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Low-frequency radio / star formation relation

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LOFAR & H-ATLAS Collaborations

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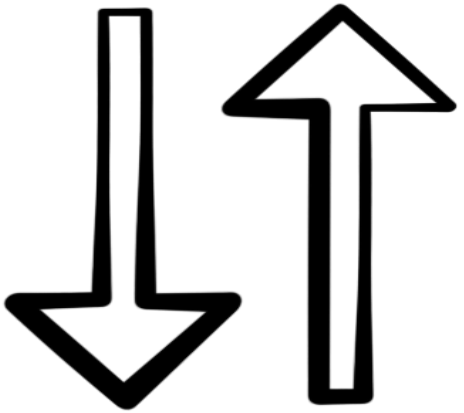
OUTLINE

- Introduction & motivation
- Observations and data
- Results

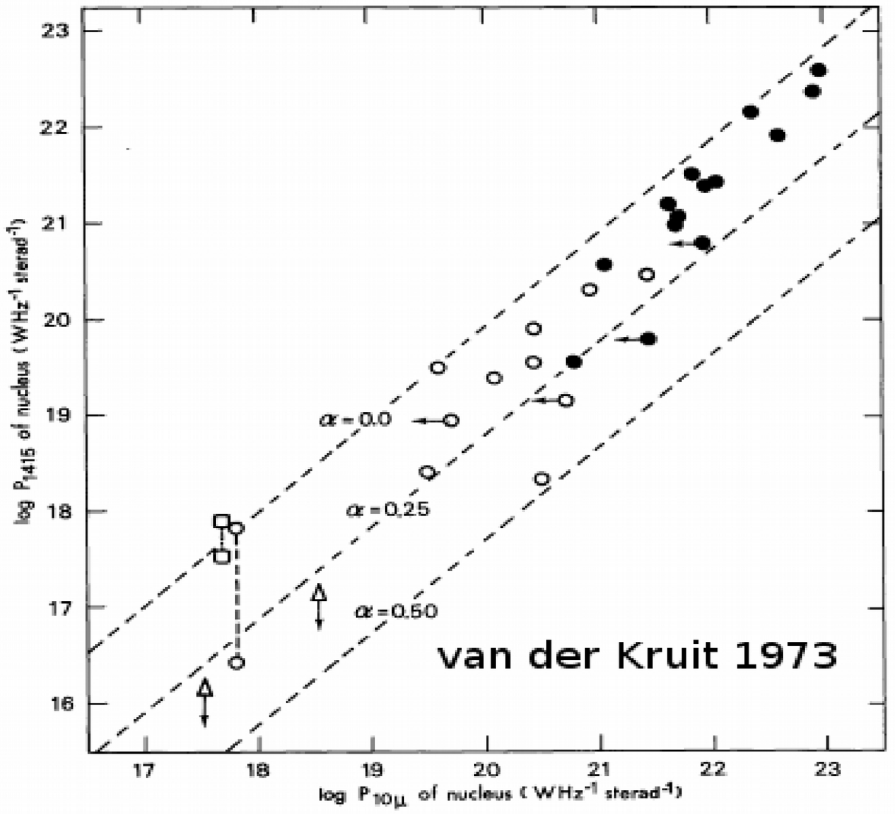
FAR-IR – RADIO CORRELATION

Far-IR → re-processed UV light from young stars



Synchrotron → cosmic ray electrons accelerated by SNs

FAR-IR – RADIO CORRELATION



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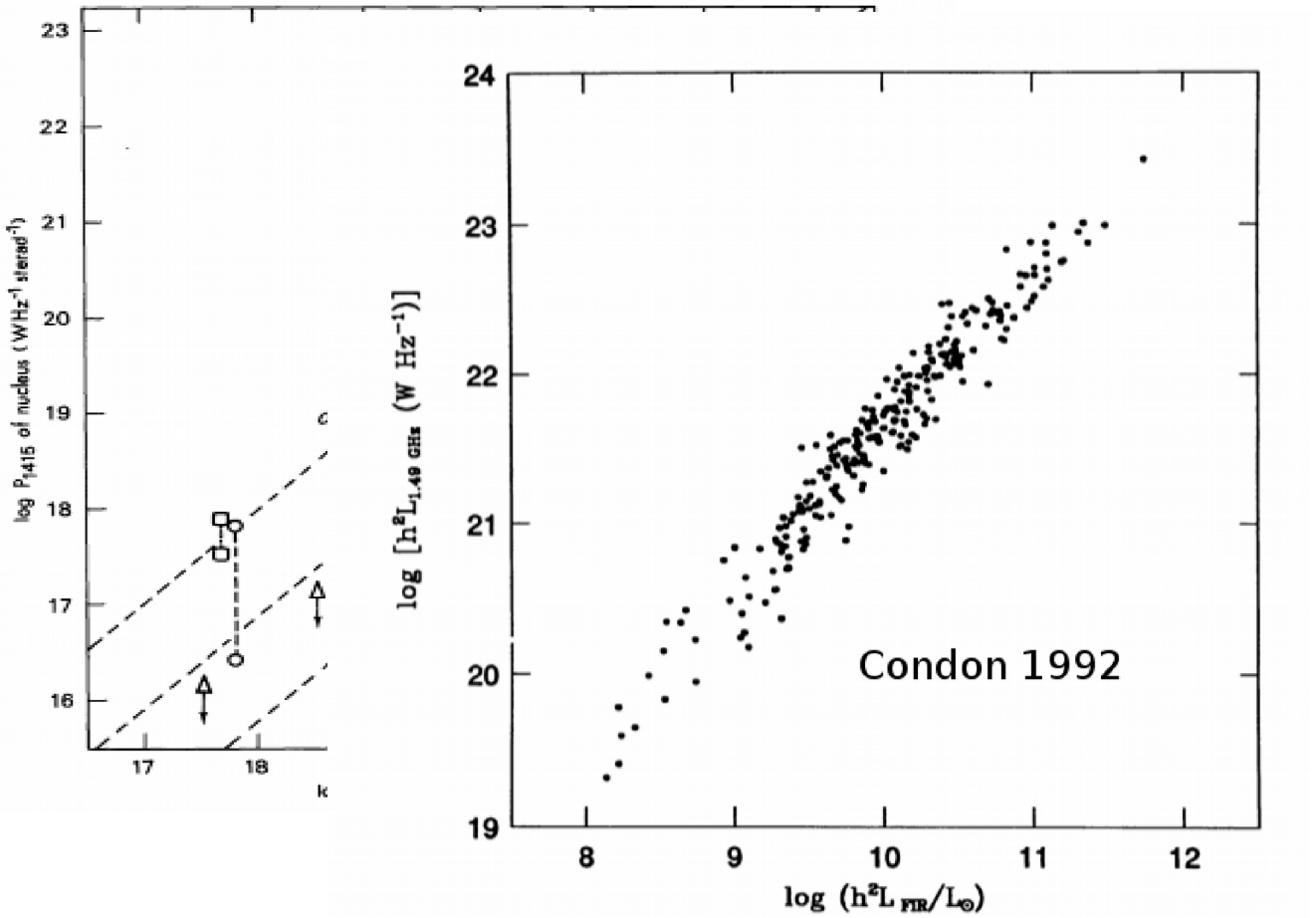

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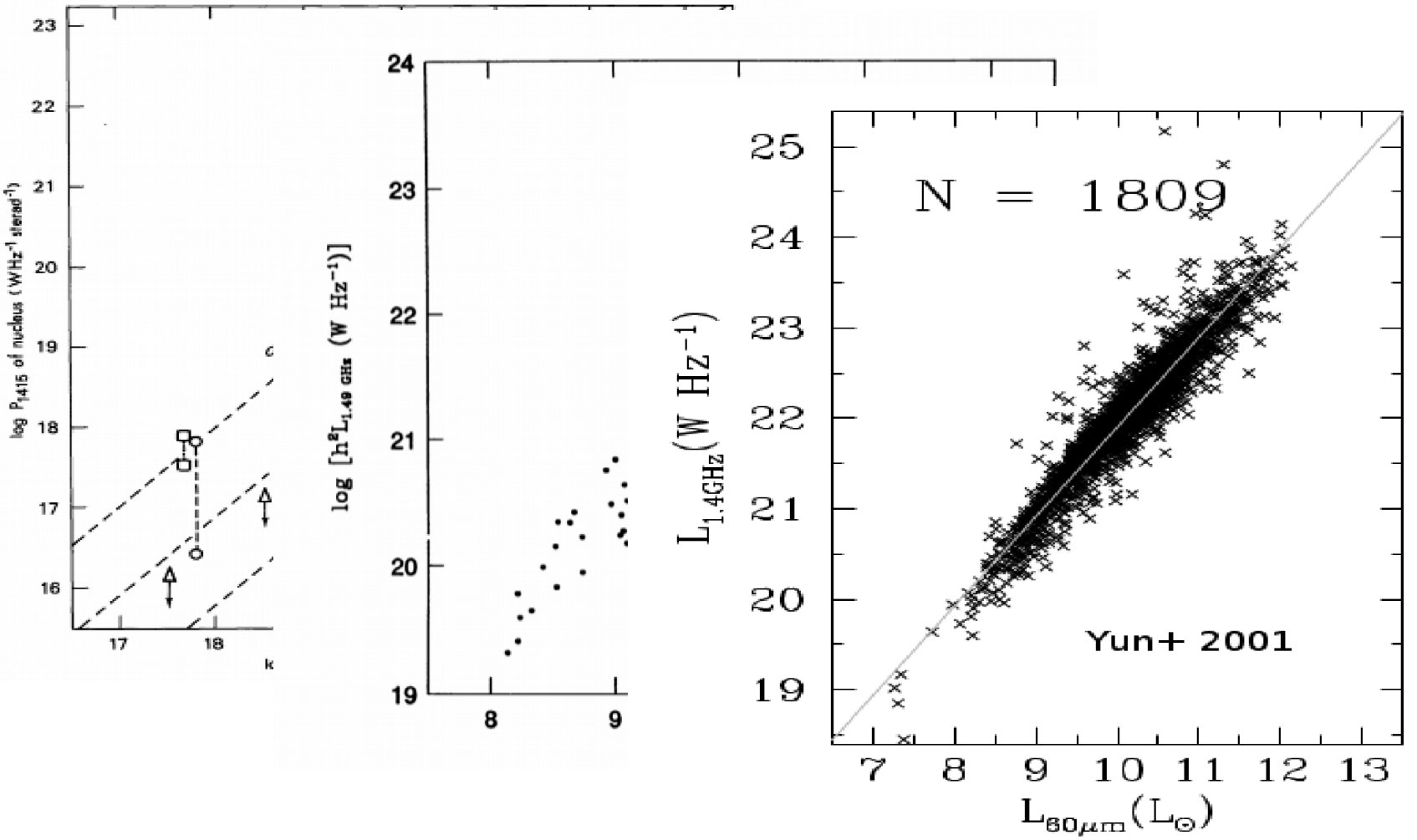

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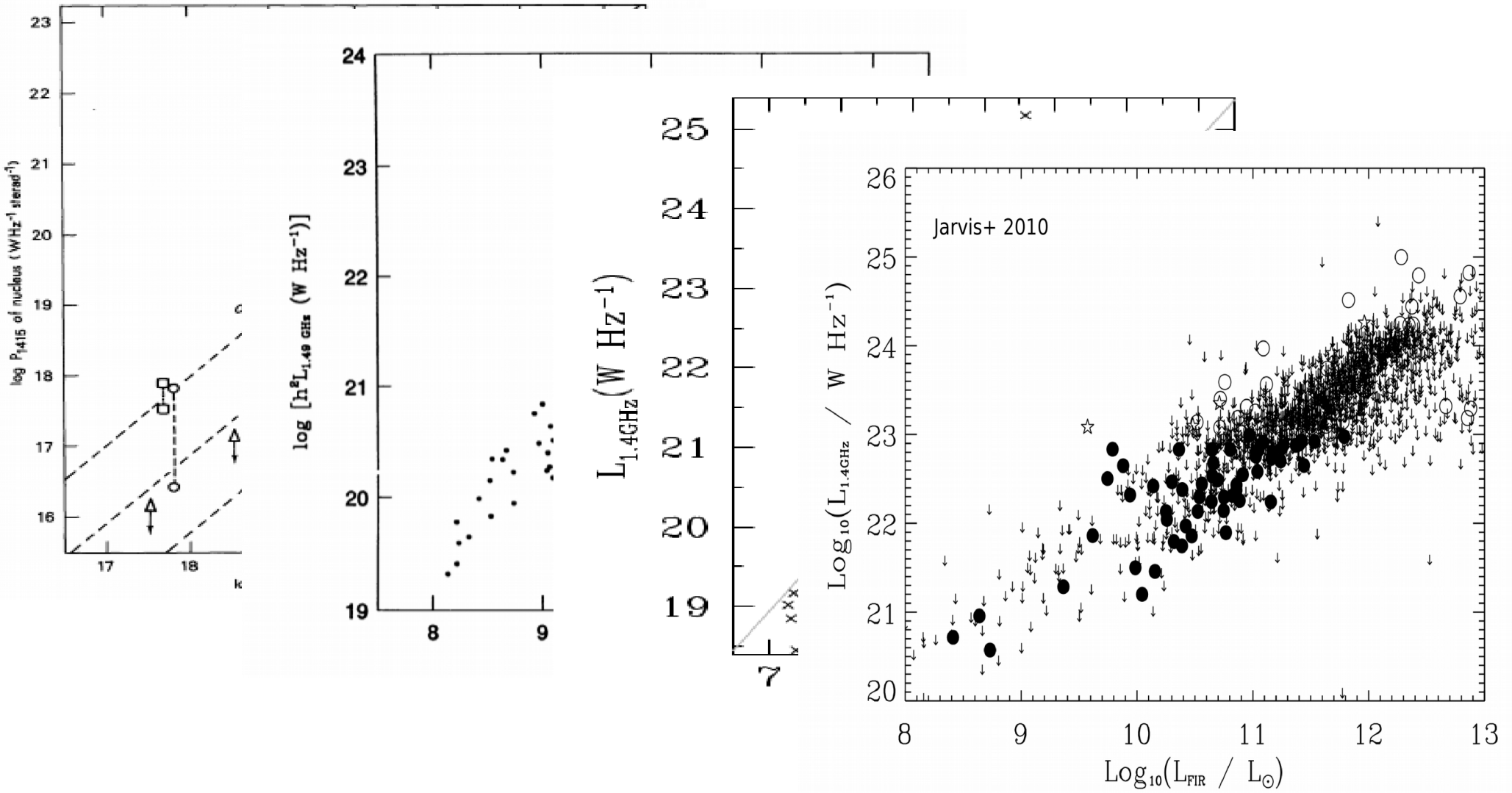

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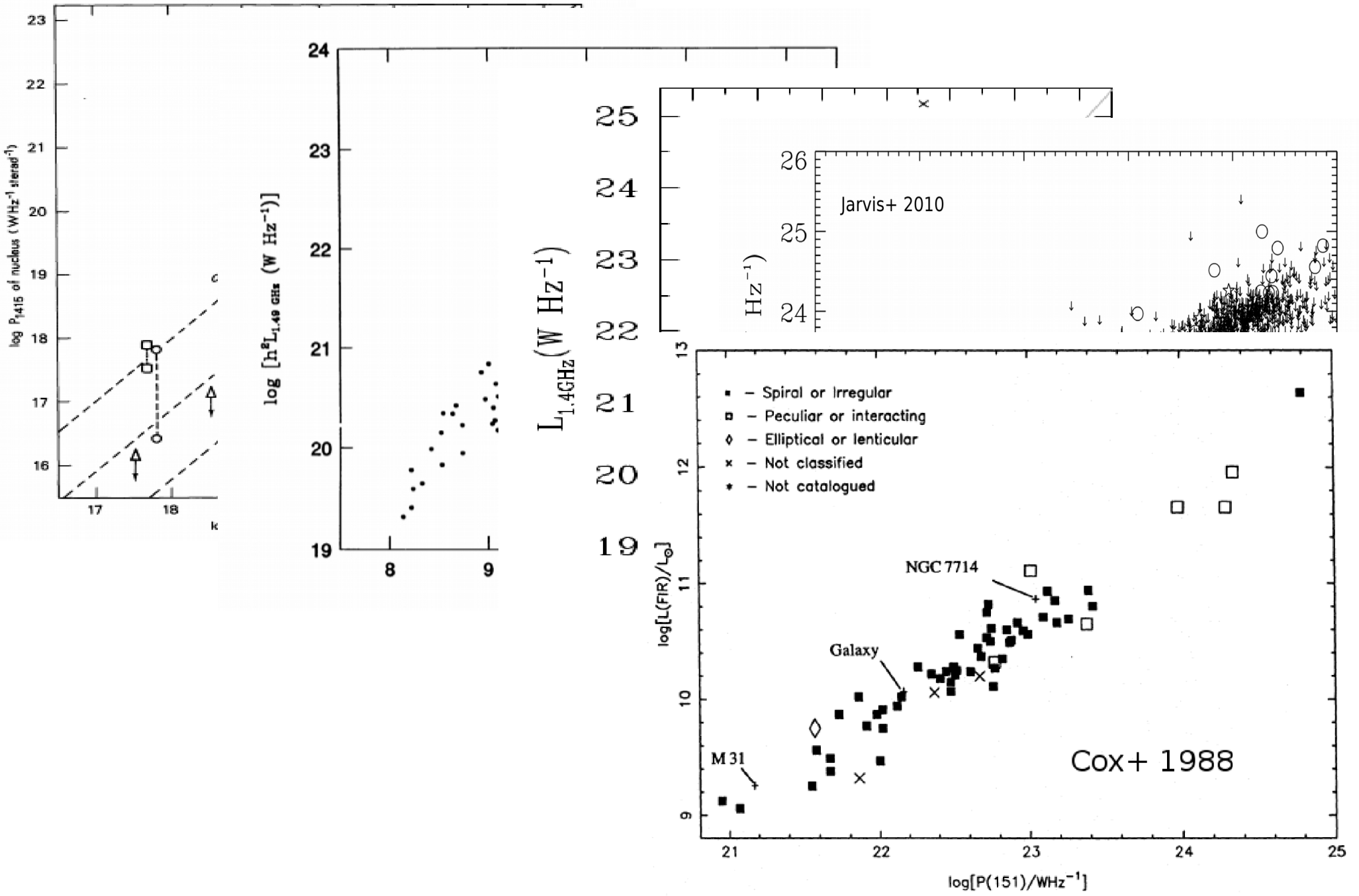


MOTIVATION

LOW-FREQUENCY RADIO AS SFR INDICATOR?

Almost all studies are @ GHz bands
Longer lifetimes of radiating electrons @ low-frequencies

<u>Advantages:</u>

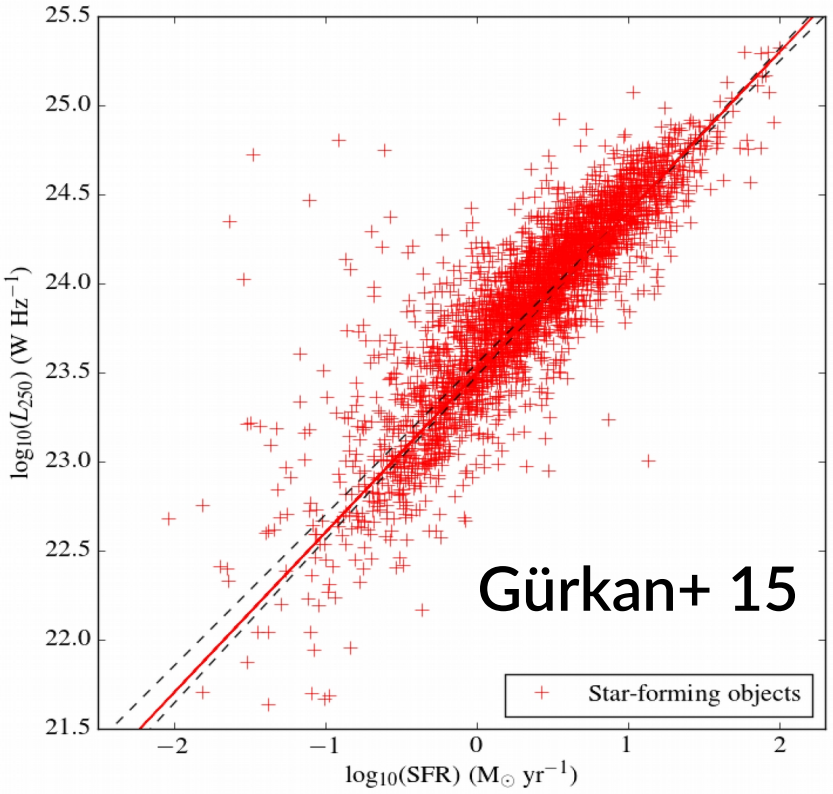
Herschel and optical data → star-formation rate
Low-frequency radio data @ 150MHz from LOFAR

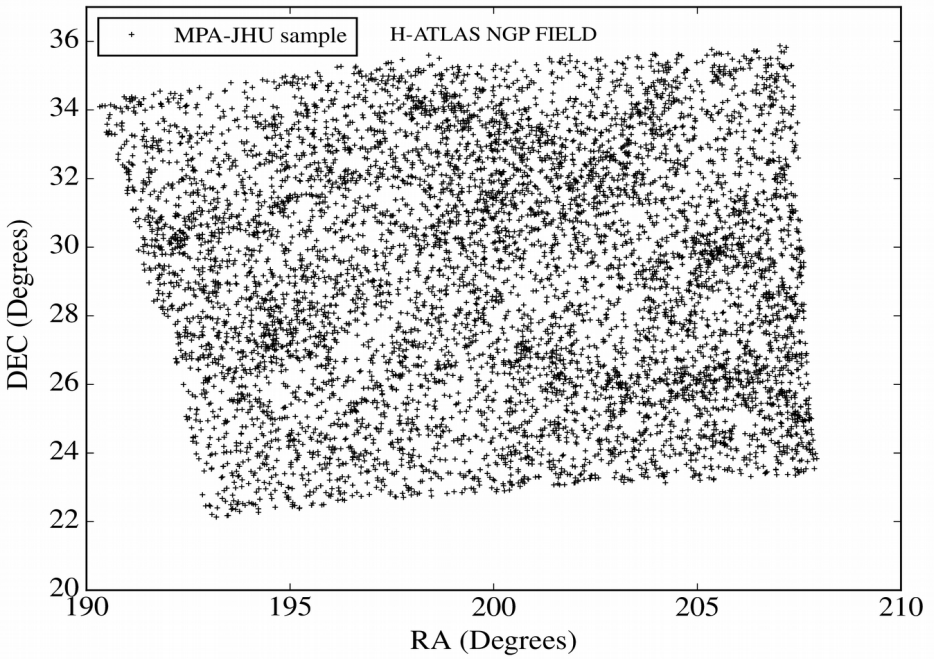
Sample and Data

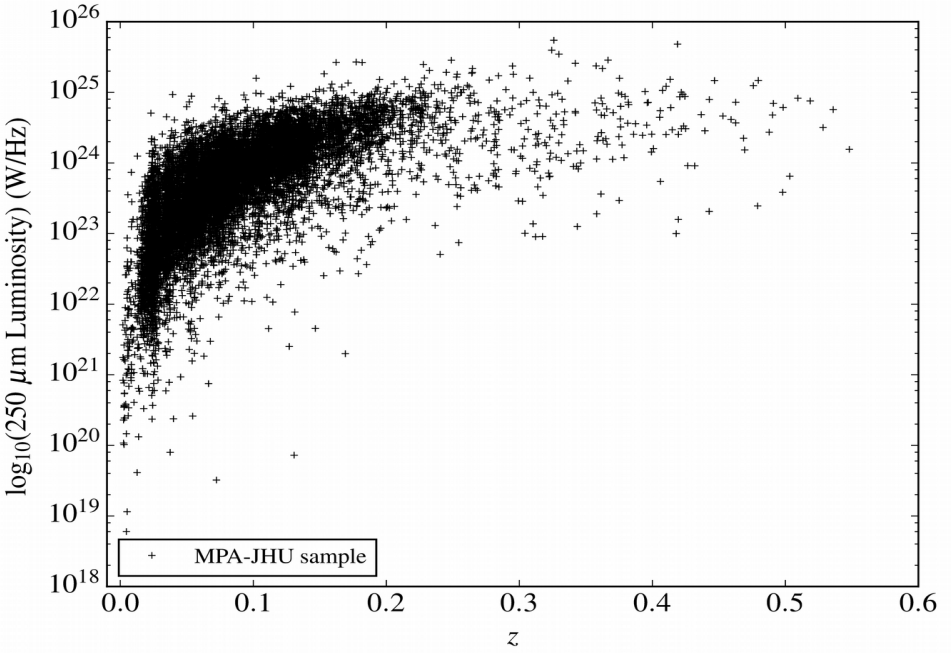
MPA-JHU Sample

Star-forming objects (8035), Composite objects (2490), Seyferts (1190), Radio-loud AGN (613)

Herschel 250-μm flux densities
Hα star formation rates







LOFAR

LOw-Frequency ARray

Low-HBA Observations
Frequency range 110-180 MHz

Ionosphere!!!

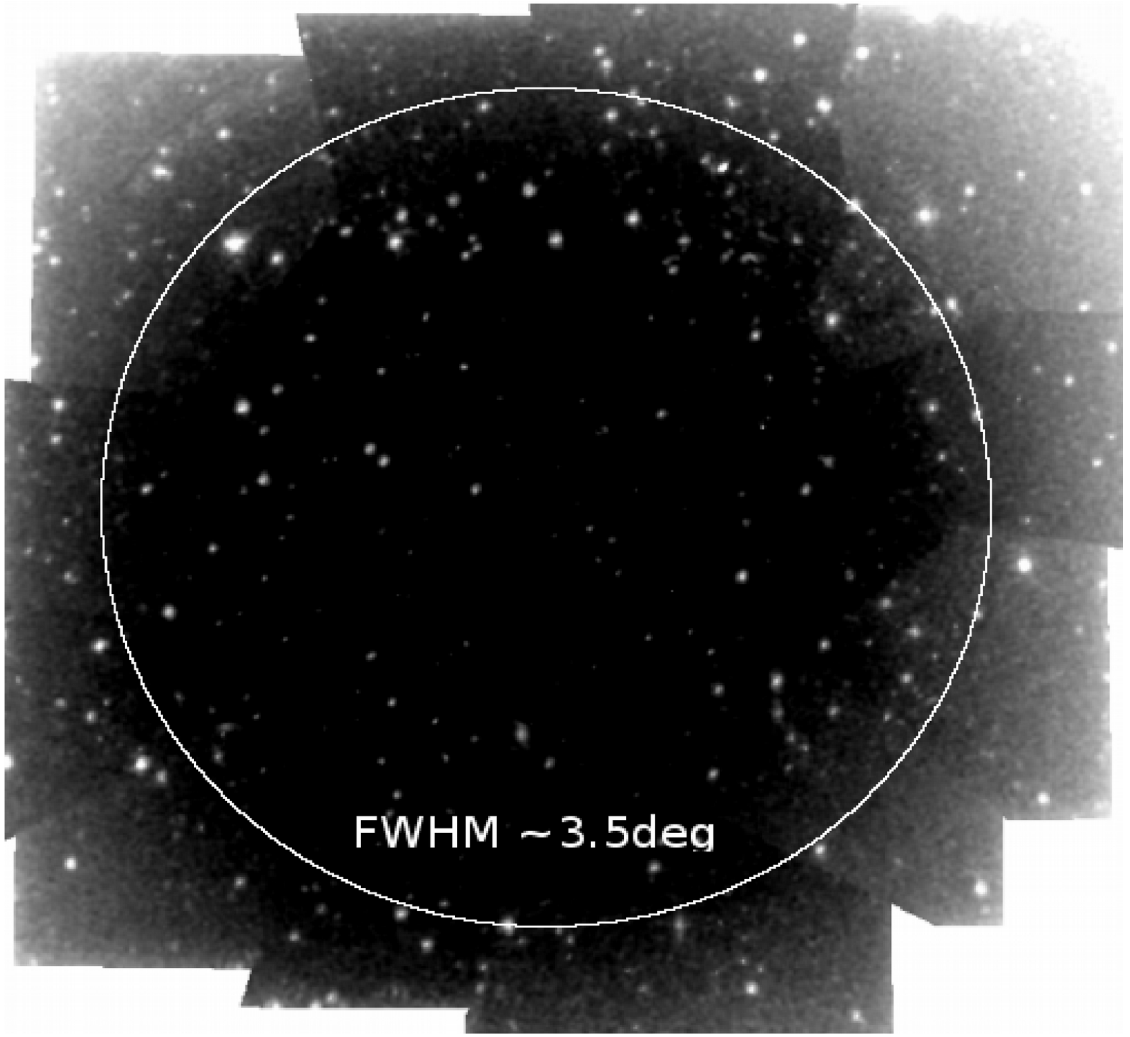
62 antennas (Core and remote stations)
Each band (10 sub-bands) has 40 channels → 55GB

~10 min int. → the calibrator, ~8 hr obs. → the source

- Flagging each sub-band for bad channels
- Directional Clock & TEC (ionosphere) calibration
- Self-amp.&-phase calibration, facet-imaging, subtraction of sources and re-imaging

Stacked final map has 10"x5" resolution

LOFAR DATA



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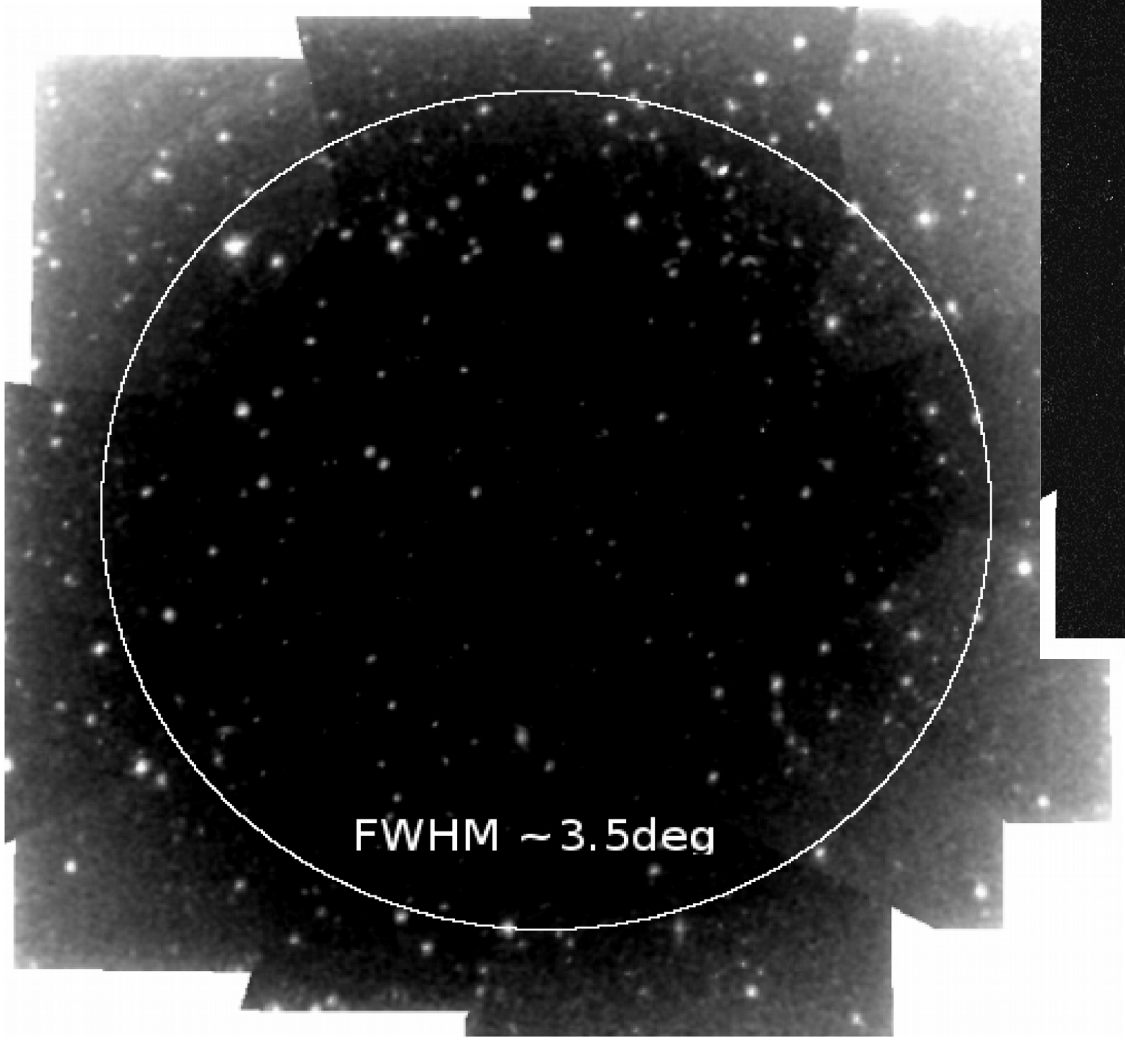

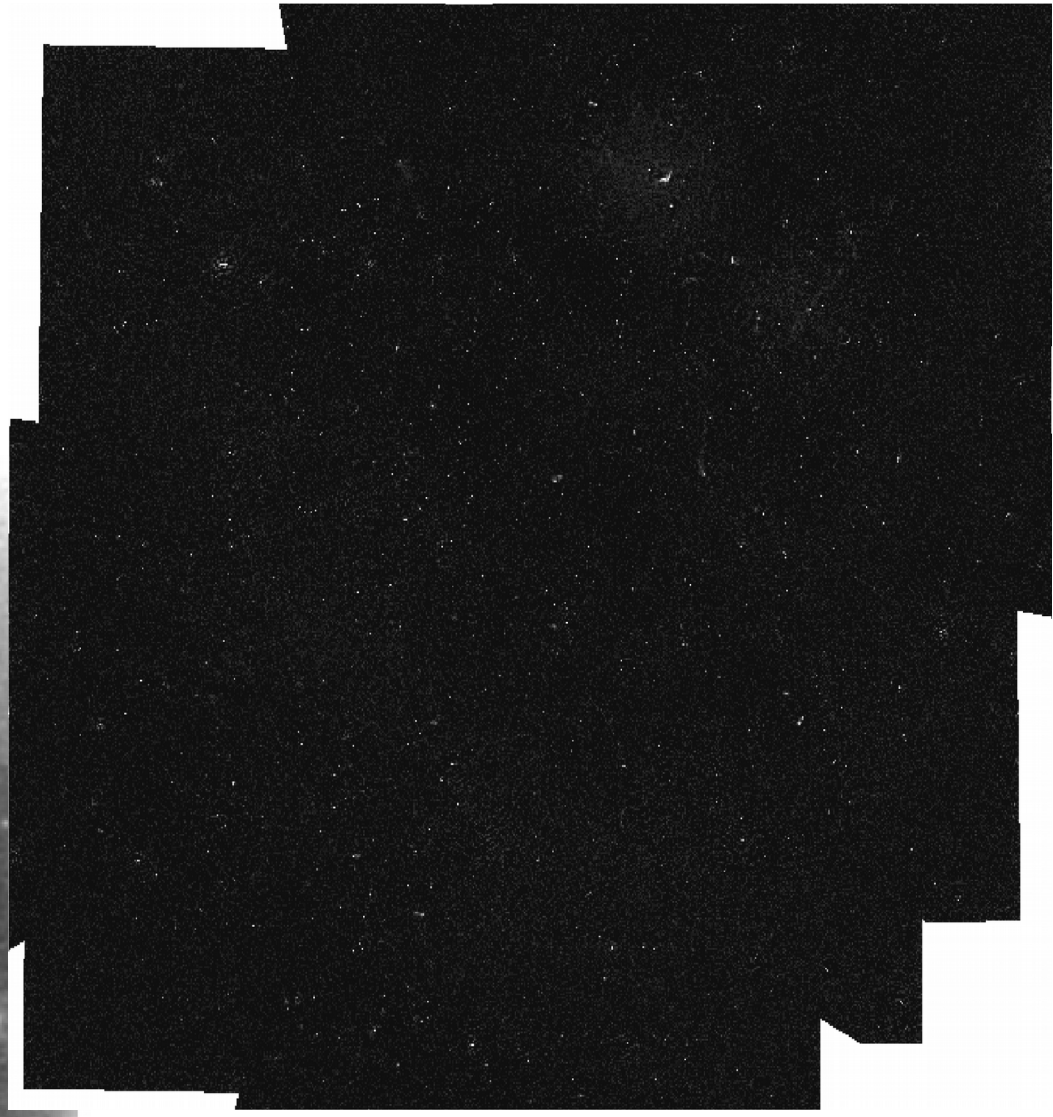

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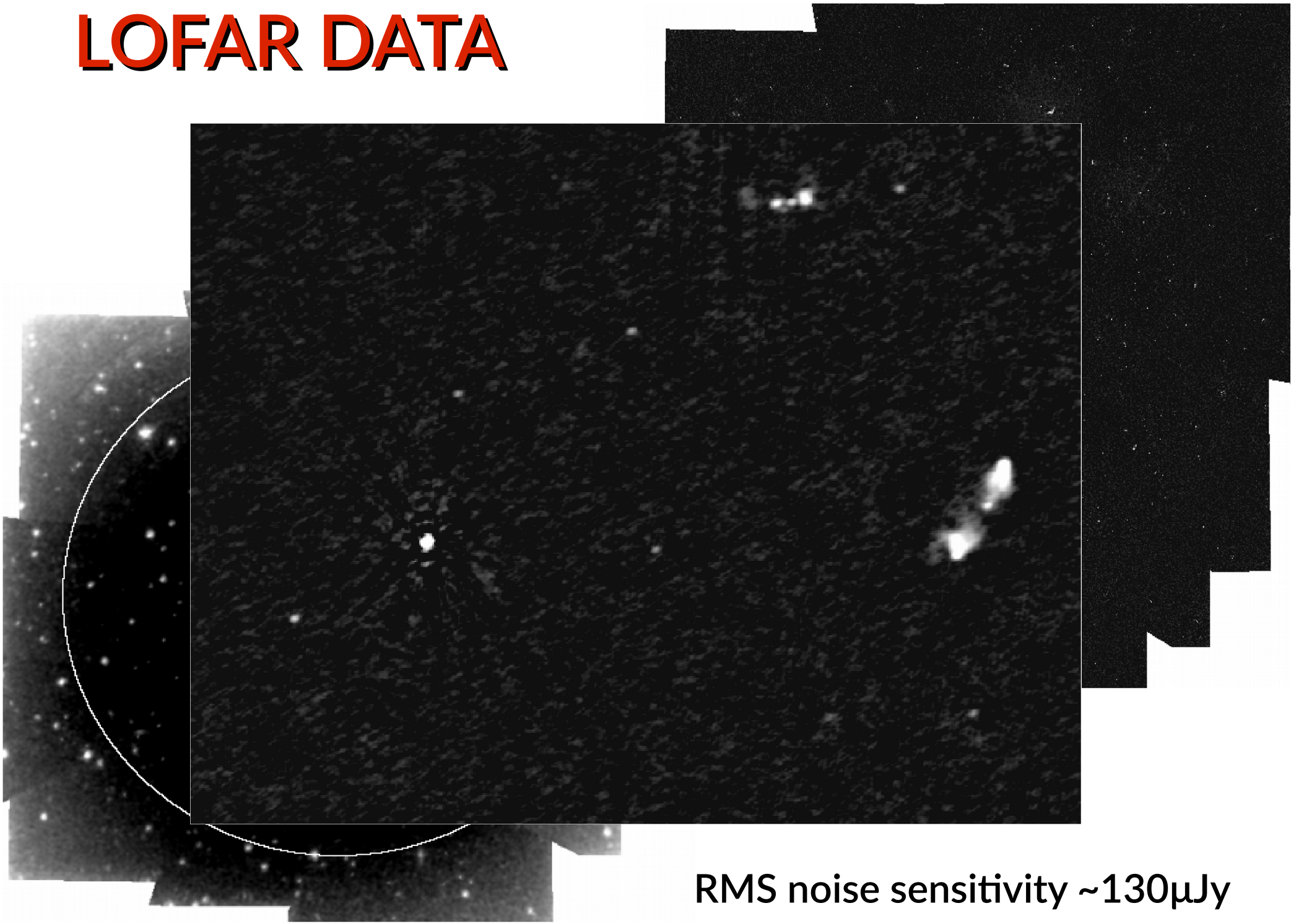
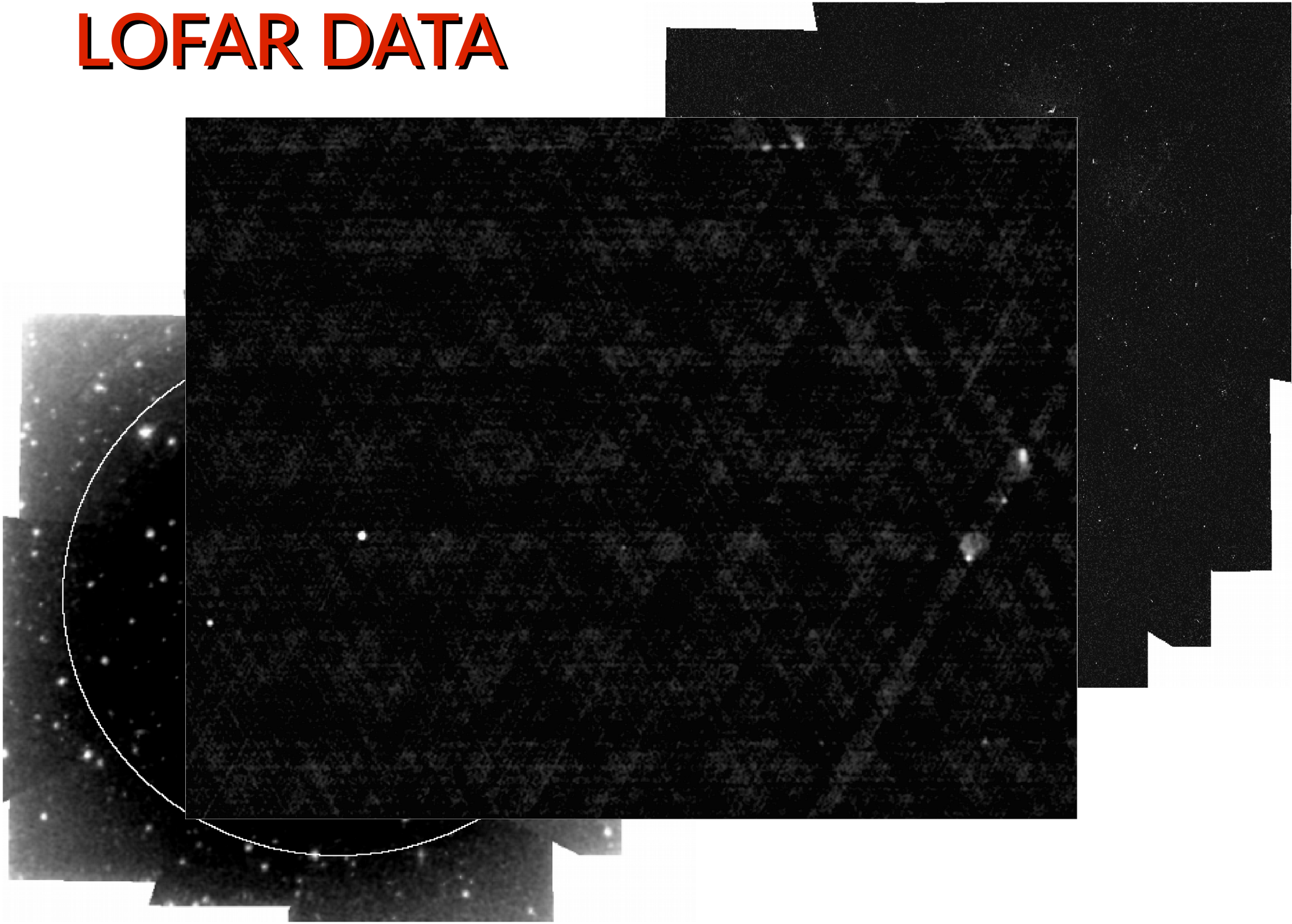


RMS noise sensitivity ~130μJy

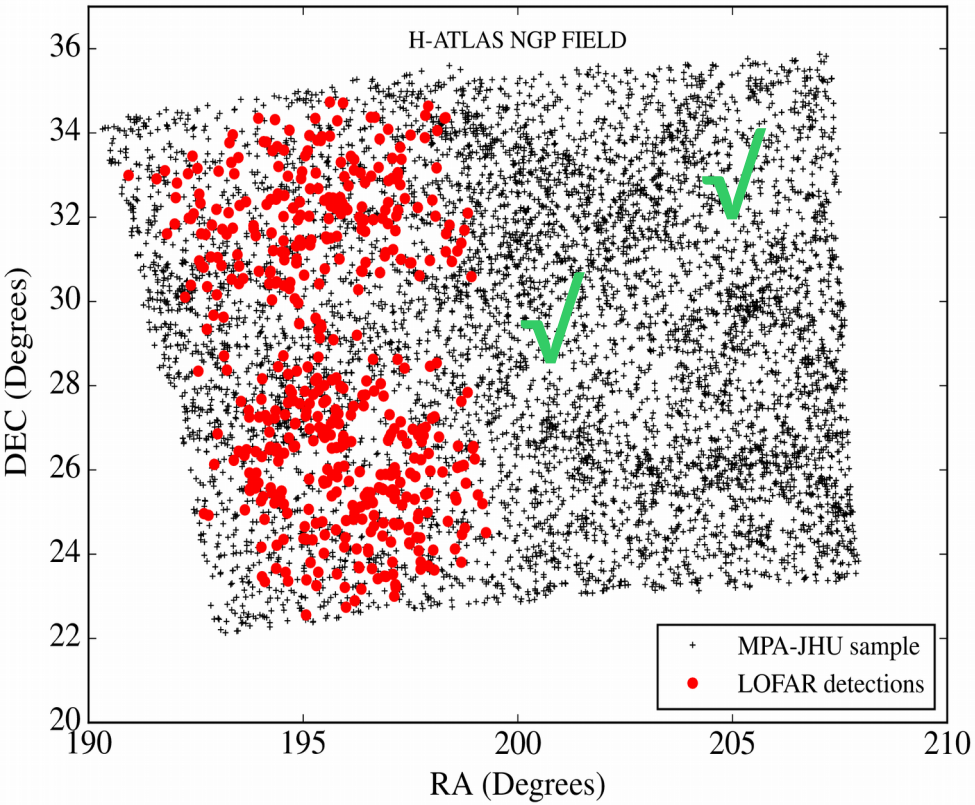
LOFAR DATA

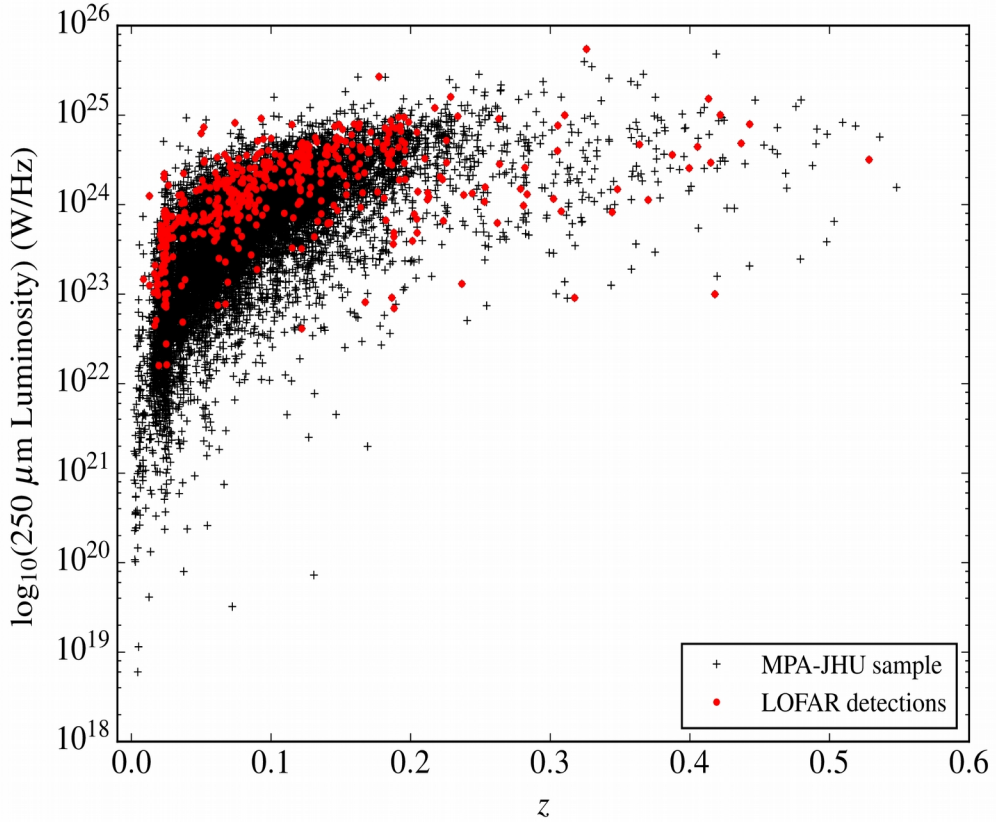


DATA & OBSERVATIONS

MPA-JHU Sample

Star-forming objects	8035
Composite objects	2490
Seyfert galaxies	1190
Radio-loud AGN	613

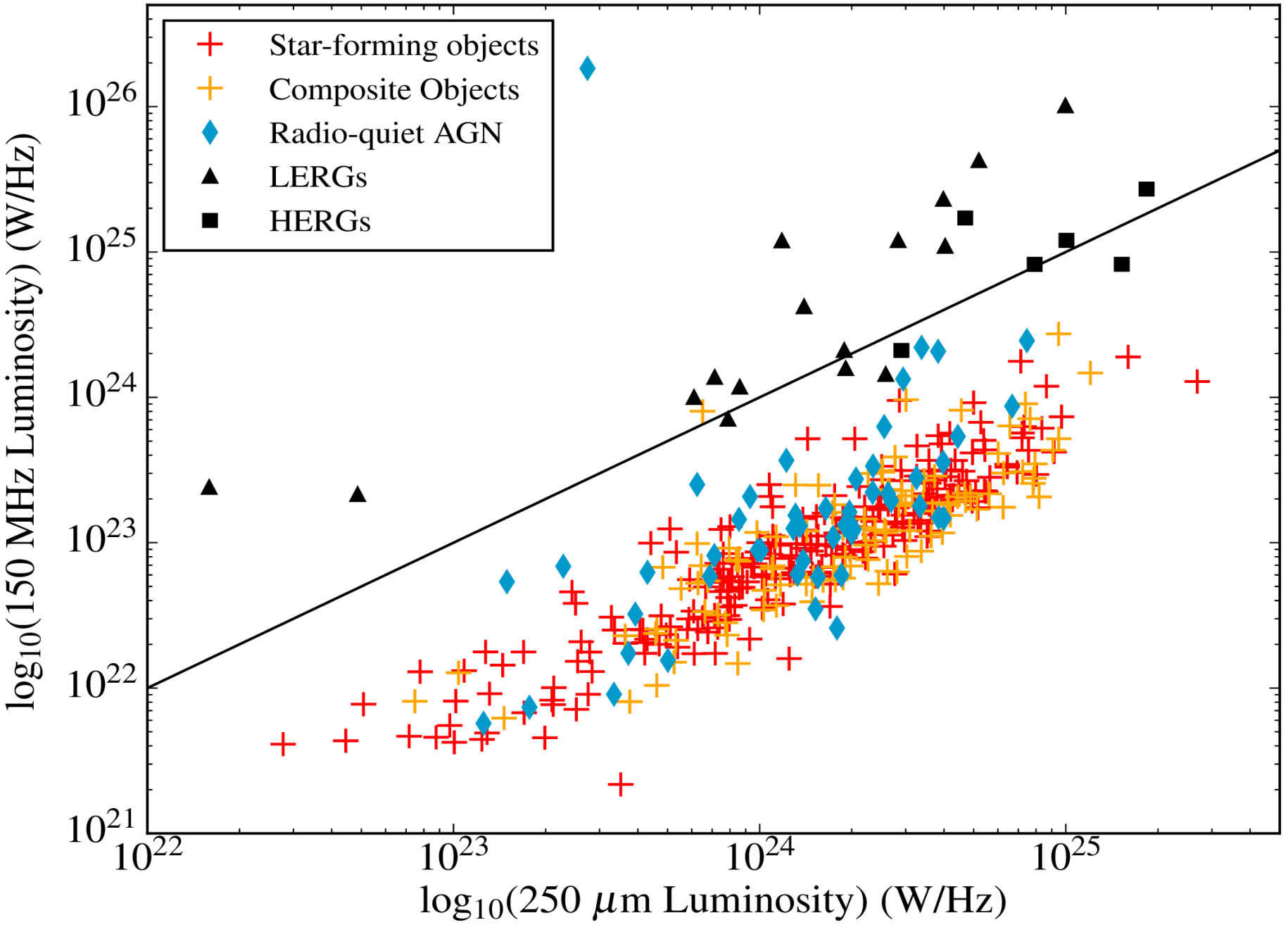




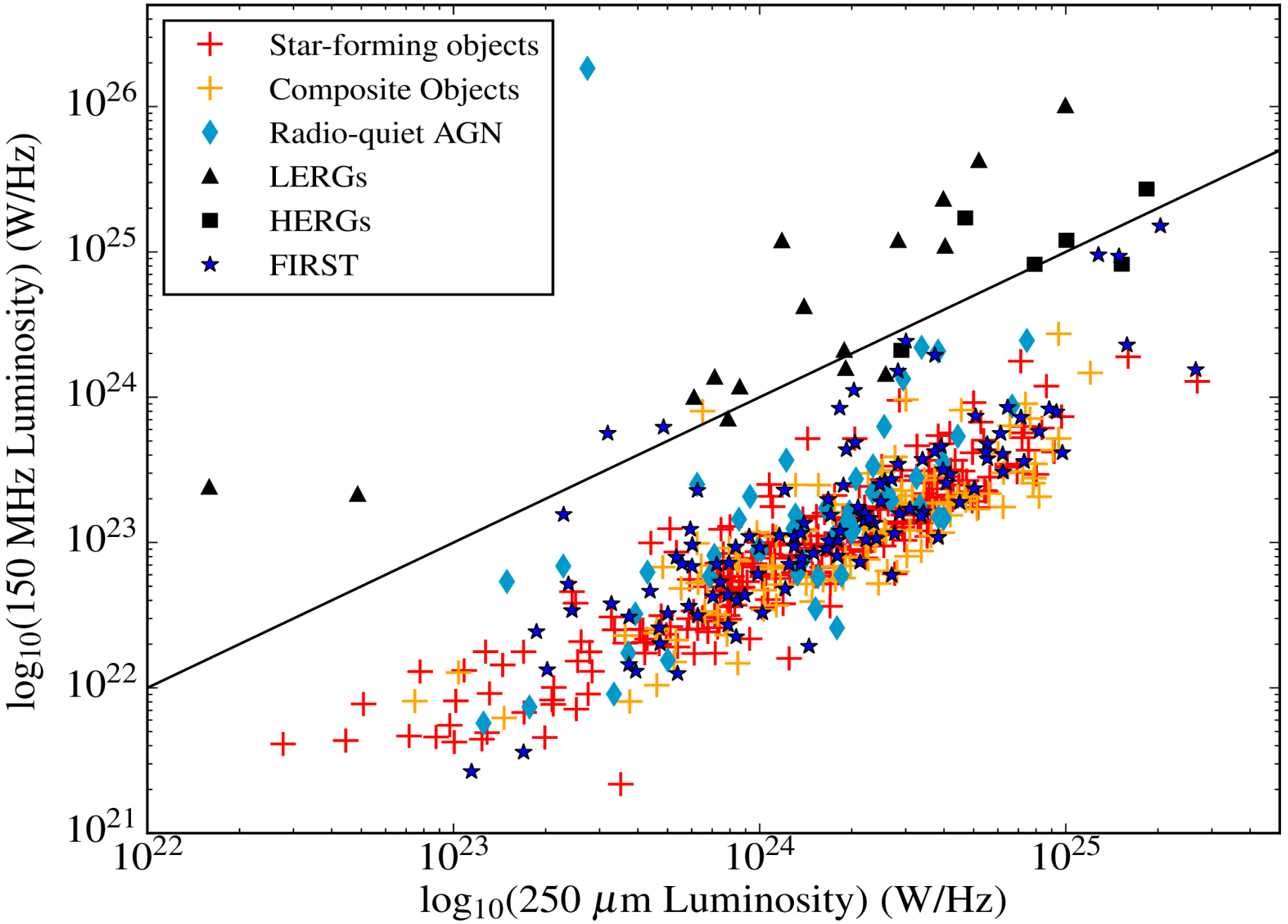
LOFAR detection rate:

Star-forming objects	232
Composite objects	106
Seyfert galaxies	52
Radio-loud AGN	99

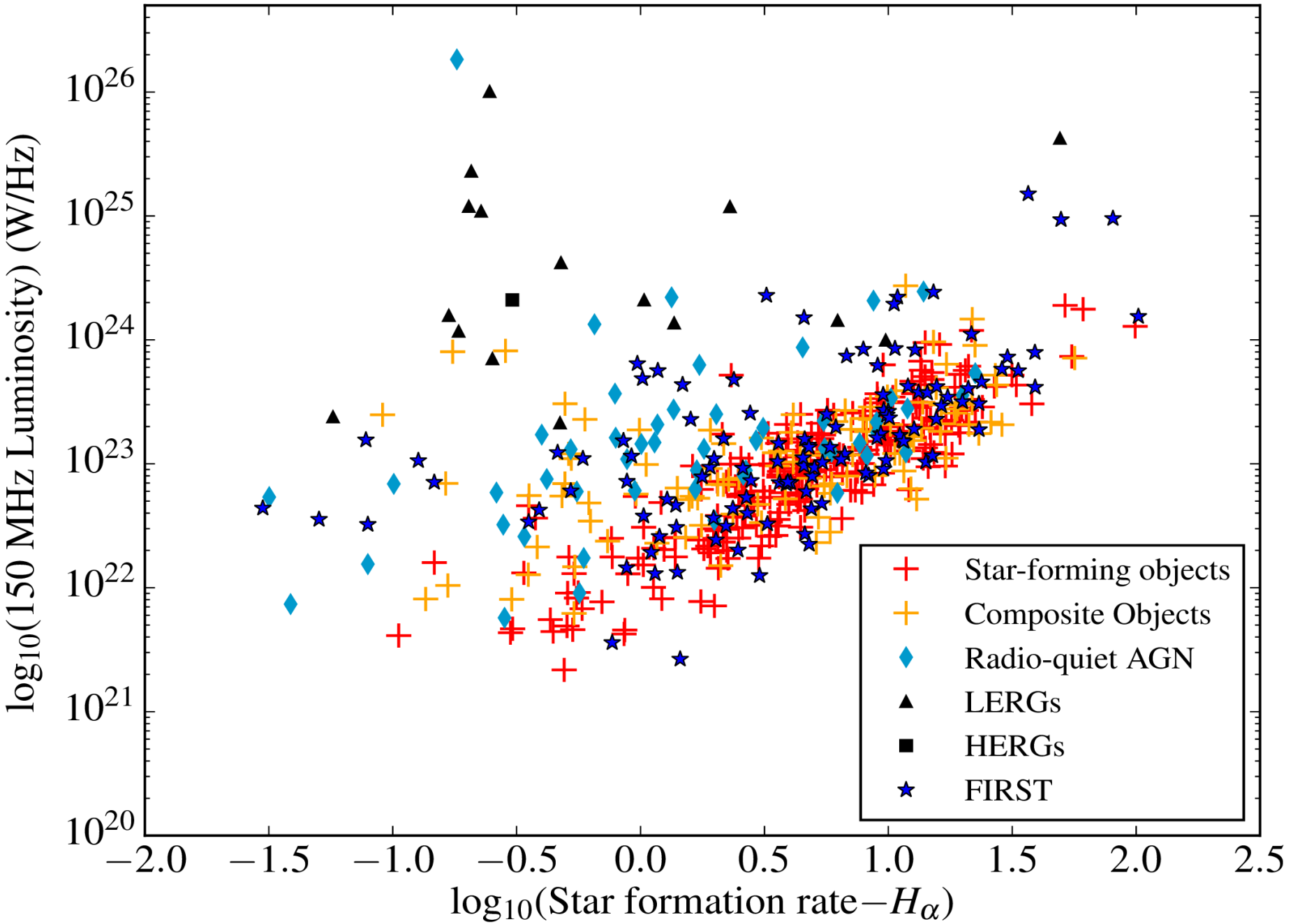
LOFAR / FAR-IR

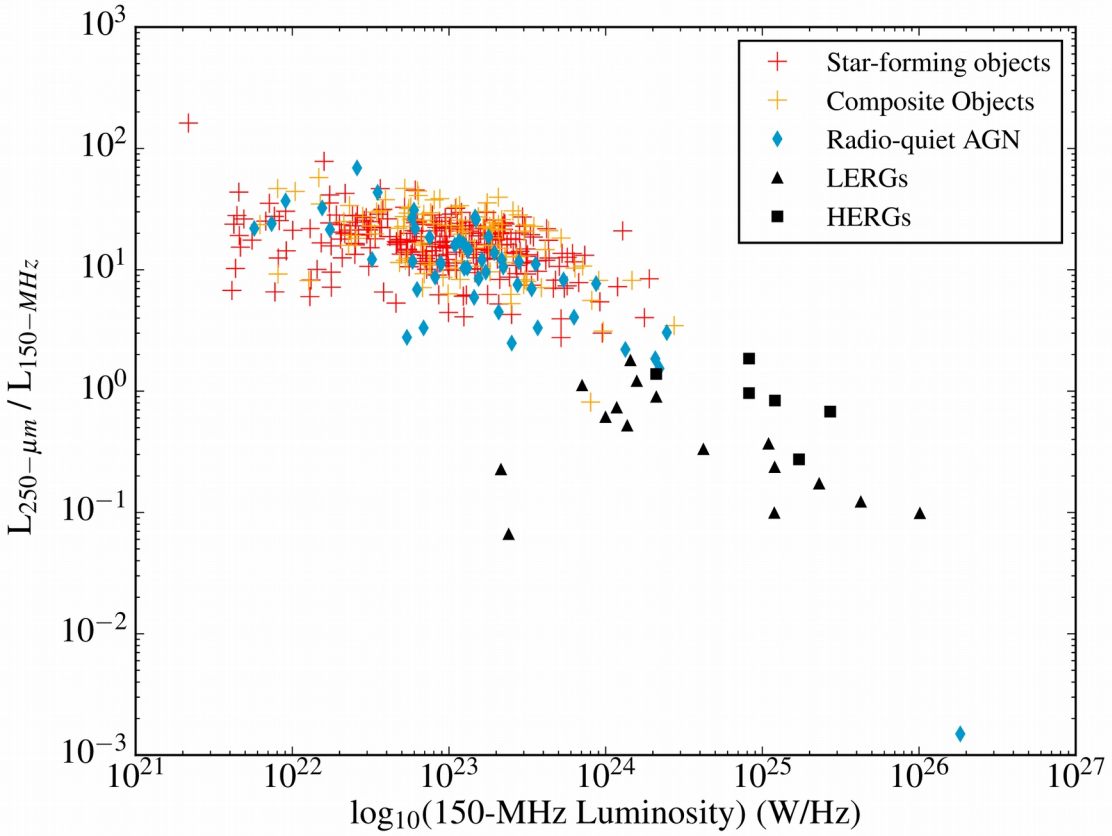

Star-forming objects
Composite Objects
Radio-quiet AGN
LERGs
HERGs
10^{26}
10^{25}
10^{24}
10^{23}
10^{22}
10^{21}
10^{22}
10^{23}
10^{24}
10^{25}
$\log_{10}$(150 MHz Luminosity) (W/Hz)
$\log_{10}$(250 μm Luminosity) (W/Hz)

LOFAR / FAR-IR


Star-forming objects
Composite Objects
Radio-quiet AGN
LERGs
HERGs
FIRST
10^{26}
10^{25}
10^{24}
10^{23}
10^{22}
10^{21}
10^{22}
10^{23}
10^{24}
10^{25}
$\log_{10}$(150 MHz Luminosity) (W/Hz)
$\log_{10}$(250 μm Luminosity) (W/Hz)

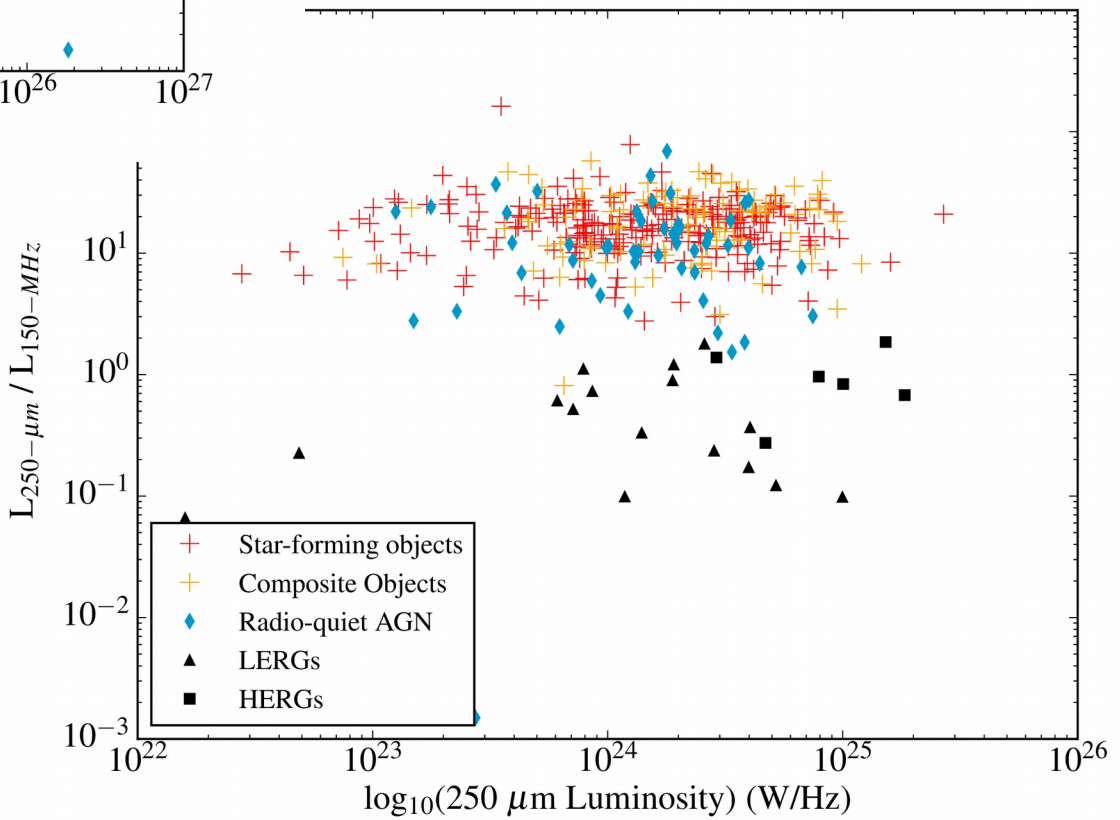
LOFAR / SFR-Hα


10^{26}
10^{25}
10^{24}
10^{23}
10^{22}
10^{21}
10^{20}
$\log_{10}$(150 MHz Luminosity) (W/Hz)
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
2.5
$\log_{10}$(Star formation rate−H_α)
Star-forming objects
Composite Objects
Radio-quiet AGN
LERGs
HERGs
FIRST



← q_{FIR} / $L_{150\text{-}MHz}$

q_{FIR} / $L_{250\text{-}\mu m}$ →



FUTURE PROSPECTS

- More sources – remaining 2 fields

- Estimating the relations between SFR and 150-MHz luminosity

- Measuring LOFAR flux for each source in the parent sample

- Stacking 150-MHz luminosities as a function of their SFRs

KEY TAKE AWAY MESSAGE !

RADIO / FAR-IR RELATION

We do not see any difference
@ low radio frequencies!

KEY TAKE AWAY MESSAGE !

RADIO / FAR-IR RELATION

We do not see any difference
@ low radio frequencies!

LOFAR data

More sensitive and deeper than FIRST!

BUT...

KEEP
CALM
AND
STAY
TUNED