Selecting Very High Energy blazar as candidates for Cherenkov telescope observations by B-FlaP learning machine technique.

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ABSTRACT

Blazars and in particular their subclass High Synchrotron Peak (HSP) objects are the main targets of atmospheric Cherenkov telescopes. The present generation of Imaging Atmospheric Cherenkov Telescopes (IACTs), such as VERITAS, H.E.S.S. and MAGIC, has opened new frontiers of γ -ray astronomy in the Very High Energy range (E >100 GeV). Since IACTs have a small field of view and observation take a lot of time, the ability to correctly identify TeV objects will be very important for the Cherenkov scientific community in the selection of targets, in order to save time and to increase the rate of detections. We used a learning machine technique to select Very High Energy candidates from the Fermi LAT 4-Year Point Source Catalog . The novelty of the present approach is that our study relies exclusively on photon flux collected at γ -ray energies where Fermi Large Area Telescope (LAT) is most sensitive (0.1 - 100 GeV) and the method remains totally independent of other information at different wavelengths.

Key words: keyword1 - keyword2 - keyword3

1 INTRODUCTION

Blazars are active galactic nuclei (AGN) with a radio-loud behavior and a relativistic jet pointing toward the observer. (?). These sources are divided into two main classes: BL Lacertae objects (BL Lacs) and Flat Spectrum Radio Quasars (FSRQ), which show very different optical spectra even if in other wavebands they are similar. FSRQs have strong, broad emission lines at optical wavelengths, while BL Lacs show at most weak emission lines, sometimes display absorption features, and can also be completely featureless. Blazars emit variable, non-thermal radiation across the whole electromagnetic spectrum, which includes two components forming two broad humps in a $v f_{\nu}$ representation. The low-energy one is attributed to synchrotron radiation, and the high-energy one is usually thought to be due to inverse Compton radiation. See ? for a recent review of the properties of γ -ray AGN. Blazars can also be classified into different subclasses based on the position

¹ of the peak of the synchrotron bump in their spectral 19 energy distribution (SED), namely, low frequency peaked 2 (LSP or sources with $v_{peak}^S < 10^{14}$ Hz), intermediate 3_4 frequency peaked (ISP or sources with 10^{14} Hz $< v_{peak}^S$ 20 21 22 $^5 < 10^{15}$ Hz) and high frequency peaked (HSP or sources 6 with v_{peak}^S $> 10^{15}$ Hz) (?). BL Lac HSP sources are 23 24 ⁷ the most numerous class of TeV sources (?). HSP are 25 $^{8} \sim 30\%$ of the sources listed in TeGeV catalog (?) which 26 9 collects all the information publicly available about the 27 $^{10}~{\rm TeV}$ sources observed by the past and current generation 28 ¹¹ of imaging Cherenkov telescopes. ¹. Therefore the ability 29 ¹² to correctly identify new BL Lac HSP objects is very 30 ¹³ interesting for the IACTs scientific community in order to 31 ¹⁴ increase the number of known TeV sources as well as the 32 ¹⁵ opportunity to increase the rate of detections, since IACTs 33 ¹⁶ have a small field of view. For a recent review of present 34 $^{\scriptscriptstyle 17}$ and future Cherenkov telescopes, see ? and CTA project 35 18

¹ The catalog ASCII file can be retrieved from the ASI Science Data Center: http://www.asdc.asi.it/tgevcat/index.php.

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https://web.cta-observatory.org/ The aim of this study was focused in finding HSP blazar that might be reliable TeV candidates. For this purpose we used B-FlaP (?), hereinafter Paper1, a classification method of blazars based on a learning machine techinque which relies exclusively on ECDF (Empirical Cumulative Distribution Function) of variability informations collected at γ -ray energies where Fermi-LAT space telescope (?) is most sensitive (0.1 -100 GeV) and remains totally independent of other data at different wavelengths. In *Paper1* the method worked very well classifying, as BL Lac or FSRQ, 573 Blazar Candidates of Uncertain type (BCU) listed in The Third Catalog of Active Galactic Nuclei (?) (3LAC). This good result encouraged us to apply B-FlaP method in the search for new HSP TeV candidates in order to achieve the purpose of this study. See 3LAC for the counterpart conditions of BCUs. As first screening step In Fig 1 we plotted the ECDF for 3LAC blazar subclasses (right) and HSPs against FSRQs (left) . As we expected, because of the fact that HSP are almost exclusively represented by BL Lac objects (98.96%), the HSPs went through an FSRQ clean area at the upper left corner of the plot on the left. Even if the FSRQ (which are mainly ISP and LSP) contamination is not neglegible, the result observed in Fig. 1 suggests the potential ability of B-FlaP to identify a flow range (less than ~ 2.0×10^{-8} ph cm⁻² s⁻¹) where it is possible to suspect the HSP subclass for a BCU source.

However, even here, visual inspection of the curves in all the ECDF figures shows that the shape of the curve does not show major differences between the observed blazar classes. Instead, a distinguishing factor is the γ flux found for any of the 48 monthly bin of the 3FGL flux history . We therefore focus our work on the possible use of the γ -ray flux as a distinguish parameter to help the HSP classification.

2 ARTIFICIAL NEURAL NETWORK TECHNIQUE

In order to find new BL Lac HSP candidates we used the B-FlaP algorithm developed in *Paper1*, based on the artificial neural network technique (ANN), which considered the empirical cumulative distribution function (ECDF) generated from the γ -ray light curves of the 3LAC classified blazars and BCU objects. The method considers flux values extracted from the distributions as predictor parameters and includes in the ANN algorithm $\gamma\text{-ray}$ flux values corresponding to 10th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, 90th and 100th percentile. This choice to use only 10 input parameters arised from a compromise between a good representation of each ECDF and to use a limited number of input parameters, in order to avoid problems related to upper limits associated to some time bins. The new feedforward 2LP is built up of 10 input nodes, 5 hidden nodes and 2 output nodes. Using the B-FlaP method we chose as source sample all the 289 HSP and the 824 non-HSP identified by their spectral energy distribution and we compute the likelihood of a BCU sources to be an HSP. In this study we apply only one modification in B-FlaP original algorithm as lower classification threshold $(L_{HSP} > 0.8)$, in order to



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Figure 1. ECDF plots for blazars subclasses : (on left) LSP($_{72}$ orange) - ISP(purple) - HSP (black) , (on right) HPS vs FSRQ $_{73}$. The cumulative percentage of bins with flux below a given level is shown as a function of the 0.1 – 100 GeV flux in a bin, in units 74 of $10^{-8}~\rm{ph}~\rm{cm}^{-2}~\rm{s}^{-1}$

77 increase the number of condidates, but at the expense of a 78 95 smaller precision ($\sim 75\%$). In this way we improved the fi-70 96 $_{80}$ nal result because the *sensitivity* increases to $\sim 15\%$ and the 97 misclassified fraction of non-HSP remains very low (~2%). 98 81 Applying the optimized algorithm we selected 52 BCUs 99 82 as the most promising HSP candidates. In Tab.1 we report 100 83 the full list of HSP candidates. We compared our predictions 84 101 with the broadband Spectral Energy Distributions (SED) 85 102 ⁸⁶ available in 3LAC which provided an estimation of the syn-⁸⁷ chrotron peak frequency v_{peak}^{S} value extracted from a 3rd-⁸⁸ degree polynomial fitt of the low-energy hump of the SED. 103 104 105 Classifications agree for $\sim 63\%$ of most promising HSP se-89 106 90 lected by ANN, validating the efficiency of our algorithm; 107 $_{91}$ disagree for $\sim 15\%,$ in agreement with the expected contam-108 $_{92}$ ination rate; and for the remaining $\sim 22\%$ ANN provides a 109 93 classification as most promising HSP while the SED is not 110 94 enough rigorous or available. As a further validation we com-111 pare our HSP list with sources listed in 2WHSP catalog (?). 58% of the sources in our List are listed in 2WHSP catalog too. This confirms the previous result obtained by the comparison of the value at synchrotron peak frequency.

In order to obtain a narrow selection of TeV candidates for direct IACTs observation we refined the HSP selection through additional parameters which might better characterize the blazar TeV sources as following:

• γ -ray spectral photon index < 1.6

• Average significance over the 100 MeV to 300GeV energy band larger than 4.0 (Acero et al. 2015)

We used these additional threshold parameters because they reproduce some peculiar characteristics of TeV sources i.e. hard spectrum and significant brightness, as shown in the Second Catalog of Hard Fermi-LAT Sources (2FHL) (?) or TeV catalogs available in literature. For a usable sample from all three most important ground Cherenkov telescope : MAGIC, VERITAS and HESS, we selected only the sources which have favorable coordinates to grant their visibility at each observatory. Using these new parameters we reduced our first HSP selection from 52 to 16 sources (*clean list*)

For each source of the *clean list* we calculate the expected energy flux in the 50 GeV - 5 TeV energy range assuming that the spectral shape does not change to much compared to what the *Fermi*-LAT obtainted in the range between 300 MeV and 100 GeV. We compute the expected energy flux using the following relation:

$$EFlux_{[50 \text{ GeV}-5 \text{ TeV}]} = \int_{50 \text{ GeV}}^{5 \text{ TeV}} \frac{dN}{dE} E \, dE \tag{1}$$

where dN/dE is the photon flux per unit energy, in units of cm⁻² s⁻¹ MeV⁻¹, derived from the spectral model that fits the data.

We use the best-fit model parameters included in the public XML Model File for LAT 4-year Point Source Catalog². In Fig.2 we report the pyhton script used to compute the expected energy.

Tab.2 shows the *cleaned* list of HSP object identified as TeV candidates for IACTs. As a further control we compare the List in Tab.2 with the 2 FHL Catalog and we found that 6 of 16 sources are in both the lists. We called these sources Very High TeV candidates and we marked as VHT, or our best TeV candidates, in Tab.2. However we consider the remaining sources as interesting candidates that deserve particular attention in future IACT's observing campaigns.

2.1 Spectral Energy Distribution

Because of we expect an hard spectrum for a candidate at the TeV energies, the *Fermi* Energy Spectrum at 0.1-100 GeV, might be an useful counterpart to our Artificial Neural Network prediction. Generally the TeV sources show an increasing slope of their energy spectrum with a maximum 169

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¹¹² around 100 GeV waiting for an average energy flux in the 157 ¹¹³ order of $10^{-11} dN/dE$ [Tev⁻¹ cm⁻² s⁻¹] at the TeV en-158 ¹¹⁴ ergies. This is the spectrum of the Crab Nebula, (?) and 159 ¹¹⁵ many other TeV observed sources. The Energy Spectrum of 160 ¹¹⁶ our TeV candidates listed in Tab.2 are fully consistent with 161 ¹¹⁷ these expected trends of the spectrum. In Figure 3 and Fig-162 ¹¹⁸ ure 4 we report the Energy Spectrum of the 6 VHT sources 163 ¹¹⁹ listed in Tab.2. All of these have an hard slope as a sus-164 pected BL Lac candidate for potential emission in the TeV 165 120 energy range. The whole list of 3FGL blazars Energy Spec-166 ¹²¹ trum can be retrieve from the ASI Science Data Center: 167 122 http://www.asdc.asi.it/fermi3fgl/. 168

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125 3 RESULTS AND CONCLUSIONS

126 In this Letter we confirm that, although a statistic method 170 127 cannot replace rigorous spectroscopy as classification tech-171 128 nique, using the improvement described in this paper the B-172 129 FlaP method and the variability informations might be con-173 130 figured as additional powerful approaches for a reliable iden-174 131 tification of HSP blazars and TeV candidates when detailed 175 132 observational or multiwavelength data are not yet available. 176 133 In this study we classified 52 3FGL BCUs as BL Lac HSP 177 134 sources and we selected 6 of them as Very High TeV candi-178 135 date for IACTs observations. This result improve the knowl-179 edge of blazar population and could help for the Cherenkov 180 scientific community to plan future observing campaigns. 181

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² The file can be retrieved from the *Fermi* Science Support Center: http://fermi.gsfc.nasa.gov/ssc/data/access/lat/4yr_catalog/.

Table 1. Full HSP list selected from 3FGL BCUs

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$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGLname	Assoc	Signif Avg	Spectral Ind.	B-FlaP Likelihood
$\begin{array}{llllllllllllllllllllllllllllllllllll$	3FGL J0030.2-1646	1 RXS J003019.6-164723	9.160	1.647	0.981
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0039.0-2218	PMN J0039-2220	4.411	1.715	0.984
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0040.3+4049	B3 0037+405	6.379	1.132	0.996
$\begin{array}{llllllllllllllllllllllllllllllllllll$	3FGL J0043.5-0444	1RXS J004333.7-044257	5.840	1.735	0.984
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0043.7-1117	1RXS J004349.3-111612	5.896	1.594	0.993
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0047.9+5447	1 RXS J004754.5 + 544758	5.042	1.334	0.995
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0132.5-0802	PKS 0130-083	4.525	1.753	0.986
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	3FGL J0153.4+7114	TXS 0149+710	7.056	1.567	0.992
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0204.2+2420	B2 0201+24	5.146	1.792	0.983
$\begin{array}{llllllllllllllllllllllllllllllllllll$	3FGL J0305.2-1607	PKS 0302-16	5.635	1.688	0.989
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0342.6-3006	PKS 0340-302	4.729	1.846	0.986
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0439.6-3159	1RXS J043931.4-320045	6.437	1.771	0.988
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	3FGL J0506.9-5435	1ES 0505-546	14.856	1.603	0.991
$\begin{array}{llllllllllllllllllllllllllllllllllll$	3FGL J0515.5-0123	NVSS J051536-012427	4.623	1.755	0.987
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0528.3+1815	1RXS J052829.6+181657	4.869	1.646	0.990
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	3FGL J0620.4+2644	RX J0620.6+2644	5.032	1.65	0.987
FGL J0646.4-5452 PMN J0646-5451 7.056 2.189 0.993 FGL J0648.1+1606 1RXS J064814.1+160708 5.270 1.775 0.985 FGL J0650.5+2055 1RXS J065033.9+205603 10.030 1.558 0.989 FGL J0733.5+5153 NVSS J07326+515355 6.251 1.741 0.989 FGL J0742.4-8133 SUMSS J074220-813139 4.518 1.464 0.995 FGL J0746.9+8511 NVSS J074715+851208 9.662 1.787 0.990 FGL J0140.8+1342 1RXS J104057.7+134216 4.887 1.76 0.989 FGL J1141.2+6805 1RXS J114118.3+680433 7.089 1.611 0.993 FGL J1155.4-3417 NVSS J115520-341718 6.193 1.335 0.995 FGL J11203.5-3925 PMN J1203-3926 7.312 1.639 0.989 FGL J11319.6+7759 NVSS J1131921+775823 9.097 1.785 0.987 FGL J1434.6+6640 1RXS J143442.0+664031 6.913 1.517 0.995 FGL J1446.8-1831 NVSS J161219-305937 9.014 1.88 0.986 FGL J1547.1-2801 1RXS J171643.8+884144 6.668 </td <td>3FGL J0640.0-1252</td> <td>TXS 0637-128</td> <td>7.961</td> <td>1.513</td> <td>0.989</td>	3FGL J0640.0-1252	TXS 0637-128	7.961	1.513	0.989
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FGL J1158.9+0818 RX J1158.8+0819 5.428 1.869 0.981 FGL J1203.5-3925 PMN J1203-3926 7.312 1.639 0.989 FGL J1319.6+7759 NVSS J131921+775823 9.097 1.785 0.987 FGL J1434.6+6640 IRXS J143442.0+664031 6.913 1.517 0.995 FGL J1434.6+6640 IRXS J143442.0+664031 6.913 1.517 0.995 FGL J1446.8-1831 NVSS J144644-182922 4.179 1.723 0.987 FGL J1547.1-2801 IRXS J154711.8-280222 4.285 1.708 0.982 FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 IRXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 IRXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 IRXS J18418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 IRXS J18418.7+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026	3FGL J1155 4-3417	NVSS J115520-341718	6 193	1 335	0.995
FGL J1203.5-3925 PMN J1203-3926 7.312 1.639 0.989 FGL J1319.6+7759 NVSS J131921+775823 9.097 1.785 0.987 FGL J1434.6+6640 IRXS J143442.0+664031 6.913 1.517 0.995 FGL J1434.6+6640 IRXS J143442.0+664031 6.913 1.517 0.987 FGL J1446.8-1831 NVSS J144644-182922 4.179 1.723 0.987 FGL J1547.1-2801 IRXS J154711.8-280222 4.285 1.708 0.982 FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 IRXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 IRXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 IRXS J18418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 IRXS J18418.7+430954 4.952 1.725 0.992 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL J1158 9+0818	BX J1158 8+0819	5 428	1.869	0.981
FGL J1303.6 0525 F1.007 0525 F1.007 0525 F1.007 0525 F1.005 0525 0.987 FGL J1319.6+7759 NVSS J131921+775823 9.097 1.785 0.987 FGL J1434.6+6640 IRXS J143442.0+664031 6.913 1.517 0.995 FGL J1446.8-1831 NVSS J144644-182922 4.179 1.723 0.987 FGL J1547.1-2801 IRXS J154711.8-280222 4.285 1.708 0.982 FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 IRXS J171643.8+884414 6.668 1.57 0.993 FGL J1711.6+8846 IRXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 IRXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 IRXS J18418.7+430954 4.952 1.725 0.992 FGL J1824.12+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL 11203 5-3925	PMN 11203-3926	7 312	1.639	0.989
FGL J1434.6+6640 1RXS J143442.0+664031 6.913 1.517 0.995 FGL J1446.8-1831 NVSS J144644-182922 4.179 1.723 0.987 FGL J1547.1-2801 1RXS J154711.8-280222 4.285 1.708 0.982 FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 1RXS J171643.8+884414 6.668 1.57 0.993 FGL J1711.6+2029 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 1RXS J18418.7+430954 4.952 1.725 0.992 FGL J1825.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL J1319 6+7759	NVSS J131921+775823	9.097	1.785	0.987
FGL J1446.8-1831 NVSS J144644-182922 4.179 1.723 0.987 FGL J1547.1-2801 1RXS J154711.8-280222 4.285 1.708 0.982 FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 1RXS J171643.8+884414 6.668 1.57 0.993 FGL J1711.6+8846 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL 11434 6+6640	$1BXS I143442 0 \pm 664031$	6 913	1.517	0.995
FGL J1547.1-2801 1RXS J154711.8-280222 4.285 1.708 0.982 FGL J1547.1-2801 1RXS J154711.8-280222 4.285 1.708 0.982 FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 1RXS J171405.2-202747 6.668 1.57 0.993 FGL J1714.1-2029 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL 11446 8-1831	NVSS 1144644-182922	4 179	1 723	0.987
FGL J1612.4-3100 NVSS J161219-305937 9.014 1.88 0.986 FGL J1711.6+8846 1RXS J171643.8+884414 6.668 1.57 0.993 FGL J1714.1-2029 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.725 0.992 FGL J1841.2+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL 11547 1-2801	18XS 1154711 8-280222	4.115	1.728	0.982
FGL J1711.6+8846 1RXS J171643.8+884414 6.668 1.57 0.993 FGL J1711.6+8846 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.725 0.992 FGL J1824.4+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FGL 11612 4-3100	NVSS 1161219-305937	9.014	1.88	0.986
FGL J1714.1-2029 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1724.1-2029 1RXS J171405.2-202747 6.795 1.344 0.994 FGL J1824.4+4310 1RXS J182418.7+430954 4.952 1.725 0.992 FGL J1841.2+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	$3FGL$ 11711 6 ± 8846	1BXS $1171643 8 \pm 884414$	6 668	1.57	0.903
FGL J1824.4+4310 IRXS J182418.7+430954 6.155 1.544 0.594 FGL J1824.4+4310 IRXS J182418.7+430954 4.952 1.725 0.992 FGL J1841.2+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FCL 11714 1-2020	18XS 1171405 2-202747	6 795	1.344	0.994
FGL J1841.2+2910 MG3 J184126+2910 8.353 1.567 0.989 FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	$3FGL$ 11824 4 \pm 4310	1BXS 1182418 7 \pm 430954	4 952	1.725	0.994
FGL J1855.1-6008 PMN J1854-6009 4.206 1.813 0.987 FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	$3FCL$ 118/1 2 \pm 2010	MC3 $I184126\pm2010$	8 353	1.567	0.989
FGL J1908.8-0130 NVSS J190836-012642 9.026 2.148 0.990	3FCL 11855 1-6008	PMN 11854-6009	4 206	1.813	0.987
	3FCL 11008 8-0130	NVSS 1100836-012642	9.026	2 1/8	0.901
ECI 11010 8 2855 1 BYS 1101053 2 285622 6 536 1 464 0 003	3FCL 11010.8+2855	1RVS 1101053 2 285622	5.020 6.536	1 464	0.003
FGL J1910.072050 IRAS J191030.27200022 0.550 1.404 0.595	3FCL 11030.6 4025	$\frac{11135}{5191055.2} = 200022$	5.086	1.404	0.995
FGL $11044 = 1.024$ 0.009 FGL $11044 = 1.024$ 0.009 FGL $11044 = 1.024$ 0.009	3FCL 11044 1 4599	1RXS 1104499 6 459996	5 207	1.024	0.303
FGL J15777.1-3020 IIIAN J1574222.0-402020 0.397 I.00 0.995 FCL 11050 8.4795 SHMSS 1105045.479510 1.094 1.594 0.009	3FCL 11050 & 4795	SUMSS 1105045 472510	0.097 1.097	1.50	0.995
ГСН J17JJJ.C-472J DUNDD J17JJ74-472J17 1.724 1.724 0.992 ЕСН J2026 6 2225 1 RVS J202650 0 222817 4 200 1 205 0.002	3FCI 19096 6 9995	1RXS 1903650 0 220217	1.924	1.024	0.992
FGE 32030.0-3323 IRAS 3203030.3-332017 4.200 1.303 0.990 FCE 19046 7 1011 DMN 19046 1010 4.014 1.600 0.001	9FGL J2030.0-3323	DMN 19042 1010	4.200	1.300	0.990
FGL J2040.7-1011 FMIN J2040-1010 4.814 1.009 0.991 FCL J2104 2.0211 NVCC J210421 021220 4.020 1.524 0.002	эгдь J2040.7-1011 2БСІ 12104 2 0211	F MIN J2040-1010 NV/SS J210421 021220	4.814	1.009	0.991
FGL J2104.2-0211 INV 55 J210421-021239 4.000 1.524 0.993	9FGL J2104.2-0211	10 V 00 J210421-021239	4.000	1.024	0.993
FGL J2100.0-0019 IRAD J210909.0-801803 4.729 1.74 0.990	3FGL J2108.0-8019	ILAS J210959.5-801853	4.729	1.74	0.990
FGL J2312.9-0923 501M55 J231347-092332 4.931 1.804 0.989	SFGL J2312.9-6923	SUMSS J231347-092332	4.931	1.804	0.989
FGL J2210.0-0209 SUIVISS J231/01-021003 S.000 1.735 0.988	3FGL J2310.8-5209	501VISS J231701-521003	0.000 4.604	1.733	0.988
гдд J2341.9+3430 INVSS J234133+343021 4.094 1.133 0.984	эг GL J2347.9+5436	INV 55 J234753+543627	4.094	1.733	0.984

[ht!]

```
#! /usr/bin/env python
```

```
# these modules come with the standard Python
import argparse, sys, os, shutil
# reopen stdout to turn off the buffered output
sys.stdout = os.fdopen(sys.stdout.fileno(), 'w', 0)
# these modules are essential
import numpy as np
def main():
    # Energy range on where perform the integer
    emin = 5.e4 # MeV -> 50 GeV
    emax = 5.e6 # MeV -> 5 TeV
    delta = 10.
    #j0650
    n0 = 0.7261442133e-14
    pi = -1.558256791
    e0 = 0.9887826601e4
    flux = 0
    for e in np.arange(emin, emax, delta):
        flux += n0 * ((e / e0)**pi) * e * delta * 1.6022e-6
        print "Energia = %e erg/cm2/s" % flux
if __name__ == '__main__':
    main()
```

Figure 2. Python script used for TeV flux extrapolation



Figure 3.



Figure 4. 0.1 - 100 GeV Energy Spectrum of 3FGL BCUs Very High candidates TeV and confirmed in 2FHL catalog

VHT 3FGL J0040.3+4049 B3 0037+405 00 43 44.4 -11 17 17.08 6.379 1.132 3FGL J1714.1-2029 IRXS J171405.2-202747 17 14 07.9 -20 29 46.6 6.795 1.344 3FGL J1714.1-2029 IRXS J171405.2-202747 17 14 07.9 -20 29 46.6 6.795 1.344 3FGL J1155.4-3417 NVSS J115520-341718 11 55 26.8 -34 17 57.4 6.193 1.305 3FGL J1056.6-3325 IRXS J10560.5-546 05 06 58.3 -54 35 01.28 14.856 1.603 VHT 3FGL J0606.0-1252 TXS 0637-128 06 40 04.99 -12 52 33.2 7.961 1.513 VHT 3FGL J0300.2-1646 IRXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.1600 1.647 VHT 3FGL J0043.7-1117 IRXS J004349.3-111612 00 43 16.1 7.108 5.896 1.504 VHT 3FGL J01043.7-1117 IRXS J0104349.3-111612 00 44.44 111717.08 5.806 1.574 SFGL J1044.1-4583 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.606 1.572	VHTeV	3FGLname	Assoc	\mathbf{RA}	Dec	Signif Avg	Spectral Ind.	L B-FlaP	50GeV-5TeV E -11
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	VHT	3FGL J0040.3+4049	B3 0037 + 405	00 43 44.4	-11 17 17.08	6.379	1.132	0.996	7.432
3FGL J2036.6-3325 IRXS J203650.9-332817 20 36 41.8 -33 25 36.8 4.208 1.305 3FGL J1155.4-3417 NVSS J115520-341718 11 55 26.8 -34 17 57.4 6.193 1.305 3FGL J1155.4-3417 NVSS J115520-341718 11 55 26.8 -34 17 57.4 6.193 1.305 3FGL J0560.9-5435 IES 0565-546 05 05 65.8 -34 17 57.4 6.193 1.335 VHT 3FGL J0640.0-1252 TXS 0637-128 06 40 49 -12 52 33.2 7.961 1.513 3FGL J0640.0-1252 MG3 J184126+2910 18 41 12.29 +29 1058.4 8.353 1.567 3FGL J0030.2-1646 IRXS J003019.6-164723 00 30 15.7 -16 46 29.6 1.603 VHT 3FGL J0043.7-1117 IRXS J004349.3-111612 04 44.4 11 17 17 7.08 5.896 1.574 VHT 3FGL J10043.7-2111 IRXS J17164.3.8+884414		3FGL J1714.1-2029	1RXS J171405.2-202747	$17 \ 14 \ 07.9$	$-20\ 29\ 46.6$	6.795	1.344	0.994	7.098
$\begin{array}{llllllllllllllllllllllllllllllllllll$		3FGL J2036.6-3325	1RXS J203650.9-332817	$20 \ 36 \ 41.8$	-33 25 36.8	4.208	1.305	0.996	4.036
 VHT 3FGL J0506.9-5435 IES 0505-546 05 06 58.3 -54 35 01.28 14.856 1603 VHT 3FGL J0640.0-1252 TXS 0637-128 06 40 04.99 -12 52 33.2 7.961 1.513 3FGL J1841.2+2910 MG3 J184126+2910 18 41 12.29 +29 10 58.4 8.353 1.567 3FGL J0030.2-1646 IRXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.160 1.647 3FGL J0043.7-1117 IRXS J004349.3-111612 00 43 44.4 11 17 17.08 5.896 1.594 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J12014.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J0620.4+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 IRXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611 		3FGL J1155.4-3417	NVSS J115520-341718	11 55 26.8	-34 17 57.4	6.193	1.335	0.995	3.863
VHT 3FGL J0640.0-1252 TXS 0637-128 06 40 04.99 -12 52 33.2 7.961 1.513 3FGL J1841.2+2910 MG3 J184126+2910 18 41 12.29 +29 10 58.4 8.353 1.567 3FGL J0030.2-1646 IRXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.160 1.647 3FGL J0030.2-1646 IRXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.160 1.57 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J2104.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 VHT 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.653 VHT 3FGL J10620.4+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J1944.1-4523 IRXS J194422.6-452326 19 44 10.8 -45 23 54.2 5.397 1.65 VHT 3FGL J19921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 <t< th=""><td>VHT</td><td>3FGL J0506.9-5435</td><td>1ES 0505-546</td><td>$05 \ 06 \ 58.3$</td><td>-54 35 01.28</td><td>14.856</td><td>1.603</td><td>0.991</td><td>3.828</td></t<>	VHT	3FGL J0506.9-5435	1ES 0505-546	$05 \ 06 \ 58.3$	-54 35 01.28	14.856	1.603	0.991	3.828
3FGL J1841.2+2910 MG3 J184126+2910 18 41 12.29 +29 10 58.4 8.353 1.567 3FGL J0030.2-1646 1RXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.160 1.647 3FGL J0030.2-1646 1RXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.160 1.57 3FGL J0043.7-1117 1RXS J004349.3-111612 00 43 44.4 11 17 17.08 5.896 1.594 3FGL J1711.6+8846 1RXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J1711.6+8846 1RXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J12104.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 157 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J0620.4+2644 RX J0620.6+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J0921.0-2258 NVSS J092067-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 <td< th=""><td>$\rm VHT$</td><td>3FGL J0640.0-1252</td><td>TXS 0637-128</td><td>$06 \ 40 \ 04.99$</td><td>-12 52 33.2</td><td>7.961</td><td>1.513</td><td>0.989</td><td>3.526</td></td<>	$\rm VHT$	3FGL J0640.0-1252	TXS 0637-128	$06 \ 40 \ 04.99$	-12 52 33.2	7.961	1.513	0.989	3.526
3FGL J0030.2-1646 IRXS J003019.6-164723 00 30 15.7 -16 46 29.6 9.160 1.647 VHT 3FGL J0043.7-1117 IRXS J004349.3-111612 00 43 44.4 11 17 17.08 5.896 1.594 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J2104.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J0620.4+2644 RX J0620.6+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J0941.1-4523 IRXS J194422.6-452326 19 44 10.8 -45 23 54.2 5.397 1.56 VHT 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 IRXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611		3FGL J1841.2+2910	MG3 J184126+2910	$18\ 41\ 12.29$	+29 10 58.4	8.353	1.567	0.989	2.945
 VHT 3FGL J0043.7-1117 1RXS J004349.3-111612 00 43 44.4 11 17 17.08 5.896 1.594 3FGL J1711.6+8846 1RXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J2104.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J1062.04+2644 RX J0620.6+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 1RXS J114118.3+680433 11 41 177 +68 05 56.4 7.089 1.611 		3FGL J0030.2-1646	1RXS J003019.6-164723	$00 \ 30 \ 15.7$	$-16\ 46\ 29.6$	9.160	1.647	0.981	1.668
3FGL J1711.6+8846 IRXS J171643.8+884414 17 11 37.9 88 46 26.0 6.668 1.57 3FGL J2104.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J1020.4+2644 RX J0620.6+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J1944.1-4523 IRXS J194422.6-452326 19 44 10.8 -45 23 54.2 5.397 1.56 VHT 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 IRXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611	$\rm VHT$	3FGL J0043.7-1117	1RXS J004349.3-111612	$00 \ 43 \ 44.4$	$11 \ 17 \ 17.08$	5.896	1.594	0.993	1.652
3FGL J2104.2-0211 NVSS J210421-021239 21 04 12.29 -02 11 27.2 4.060 1.524 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J1203.5-3925 PMN J1203-3926 12 03 31.6 -39 25 31.4 7.312 1.639 VHT 3FGL J0620.4+2644 RX J0620.6+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J1944.1-4523 IRXS J194422.6-452326 19 44 10.8 -45 23 54.2 5.397 1.56 VHT 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 IRXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611		3FGL J1711.6+8846	1RXS J171643.8+884414	$17 \ 11 \ 37.9$	$88 \ 46 \ 26.0$	6.668	1.57	0.993	1.609
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		3FGL J2104.2-0211	NVSS J210421-021239	$21 \ 04 \ 12.29$	-02 11 27.2	4.060	1.524	0.993	1.541
VHT 3FGL J0620.4+2644 RX J0620.6+2644 06 20 28.99 +26 44 22.19 5.032 1.65 VHT 3FGL J1944.1-4523 1RXS J194422.6-452326 19 44 10.8 -45 23 54.2 5.397 1.56 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 1RXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611		3FGL J1203.5-3925	PMN J1203-3926	$12 \ 03 \ 31.6$	$-39\ 25\ 31.4$	7.312	1.639	0.989	1.525
VHT 3FGL J1944.1-4523 1RXS J194422.6-452326 19 44 10.8 -45 23 54.2 5.397 1.56 3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 0.4 4.101 1.553 3FGL J1141.2+6805 1RXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611	$\rm VHT$	3FGL J0620.4+2644	RX J0620.6+2644	$06\ 20\ 28.99$	$+26\ 44\ 22.19$	5.032	1.65	0.987	1.340
3FGL J0921.0-2258 NVSS J092057-225721 09 21 00.4 -22 58 00.4 4.101 1.553 3FGL J1141.2+6805 1RXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611	VHT	3FGL J1944.1-4523	1RXS J194422.6-452326	$19\ 44\ 10.8$	$-45\ 23\ 54.2$	5.397	1.56	0.993	1.297
3FGL J1141.2+6805 1RXS J114118.3+680433 11 41 17.7 +68 05 56.4 7.089 1.611		3FGL J0921.0-2258	NVSS J092057-225721	$09 \ 21 \ 00.4$	-22 58 00.4	4.101	1.553	0.994	1.202
		3FGL J1141.2+6805	1RXS J114118.3+680433	$11 \ 41 \ 17.7$	$+68\ 05\ 56.4$	7.089	1.611	0.993	1.196

 Table 2. Very High Candidates for IACTs telescopes

REFERENCES

Abdo A. et al., 2011, ApJ, 716, 30	193
Abdo A. A. et al. , 2011, ApJ, 716, 30	194
Acero F. et al., 2015, ApJS, 218, 23	195
Acero F. et al., 2015, ApJ, 218, 23	196
Ackermann et al., 2015, ApJ 810, 14, 34	197
Ackermann et al., 2016, ApJ 222, 1, 5	198
Alvarez Crespo N. et al. 2016 AJ, 151, 32	199
Atwood W. B. et al., 2009, ApJ, 697, 1071	200
Carosi A. et al., 2015, Proceeding of the 34th International Cos-	201
mic Ray Conference, p. 5	202
Chang Y.L. et al., 2016 in press arxiv 1609.05808	203
Chiaro G. et al., 2016 MNRAS 462.3.3180C	204
De Naurois, M. et al., 2015, Comptes rendus - Physique, 16, 610	205
Ghisellini G., 2013, EPJ Web of Conference, Vol. 61, id.05001.	206
Gish H., 1990, Proceeding on Acoustic Speech and Signal Pro-	207
cessing, p. 1361	208
Hillas A.M. et al., 1998, ApJ, 503, 744	209
Horan D., Wakeley S., 2008, AAS, HEAD meeting 10, id.41.06	210
Richard M. P., and Lippman R. P., 1991, Neural Computation,	211
3, 461	212

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