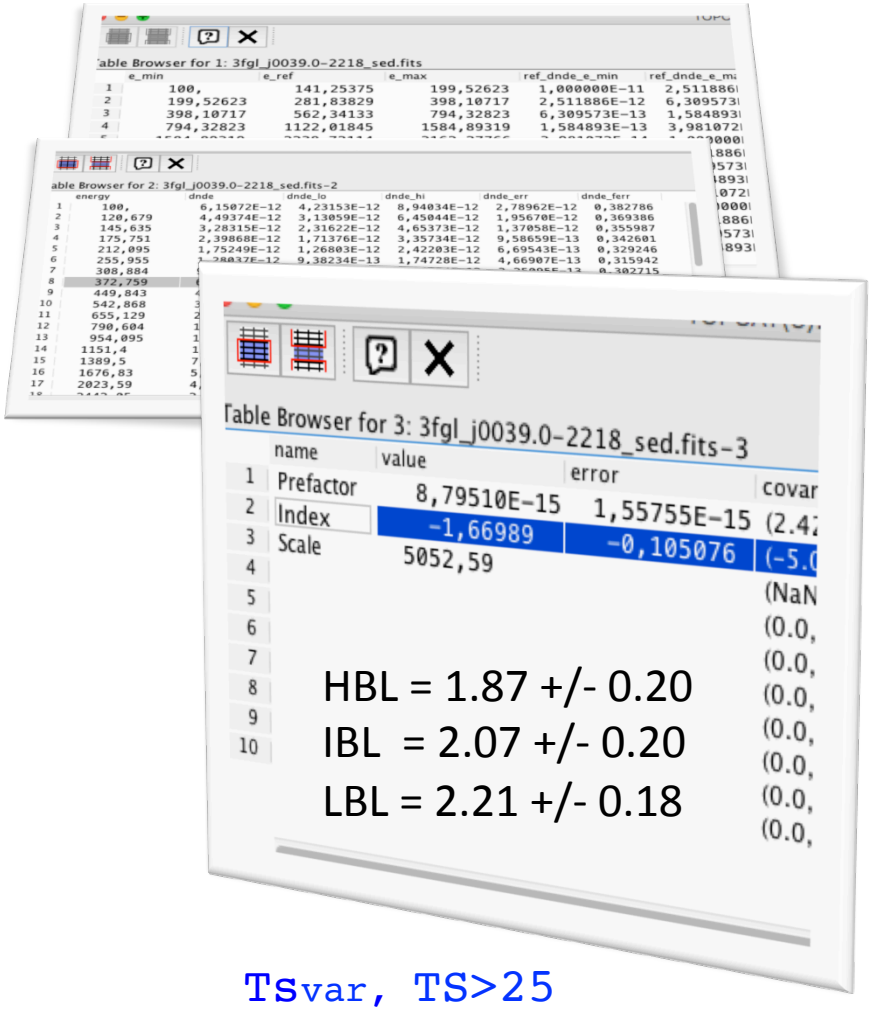






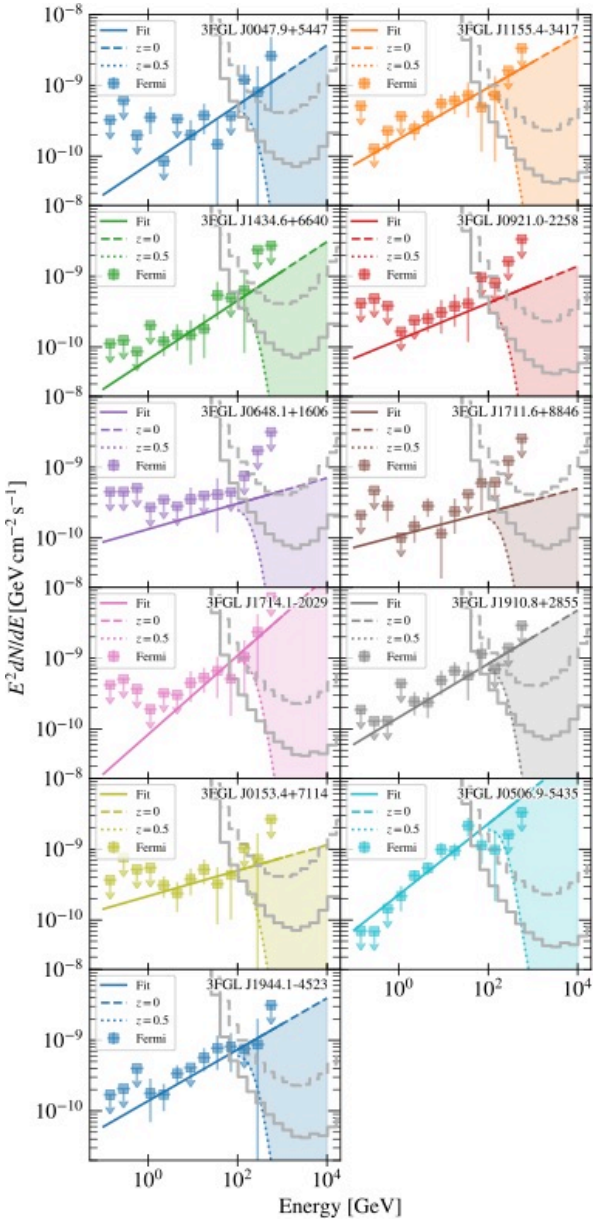


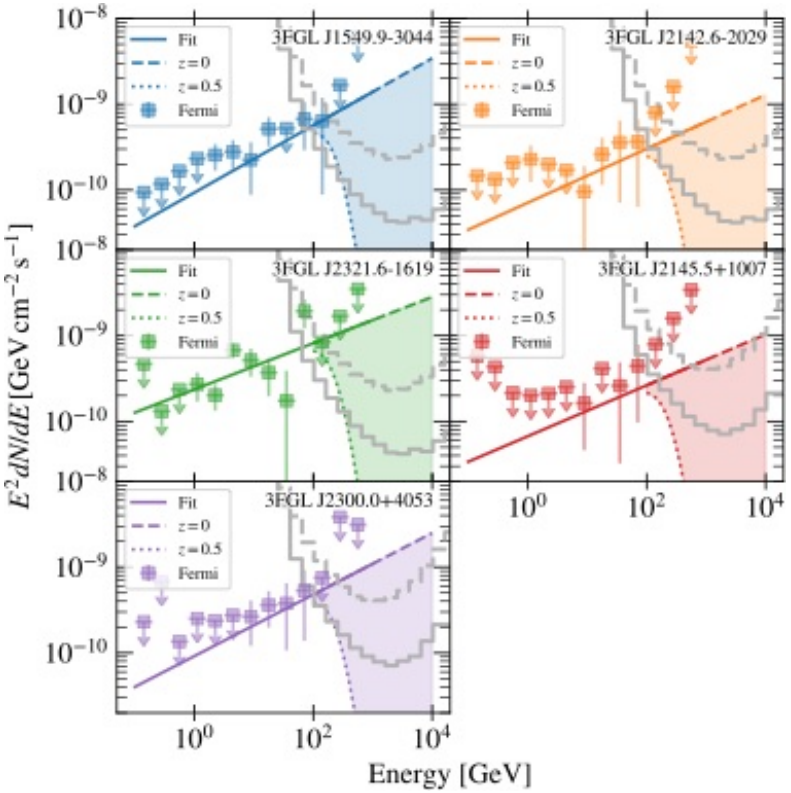




TSvar, TS>25

TeV candidates





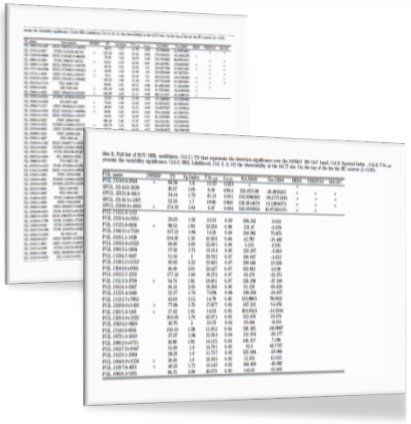
Fermi-LAT SEDs
z = 0 / z = 0.5
1TeV – 10 TeV
EBL model Dominguez et al.(2011)
IACTs = 5 HOURS CTA

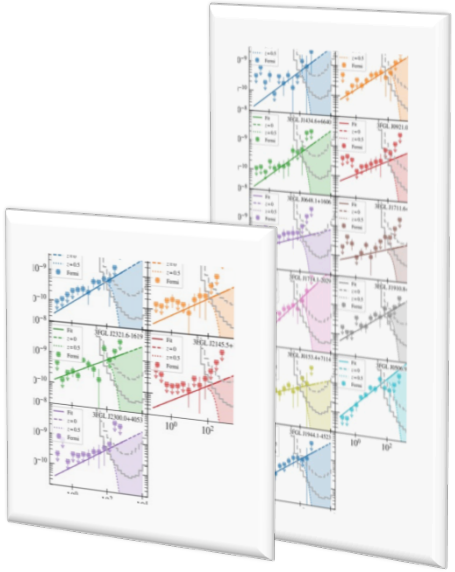
RESULTS

Candidates are consistent
with 2WHSP and HSP catalog (in preparation P.Giommi)

676 uncertain blazar-*like* sources → 80 HBL candidates → 16 TeV candidates

OUR SAMPLE





Thank you.

https://confluence.slac.stanford.edu/pages/viewpage.action?pageId=236491598