HSC-AGN survey: Synergy with Radio surveys

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Abstract

Today, The importance of searching high-z radio-loud objects are well recognized, but there are only small number of known distant radio-loud objects to date. The combination of some wide-field radio surveys with newly obtained HSC wide-layer dataset will solve this problem and provide a new sample of distant radio-loud populations. In this poster, we (SWANS: Subaru Wide field AGN Survey) report current status of out study and future works.

1.Introduction

☞ Radio-loud quasars (RLQs) and radio galaxies are unique probes to explore **the structure formation and galaxy evolution in the early Universe.**

☆RLQ: radio-mode feedback affects the star-formation around them.

☆Radio galaxies harbor an enhanced number of associated galaxies

☞At higher redshift (z > 3), however, there are few known RLQs and radio galaxies. They are much brighter ($L_{bol} \sim 10^{48}$(erg/s)) than local sources.

☞Combining the depth and the large area of HSC-wide survey with previous Radio surveys (e.g. FIRST: Faint Images of the Radio Sky at 20cm, NVSS: NRAO VLA Sky Survey, ATC: Atakama Cosmological Survey, and so on), we could find

★radio loud objects at high redshift (z > 3)

★radio-loud and opticaly-faint objects

★radio loud objects and their environment at intermediate redshift (z~1)

2. Data

★Optical Surveys: SDSS DR7

★ Radio Surveys:

FIRST(Faint Images of the Radio Sky at 20 Centimeters, Becker+95).

We chose this survey for the following reasons:

I. covering the entire field of the HSC-wide survey

II. their all images and properties are published

III. largest and deepest survey at 20cm (= 1.4GHz)

and the main reason is:

~60% of the SDSS counterparts are **non-detected** (e.g., Ivezic+02)!

3. How far can FIRST and HSC-wide survey detect?

✓ At each redshift, we computed detection limits of RLQs for optical survey, using composite SED of local RLQs from Shang+11. Table 1 and figure 1 shows the results (note: no extinction applied).

✓Combining FIRST and HSC-wide survey, radio-loud and optically faint (non-SDSS) RLQs can be detected.

✓According to Ivezic+11, non-SDSS FIRST sources are probably too optically faint (r > 22), but their radio properties are same as SDSS FIRST sources.

✓With HSC-wide survey, the low luminosity end of luminosity function of RLQs are

z	FIRST	HSC	SDSS
4.0	44.5	44.0	46.0
5.0	45.0	44.5	46.0
6.0	45.0	44.5	46.5
7.0	45.0	45.0	46.5

Table 1: Luminosity ($\log[\lambda L_{3000A}]$) limit of radio and optical surveys for RLQs at each redshift.

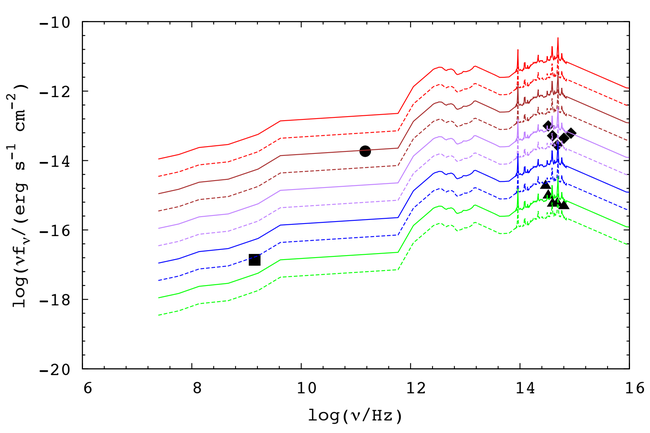

Figure 1: Composite SED of RLQs at z = 4.00 scaled with $\log[\lambda L_{3000A}]$ = 44, 45, 46, 47, 48 (solid line, from bottom to top), and 43.5, 44.5, 45.5, 46.5, 47.5 (dashed lines).
black point: the detection limit of HSC-wide (square), SDSS (triangle), FIRST (cross), and ACT (circle).

4. Radio to optical ratio

✓Radio to optical flux ratio ($Ri = \log[f_{1.4GHz}/f_{opt}]$) is used to separates radio-loud (Ri > 1) and radio-quiet (Ri < 1) objects.

✓The distribution of Ri of SDSS-detected FIRST sources shows a local maximam at Ri ~ 3 (Ivezic+02, figure 2).

✓For non-SDSS FIRST source (Waddington+00, 22 < r < 26), we computed Ri and discovered the median of Ri (~3.5) is somewhat larger than that of SDSS-detected sources (Figure 3).

✓Observing non-SDSS FIRST source with HSC-wide survey, we could find many Radio-loud objects (Ri > 3.0).

✓**Extremely radio-loud objects (Ri > 5.0) might exist!**

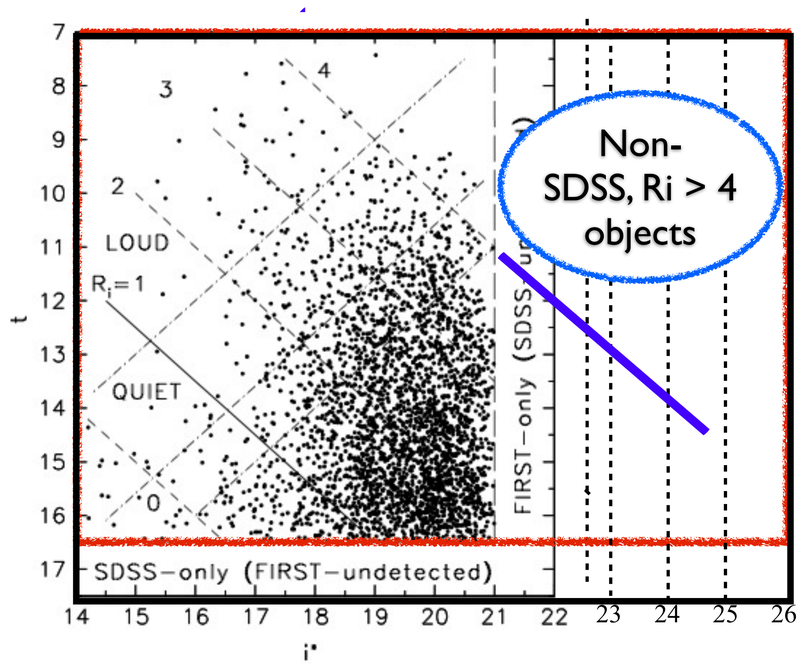

Figure 2: The t (radio magnitude, $-2.5\log[F_{FIRST}/3631Jy]$) vs. i* (optical magnitude) distribution of the SDSS-FIRST sources (Ivezic+02).

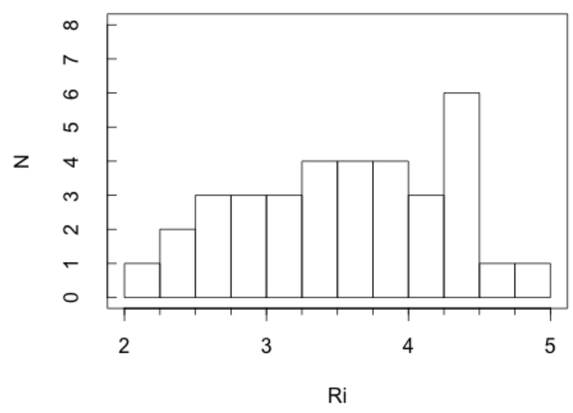

Figure 3: Ri distribution of the nonSDSS-FIRST sources (Waddington+00).

Summary & Future Works!

- We reviewed the Synergy of HSC-wide survey with FIRST survey
- ~60% of FIRST sources are non SDSS detected.
  - => ★too optically faint source?
  - => ★thier SEDs are not same as local RLQs? (not discussed yet.)
- Observing non-SDSS FIRST source, we can find ***more radio-loud objects than SDSS-FIRST sources.***
- **The environments around intermediate radio-loud objects** can be studied with HSC-wide phot-z data (not discussed yet.)
- (Especially for ph-D students)
  - If you are interested in these subjects, please join us.