The optical continuum of BL Lac objects

A.Veronesi[1], B. Sbarufatti[2], S. Ciprini[3], R. Decarli[1], A. Treves[1], R. Falomo[4], J. Kotilainen[5]

[1] Università degli Studi dell'Insubria, via Valleggio 11, I-22100 Como, Italy
[2] INAF, Istituto di Astrofisica Spaziale e Fisica Cosmica di Palermo, Via Ugo La Malfa 153, I-90146 Palermo, Italy
[3] Dipartimento di Fisica e Osservatorio Astronomico Università di Perugia, via A. Pascoli, 06123 Perugia, Italy
[4] INAF, Osservatorio Astronomico di Padova, Vicolo dell'Osservatorio 5, I-35122 Padova, Italy
[5] Tuorla Observatory, University of Turku, Väisäläntie 20, FIN-21500 Piikkiö,Finland

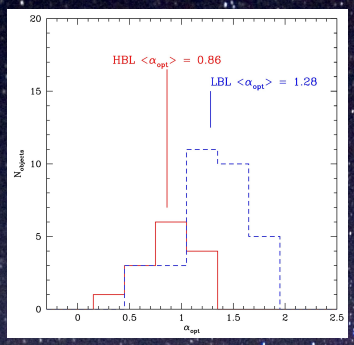

Figure 1. Optical spectral index distributions of 14 HBL (in red) and 32 LBL (in blue).

We consider a sample of 46 BL Lac objects (BLL) for which we have spectra in the 3800-8000 Å range obtained with the ESO 8 meter VLT + FORS1 (see Table 1). Here we discuss some global properties.

The Continuum

The continuum is fitted supposing that it is due to the superposition of a power law and an elliptical host galaxy. For 8 objects the galactic contribution is not negligible.

We present the optical spectral index ($F_\nu \approx \nu^{-\alpha}$) distribution in Fig.1.
For 30 objects with X-ray data traced in literature, we present also the optical-X-ray spectral index distribution in Fig.2.

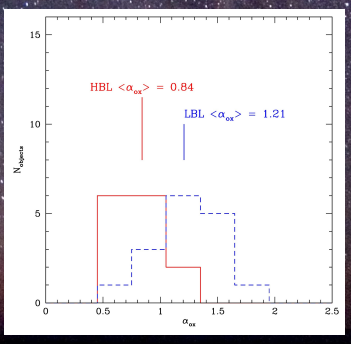

Figure 2. Optical-X-ray spectral index distributions of 14 HBL (in red) and 16 LBL (in blue).

It is apparent the distinction in the indices between High Energy Peaked BL Lacs (HBL) and the Low Energy Peaked ones (LBL), which is statistically highly significant.

Object name	m_R	Redshift	Lines	Class
PKS 0019+058	18.4	>0.35		L
PKS 0047+023	19	>0.82		L
PKS 0048-09	16	>0.3		L
GC 0109+224	14.6	>0.23		L
RBS 0231	18.6	>0.41		L
1RXS J022716.6+020154	18.9	0.46	g	H
PKS 0306+102	21.2	0.86	e	L
1RXS J031615.0-260748	18.1	0.44	e g	L
PKS 0338-214	17.9	0.22	e g	L
PKS 0422+00	16.2	>0.31		L
PKS 0426-380	18.6	1.11	e g	L
1RXS J055806.6-383829	16.8	0.3	g	H
PKS 0627-199	19.3	>0.63		L
PKS 0808+019	18.4	1.15	e	L
1WGA J1012.2+063	17.6	0.73	e	L
PKS 1057-79	15.9	0.58	e	L
OM 280	15.7	>0.17		L
1ES 1212+078	17.3	0.14	e g	H
1ES 1248-296	19.5	0.38	g	H
PKS 1250-33	20.1	0.86	e	L
PKS B1256-229	17.9	0.48	e	L
PKS 1349-439	16.9	>0.39		L
QQ 012	18.1	>0.46		L
1RXS J144505.9-032613	17.7	>0.51		H
1RXS J150343.0-154107	17.8	>0.38		H
PKS 1519-273	17.8	1.3	e	L
PMN J1539-0658	19.5	>0.84		L
HB89 1553+113	14	>0.09		H
H 1722+119	14.7	>0.17		H
PKS 1830-589	17.7	>0.47		L
PKS 2012-017	19.3	>0.94		L
RBS 1752	17.5	0.45	g	L
1RXS J213151.7-251602	19	>0.86		H
PKS 2131-021	19.2	1.28	e	L
MH 2133-449	19.5	>0.98		H
MH 2136-428	15.6	>0.24		L
RX J22174-3106	19.7	0.46	g	H
PKS 2223-114	21.5	0.98	e	L
PKS 2233-148	18.5	>0.65		L
RBS 1915	16.8	0.24	g	L
PKS 2254-204	17.1	>0.47		L
1RXS J231027.0-371926	19.6	>1.03		H
MS 2342.7-1531	21.4	>1.03		H
TXS 2346+052	18.3	0.42	e	L
PKS 2354-021	20.4	0.81	e	L
1RXSJ235730.1-171801	17.7	>0.85		H

Table 1. List of the BLLs obtained by the ongoing program in which we are engaged. See Sbarufatti et al. 2005, 2006 and 2008 at this conference. Column (1) BLL name (2) m_R (3) Redshift or lower limit to it (4) emission lines (e) or absorption lines of the host galaxy (g) detected (5) HBL (H) or LBL (L) objects.

Photo Courtesy of ESO: Southern sky above the VLT Paranal

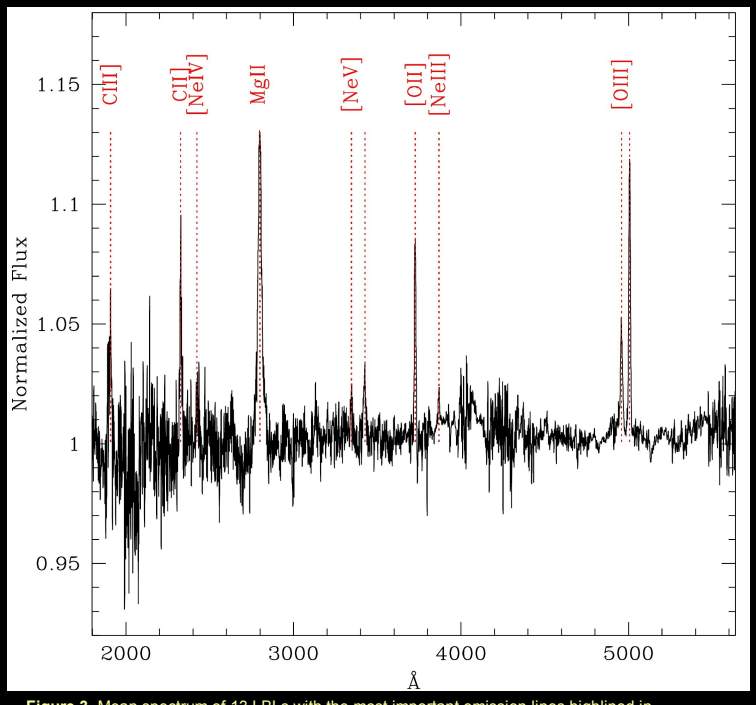

Figure 3. Mean spectrum of 13 LBLs with the most important emission lines highlined in red.

Line Spectrum

The normalized spectra of the 13 objects for which the emission lines are detected, are composed in a mean spectrum in Fig. 3.

Several lines are apparent and the correspondent Equivalent Widths (EW) are reported in Table 2.

The CII], CIII] and the broad line MgII, in addition with several narrow forbidden lines are well detected.

Emission Lines	Lambda Å	EW Å
(1)	(2)	(3)
$[OIII]$	5007	-1.44
$[OIII]$	4959	-0.69
$[NeIII]$	3869	-0.18
$[OII]$	3727	-0.95
$[NeV]$	3346	-0.39
$[NeV]$	3426	-0.19
$MgII$	2798	-4.31
$[NeIV]$	2423	-0.19
$CII]$	2326	-0.97
$CIII]$	1909	-1.08

Table 2. List of the most important emission lines of the mean spectrum obtained from 13 objects.

http://www.oapd.inaf.it/zbllac/

References:

Sbarufatti et al. 2005, AJ, 129, 559
Sbarufatti et al. 2006, AJ, 132, 1
Sbarufatti et al. 2008, submitted to AJ