AGN Sample in the VIMOS-VLT Deep Survey

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+VVDS-team

- Gavignaud I, Bongiorno A., Paltani S., Mathez G, Zamorani G. et al., A&A accepted
- Bongiorno A., Zamorani G., Gavignaud I., Marano B., Paltani S. et al., to be submitted
The VIMOS VLT Deep Survey: 1st epoch data

**DEEP Sample:**
- $17.5 < I_{AB} < 24.0$
- 2 fields

- 0226-04
  - ~0.7 deg$^2$
  - 9600 spectra

- CDFS
  - ~0.15 deg$^2$
  - 1700 spectra

**WIDE Sample:**
- $17.5 < I_{AB} < 22.5$
- 4 fields
- each 2x2 deg$^2$

- 1003+01
  - ~0.33 deg$^2$
  - 2100 spectra

- 2217-00
  - ~0.8 deg$^2$
  - 5700 spectra

Today, coverage of 02h & 22h fields
The VVDS type -1 AGN Sample: Selection

- Pure magnitude limited sample $I_{AB}$ band
- Free of morphological or colour selection biases

130 BLAGN

Optically selected ONLY on the basis of their SPECTRA:
    - At least ONE broad line

Wide sub-sample $\rightarrow$ 56 AGN
($I_{AB} \leq 22.5$)

Deep sub-sample $\rightarrow$ 74 AGN
($I_{AB} \leq 24.0$)

$\sim$ 700 AGN
Expected at the end of the survey
Redshift degeneracy

Spectroscopic follow-up (3500-6500Å)
Observation Nov 2005 FORS1 VLT
Incompleteness function

1. Treatment of non-targeted BLAGN:

\[ W^{TSR} = \frac{1}{TSR} \]

**TSR (target sampling rate):** fraction of objects in the photometric catalog inside our targeted area which have been spectroscopically observed

2. Treatment of misclassified BLAGN:

\[ W^{SSR} = \frac{1}{SSR} \]

**SSR (spectroscopic success rate):** probability of a spectroscopically targeted AGN to be securely identified. \( F(z,m,SED) \)
Counts

\[
N(\leq I_{AB}) = \frac{1}{A} \sum_{i,I_{AB},i \leq I_{AB}} W_i^{TSR} W_i^{SSR}
\]
Standard pre-selection methods

Morphological analysis:
\[ I_{\text{AB}} < 22.5 \]
\[ 3.5\sigma \]
\[ \begin{align*}
77\% & \text{ point-like} \\
23\% & \text{ extended}
\end{align*} \]

Stars (f>2) 18.5<I_{\text{AB}}<22.5 \rightarrow 95\% \text{ point-like}

16/19 extended \rightarrow z<1.6
42\% \ z<1.6 \rightarrow \text{ extended}

Color analysis:
\[ z<2.3 \]
\[ 24\% \text{ excluded} \]
\[ I<22.5 \quad 27\% \text{ excluded} \]

Morphology+color selection
applied to our sample (faint) \rightarrow z<2.3
35\% \text{ excluded}
The contamination of the host galaxy is reddening the colors of faint AGN.
BLAGN are intrinsically redder when they are faint.
The reddest colors are due to presence of dust.
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BLAGN are intrinsically redder when they are faint

The reddest colors are due to presence of dust
Luminosity function

Coherent sample (Avni e Bachall 1980)

\[ \Omega_{\text{tot}} = \Omega_{\text{deep}} + \Omega_{\text{wide}} \text{ for } I_{AB} \leq 22.5 \]

\[ \Omega_{\text{tot}} = \Omega_{\text{deep}} \text{ for } I_{AB} \leq 24.0 \]

Absolute magnitude

\[ M = m_{\text{obs}} - 5 \log_{10}(dl(z)) - 25 - K \]

\( m_{\text{obs}} \), for each object, is chosen in the band which is sampling the rest-wavelength closer to the band in which we compute the LF

Luminosity function:

\[ \frac{1}{V_{\text{max}}} \text{ estimator} \quad (Schmidt, 1968) \]

\[ \phi(M) = \frac{1}{\Delta M} \sum_{M - \Delta M / 2}^{M + \Delta M / 2} \frac{w_i^{\text{TSR}}}{V_{\text{max},i}} \frac{w_i^{\text{SSR}}}{V_{\text{max},i}} \]
Low redshift luminosity function

Double Power Law

$$\phi(M,z) = \frac{\phi(M^*)}{10^{0.4(\alpha+1)(M-M^*)}} + 10^{0.4(\beta+1)(M-M^*)}$$

Pure Luminosity evolution

$$M^*(z) = M^*(0) - 2.5(k_1z + k_2z^2)$$
High redshift luminosity function

- VVDS 2.0 < z < 3.6
- Hunt et al. z = 3
- COMBO-17 2.4 < z < 3.6
- Warren et al. 2.2 < z < 3.5
- SDSS 3.6 < z < 3.9

\[ \Phi(M_{1450}) \propto (\text{erg s}^{-1} \text{Mpc}^{-3} \text{mag}^{-1}) \]

\[ R_p = 54 \text{ km s}^{-1} \text{ Mpc}^{-1} \]

\[ R_p = 1.0 \pm 0.2 \]

\[ N = 32 \]

\[ N = 42 \]

Absrute Magnitude \( M_{1450} \)
Comparison with results from X-ray surveys

Black dots: our data
Open circles: 2dF data
Red squares: X data
(Barger et al. 2005)
Luminosity function fit: maximum likelihood

\[ \phi(M, z) = \frac{\phi(M^*)}{10^{0.4(\alpha+1)(M-M^*)} + 10^{0.4(\beta+1)(M-M^*)}} \]

\[ M^*(z) = M^*(0) - 2.5(k_1z + k_2z^2) \]

\[ \phi^*(z) = \phi^*(0) \cdot 10^{(k_3z + k_4z^2)} \]

FAINT END SLOPE

2dF-Croom (2004) \( \beta = -1.58 \)
(2dF-Boyle 2001) \( \beta = -1.09 \)
VVDS-PLE \( \beta = -1.30 \)
VVDS-PLE+PDE \( \beta = -1.24 \)
2SLAQ-Richards(2005) \( \beta = -1.45 \)
Summary

✓ VVDS-AGN Sample: 130 type-1 AGN (~700 at the end of the survey)
✓ Free of morphological or colour selection biases
✓ Surface Density $I_{AB}<24$ N=470±65 BLAGN deg$^{-2}$
✓ Applying a morphological and colour analysis to our AGN sample:
  • 23% $I<22.5$ extended
  • 35% $I<22.5$ $z<2.3$ missed

✓ Composite spectrum: continuum shape much redder at $\lambda>3000$ Å
✓ Host galaxy contamination as expected from the faint absolute magnitudes sampled by our survey
✓ Low redshift LF: consistent with a PLE model, but with an excess in the faint part of the first redshift bin
✓ High redshift LF: good agreement with previous data
✓ X-ray LF comparison: good agreement
✓ Data fit: PLE (+PDE)