International Centre for Radio Astronomy Research

Disentangling the radio emission from 'radio-quiet' quasars

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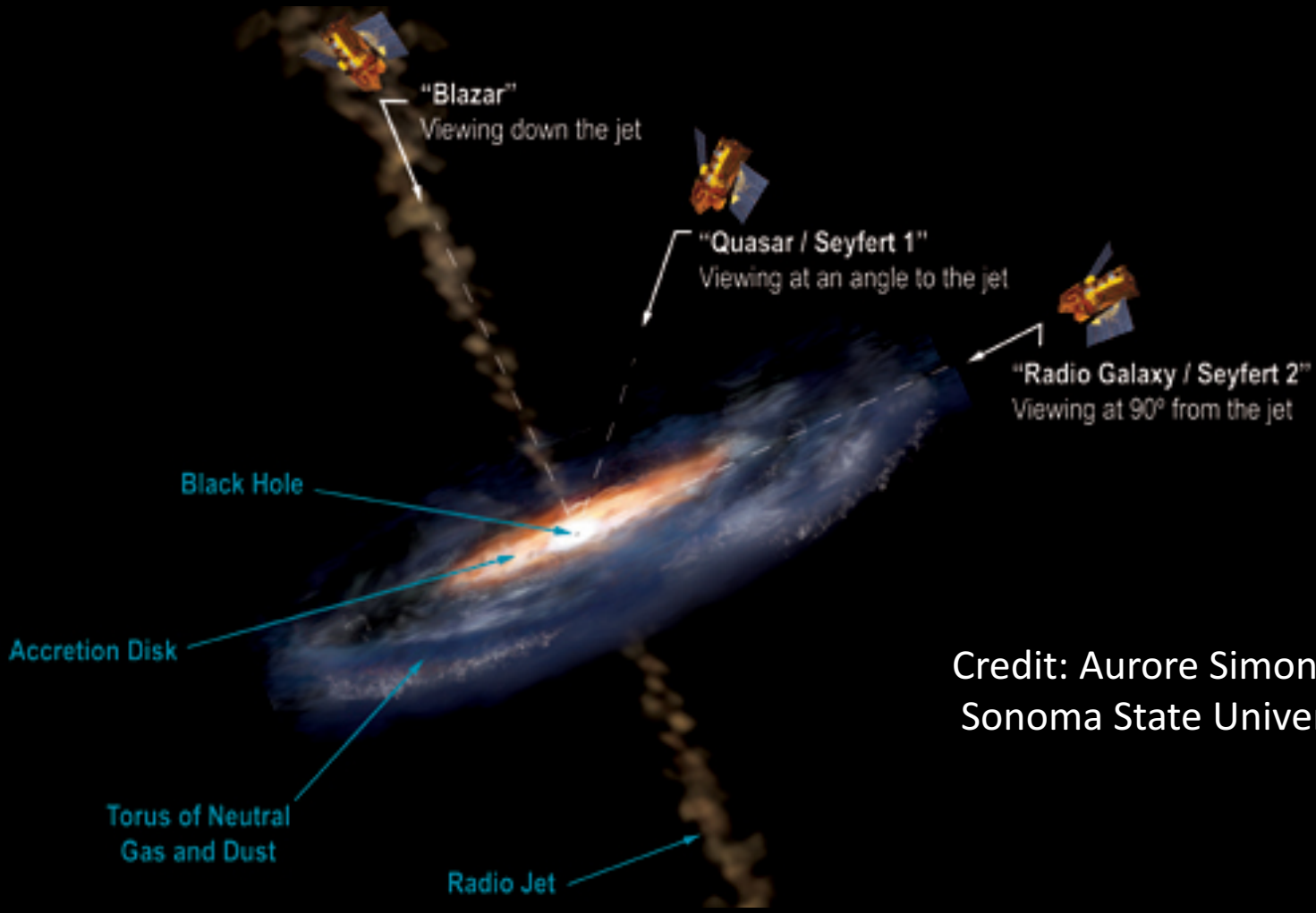
Government of Western Australia
Department of the Premier and Cabinet
Office of Science

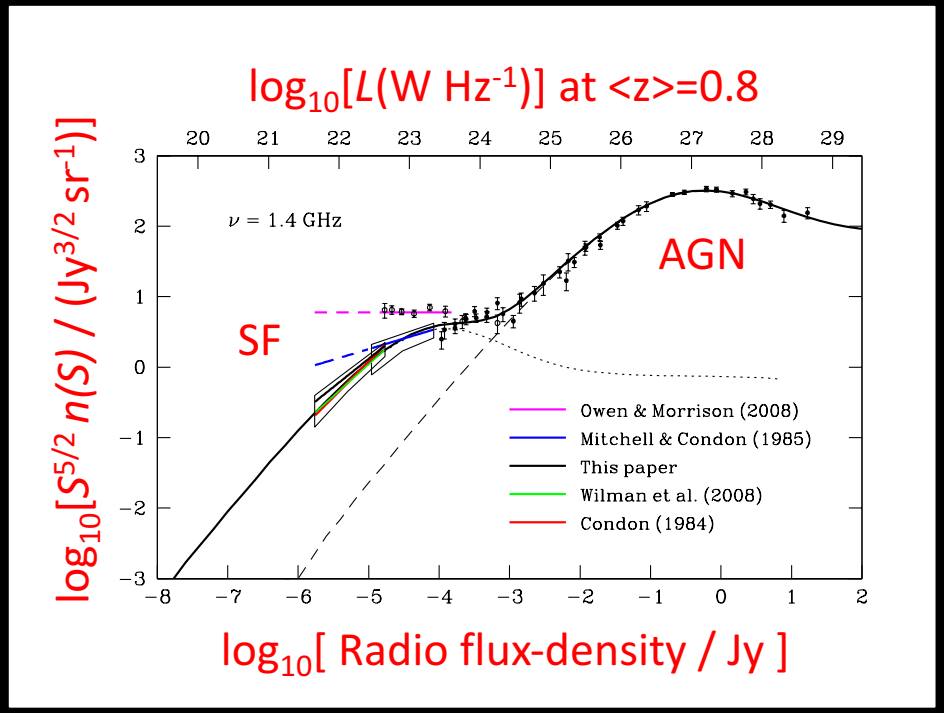
Active Galactic Nuclei (AGN)



Credit: Aurore Simonnet, Sonoma State University

Radio emission from star formation and accretion

Brightness-weighted number counts

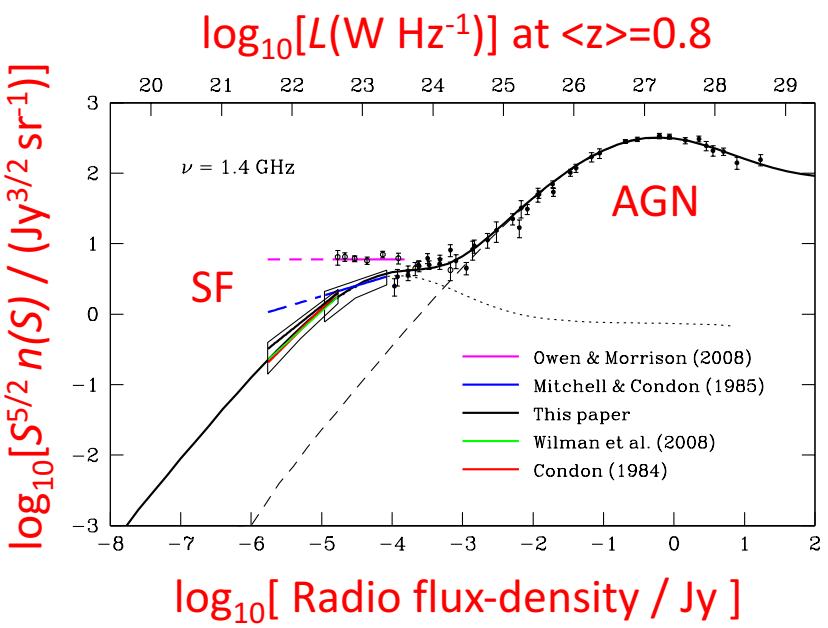


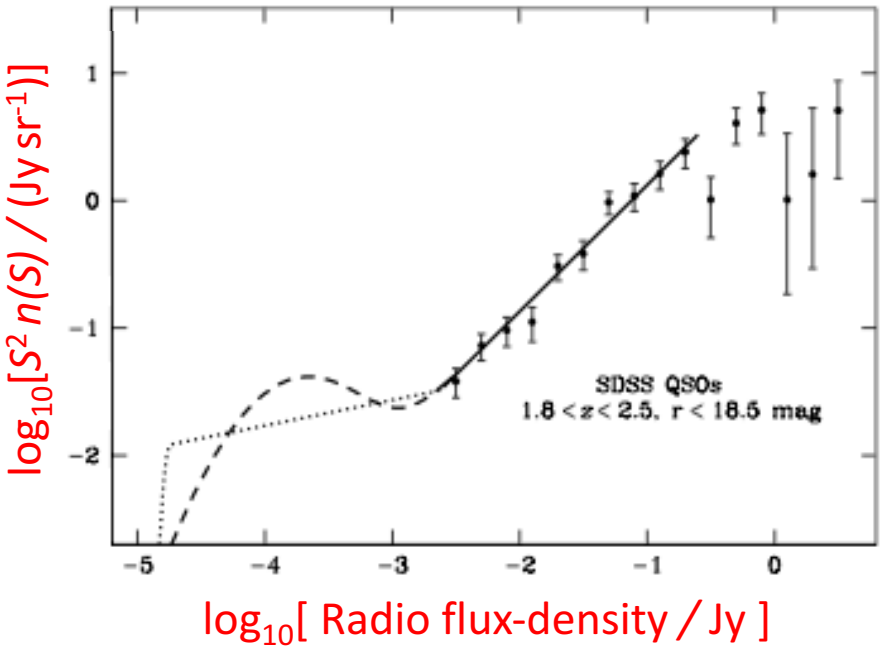
Condon et al. (2012)

All radio sources, < *z* > = 0.8

Does SF dominate the radio emission in RQQs?

Brightness-weighted number counts





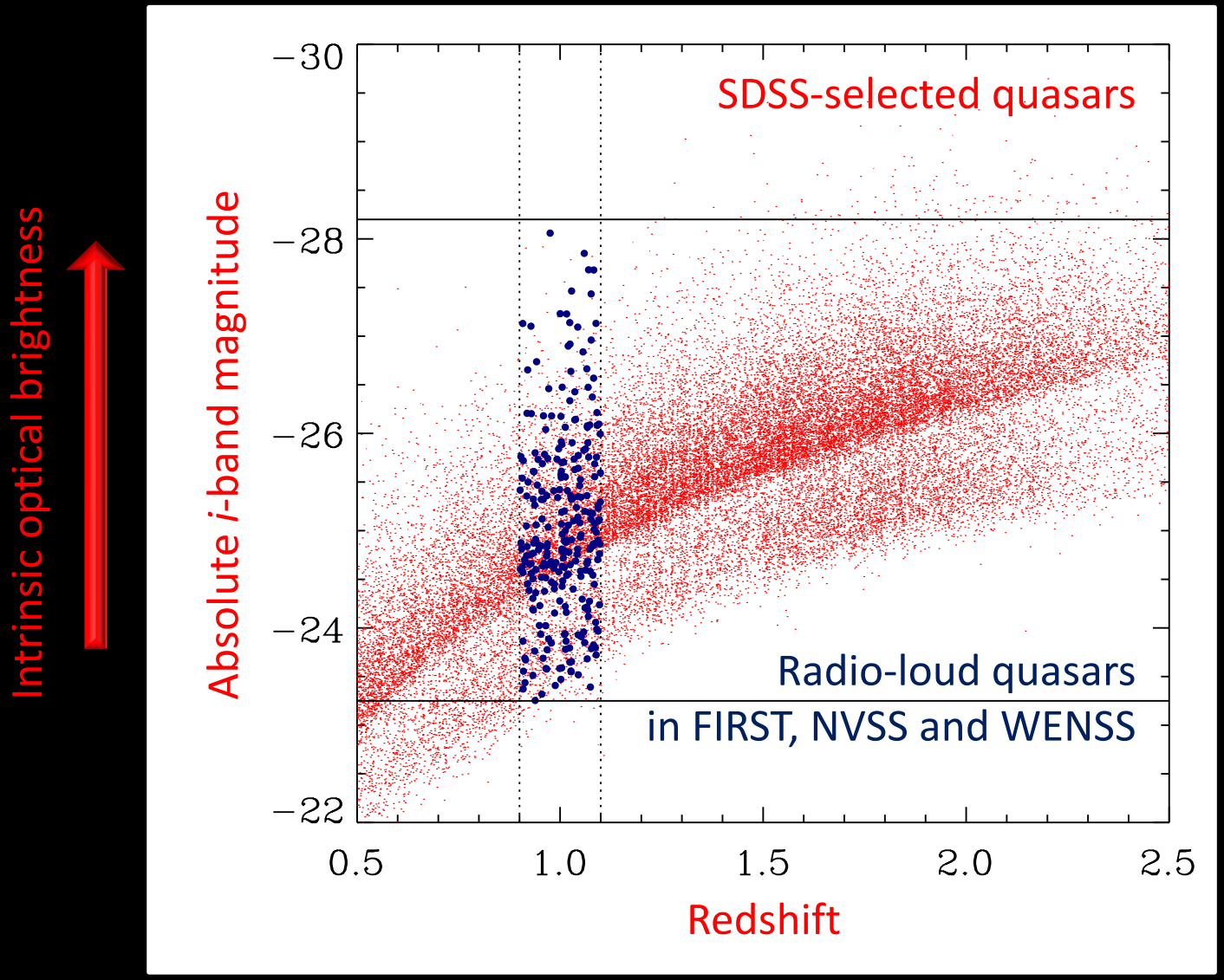
Condon et al. (2012)

All radio sources, < *z* > = 0.8

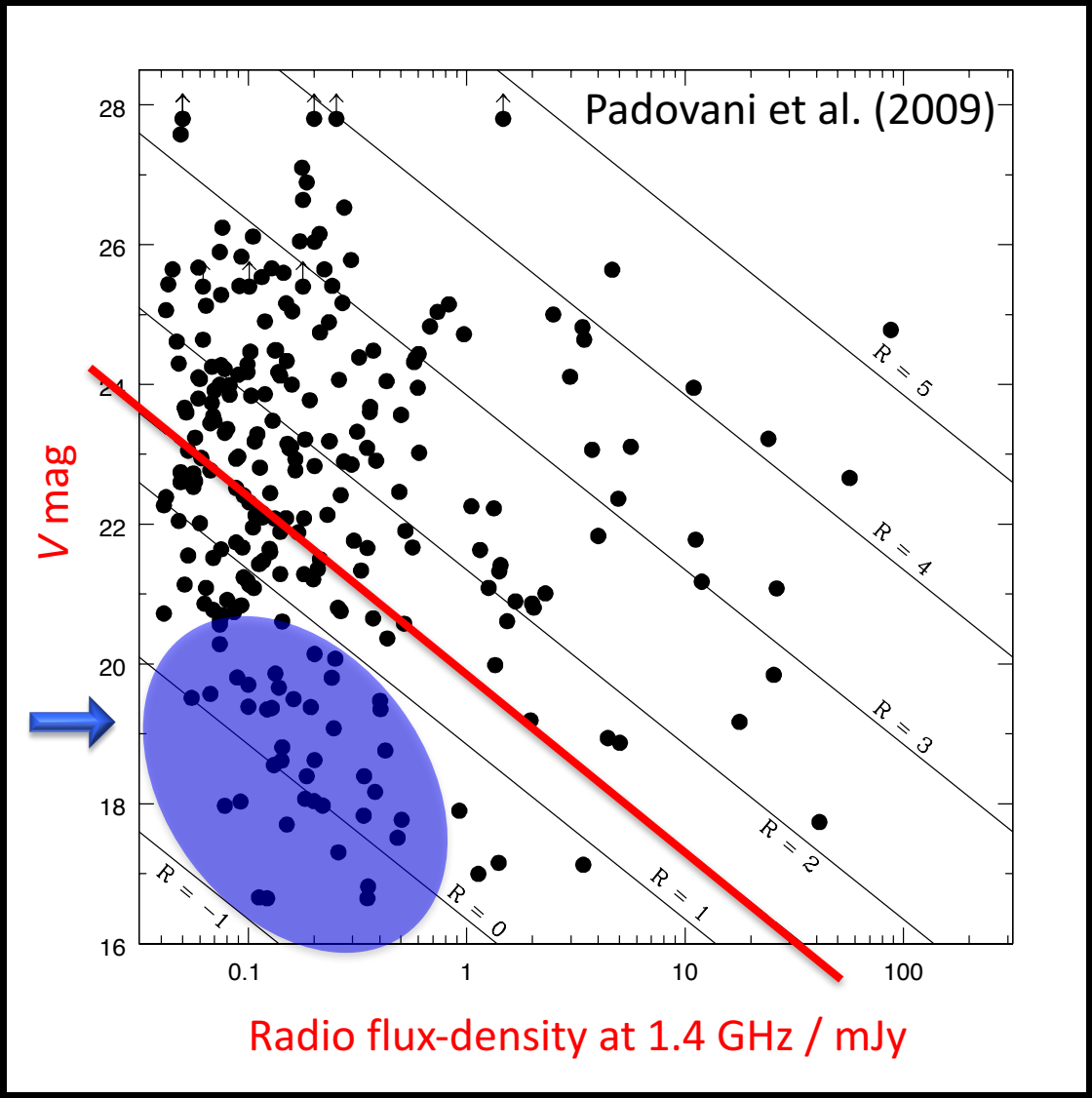
Condon et al. (2013)

Optically-selected quasars, 1.8 < *z* < 2.5

Quasar sample from SDSS



The radio/optical definition of ‘radio quiet’

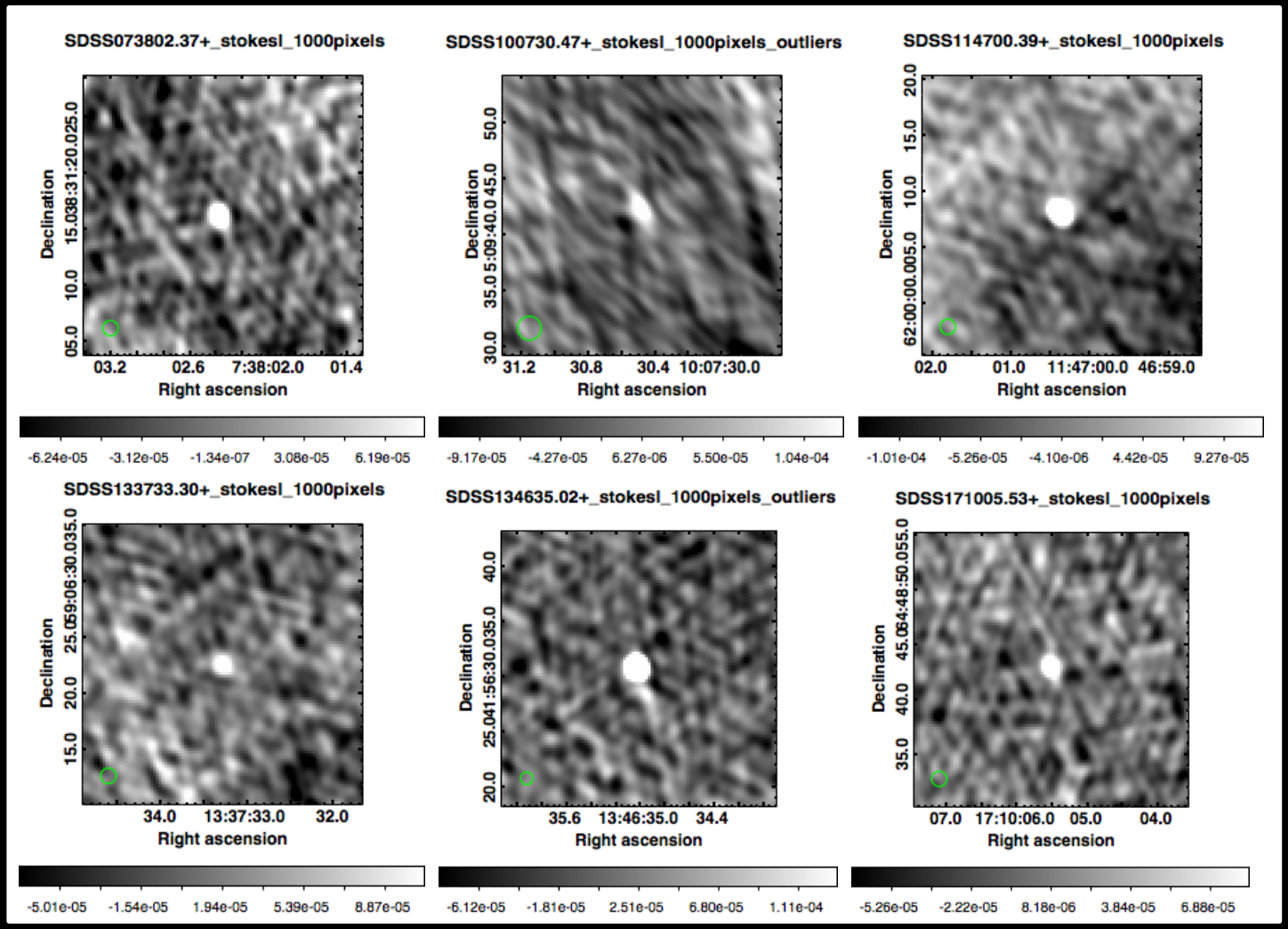


Radio loud

This sample

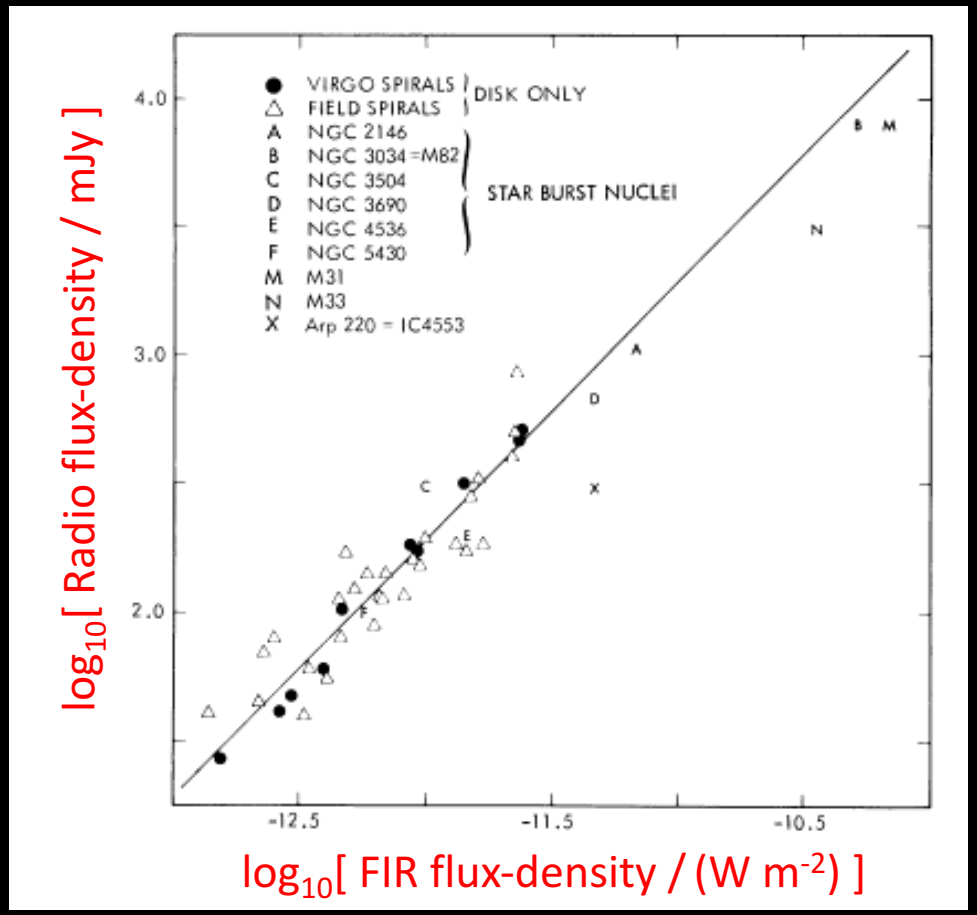
Radio quiet

Detections with the JVLA



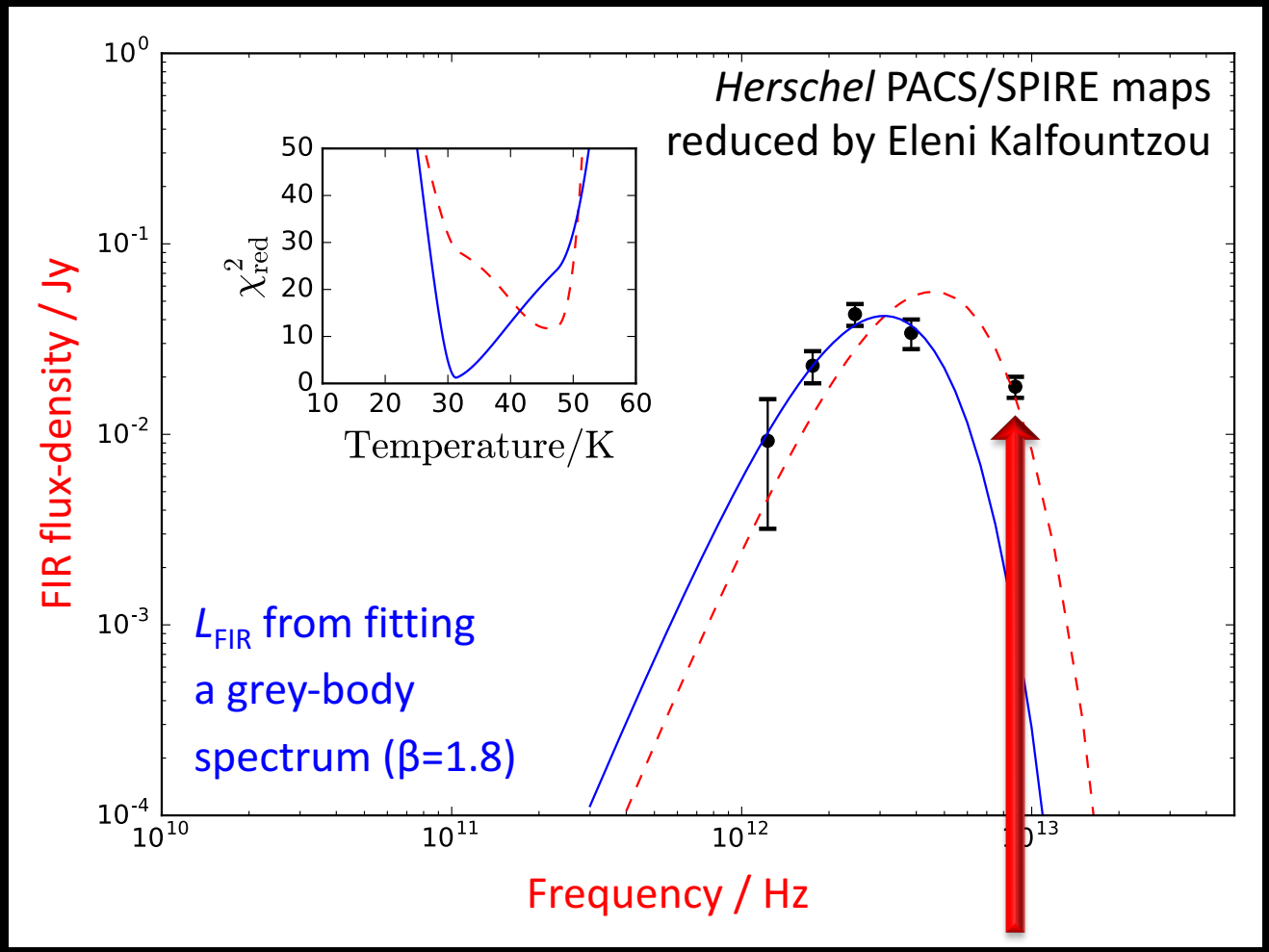
30/70 RQQs detected at 3σ - White et al. (2017), arXiv:1702.00904

The Far-Infrared to Radio Correlation (FIRC)



Far-Infrared Radio Correlation (FIRC), e.g. Helou et al. (1985)

FIR luminosity from fitting the dust emission

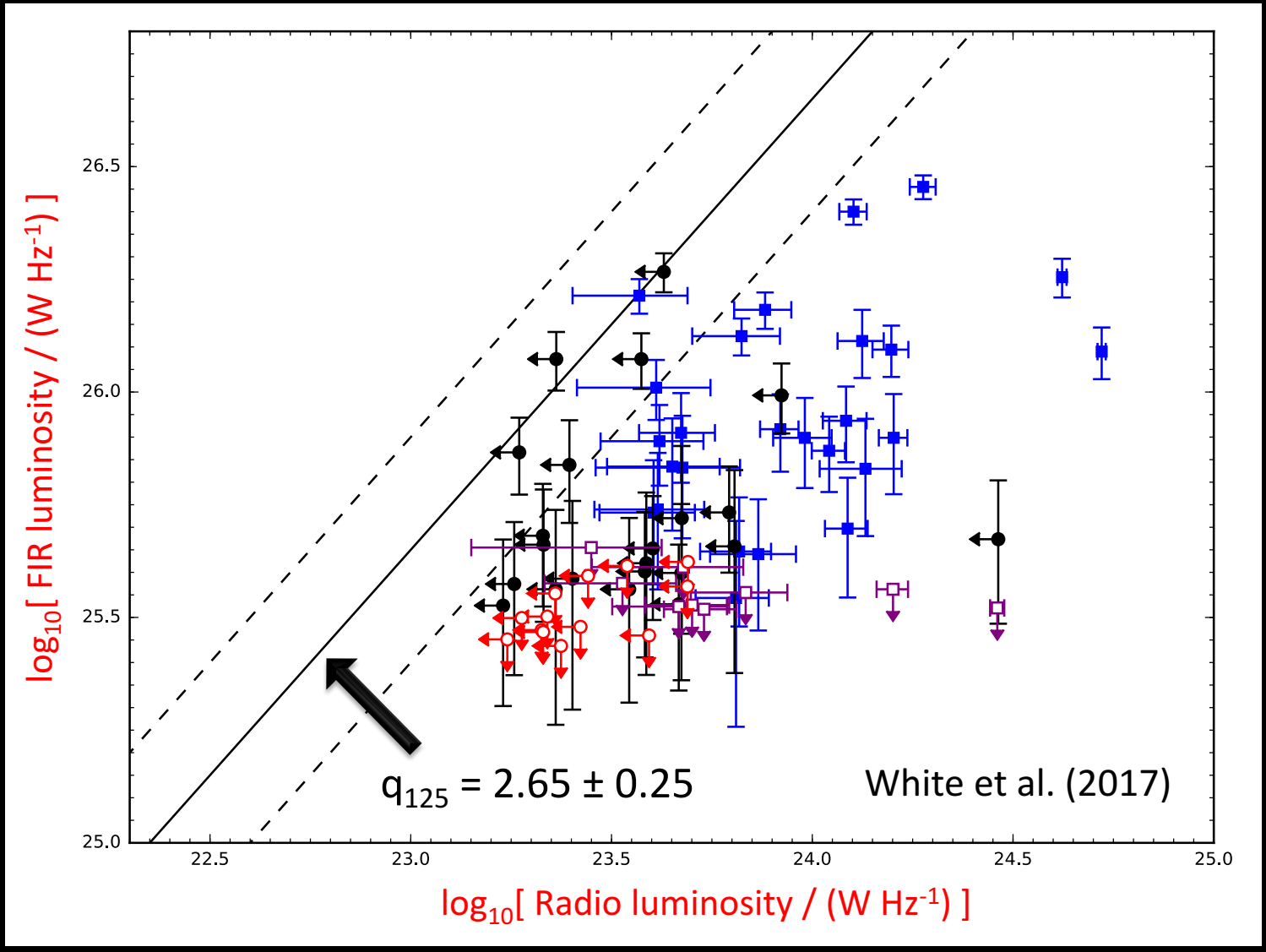


Median temperature = 24.5 K

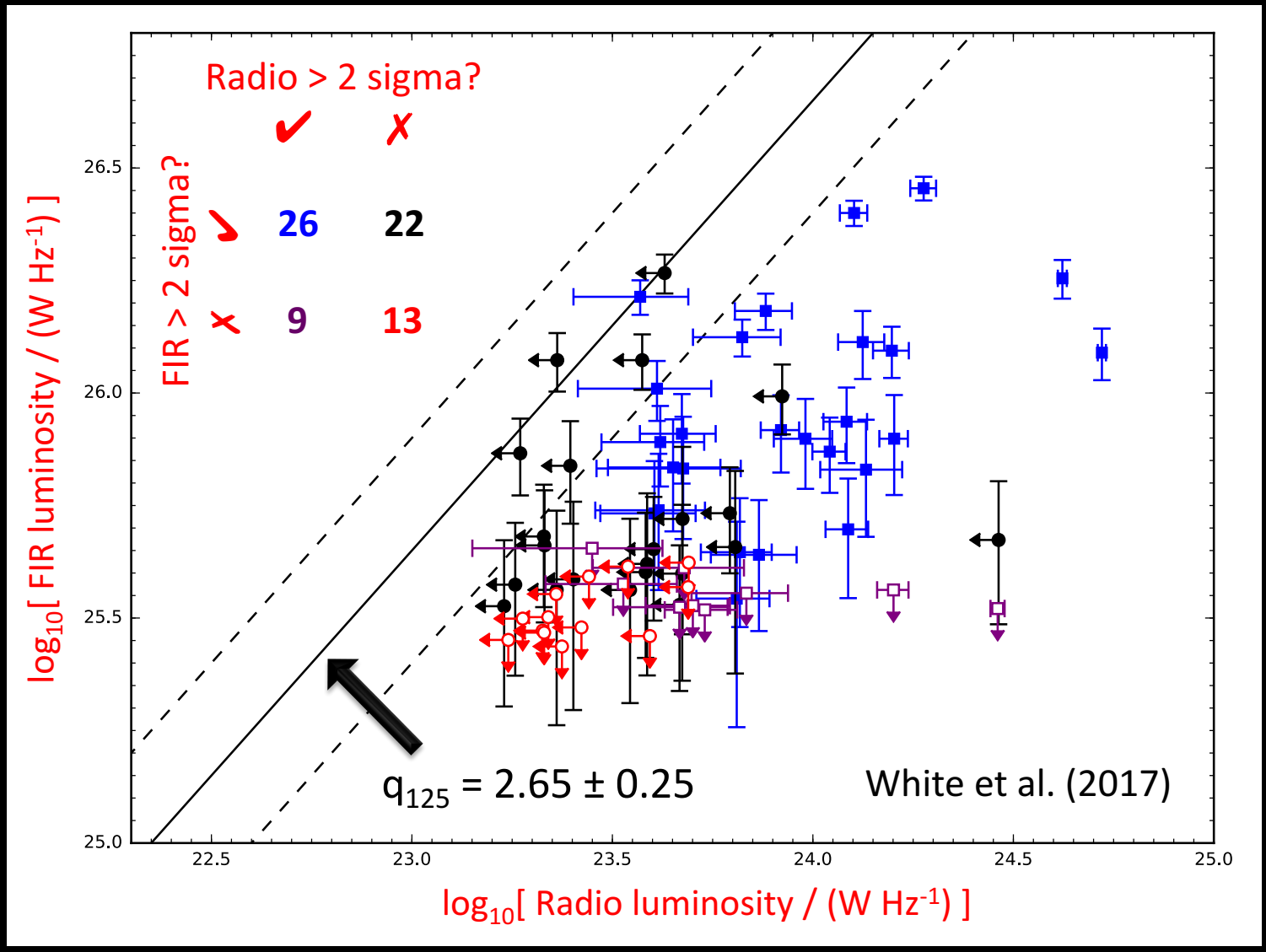
250 μm tracing peak emission at z = 1

70-μm band contaminated by AGN emission

The FIRC for objects at $z \sim 1$

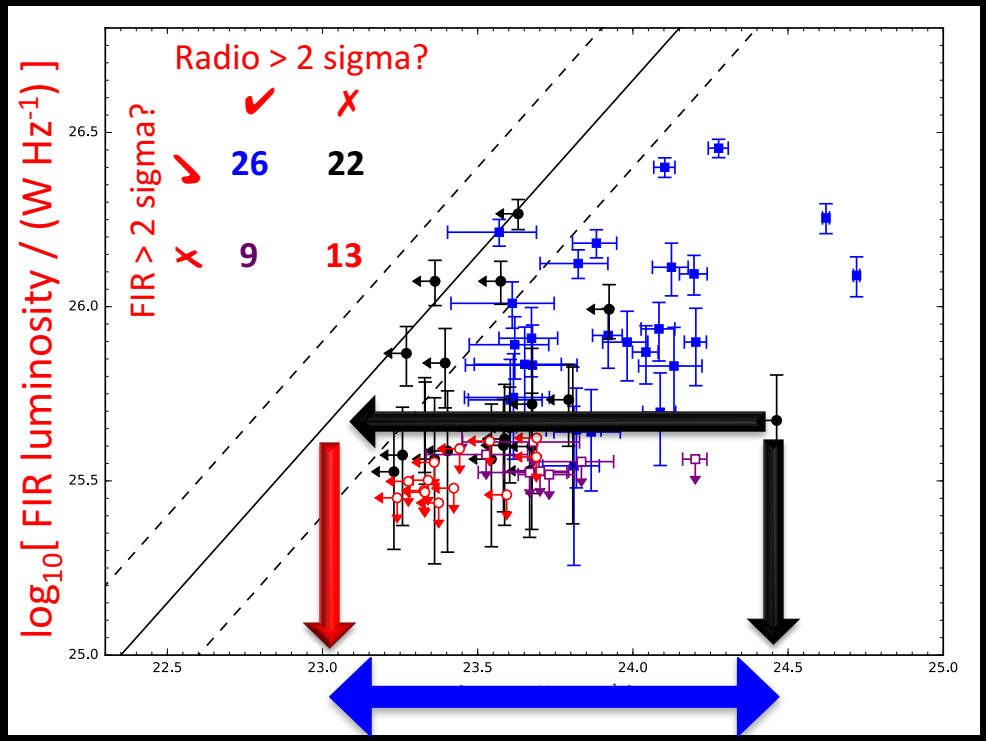


The FIRC for objects at $z \sim 1$



The accretion-related radio emission

White et al. (2017)

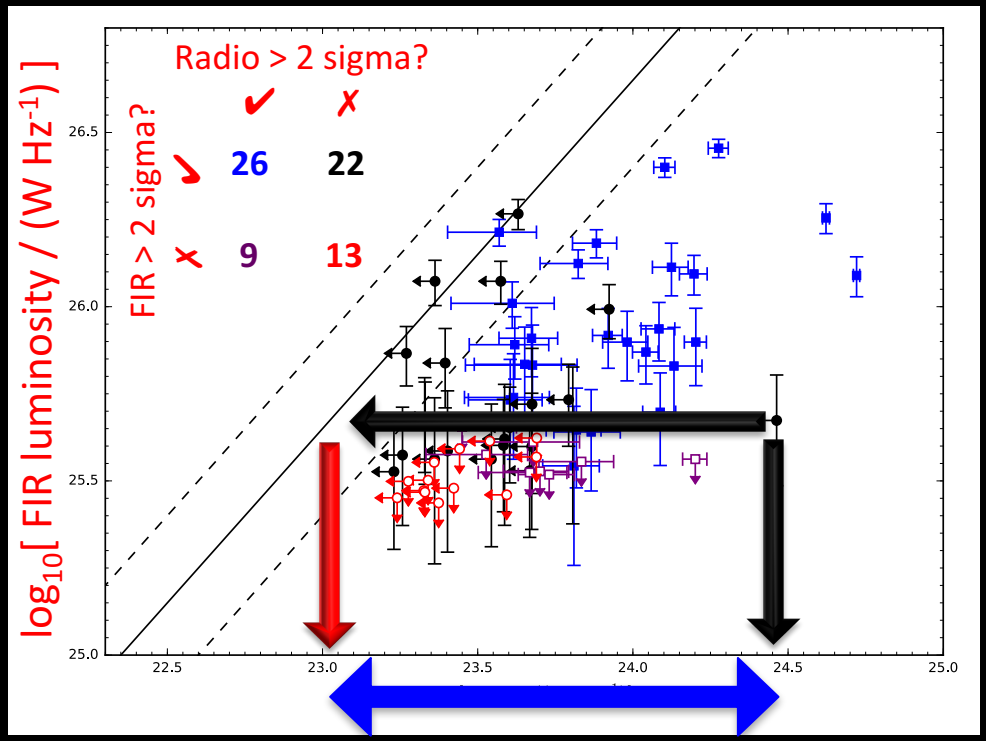


Star-formation radio luminosity

Accretion radio luminosity

The accretion-related radio emission

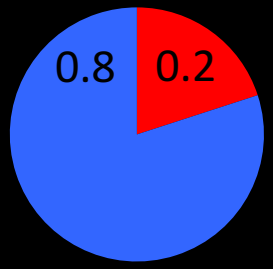
White et al. (2017)



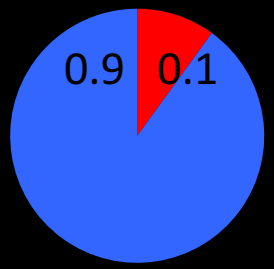
Star-formation radio luminosity

Accretion radio luminosity

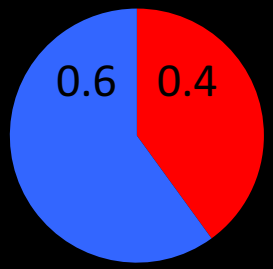
Radio-detection, FIR-detection



Radio-detection, FIR non-detection



Whole sample (lower limits)



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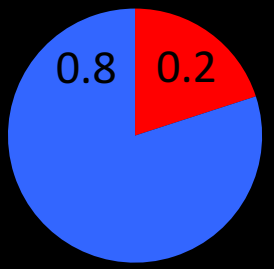
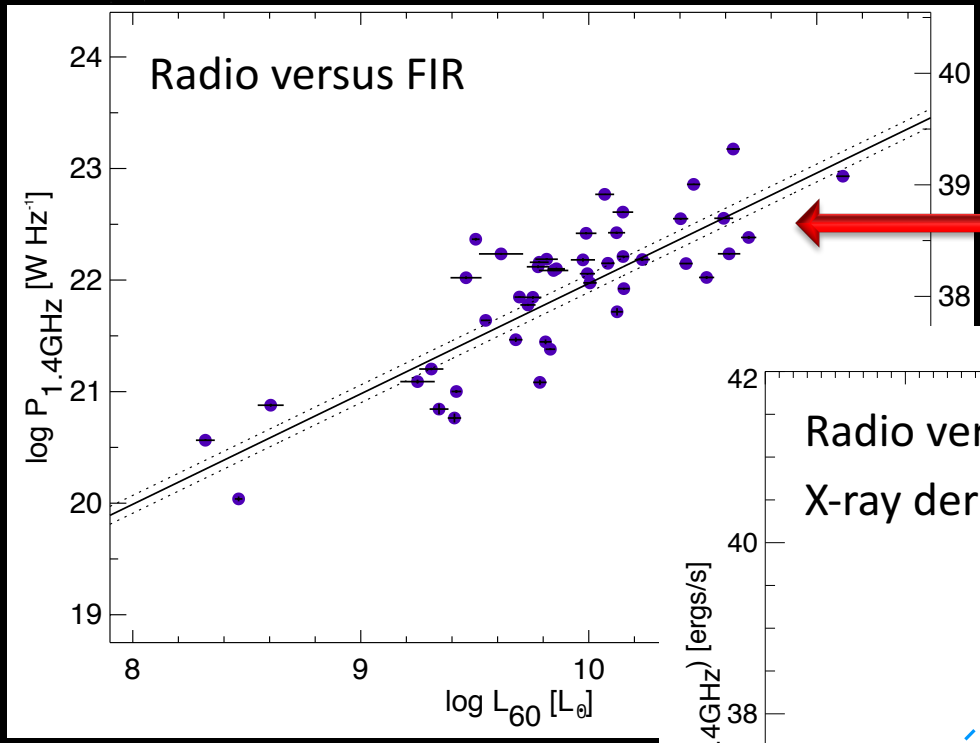
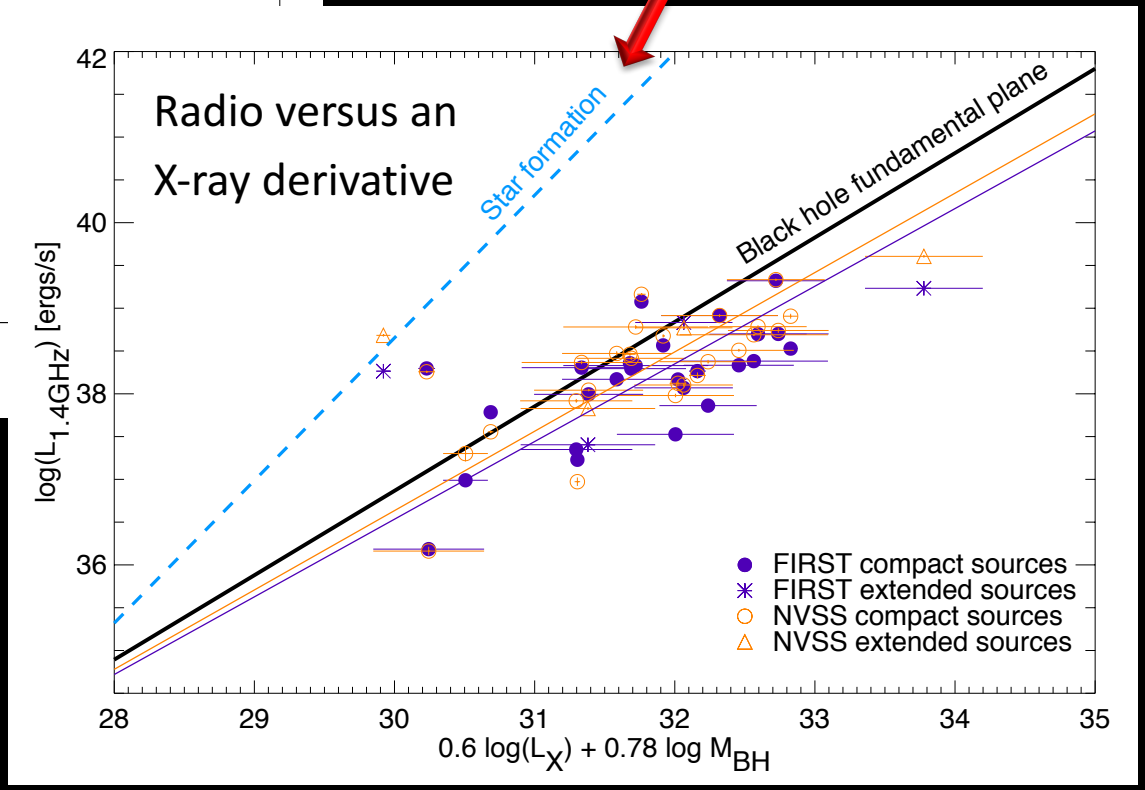


Underestimated, due to exceptions to the FIRC?

Wong et al. (2016)

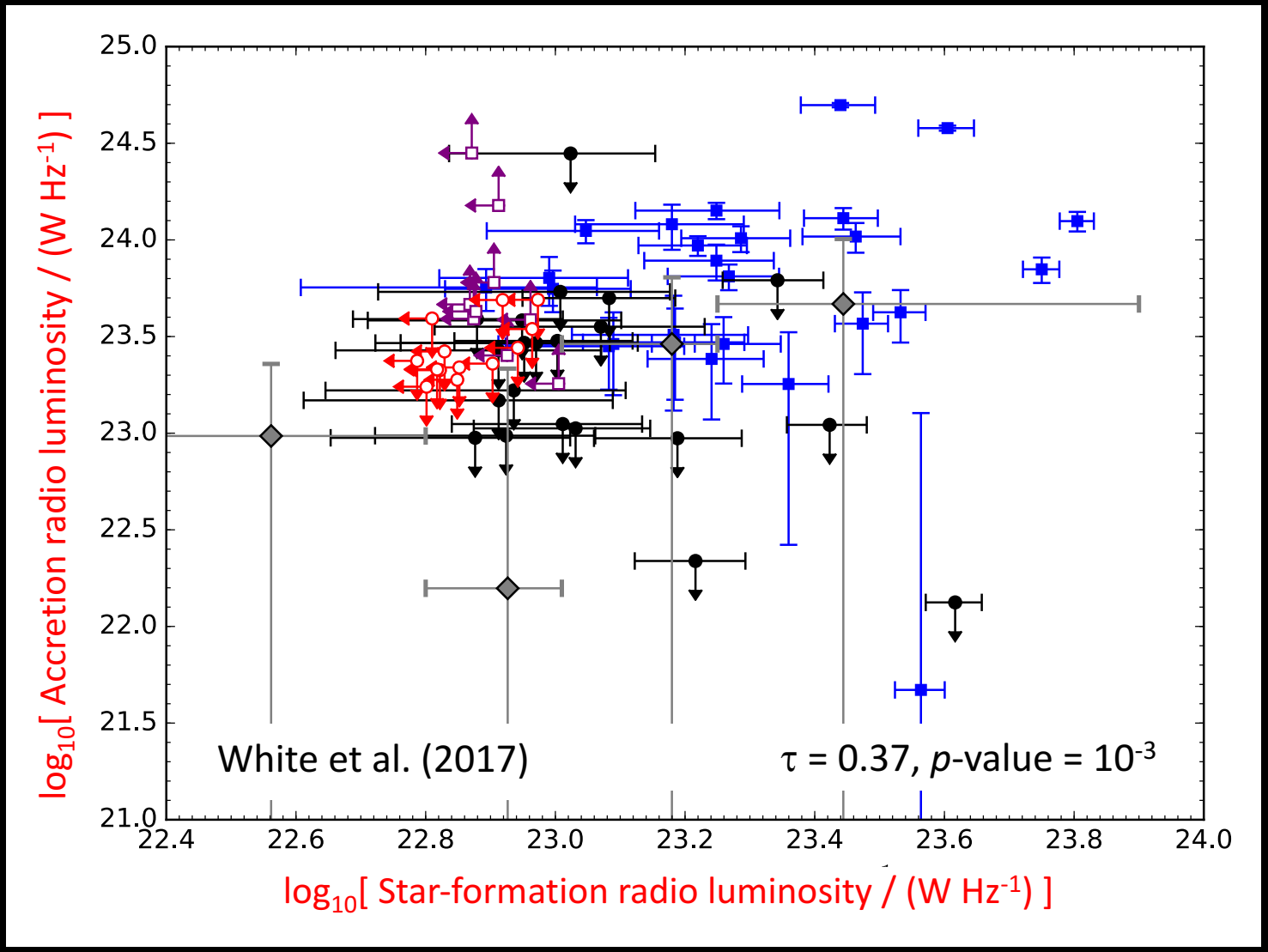


Star-forming galaxies lie along these lines



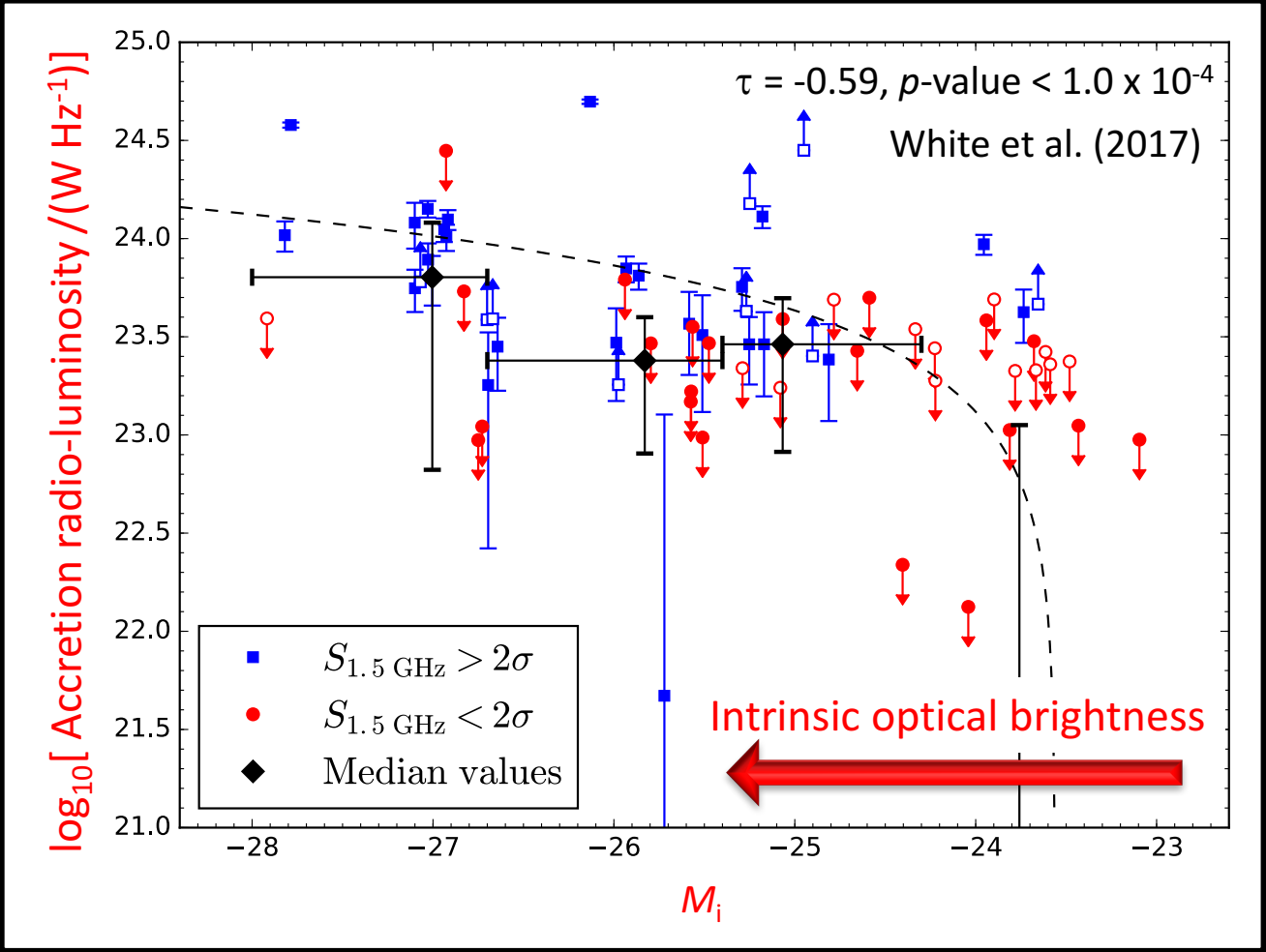
- All are X-ray selected AGN
- They mimic SFGs in the FIR
- …but have a significant accretion component

Accretion vs. star formation



Accretion radio-emission vs. absolute magnitude

Kendall-τ test provides evidence of a correlation



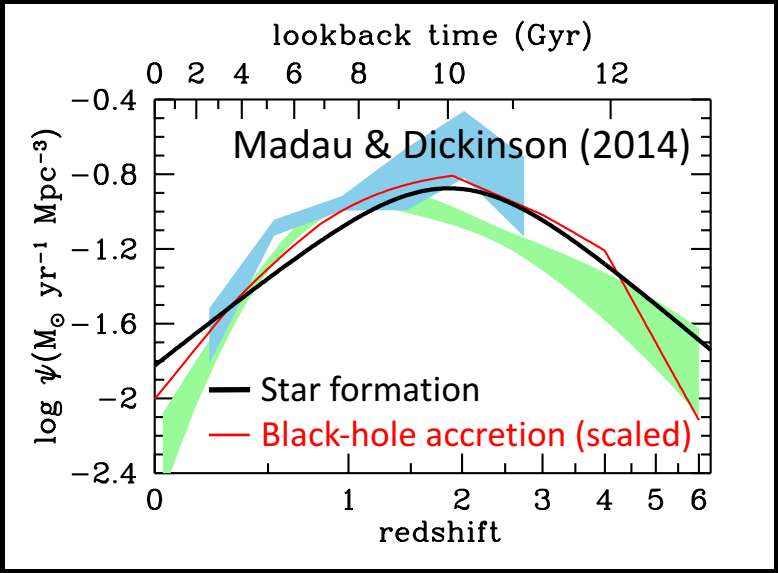
Scatter due to magnetic fields, timescale, or environmental density?

Summary

Radio observations – unbiased tracer of both accretion and star formation

FIR data from *Herschel* + radio data from JVLA + FIR-to-radio correlation
-> separate radio emission from SF and that from the AGN
(White et al. 2017, arXiv:1702.00904)

Black-hole accretion dominates the faint radio emission of 'radio-quiet' quasars -> History of star formation may be over-estimated, whilst accretion may be under-estimated



Statistical evidence of correlation between accretion-related radio emission and optical luminosity (proxy for accretion rate)

The FIRC's temperature dependence

Temperature dependence of the FIRC found by Smith et al. (2014)