The ever elusive blazar host galaxies: a guide to their characterisation

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Blazars are a class of **Active Galactic Nuclei (AGN)**, galaxies with a central engine: a **Super-Massive Black Holes (SMBHs).** They are characterized by relativistic jets of particles that point toward our line of sight. They are **multi-wavelength** and **multi-messenger emitters**, and the typical **Spectral Energy Distribution (SED)** exhibits two humps: the first due to **Synchrotron** emission and the second probably caused by **Inverse Compton** scattering.

Blazars are typically divided into two subclasses: **Flat-Spectrum Radio Quasars (FSRQs)** and **BL Lacertae objects (BL Lacs)** (*Fig.1*).

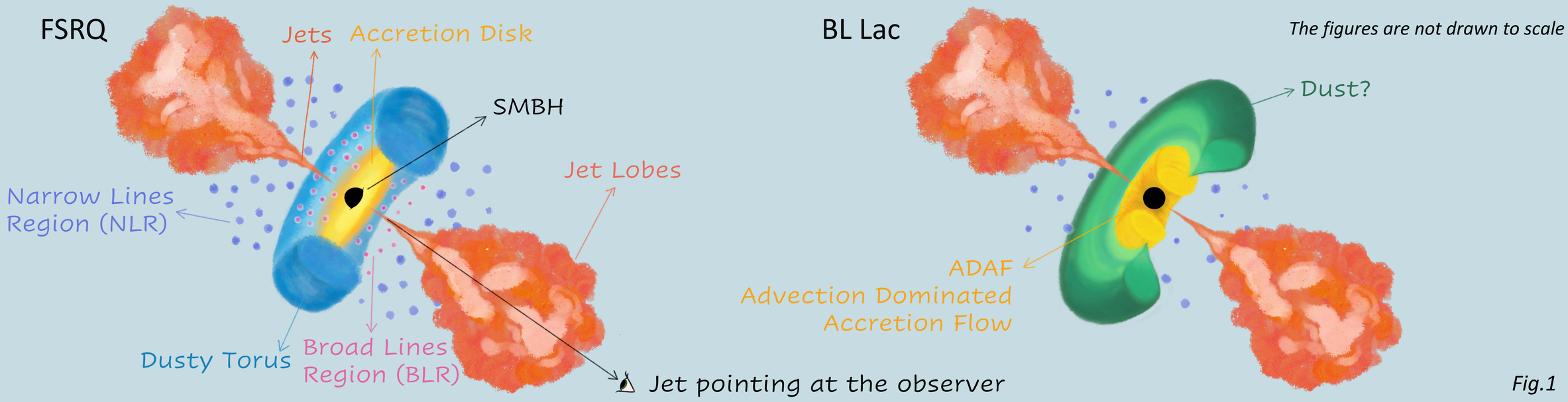


Fig.1

The absence of strong emission lines in BL Lac objects makes it impossible to estimate the black hole mass using line luminosity. As a result, the mass is instead inferred through the correlation with the host galaxy's luminosity, which is expected to change for different types of galaxies.

Can *only* massive elliptical galaxies host blazars?

BL Lacs UV-IR single epoch synthetic spectra decomposition analysis

Synthetic spectra

We combined phenomenological **BL LAC SEDs** of 5 different γ-ray luminosities [1], and 7 **host galaxy** templates from the Swire collection [2] (*Fig.2*), varying redshift in the range 0.05-1.2, and fixing the host absolute magnitude to $M_R = -22.9$ [3]. An example of synthetic spectra is shown in *Fig.3*.

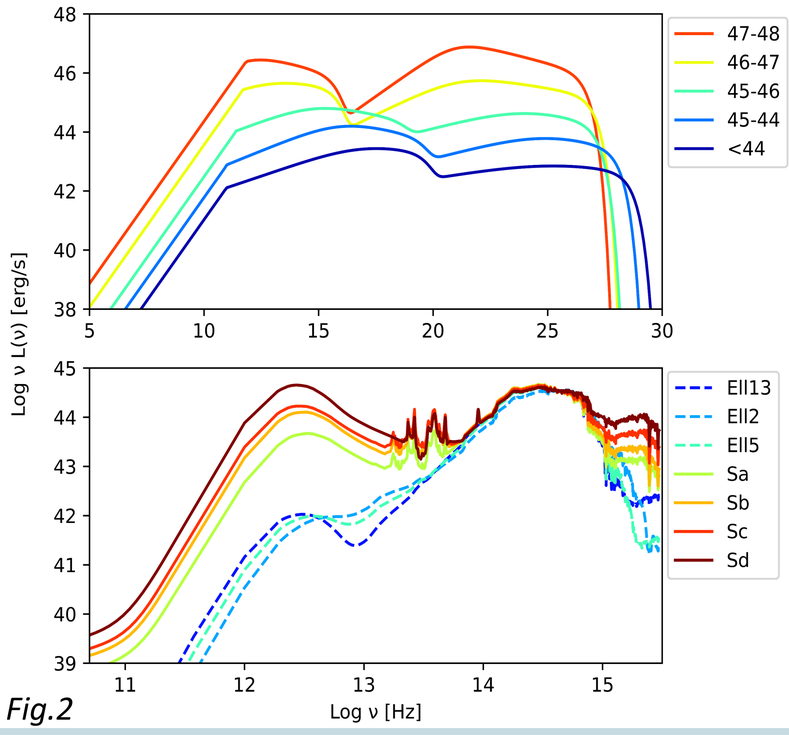


Fig.2

Synthetic spectrum example

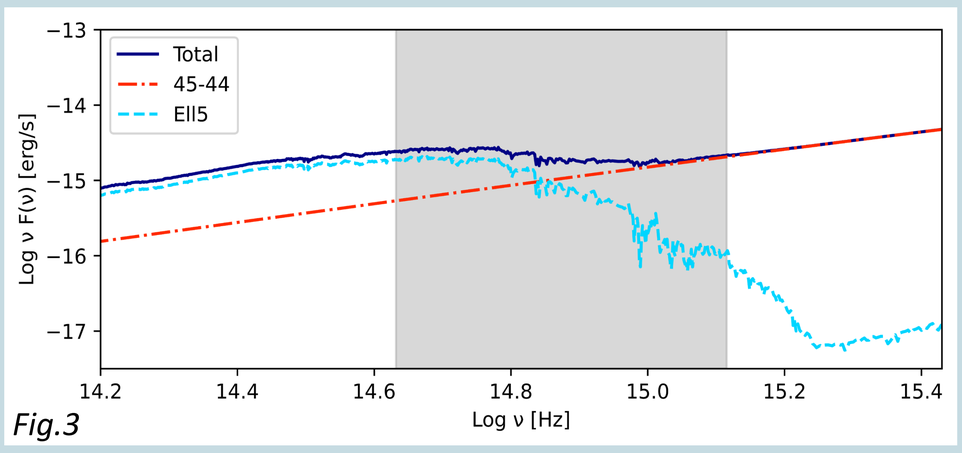
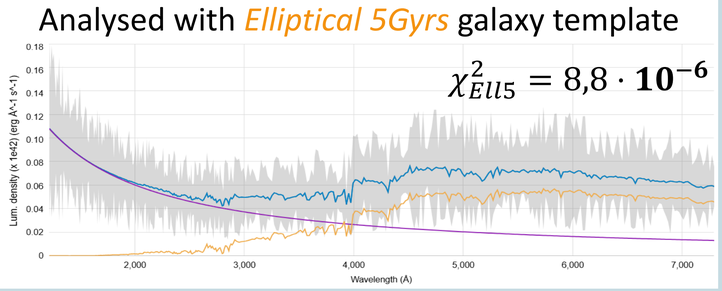


Fig.3

QSFit analysis

450 synthetic spectra were analysed using an adapted version of the **QSFit software** [4] with 2 galaxy template: Elliptical 5Gyrs and Spiral b spectra.
An example of QSFit analysis is shown on the left (*Fig.4*).
A comparison of the resulting statistics (χ^2) for all spectra is shown below (*Fig.5*).

Analysed with *Elliptical 5Gyrs* galaxy template



Analysed with *Spiral b* galaxy template

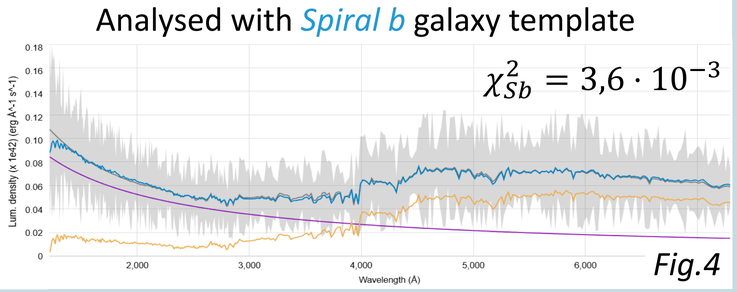


Fig.4

χ^2_{Sb} vs χ^2_{Ell5} plot and how to read it

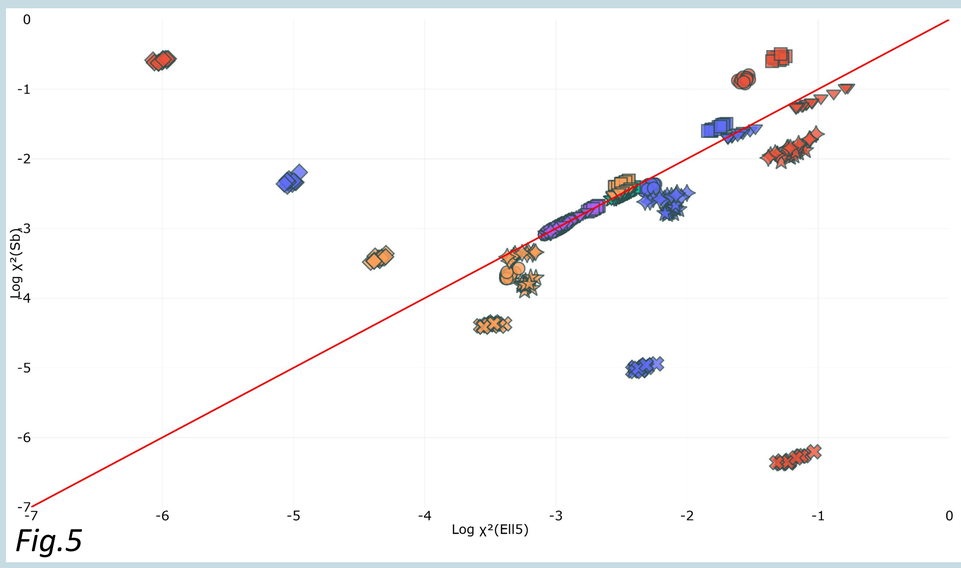
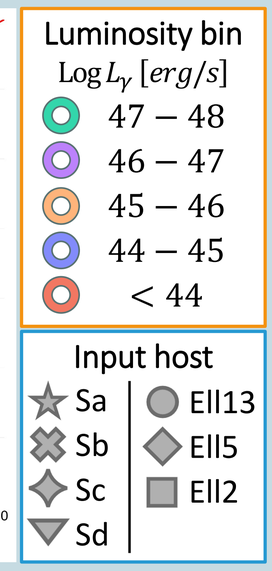
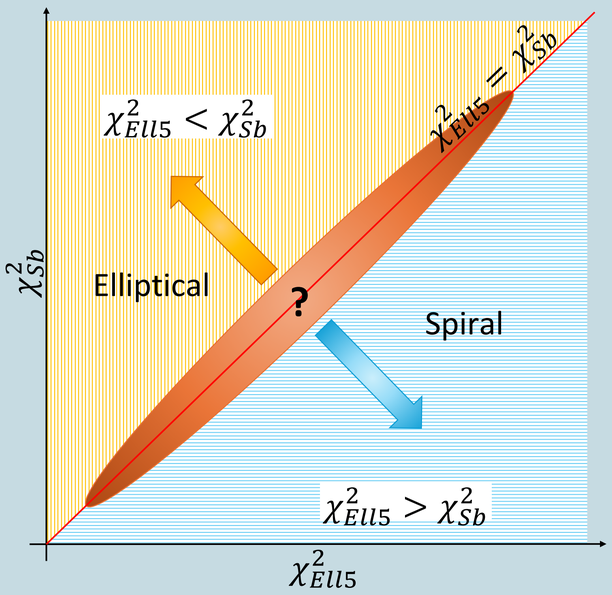
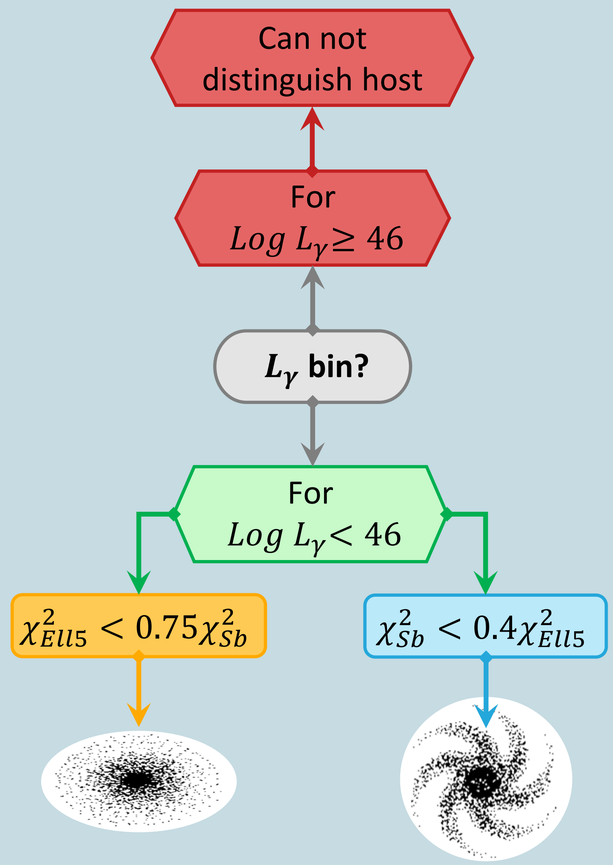


Fig.5







Using this method based on **UV-IR single epoch spectra**, for the first time we demonstrate that it is possible to systematically identify the host galaxies of BL Lacs under a limiting luminosity ($L_\gamma < 10^{46} erg/s$).

➡ This work could be applied to new-generation space telescopes, as **Euclid** and **JWST**.

REFERENCES: [1] *Ghisellini et al. (2017);* [2] *Polletta et al. (2007);* [3] *Sbarufatti et al. (2005);* [4] *Calderone et al. (2017)*