Dissecting the first radio galaxies with the E-ELT

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Shaping E-ELT Science and Instrumentation · 2013 February 28

Outline

1) The first galaxies: not only SF

2) The radio view of the highest-z Universe

3) The currently "unknown" radio panorama

4) Upcoming ventures on Deep Radio Probes of the Universe

5) Requirements for a MOS on the E-ELT

Where are the first Active Galactic Nuclei?

- Considerable number of faint optical AGN at high-z (Siana+, 08, Glikman+, 11) - AGN contribution to Re-ionization unknown.

- Considerable number of strong AGN at the highest z's.
E.g. X-ray selected AGN:

(Silverman+, 05)
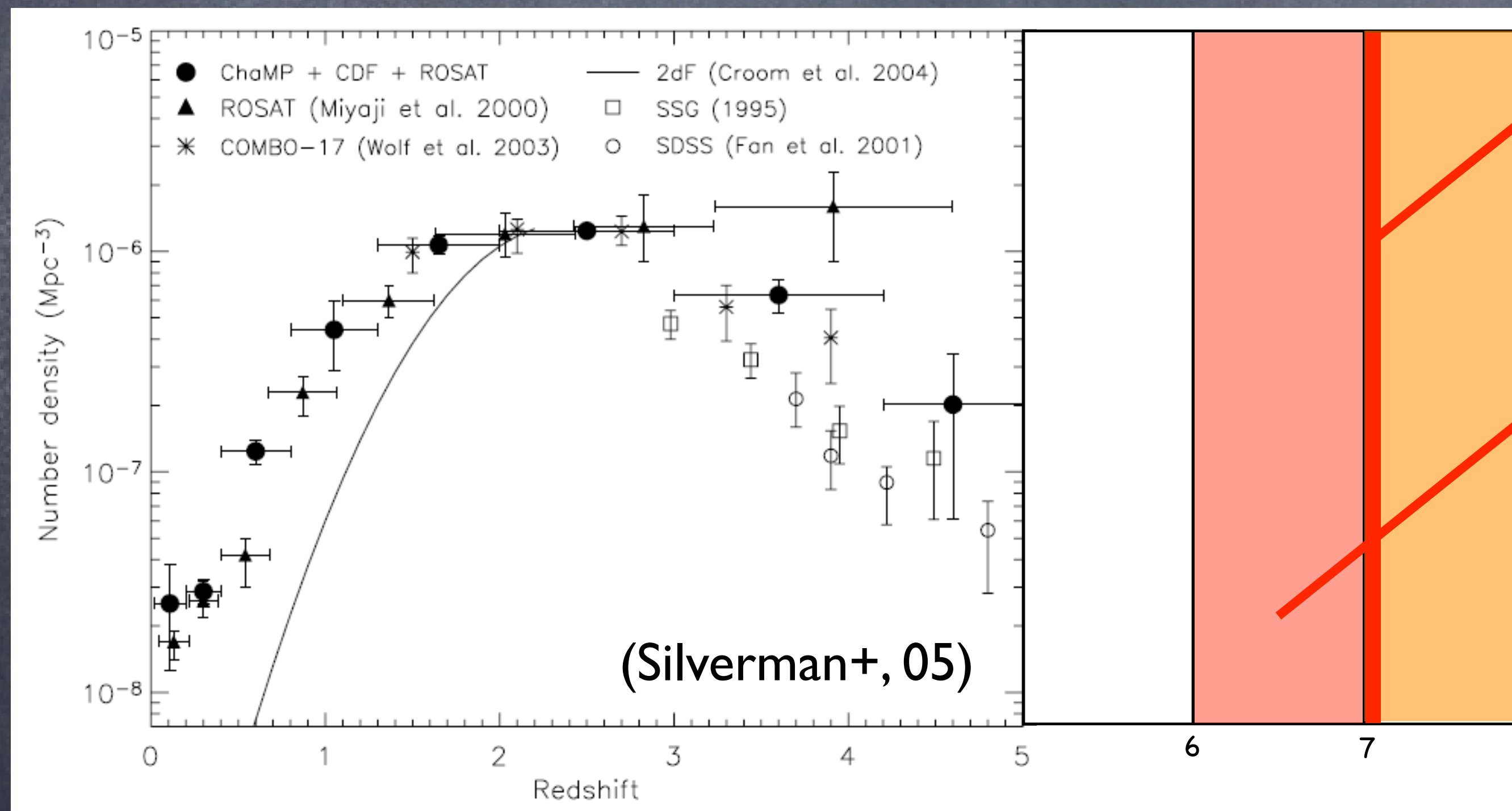
UKIDSS
z=7.09(Mortlock+, 11)

>30 quasars (Fan+, 12)

10^8-10^9 $M_\odot$ SMBHs in 10^{13} $M_\odot$ Dark Matter Haloes.

Likely exist at z~8 already (Li+, 07; Volontery+, 10)

Radio Galaxies = Active Galactic Nuclei

More powerful...   **...less powerful...**   **...or "radio-quiet".**

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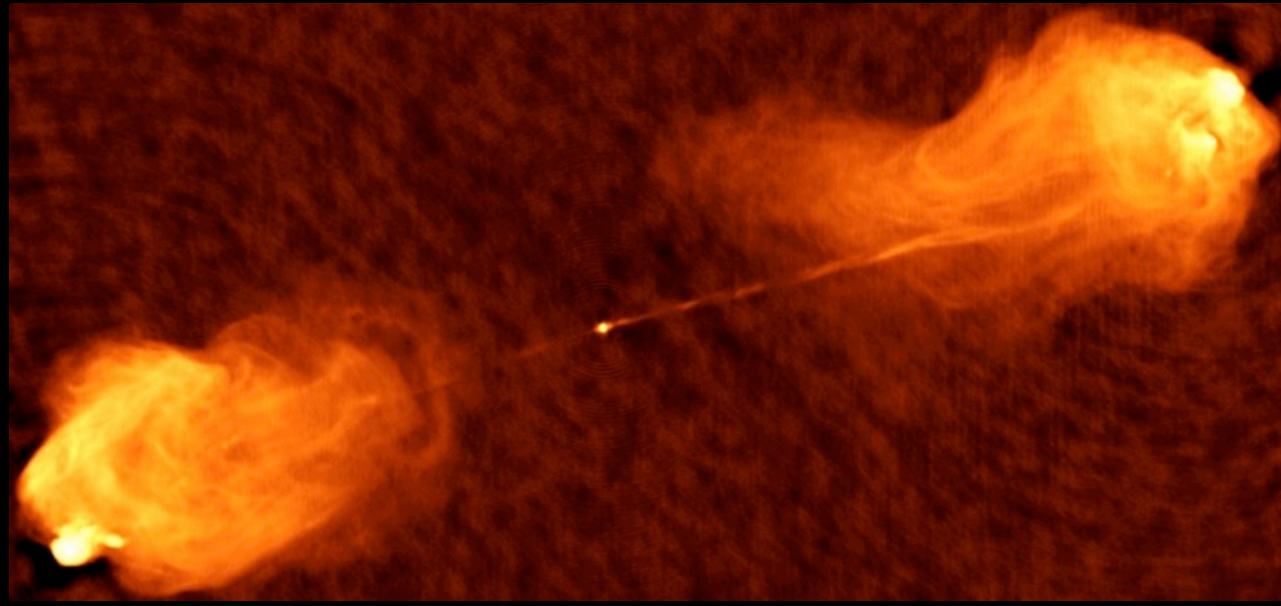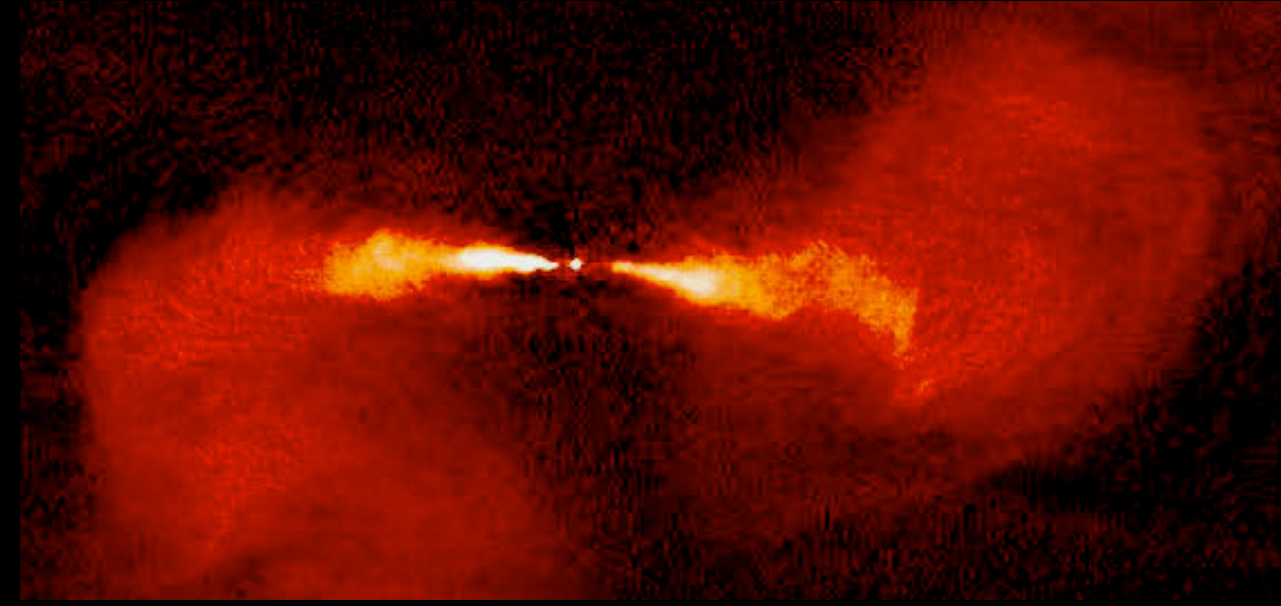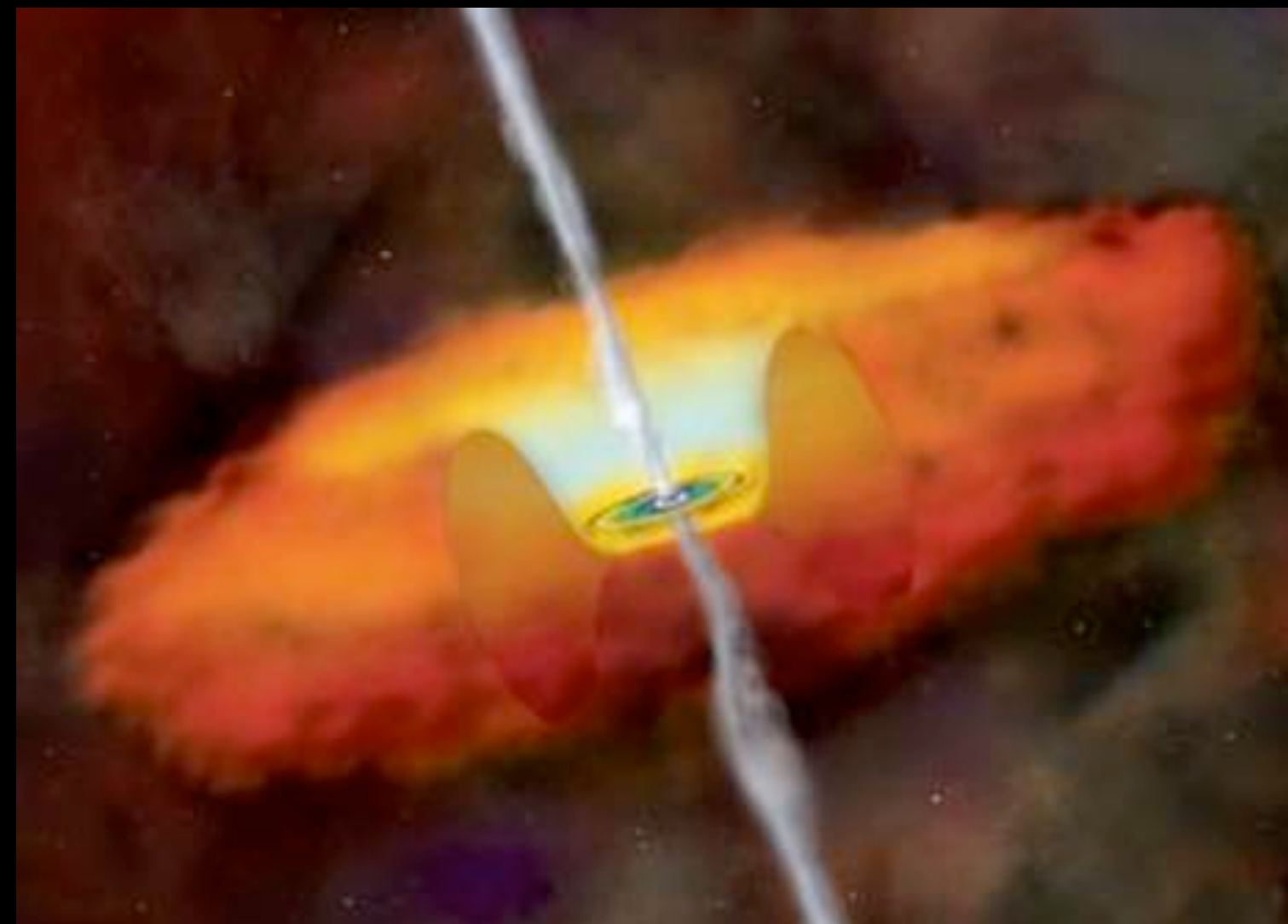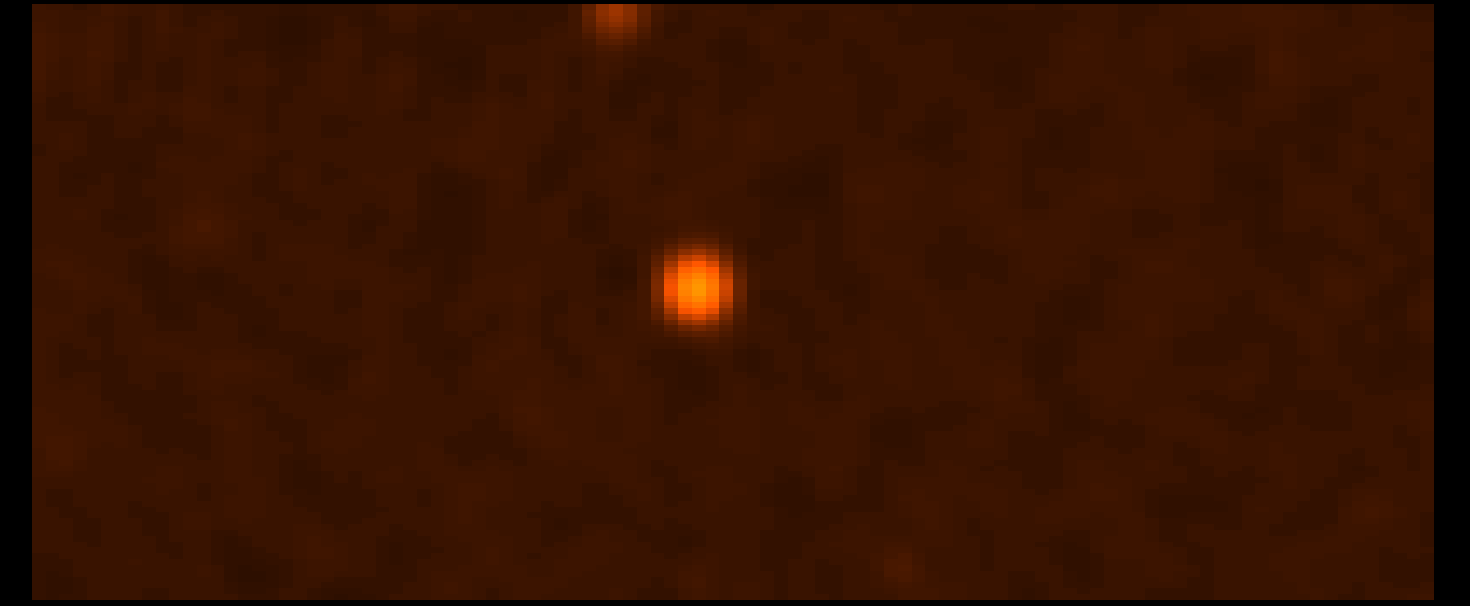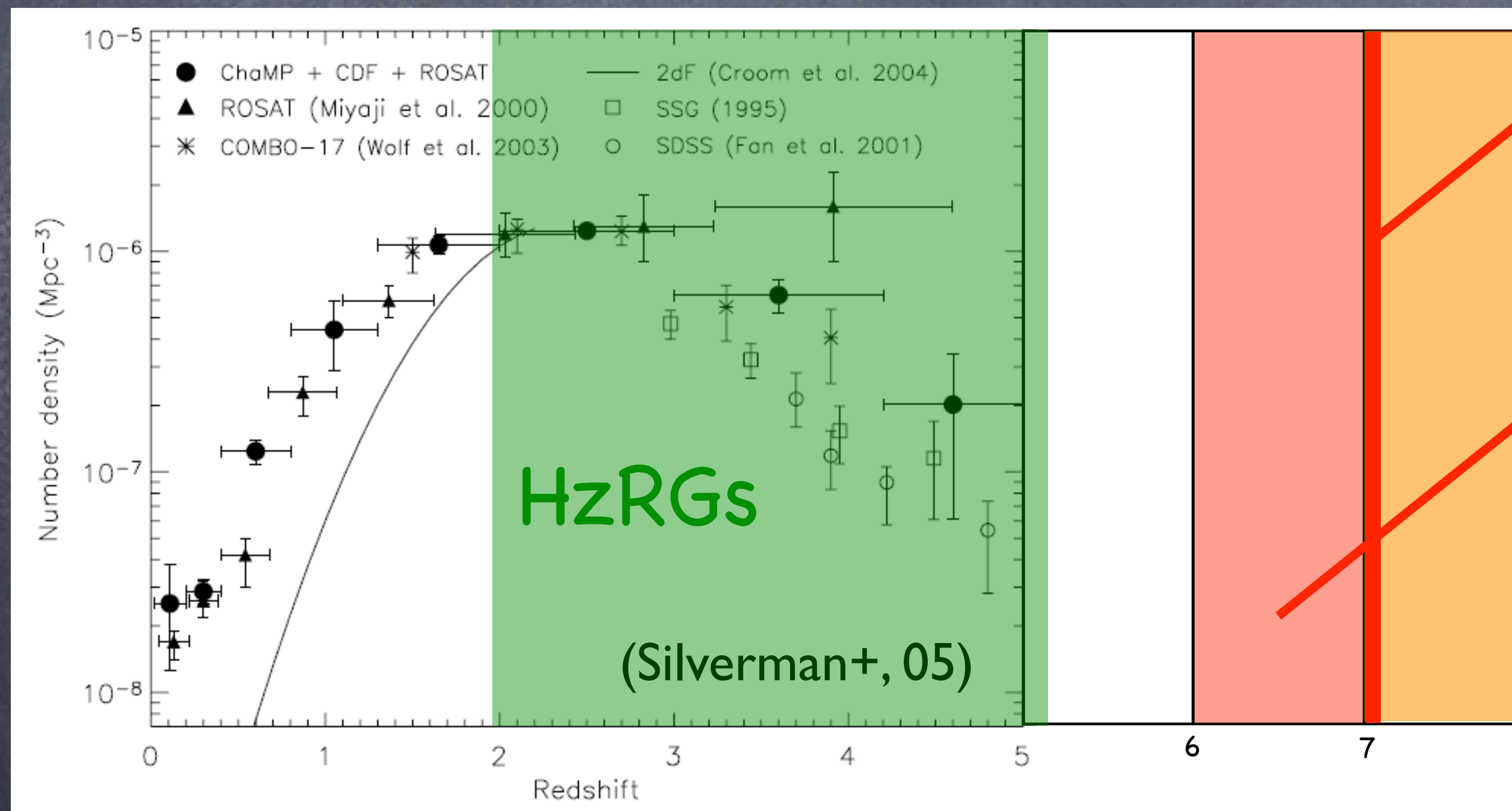
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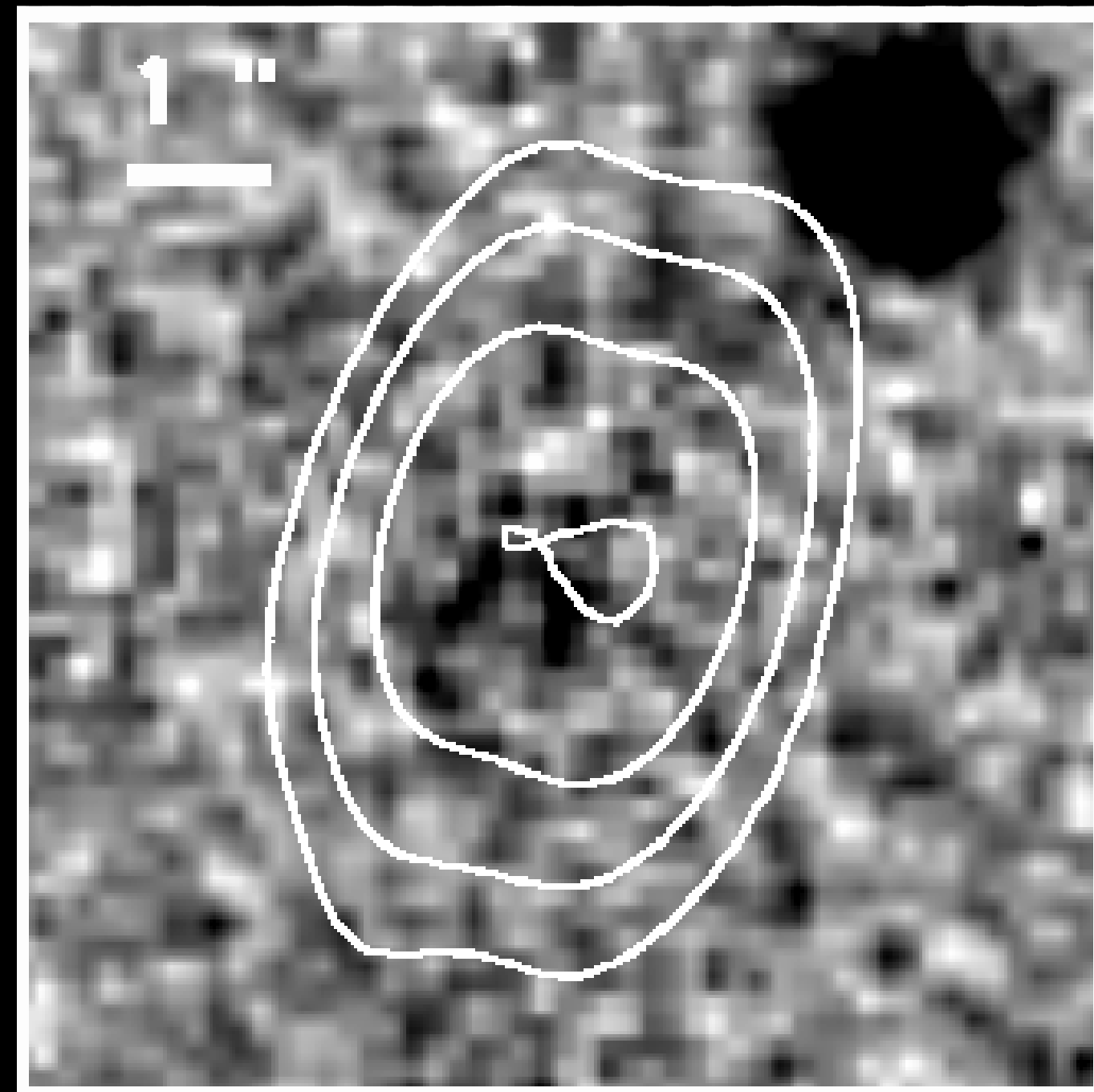

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Record Breakers

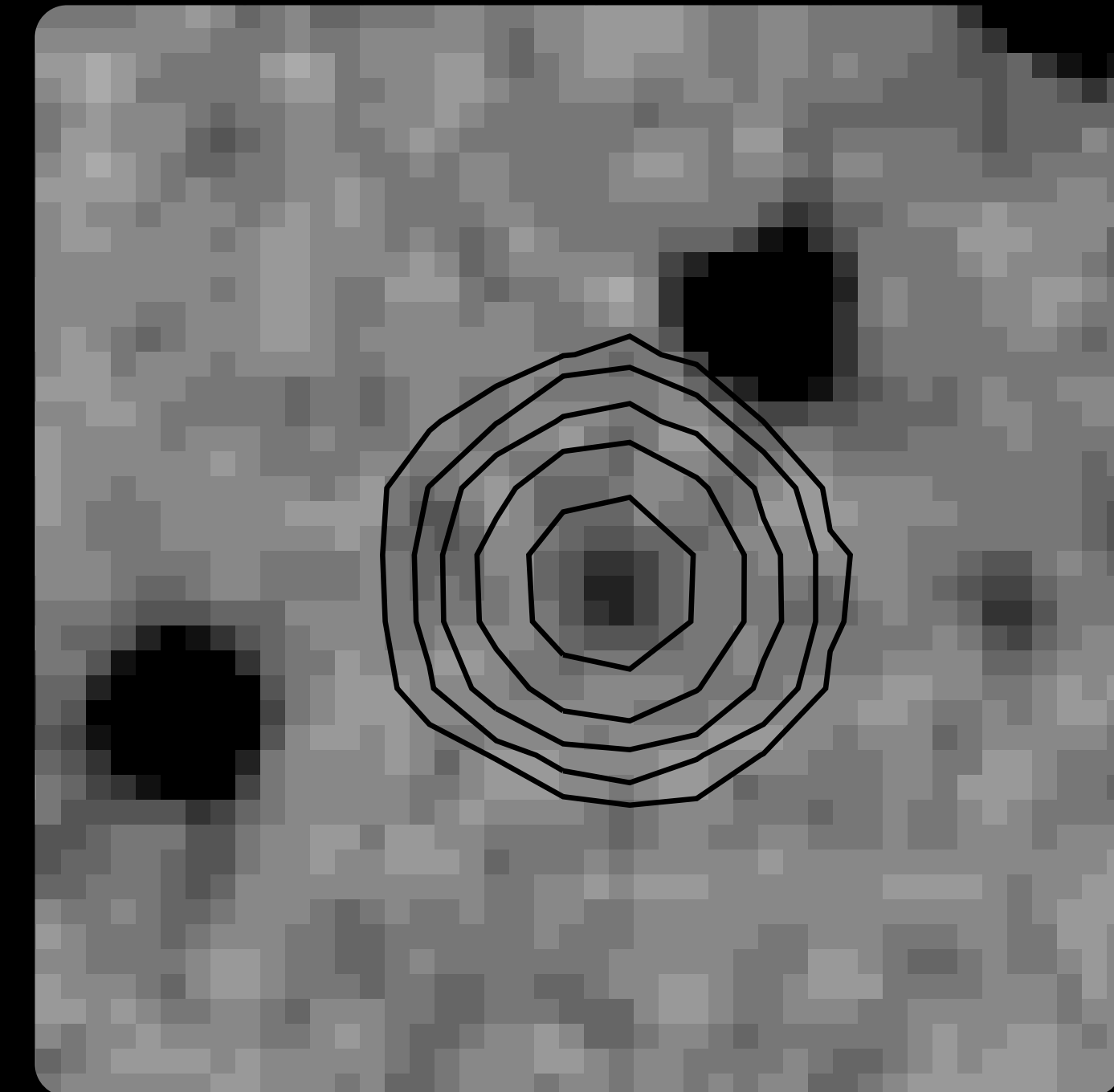TN J0924-2201 @ z=5.2 (van Breugel+, 99)   J163912.11 + 405236.5 @ z=4.9 (Jarvis+, 09)

Current "typical"
deep sensitivity limit
of radio surveys:
$S_{1.4GHz}$=10-100 μJy

$S_{1.4GHz}$=73 mJy $S_{1.4GHz}$=22 mJy

Where are the first Active Galactic Nuclei?

High-z (Powerful) Radio Galaxies:

1) Among the most luminous galaxies at any redshift

2) Associated with the most massive systems

3) Progenitors of brightest cluster ellipticals

4) Track proto-cluster environments

5) Actively forming: dusty, violent SF ($\sim$1000 $M_\odot$/yr, Reuland+03, 04, Seymour+12)

6) May show large gas reservoirs (Ly-α halos)

Tracers of galaxy buildup AND structure formation.

Where are the first Active Galactic Nuclei?

HzRGs at even higher redshifts?

- Powerful radio galaxies in the EoR are within reach of current deep (μJy) radio surveys: and they should exist (but probably very rare) at z~8-10.

- Slightly less powerful radio galaxies - more abundant - should have been already detected at z~6-8 (certainly a few tens already; e.g: Wilman+, 08)!
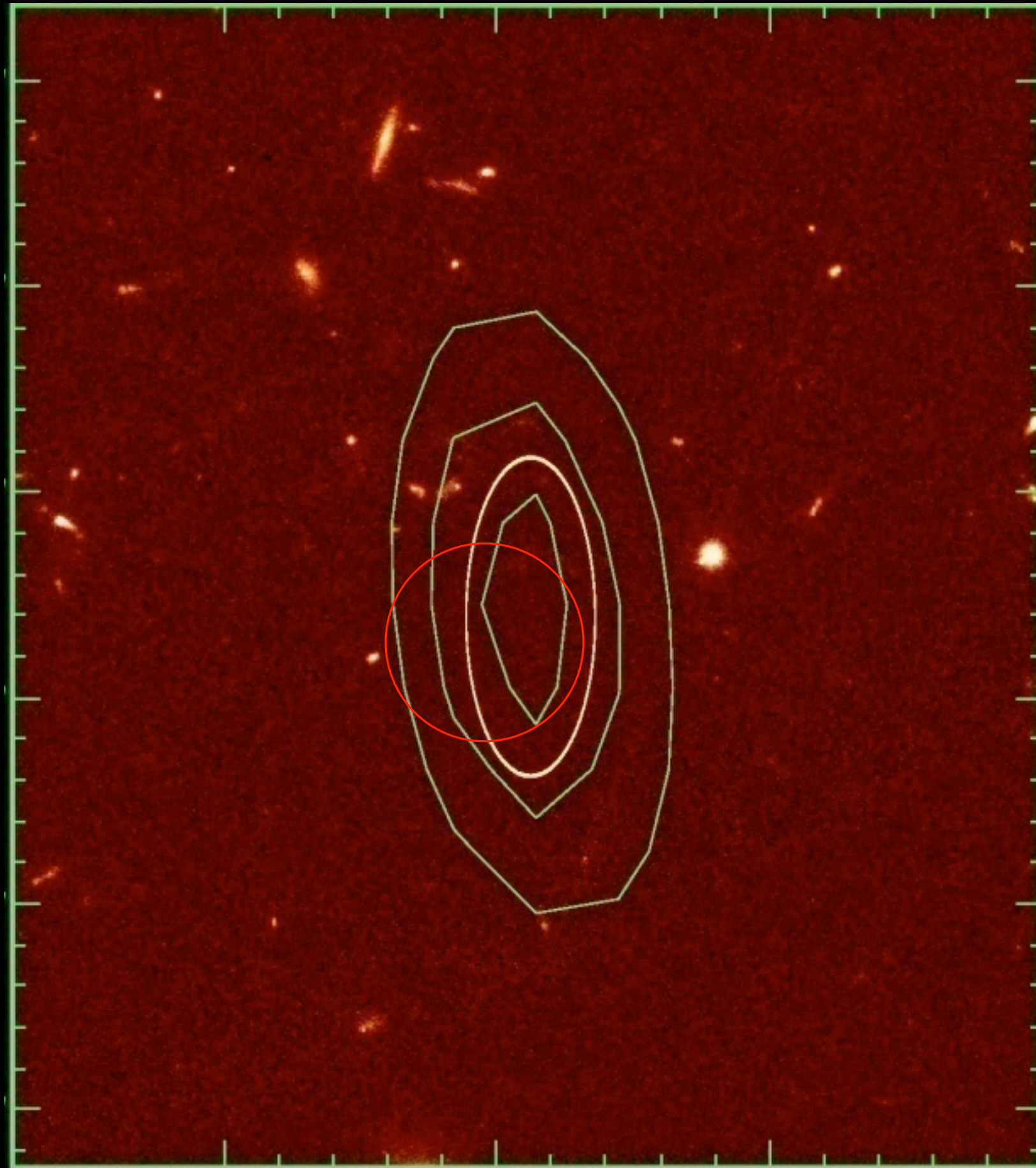
Perhaps they have...

The currently "unknown" radio panorama
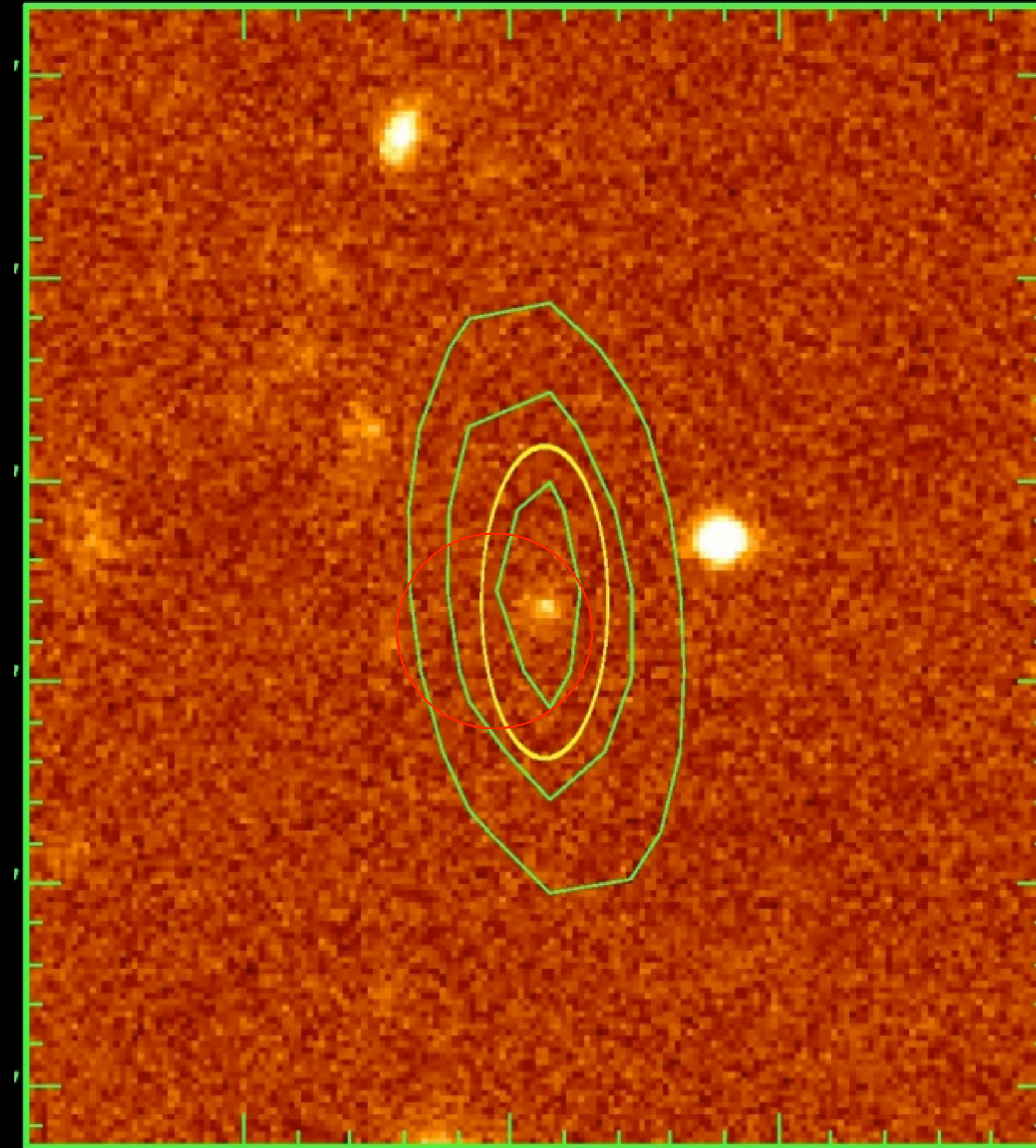
- RGs undetected in the optical to very deep levels
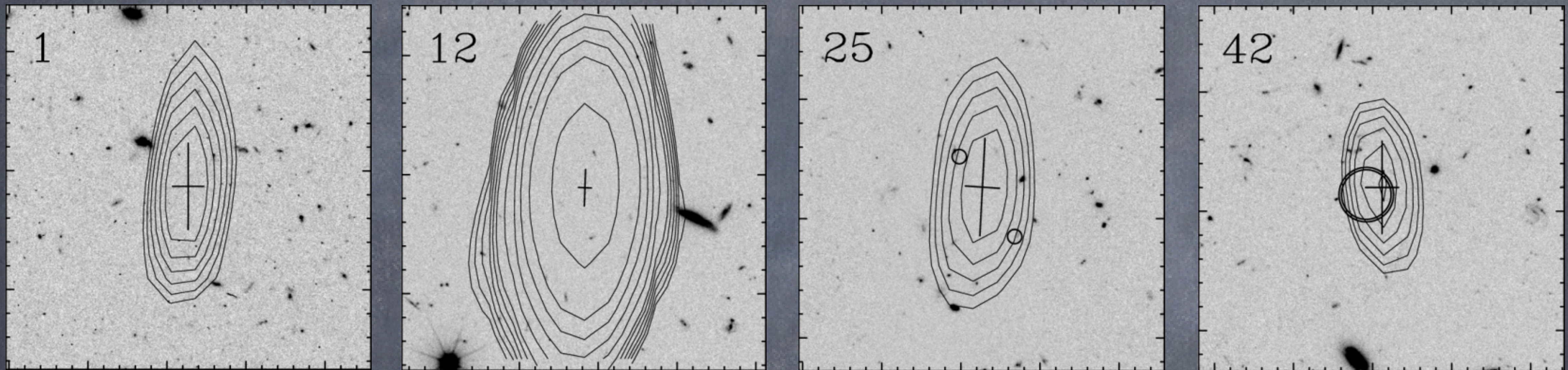
(e.g., CDFS, Lockman Hole: Afonso et al 2006; 2011)

An extreme ERO AGN

VLT: J_{AB}, K_{AB}= 27.2, 23.1
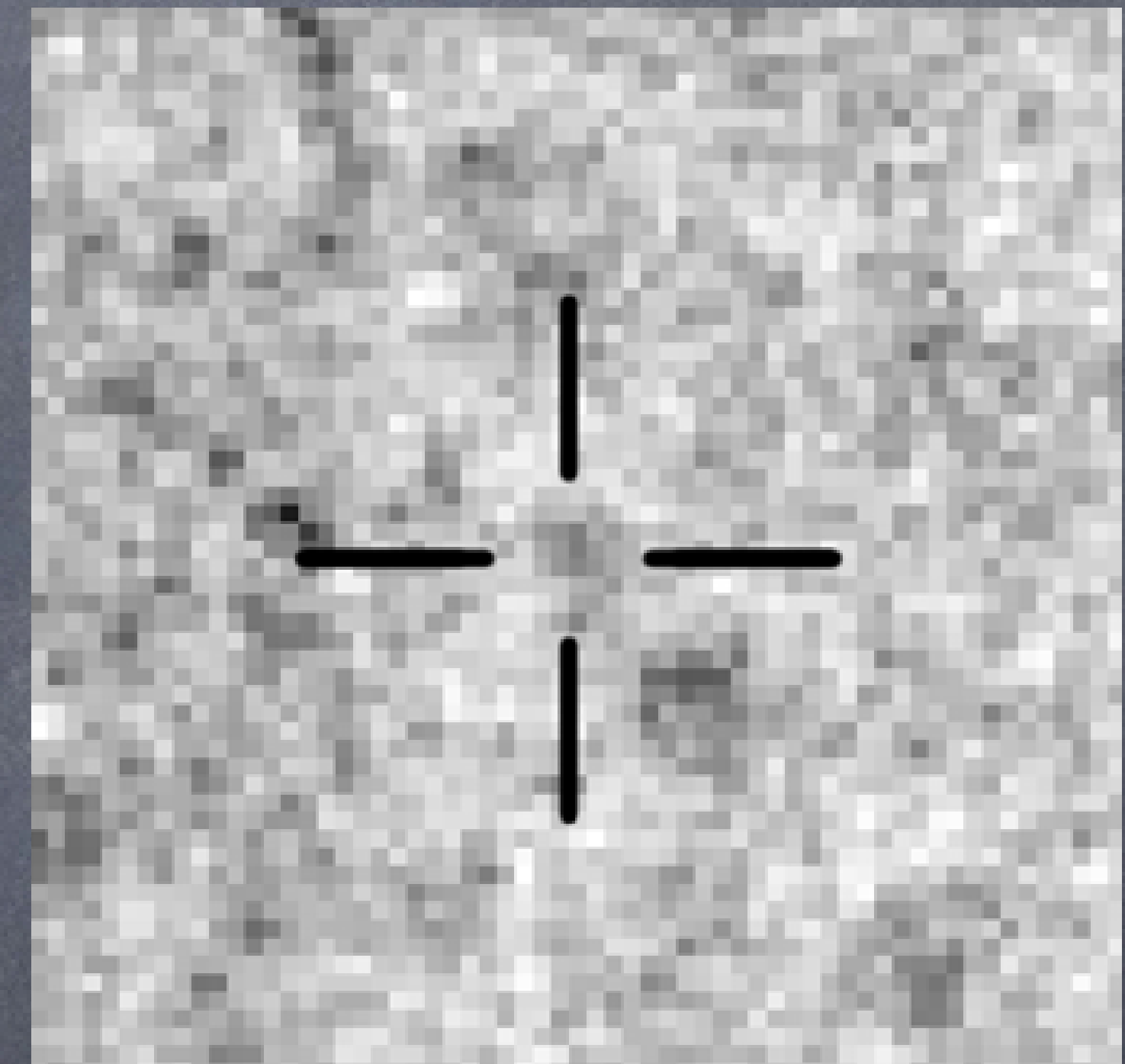
z-K>4.5, J-K=4.1

The currently "unknown" radio panorama

- RGs undetected in the optical to very deep levels
- Infrared Faint Radio Sources (high radio/IRAC flux ratios)

(Norris+, 11)
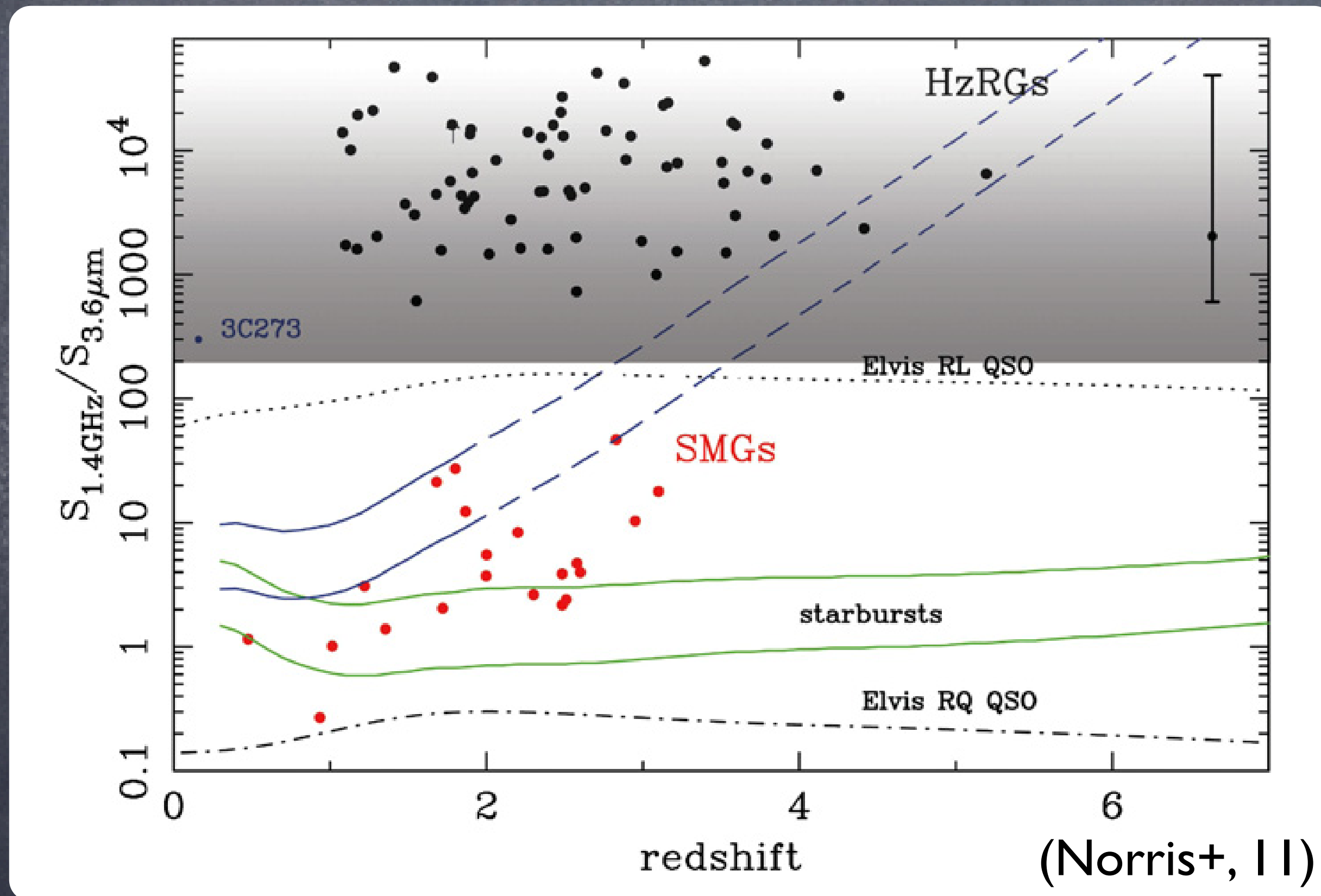
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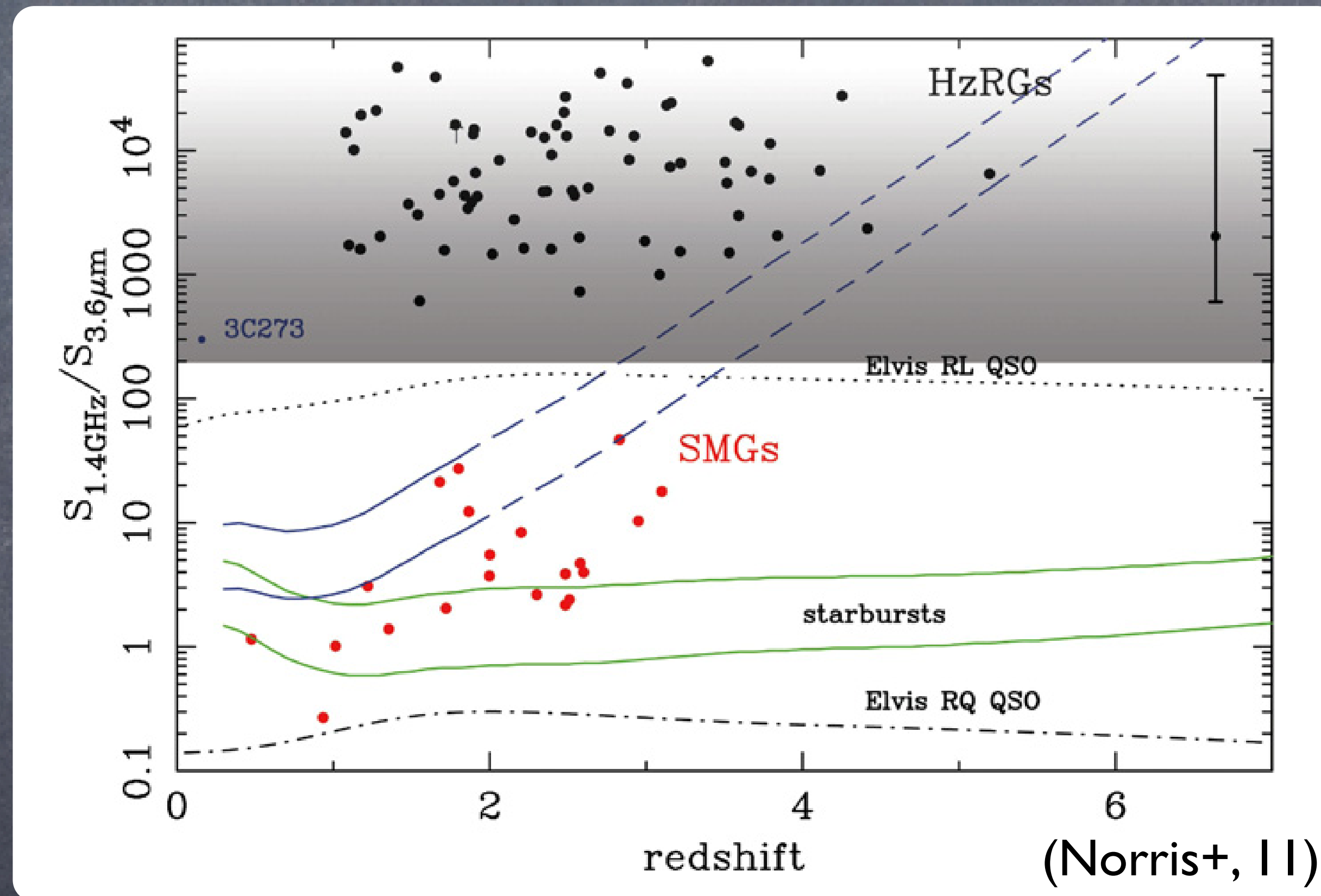
IRAC stack of 39 sources
$S_{1.4GHz} \sim 0.1\text{-}20$ mJy

The currently "unknown" radio panorama

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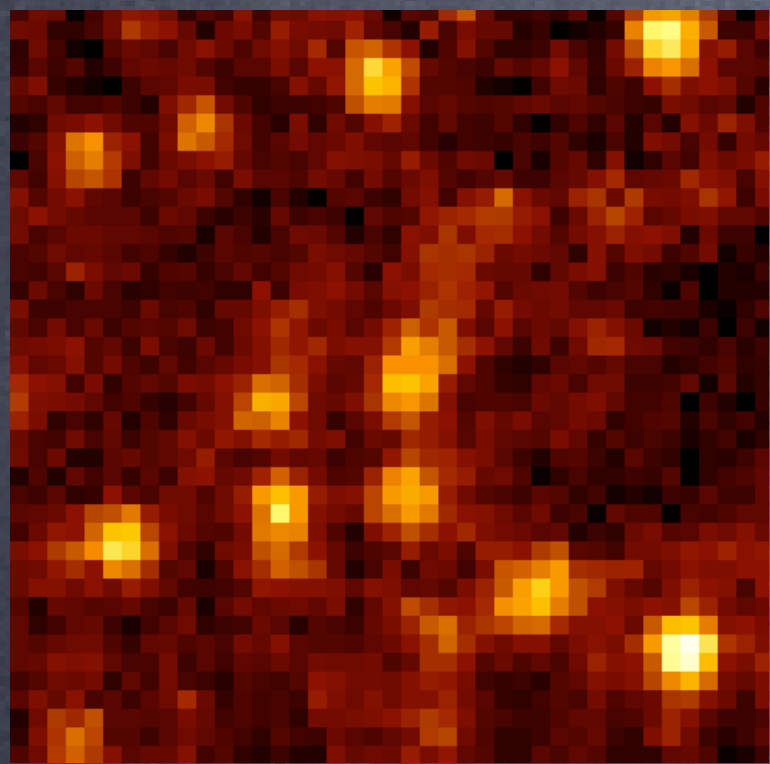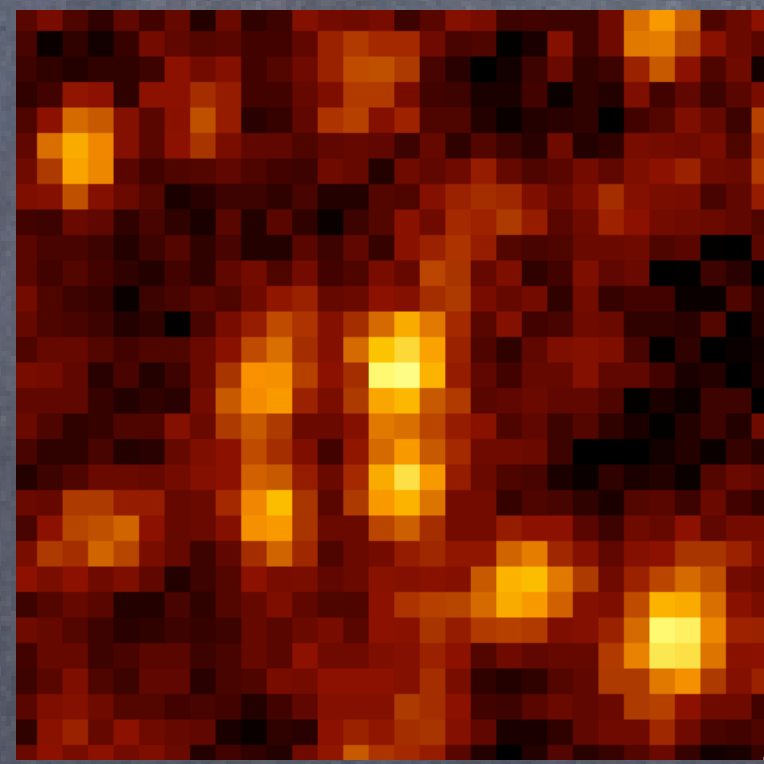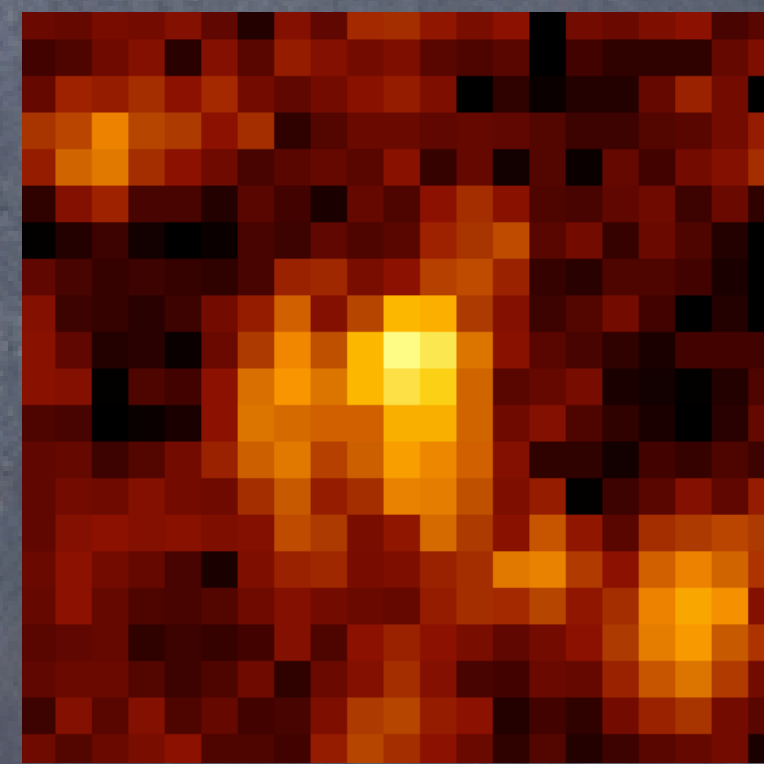- Infrared Faint Radio Sources (high radio/IRAC ratios)

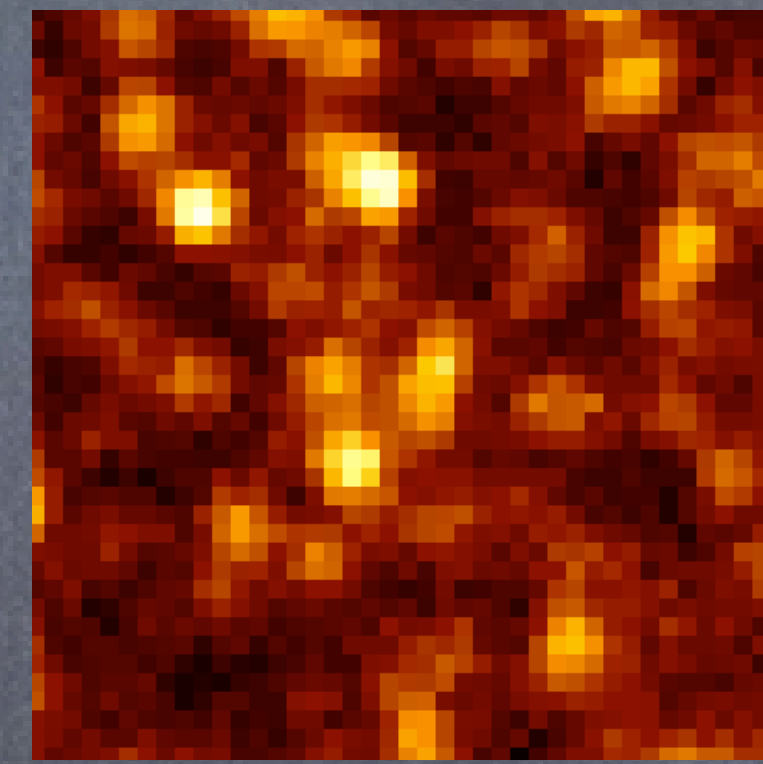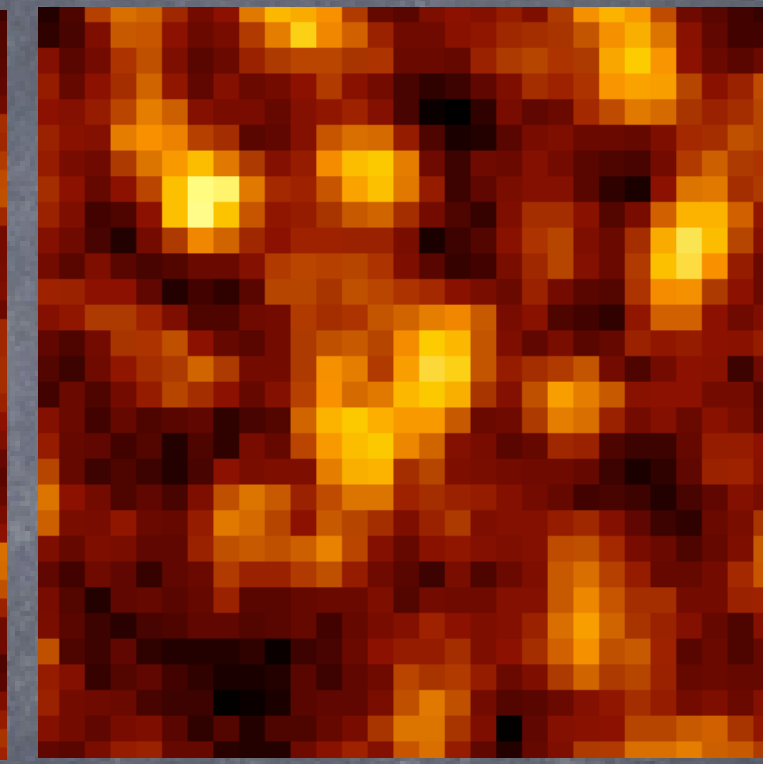Some are even detected with Herschel, with interestingly raising SED slopes in the FIR:

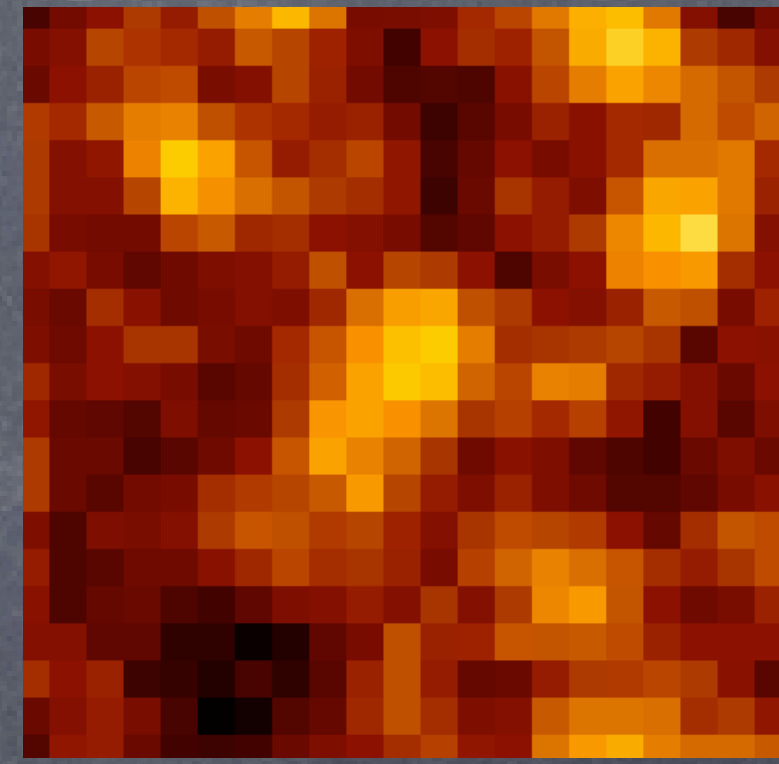250 μm   350 μm   500 μm   250 μm   350 μm   500 μm

Ideally suited for ALMA...

Upcoming ventures in Deep Radio Probes of the Universe

By 2018, millions of sources to examine from EMU and WODAN (and don't forget LOFAR...), over the entire sky!
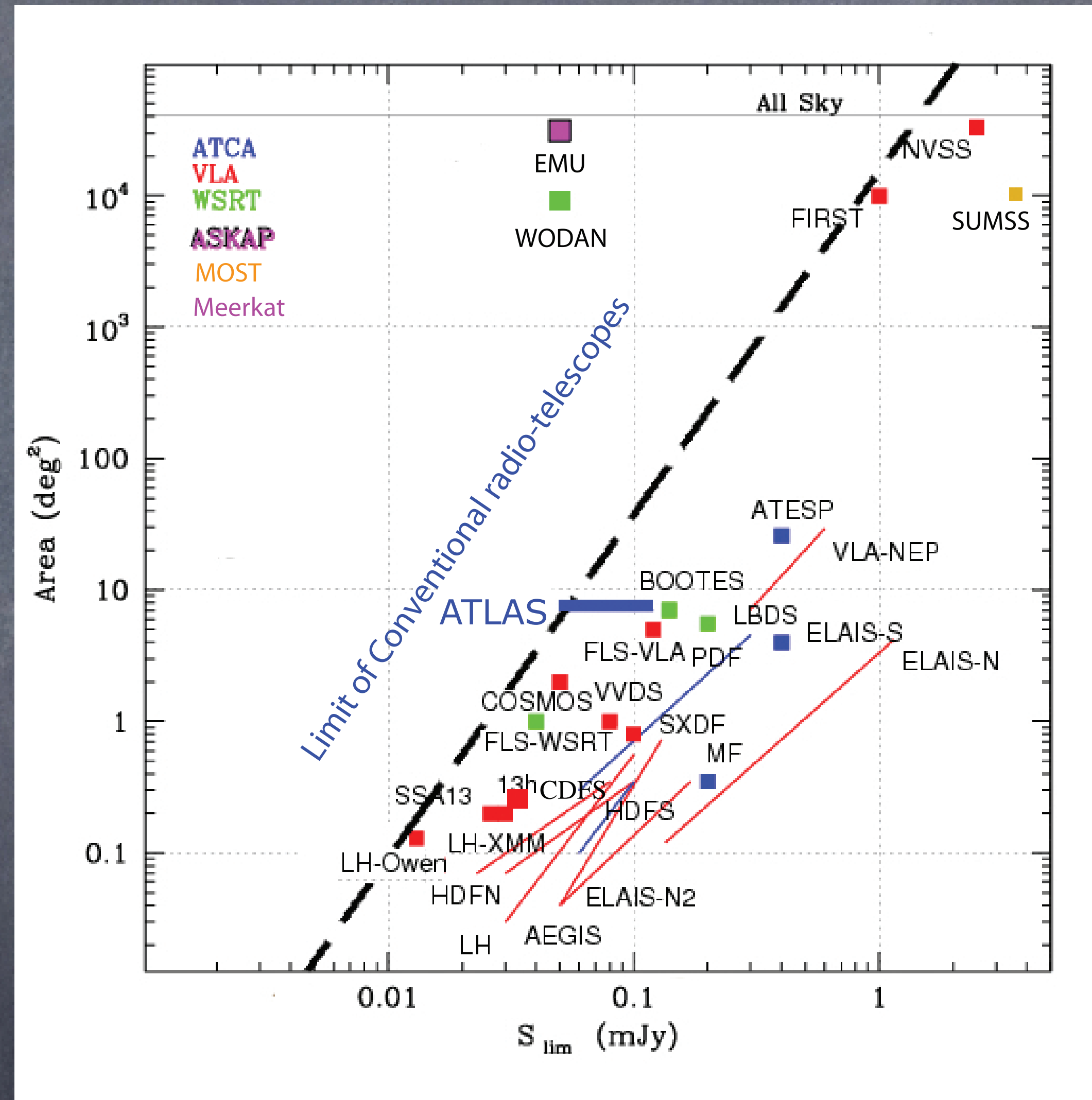

Evolutionary Map of the Universe (ASKAP); Norris+, 11

Westerbork Observations of the Deep APERTIF Northern-Sky; Rottgering+, 11

=> FULL SKY @ 1.4GHz, 10-15'' resolution, 15 µJy rms

Upcoming ventures in Deep Radio Probes of the Universe

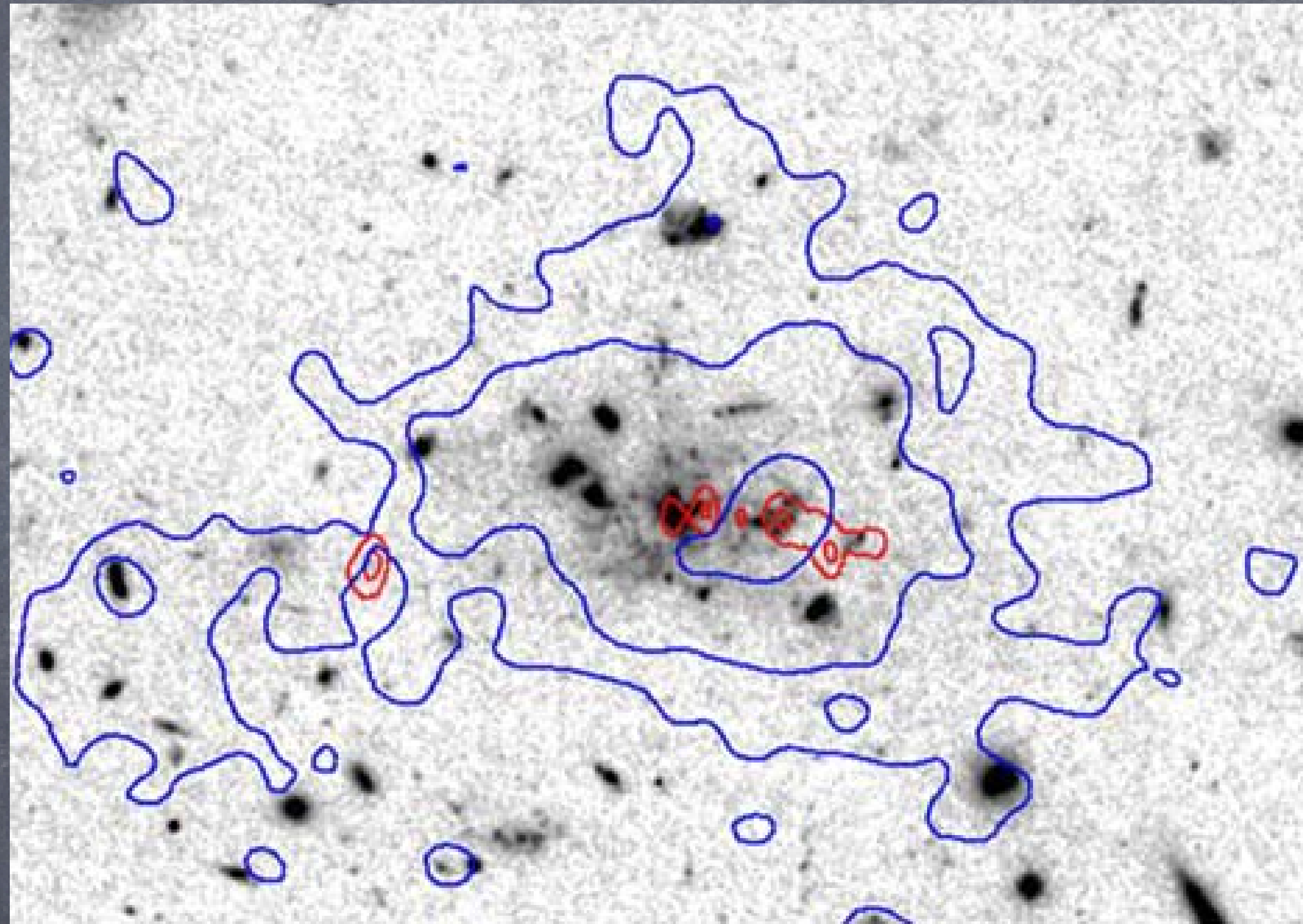# Dissecting the first Radio Galaxies with the E-ELT

At the E-ELT first light:

Thousands of candidates for first radio galaxies

Some will have been targeted by ALMA, JWST ($J_{AB} \sim 27\text{-}30+$)

Will need spectroscopic E-ELT capabilities (JHK, GLAO or MOAO, OH supression) for systematically following galaxy AND environment buildup:

- Dynamics of the Radio Galaxy (IFU)

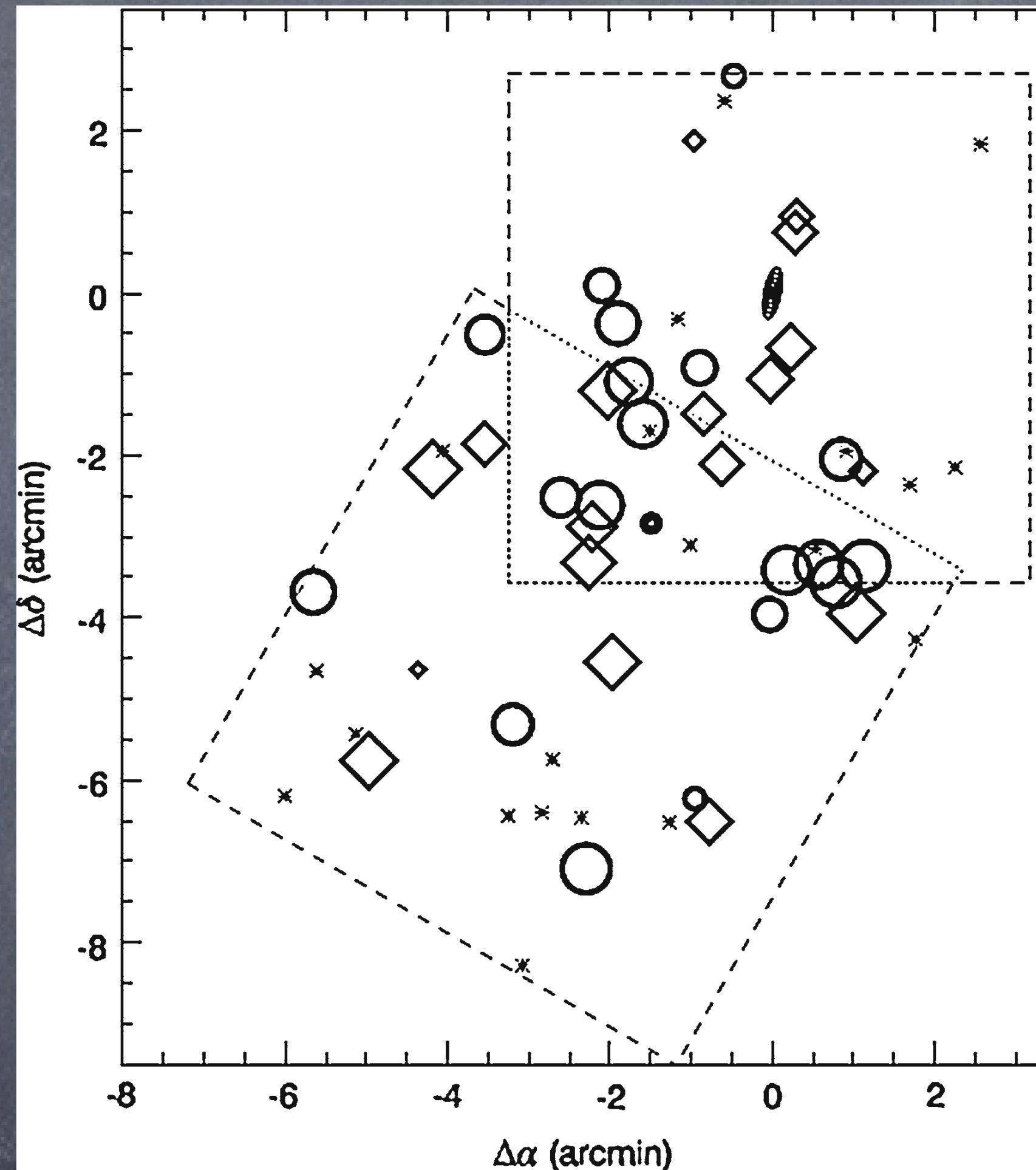- Protocluster build-up (MOS, 5-10 arcmin across)

Dissecting the first Radio Galaxies with the E-ELT

~10"

Spiderweb galaxy @z=2.2 (Miley+ 06, 08)

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TN J1338-1942 @z=4.1 (Venemans+ 02, 07)

In epitome…

» Radio Surveys have probably already revealed tens of z>6 AGNs

» Potentially able to reveal z~10 Radio Galaxies (the first such objects?)

» Require E-ELT equipped with a MOS/IFU capability to reveal the galaxy build-up

» Require E-ELT equipped with a MOS/IFU capability to reveal the expected environment build-up

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