O n t h e b l a z a r S E D s

Sónia Antón Ian Browne Alessandro Caccianiga Maria Marchã

Faculdade de Ciências – University of Lisbon Jodrell Bank Observatory – University of Manchester Osservatorio de Brera – INAF

To improve our knowledge of the broad range of blazar properties we have been studying sets of radio selected objects: the core-jet flat spectrum low luminosity objects from the 200-mJy sample and relativistic-jet flat-spectrum objects from the Caltech-Jodrell Bank (CJF) sample. This work is still in progress. Up to now our findings are the following: (a) low radio-luminosity blazar-like objects have been identified with SED peaks at low frequencies (b) high radio-luminosity FSRQ have SED peaks at high frequencies (c) by comparing the radio luminosity range and peak frequency distribution of the 200-mJy, CJF, Slew and 1-Jy objects, we do not find evidence for a blazar sequence. We conclude that the luminosity is not the main parameter that controls the blazar SED's colour.

It is believed that the continuum radiation from blazars is predominantly non-thermal emission arising from a relativistic jet pointing at a small angle to line of sight to the observer. The Spectral Energy Distribution (SED) may be described by 2-humps in units of νL, the frequency of the first energy peak showing a remarkable range of 7 magnitudes – from ~10^{11} to 10^{18} Hz [1,2]. The blazar spectral sequence (bss) [6,7] tries to explain the diversity of colours in the SEDs of blazars; observational results suggest an anti-correlation between power and the 1st-peak frequency and theory can explain this in terms of inverse Compton scattering of ambient photons by jet relativistic electrons.

Recently objects that do not fit in the spectral sequence have been found [1,2,4,9,10] , indicating that restrictive observational selection may lead to systematic trends or correlations (see below). If we aim to study the properties of jet emission we believe we should look at widest range of compact synchrotron sources possible and not just restrict ourselves to the objects exhibiting the most obvious blazar behaviour. For this end we have analysed two different radio selected samples: a low luminosity radio selected sample (a type of sample absent in the bss investigation), the 200-mJy [1], in particular a sub-sample comprising only core-jet flat spectrum objects [3], and a sample of objects known to have relativistic jet emission, the CJF [12], in particular the ones which have VLBI jets and measured super-luminal motions [10].

The SEDs of the 200 mJy [2] and CJF objects have been model fitted to estimate the peak frequency - the model is based on Fossati et al [4]. In the case of CJF sample the model fitting is still in underway, and here we present the results of 75% of the sub-sample under study. To ensure consistency, the SEDs of the Slew and 1 Jy objects were fitted with same recipe. **Figure 1** shows some examples of fitted SEDs.

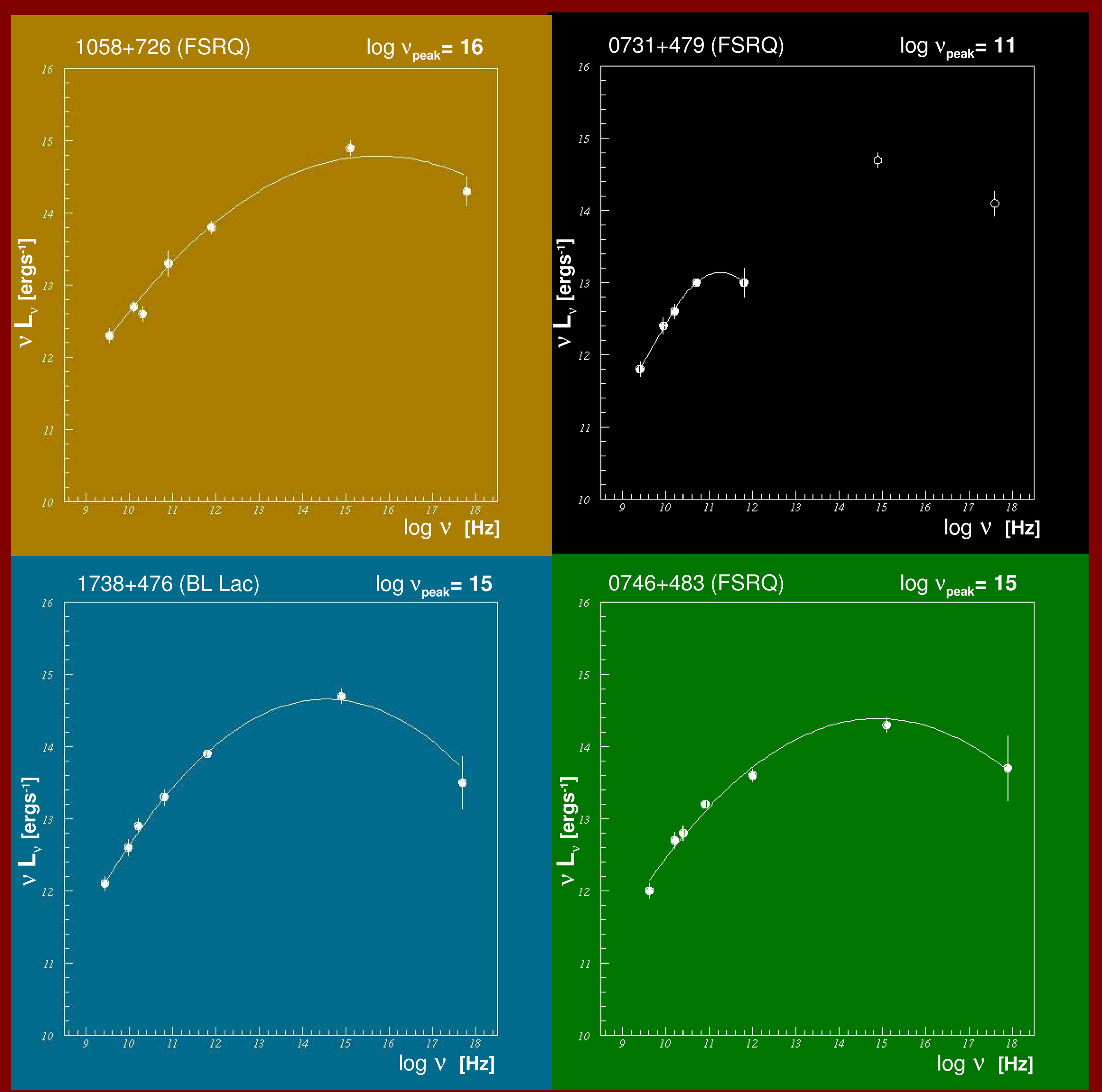

Figure 1 Representative model fits to the SEDS of CJF objects

We note that the strength of non-thermal emission in the optical band is, obviously, dependent of the frequency at which this component begins to decline, i.e., dependent of the peak frequency. This is well illustrated in **Figure 2** that presents the 4000 A break contrast versus the peak frequency of the 200-mJy objects. Not all the objects meet the optical criteria of a reduced 4000 A break (below 25%)[11]. **Figure 2** shows that: (a) the decrease of the 4000 A break is related with the peak frequency (b) objects that meet the optical criteria of BL Lac classification all have $\nu_{peak} > 10^{13.5}$ Hz .

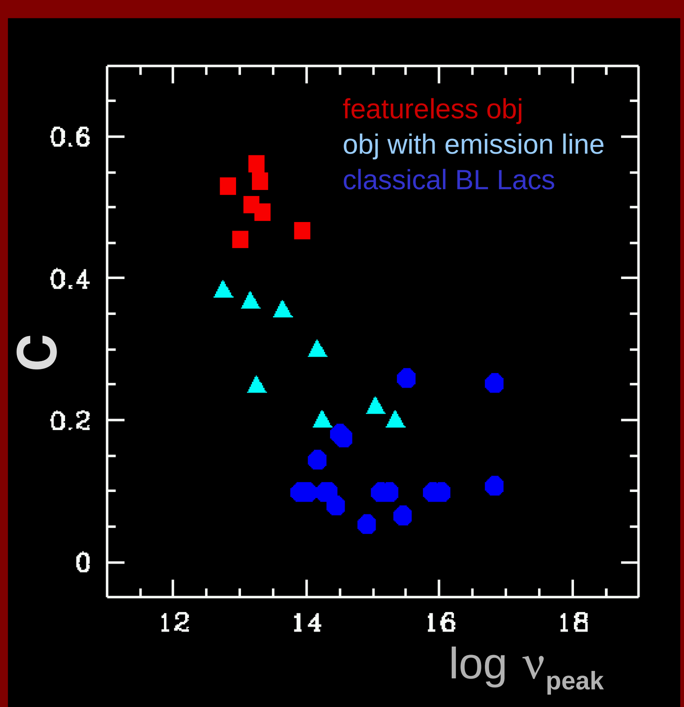

Figure 2 4000 A break contrast vs synchrotron peak for the 200-mJy.

In particular, if there is a wide range of peak frequencies and a range of luminosities, the low luminosity objects are only easily recognised as blazars if they are high frequency peaked objects, whereas for high luminosity objects the recognition is possible for a wide range of frequencies. ***This is one luminosity dependent selection effect***.

This has motivated us to dispense with optical selection and to measure the SEDs of all core-jet (at VLBI resolution) flat-spectrum objects from the 200-mJy sample and relativistic-jet flat-spectrum objects from the CJF sample.

S P E C T R A L S E Q U E N C E

Figure 3 shows the radio luminosity and synchrotron peaks distributions for the 3 radio-selected samples (200-mJy, 1-Jy and CJF) and the x-ray selected sample (Slew). We note that the radio luminosity distribution of the 200 mJy objects is similar to that of the Slew sample. In the framework of spectral sequence one would expect the 200 mJy and the Slew to have similar peak frequency distributions. However, it is clear from **Figure 3** that it is not the case. Instead, the peak frequency distribution of the 200 mJy is similar to that of the 1 Jy sample.

Actually the mean frequency peak of all the radio selected samples is ~10^{14} Hz and independent of the range of radio power (almost 4 orders of magnitude), whereas the mean frequency peak of the x-ray selected sample (Slew) is ~$10^{15.9}$ Hz. Considering the peak frequency distributions for the different samples we found that the radio selected objects are consistent with being drawn from the same population and that the x-ray selected objects are drawn from a different population (according to Kolmogorov-Smirnov test, with 95% as confidence level to reject the null hypothesis).

The above results are not consistent with the spectral sequence model. No correlation between power and frequency peak is found when the radio-selected samples are considered, but only when the X-ray selected sample is also present (at 99.9% significance level).

The results indicate that the method of selection has more influence on the peak distribution than does the intrinsic power. In particular, within a population with a broad distribution of spectral shapes, a low frequency band of selection biases the samples to objects that are stronger at low frequencies and a high frequency band of selection biases the samples to objects that are stronger at high frequencies. Objects that are strong at a certain band tend to have peak frequencies in that band. ***This is another luminosity-dependent selection effect***.

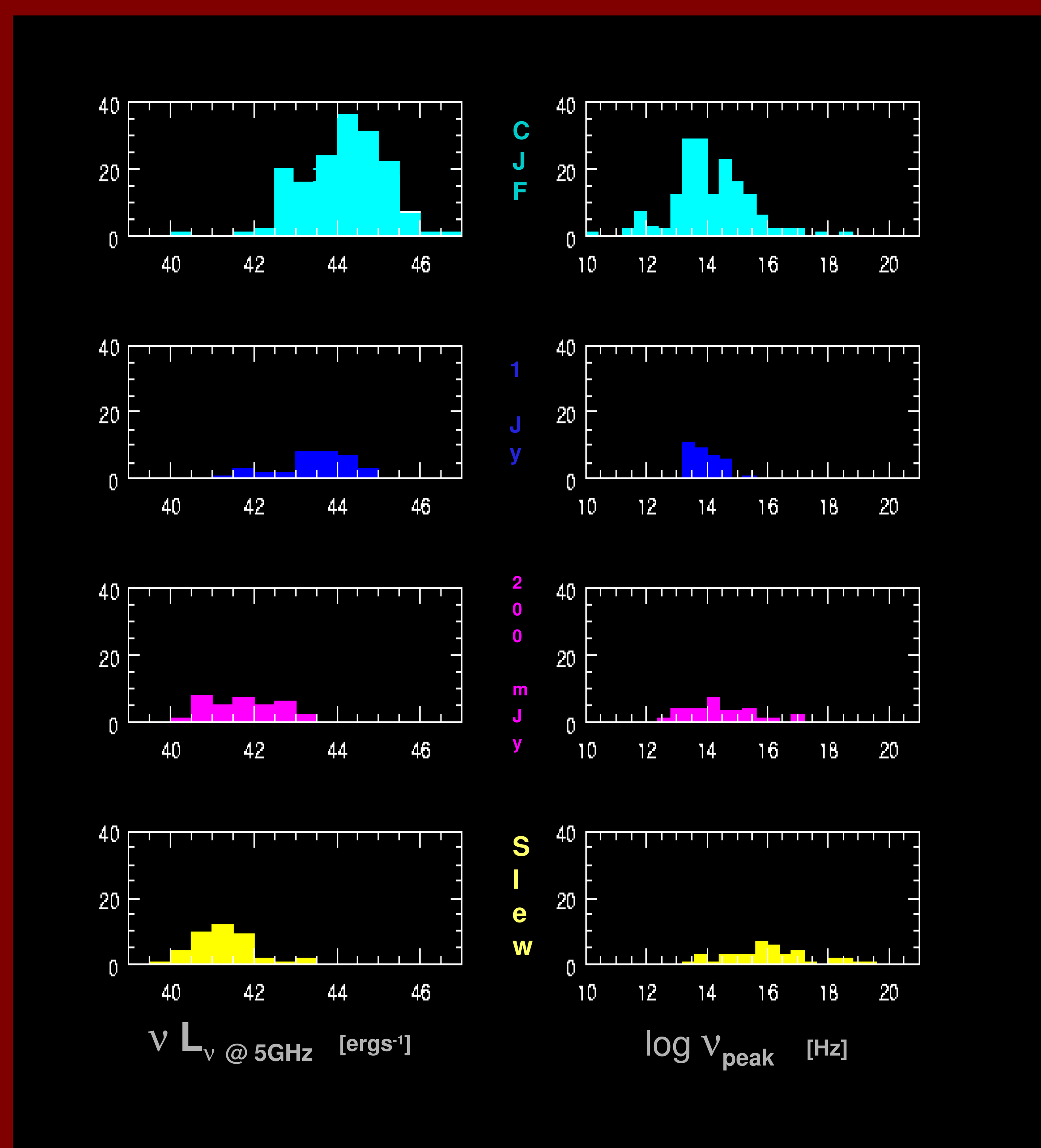

Figure 3 Luminosity (at 5GHz) and synchrotron peak distributions of, from the top to the bottom: CJF, 1-Jy, 200-mJy and Slew objects

C O N C L U S I O N S Both the identification of low frequency peaked low radio luminosity blazar-like objects, and the finding of a non-correlation between radio power and peak frequencies amongst radio-selected samples, do not confirm the nice theoretical bss model. Two selection effects may account for the apparent blazar spectral sequence: amongst low luminosity blazars only those that have high peak frequencies are easily recognised as blazars and the peak frequency distribution is correlated with the initial sample selection frequency. Why there is such a spread of peak frequencies amongst blazars is still an open question, and from the CJF sample SED analysis we expect to be able to establish some firm observational facts in the near future.

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e-mail : santon@fc.ul.pt

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