ABSTRACT. We present the aim and the status of the BLEIS project currently under development at SISSA. This project consists in selecting a complete Blazar sample from deep optical data, down to B=24.6, V=24.4 and I=23.7 (80% completeness). The optical images are taken from the ESO Imaging Survey (EIS - Wide), a public survey covering $\sim 16 \text{ deg}^2$ of the Southern Hemisphere. This new Blazar sample, thanks to the different energy band of the selection and to the faintness of EIS images, will be useful not only in understanding the physics of such objects, but also in evolutive and cosmological studies. It will also be a new test for the unified models of AGNs and will be helpful in making predictions for future deep surveys.

1. Introduction

The BLEIS (BLazars + EIS) project is a search for blazars from the faint optical images of the ESO Imaging Survey Wide (EIS Wide). The aim of the project is to select a complete sample to understand the physics and evolutive properties of blazar and to select interesting sources for VLT. This will be the first blazar sample selected from optical images and colors at such faint fluxes (B=24.6, V=24.4 and I=23.7, 80% completeness).

2. The EIS Wide

We used for our project the EIS Wide, a survey covering 4 regions of the southern sky for a total of $\sim 16 \text{ deg}^2$ in two/three colors. It was planned with the goal of generating a unique publicly available database for the ESO community to prepare the widest possible range of programs for the first two years of operation of VLT (e.g. Renzini & Da Costa 1997). Table 1 summarizes the positions and the sky coverage for each filter. EIS wide consists of a mosaic of overlapping EMMI-NTT frames (9 $\times$ 9 arcmin) with each position of the sky being sampled twice for a total integration time of 300 s (Da Costa et al. 1999).

3. Sources selection

We started our analysis from Patch B, being the region covered with all the 3 filters. We cross-correlated each EIS Patch B filter catalog with the NRAO VLA Sky Survey (NVSS, Condon et al. 1998) sources. The NVSS is a radio survey that covers the sky north of J2000 $\delta = -40^\circ$ (82% of the sky) at 1.4 GHz. The flux limit is $\sim 2.5 \text{ mJy}$ and the rms uncertainties in right ascension and declination vary from $\leq 1''$ for the sources brighter than 15 mJy to $\sim 7''$ at the survey limit. For a first preliminary cross-correlation we used a conservative radius of $10''$ and then performed a more accurate
cross-correlation using as radii both the 1σ and 2σ errors associated with the position of each radio source. We then excluded all the optical sources fainter than the catalogs 80% completeness limits and cut at two different radio fluxes: 2.5 mJy (the NVSS limit) and 5 mJy. We considered only the radio sources with a counterpart in all the 3 filters whose optical positions lie within 0.8′′ one from each other.

Cutting at 5 mJy, we find 5 radio sources with at least one optical counterpart within the 1σ uncertainty on the radio position and 15 within 2σ; at 2.5 mJy we have 22 sources within 1σ and we expect about 60 sources within 2σ. Hereafter we will focus on the 15 sources found within 2σ with a cut at 5mJy.

### Tab. 1 - EIS Wide sky coverage

| Name  | Center Position | Area Covered (deg²) |
|-------|-----------------|---------------------|
|       |                 | B       | V       | I       |
| Patch A | 22:43:03 -39:58:30 | –       | 1.2     | 3.2     |
| Patch B | 00:48:22 -29:31:48 | 1.5     | 1.5     | 1.6     |
| Patch C | 05:38:24 -23:51:54 | –       | –       | 6.0     |
| Patch D | 09:51:40 -21:00:00 | –       | –       | 6.0     |
| Total  |                 | 1.5     | 2.7     | 16.8    |

### 4. Optical classification

We used the classification based on optical colors presented in Zaggia et al. (1999) and found that ∼3 sources fall in the region occupied by the high redshift quasars (z > 3.5), 5 sources in the low redshift quasar region (z < 3) and 5 in an unclassified region. The colors of 3 of these 5 sources are compatible with those of BL Lacertae objects found by Moles et al. (1985).

### 5. α_{RO} distribution

By extrapolating the NVSS flux (assuming a flat slope to 5 GHz) and using the V magnitudes we calculated the α_{RO} distribution for our sources and compared it to various classes of sources. Figure 1 shows the BLEIS sources compared to, from top to bottom:

- the X-ray selected BL Lacertae objects of the *Einstein* slew survey (Elvis et al. 1992);
- the radio selected BL Lacs of the 1Jy sample (Stickel, Meisenheimer & Kuhr, 1994);
- the radio galaxies of the 3CR sample, whose flux was extrapolated to 5GHz assuming an average slope for the radio spectrum of α = 0.7;
- the FSRQ sample selected by Padovani & Urry (1992) from the ‘2Jy sample’ of Wall & Peacock (1985).

As shown in Figure 1, the BLEIS sources properties are compatible with those of radio selected BL Lacs and FSRQ.
6. Future work

We plan to extend the analysis to the other patches: Patch A has V and I data only and there is no NVSS for it, but it will soon be covered by the Sydney University Molonglo Sky Survey (SUMSS, e.g. Hunstead et al 1998) planned to have the same positional uncertainty and flux limit of the NVSS. Patches C and D have I band images only and NVSS data. We will ask VLA time to obtain good positions (∼ 1") and faint flux limits (∼ 1 mJy) and two estimate of the radio flux at different wavelengths to be able to select in a confident way fainter sources and have a slope for their radio spectra. We will also apply for VLA time for a spectroscopic identification of the interesting sources and a possible estimate of their redshift. This would enable us to estimate a luminosity function, a redshift distribution and compare the results with the predictions of the unified models. The immediate goal is to determine the counts of blazars at low fluxes and compare them with the predictions of evolutive and beaming models.

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