The AGN Component in Deep Radio Fields

the First Look Survey

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I – Modeling the sub-mJy sources

EXCESS @ S<1 mJy

Classical RL-AGNs ➔ PLE
  ➔steep/flat *(e.g. Dunlop & Peacock 80)*
  ➔FRI/FRII *(e.g. Willott+ 01,*
   Clewley & Jarvis 04, Sadler+ 06)

SF gals. ➔ PLE
  ➔ local F(L) + L ~ (1+z)^p p~3
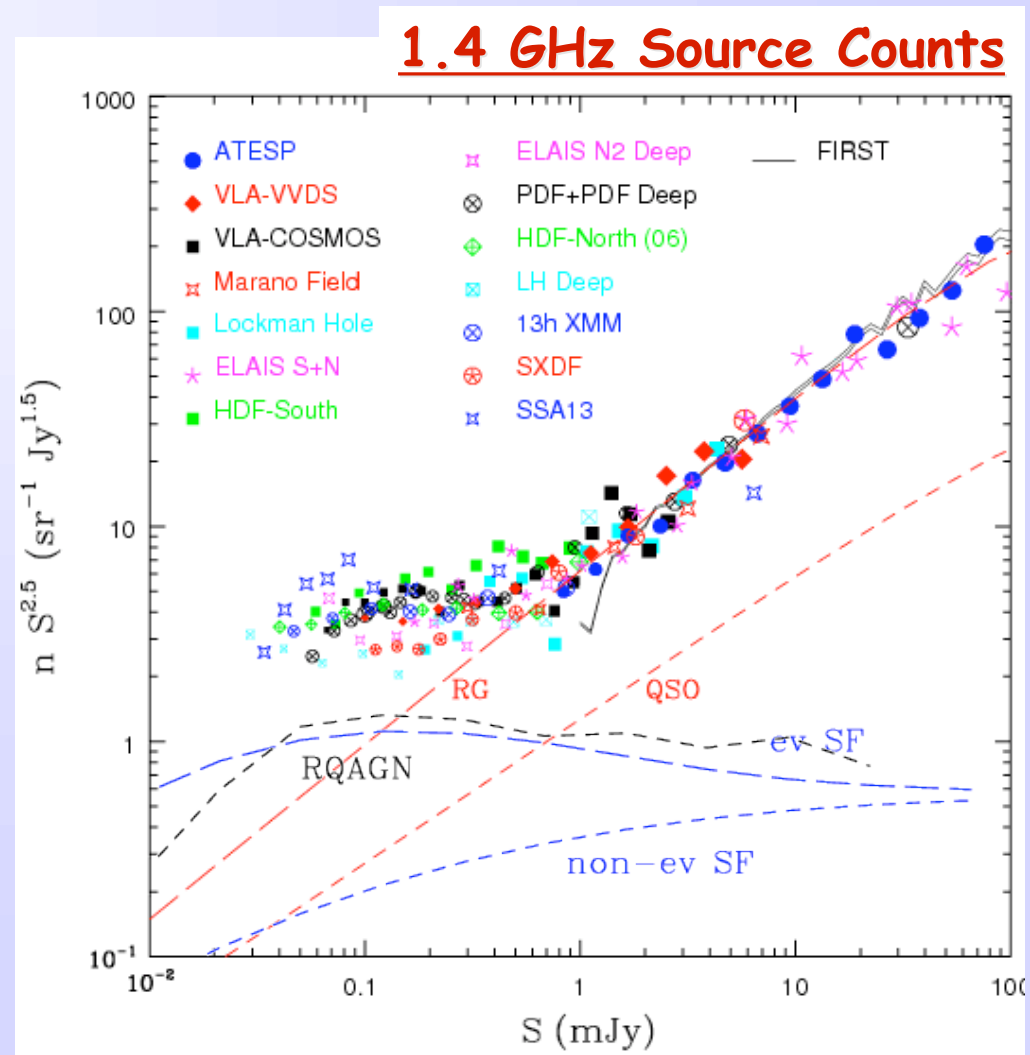
  (*e.g. Condon 89, Saunders+ 90,*
  Machalski & Godlowski 00, Yun+ 01,
  Sadler+ 02)

RQ-AGN: (*Jarvis & Rawlings 04*)

➔LDDE [largest comp. at z<1

 RS ➔compact & steep (<<10 kpc)
    22< logP <24

host galaxy ➔ (em. line spectrum)

1.4 GHz Source Counts

I – SCIENCE DRIVERS

- **SFGs → SF History (z>2)** (Dust-enshrouded obj)

- **AGNs → BH Accretion History**   (Type II AGNs)
  - low/high accr. rates → FRI vs. RQQ   [Radio vs.QSO mode]
  - RQ/RL dichotomy   A   G   N
                                            feedback
  - Ev. Of LLAGNs: Downsizing? LLAGNs peak at lower z?
        [NB: as recently found for opt/X-ray AGNs]

- **Connection between SFH & MBH accretion**

II – The AGN component @ S< 1mJy

ATESP-DEEP1 Sample:115 RS with S>0.4 mJy in 1 sq. degr.

Radio Power Distribution: (DEEP1abc)

·ETS →10^{23-25} W Hz^{-1}

Low-intermediate power AGNs

·QSO → P < 10^{25-26} WHz^{-1}

RI-QSOs   [RQ-QSOs: 22<logP<24]

·LTS → 2/3 P < 10^{24} W Hz^{-1}

Star-forming gals

64 %

14 %

19 %
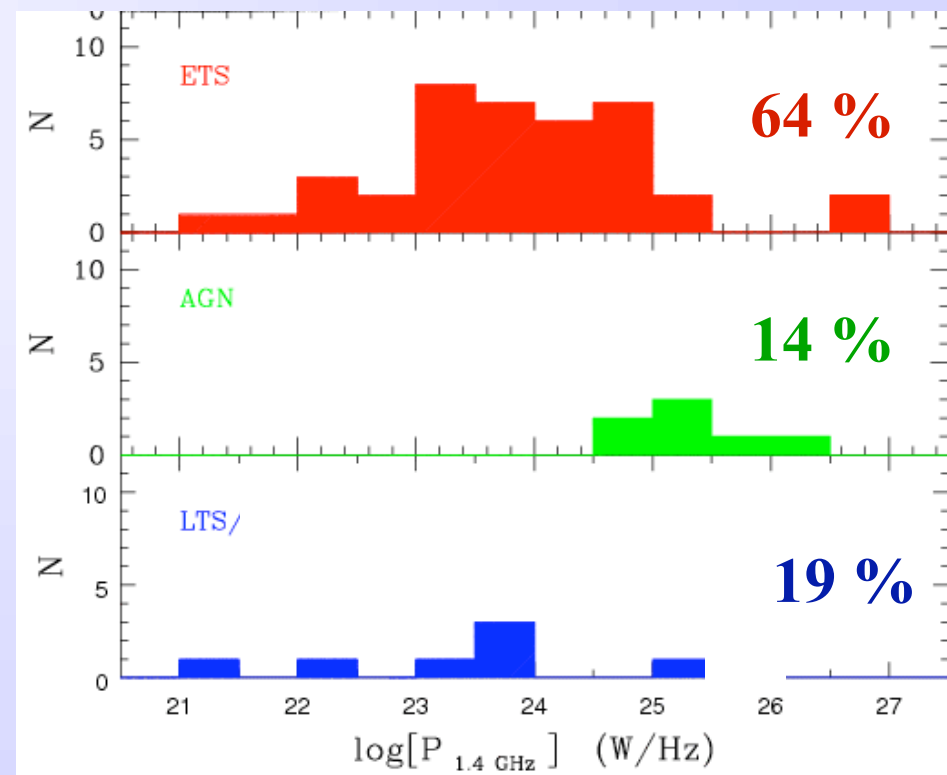
(Mignano,IP+ 08)

→Sample largely dominated (78%) by AGN activity

→AGNs: mostly associated to abs. systems (FRI-like)
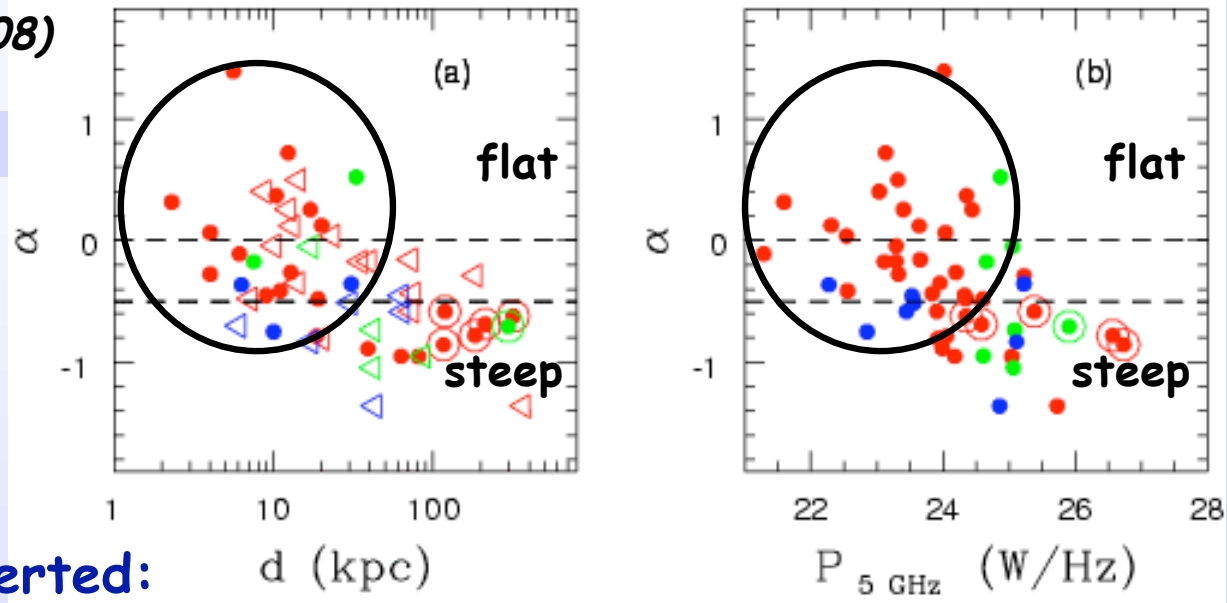
II – Flat spectrum ETS

(Mignano, IP+ 08)

- AGN   • ETS   •LTS/SB

◁ **Upper limits**

⊙ **Double/Extended RS**

In **DEEP1abc:**

24/39 ETS are flat/inverted:

- $P_{5\ GHz} \sim 10^{22-24}$ W Hz^{-1} (+ ETS spectra)

- Typically compact (<10-20 kpc) (+ flat) ➔

- ADAF-ADAF+jet systems? (local LLAGNs)

eg. Falcke & Biermann 99

- Obscured flat-spectrum RQ-AGNs ?

FRI larger & steep
core-dominated FRI?
[base-jet emission]

III – AGN Component in FLS

First Look Survey (FLS)

[area ~ 4 sq. degr.]

Multi-band information:
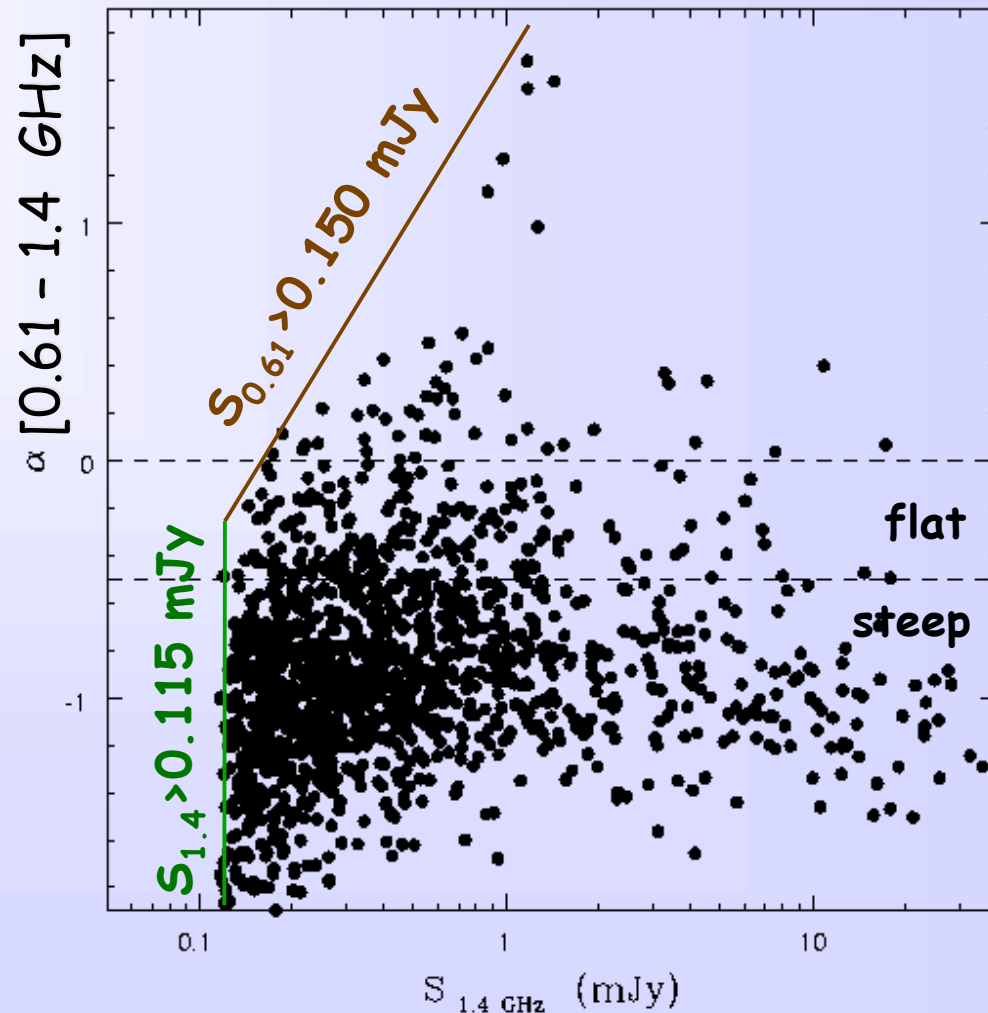
- 1.4 GHz → VLA/WSRT
- 0.61 GHz → GMRT
- 3.6, 4.5, 5.8, 8, 24, 70, 160 μm
        → Spitzer IRAC/MIPS
- opt. spectra → MMT Hectospec

→ Spectral index α(0.61-1.4)

→ MIR-Radio correlation

→ MIR Color-Color plot

→ Redshifts & Spectral types

Prandoni, Morganti+ in prep

III – AGN Component in FLS
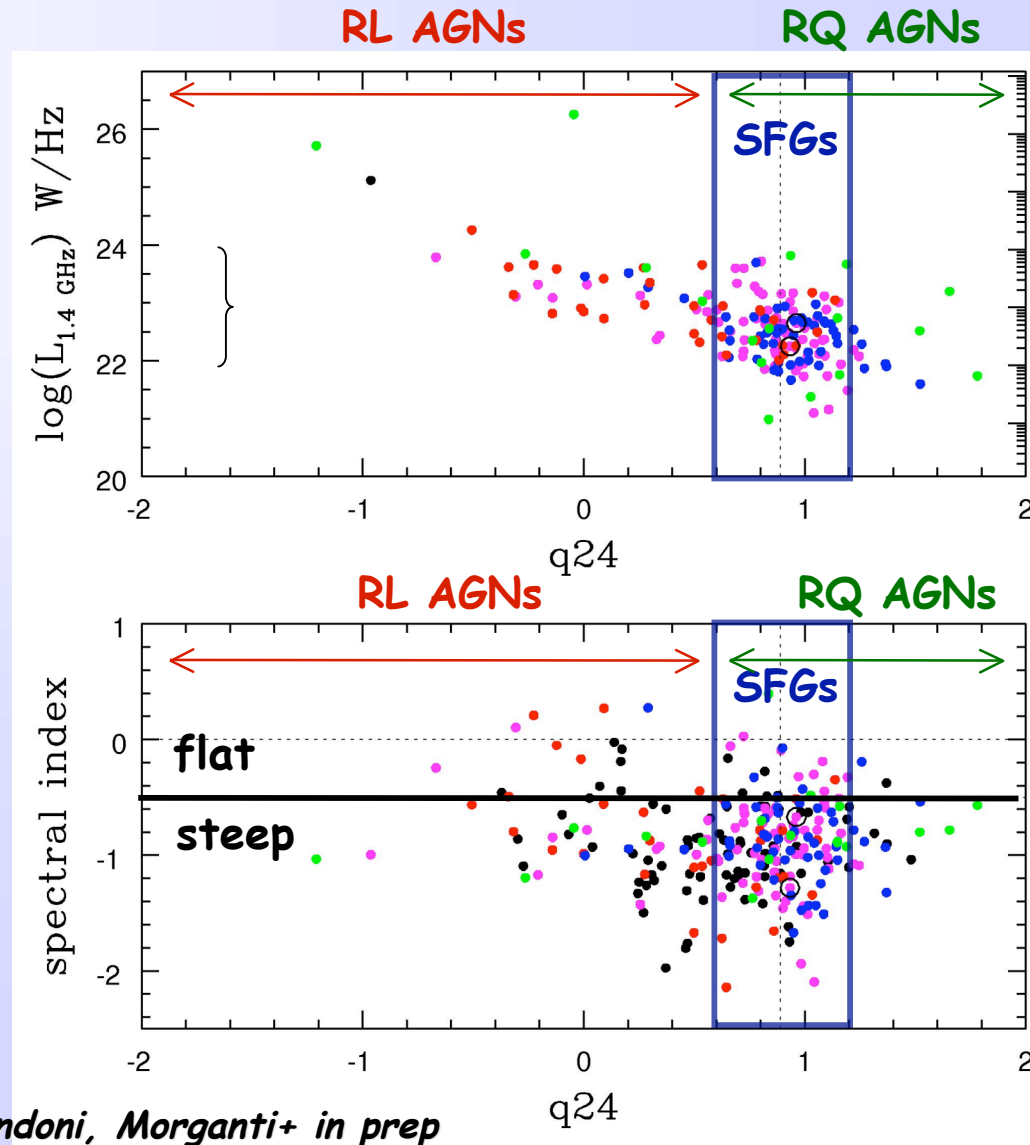
→**MIR-Radio correlation:**

q24=log(S24/S1.4)=0.83±0.31
for SFGs   (Marleau+07)

At $S_{1.4}$ >0.115 mJy
➔ **Composite Population of**
RL-AGN & RQ-AGN

optical spectral type:

•**Early Type (ETS)**

• Sy 1 & Sy2 (AGN)

•Star Forming (SFG)

• Narrow lines

•Unclassified

Prandoni, Morganti+ in prep

III – AGN Component in FLS

→**IRAC Color-Color diagram:**
$S_{8.0}/S_{4.5}$ vs. $S_{5.8}/S_{3.6}$

SFGs + RQ AGNs

Sources with q_{24} >0.6:
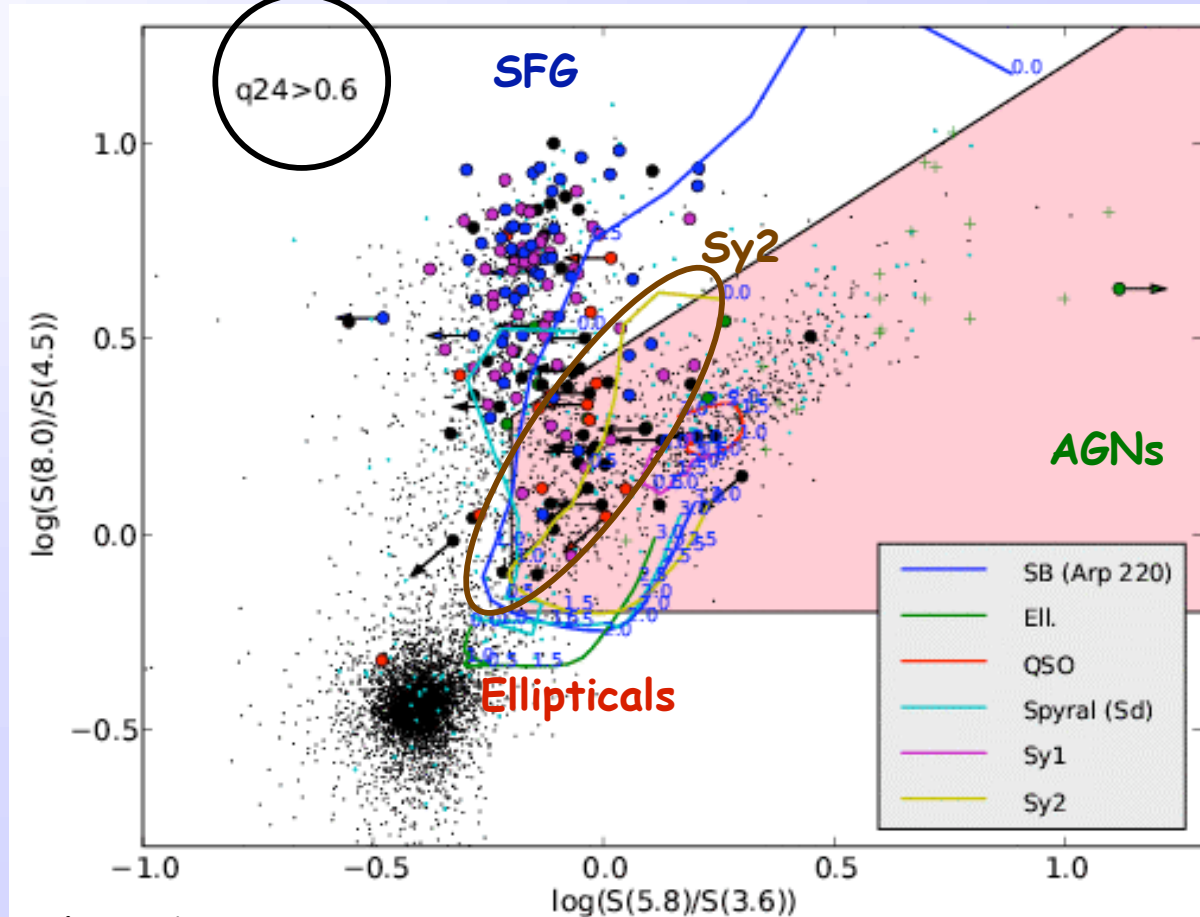➔**Mostly have MIR colors typical of SFGs**

➔ **Some have MIR colors typical of AGNs**

➔ **Genuine RQ-AGN!**

optical spectral type:
- •Early Type (ETS)
- • Sy 1 & Sy2 (AGN)
- •Star Forming (SFG)
- • Narrow lines
- •Unclassified

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III – AGN Component in FLS

→ **IRAC Color-Color diagram:**

$S_{8.0}/S_{4.5}$ vs. $S_{5.8}/S_{3.6}$

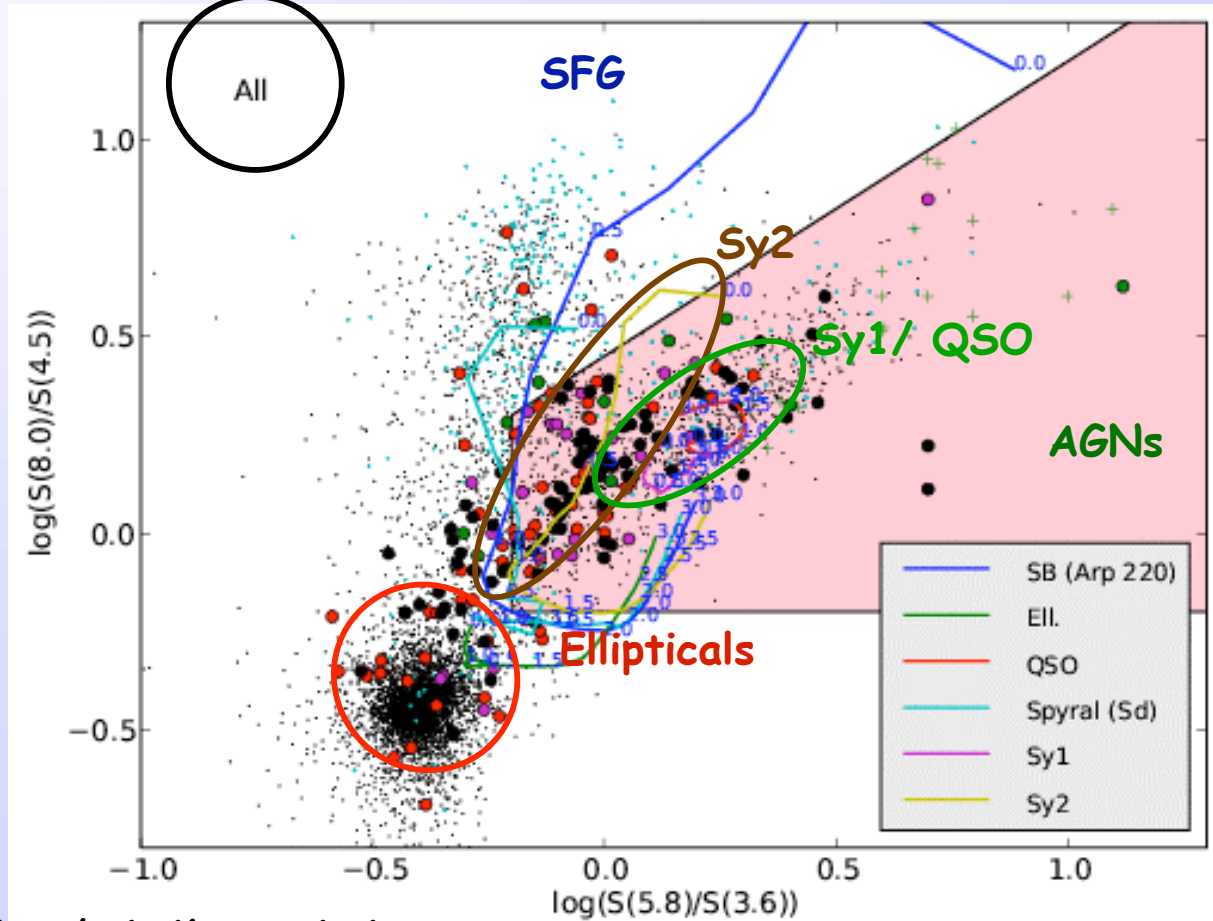**MIR properties of AGNs**

- **RQ-AGNs:**
  - ➔ Mostly Sy2
- **RL-AGNs:**
  - ➔ Sy2, Sy1, QSO
  - + Ellipticals (FRI-like)

optical spectral type:

- **Early Type (ETS)**
- Sy 1 & Sy2 (AGN)
- **Star Forming (SFG)**
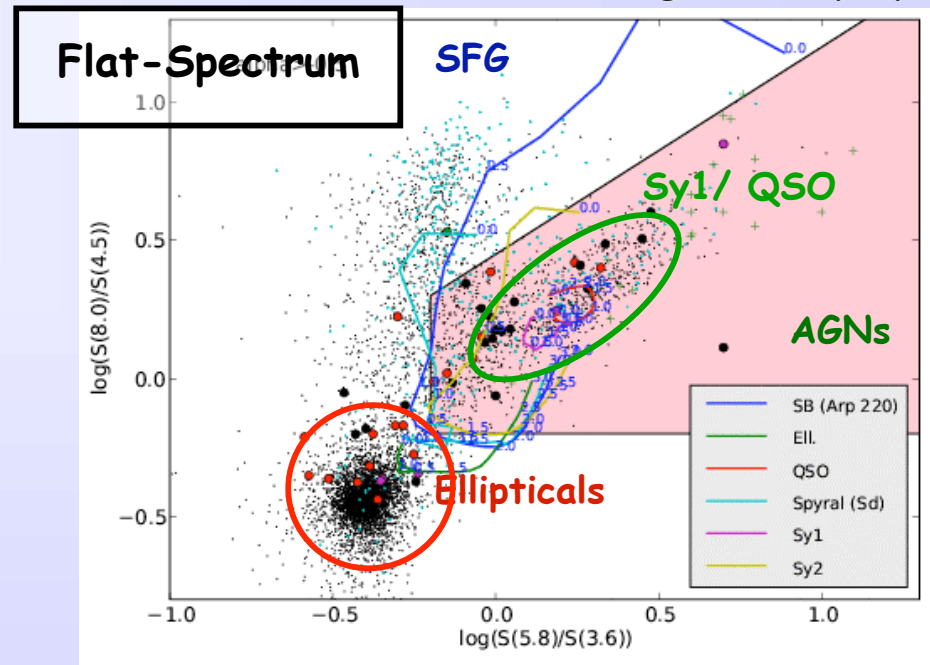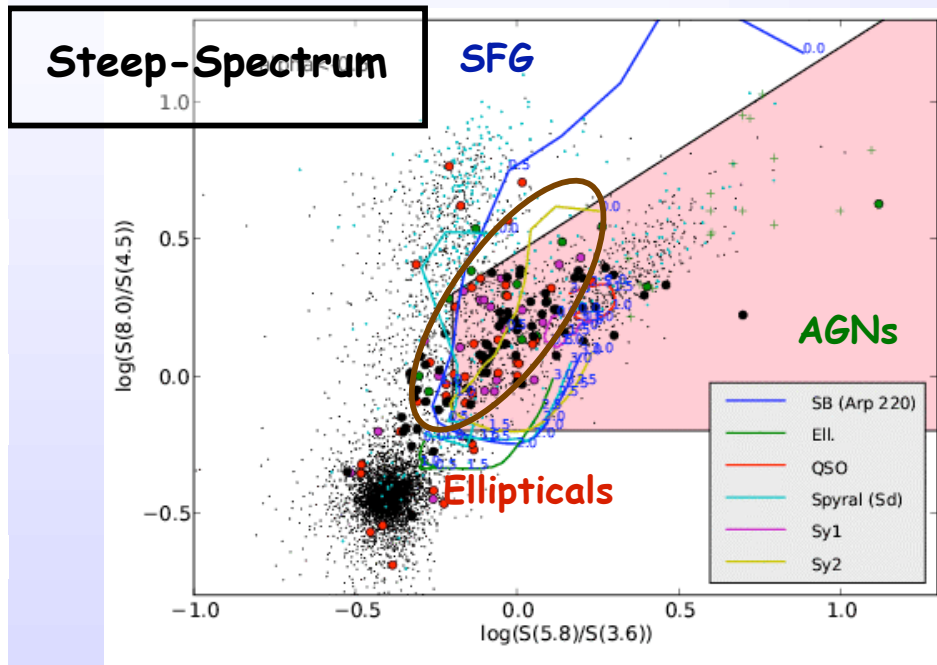- **Narrow lines**
- **Unclassified**

RL AGNs + RQ AGNs

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III – AGN Component in FLS

→**IRAC Color-Color diagram:** $S_{8.0}/S_{4.5}$ vs. $S_{5.8}/S_{3.6}$

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• **Steep-spectrum:**
  Mostly Sy2 plus Sy1, QSO

• **Flat-spectrum:**
  Mostly Sy1, QSO plus Ell.

➔ **We find again a class of flat-spectrum AGNs associated to ellipticals!**

Conclusions

1) Probing the RQ-AGN component

➢ At $S_{1.4}$>0.4 (ATESP) no evidence of RQ-AGN component

➢ At $S_{1.4}$>0.1 (FLS) 44% of AGNs are RQ

RQ-AGN obs. Properties:

- steep radio spectra;
- Sy2 opt. spectra/MIR colors

→ Agreement with AGN Unification

→ radiatively efficient systems

2) A new class of compact flat spectrum ETS found in both samples

➢ ATESP: (base-)Jet/Jet+ADAF scheme most plausible

➢ FLS: no obscuring torus and/or RIAF

3) Multi-λ info is very important

→ Jet-driven kinetic feedback

→ radiatively inefficient systems