AGN Feedback Clusters in MSSS

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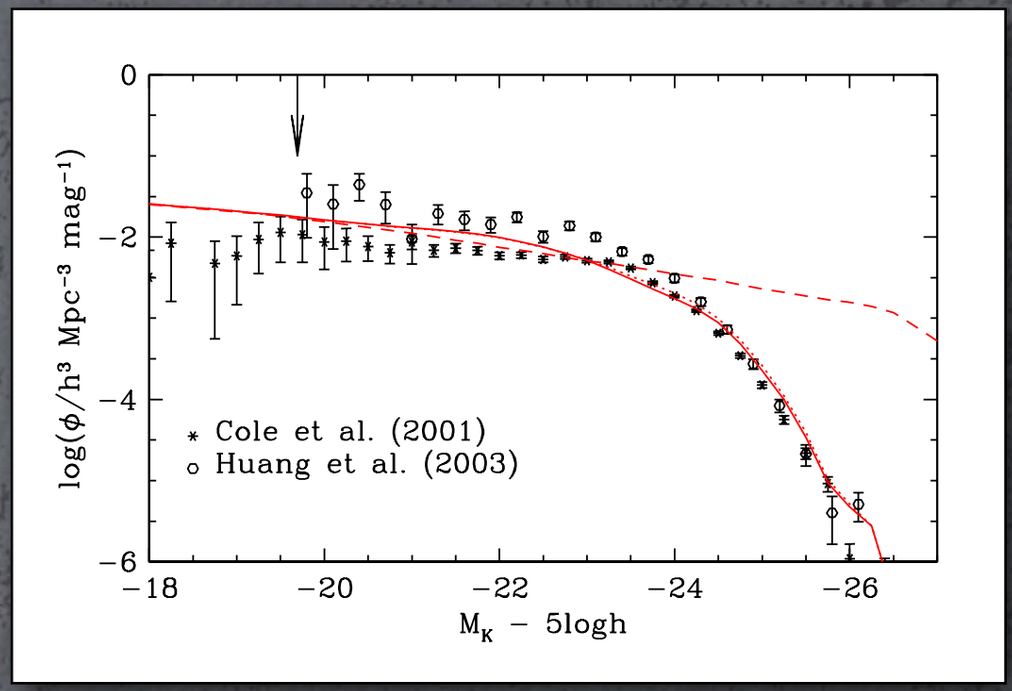
AGN Feedback in Clusters

Impacts of Feedback

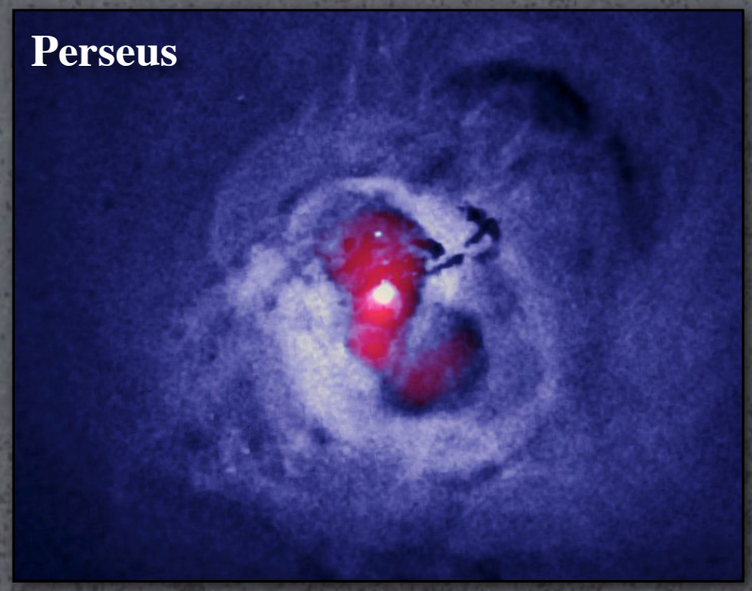
- Interaction between SMBH and ICM
- Present in many clusters core
- Can regulate growth of galaxies
- Can regulate the growth of BHs
- Impact on growth of large scale structure



Bower et al. (2006)

Observational Evidence

- X-ray cavities
- Radio lobes



Fabian et al. (2003, 2008, 2011)

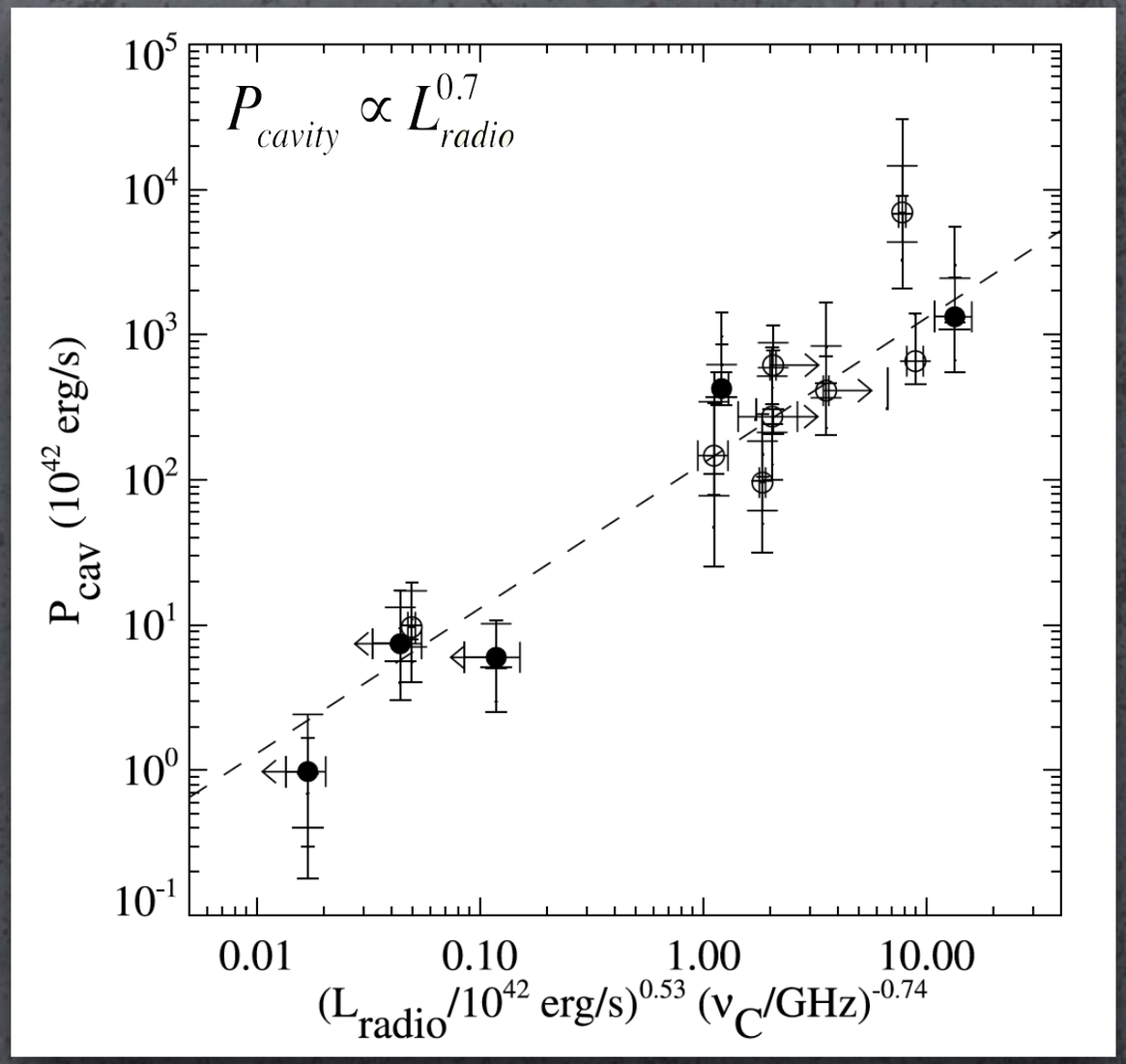
McNamara et al. (2000), Wise et al. (2007)

L_{radio} as proxy for P_{cavity}

Bîrzan sample of strong feedback systems

(Bîrzan et al. 2004, 2008; Rafferty et al. 2006)

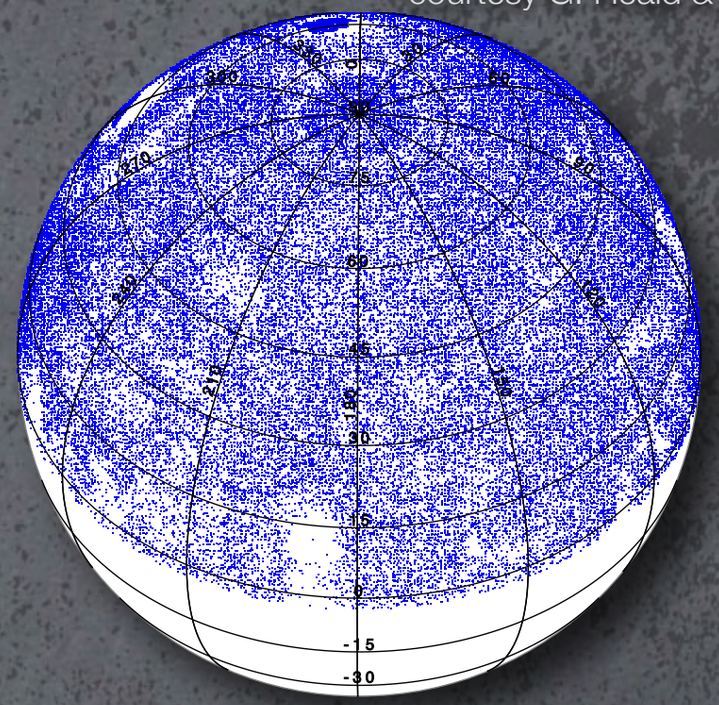
- 24 cavity systems
- Observed with
  - Chandra
  - VLA at
    330 MHz
    1.4 GHz
    4.5 GHz
    8.5 GHz



Bîrzan et al. (2008)

Goals

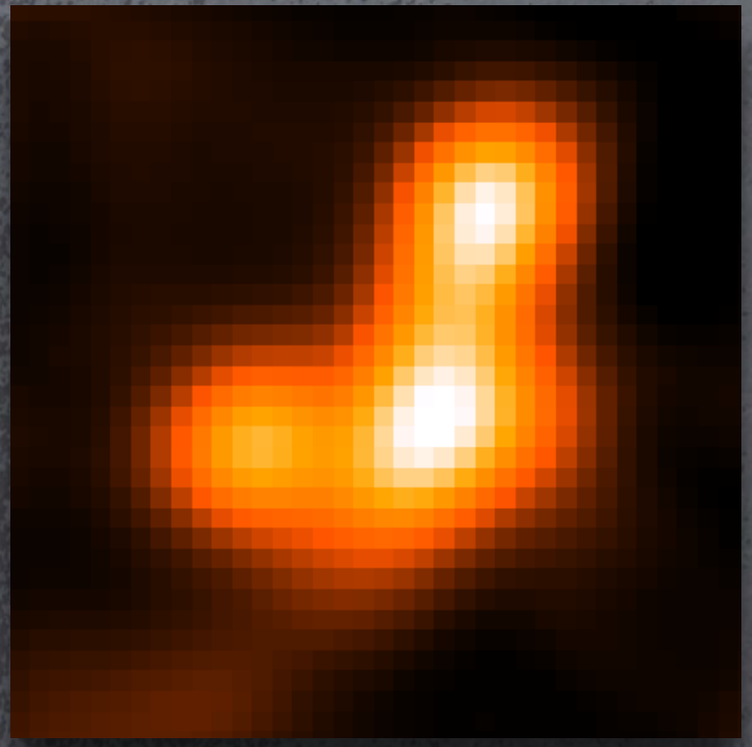
courtesy G. Heald & A. Clarke



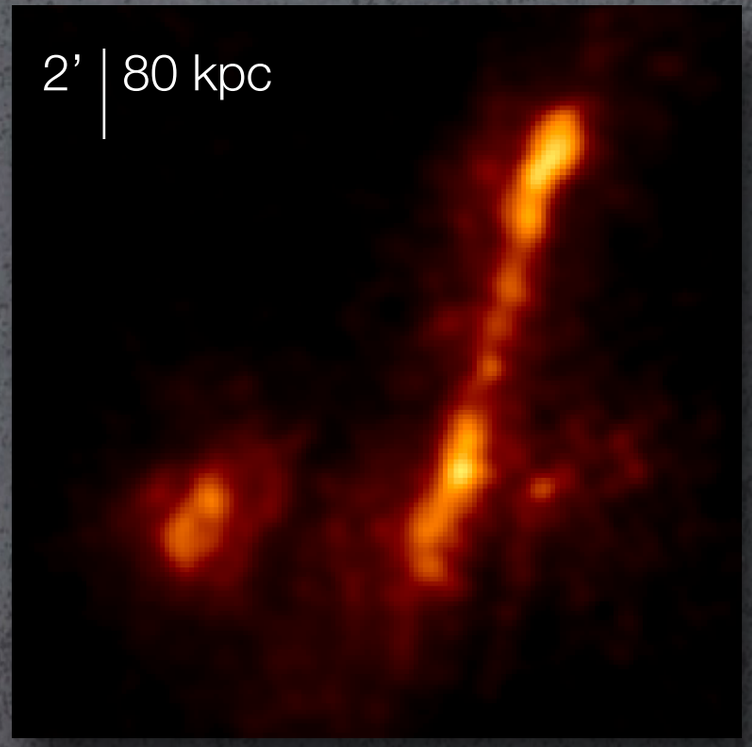
- Revisit the P_{cavity} vs. L_{radio} at lower frequencies using MSSS
  - Low frequencies better proxy for total energy output
  - Resolve sources
  - Explore the correspondence between X-ray cavities and radio emission

Reprocessing

- Image with longer baselines to higher resolution, extract sky model
- Phase-only, direction-independent self-calibration
- Recreate new high-resolution image



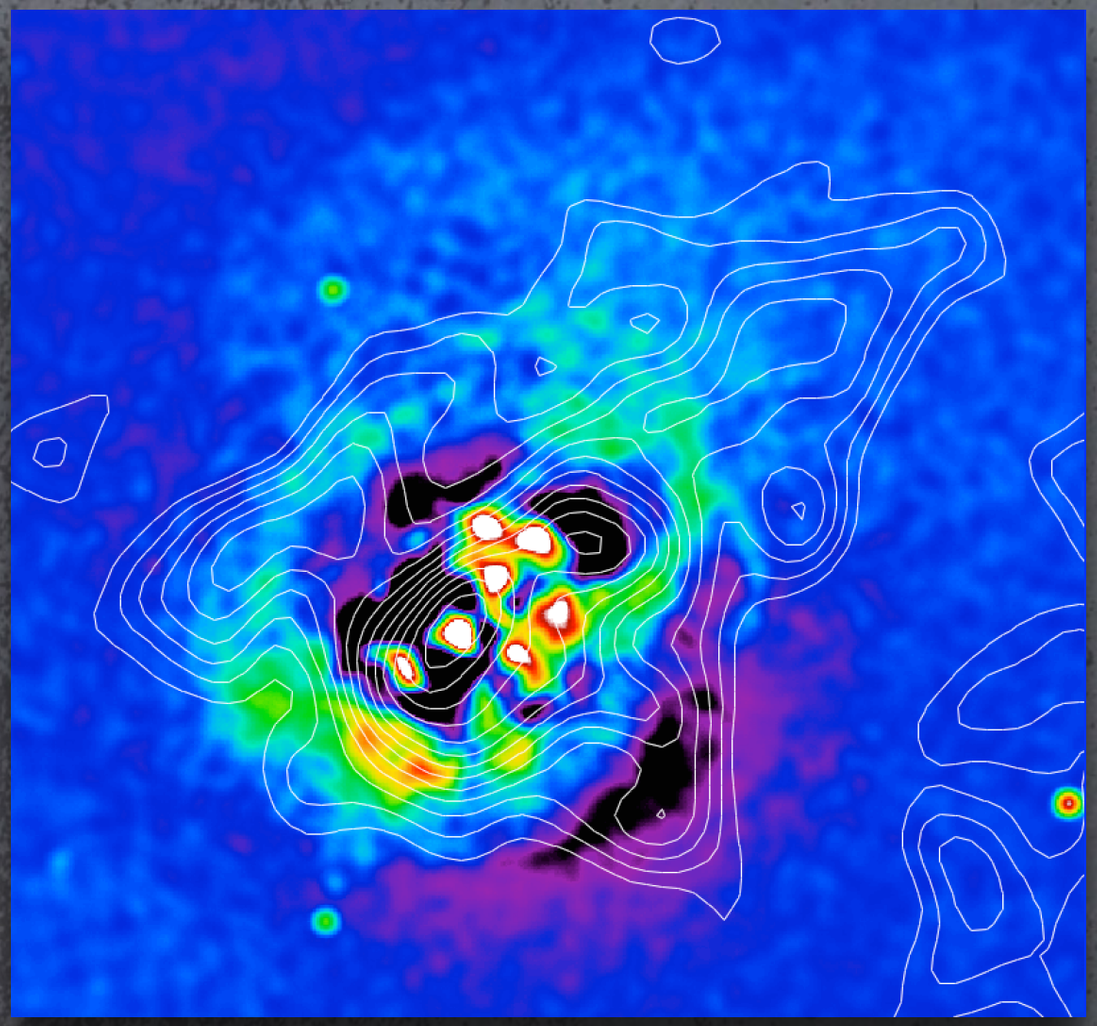
Default MSSS 2A 0335+096
res. 176”, noise 30 mJy/beam



Reprocessed 2A 0335+096
res. 24”, noise 15 mJy/b

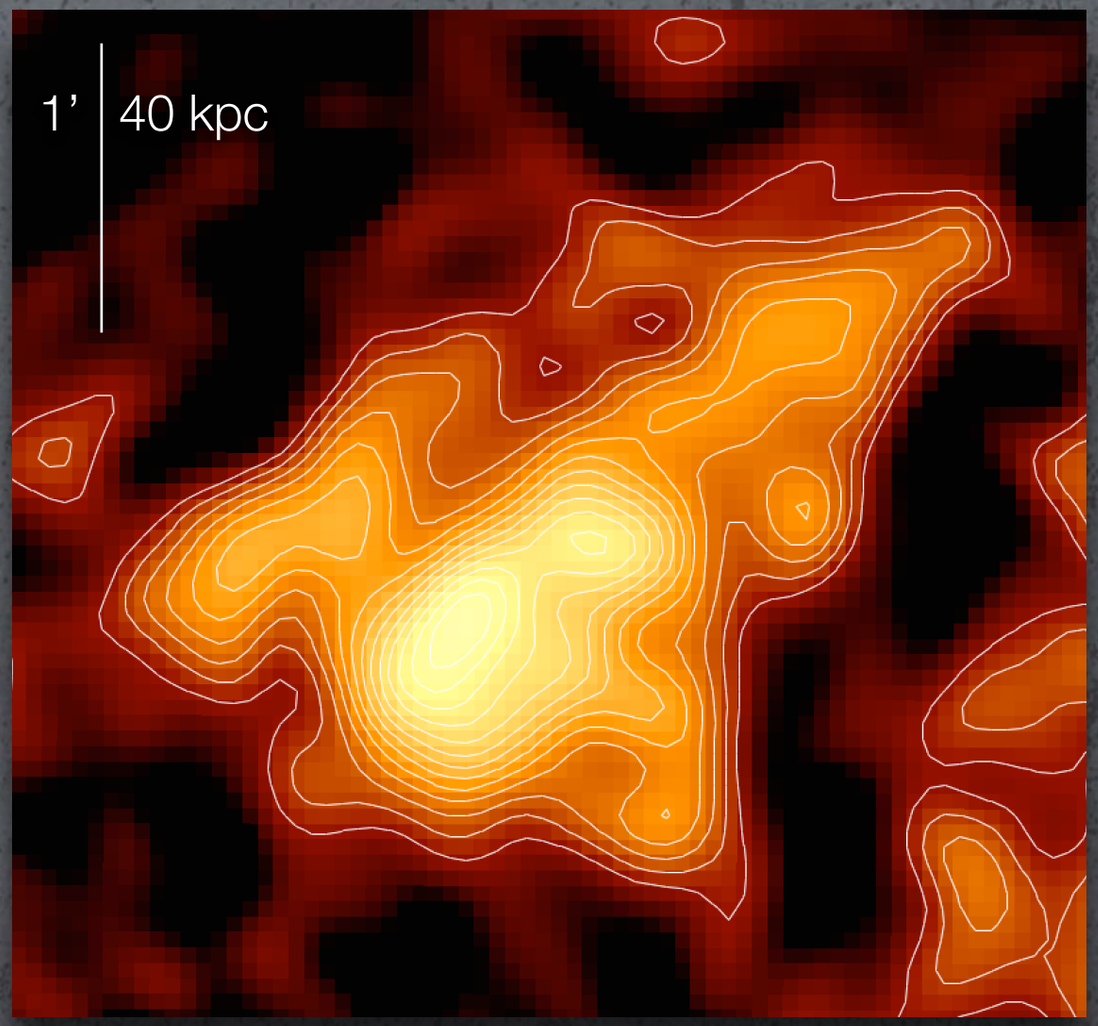
Comparison with X-rays

2A 0335+096



X-ray courtesy M. de Vries

X-ray residual map with radio contours

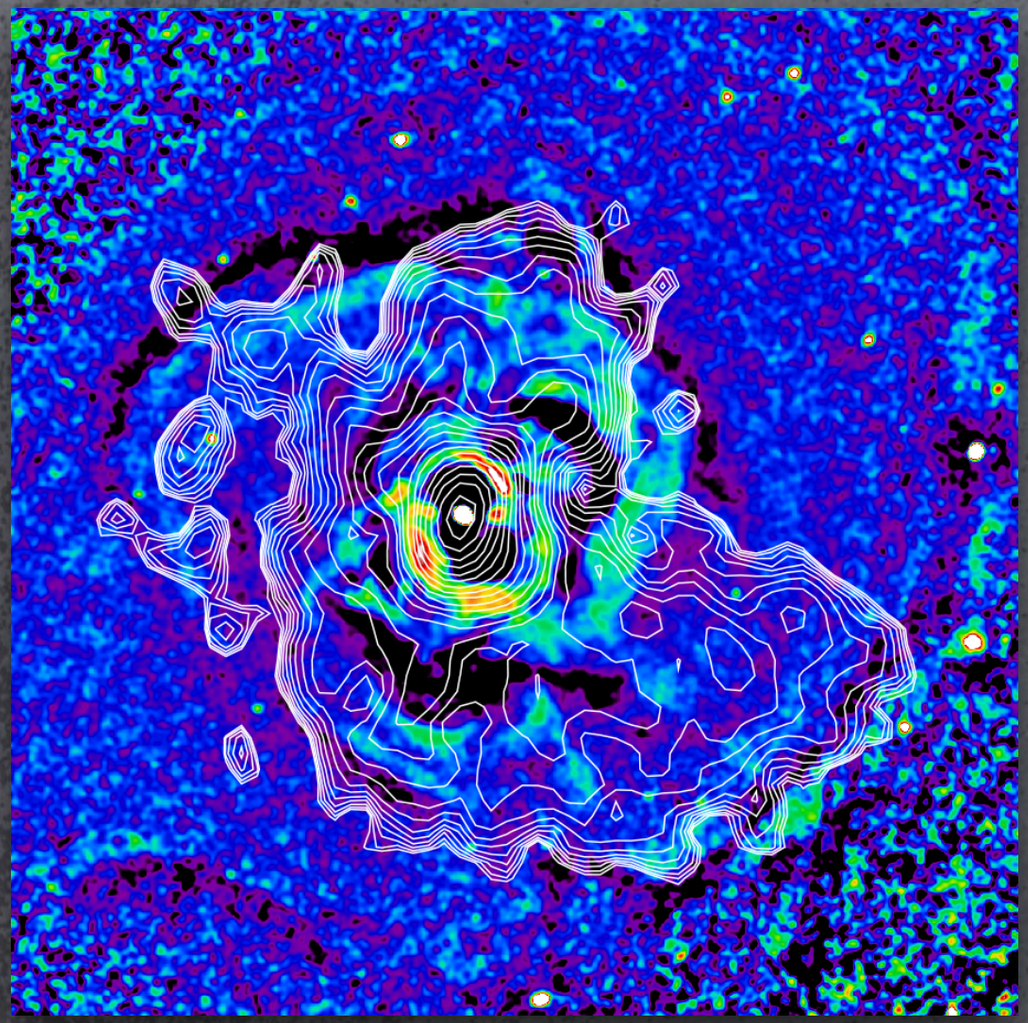


Reprocessed MSSS at 140 MHz

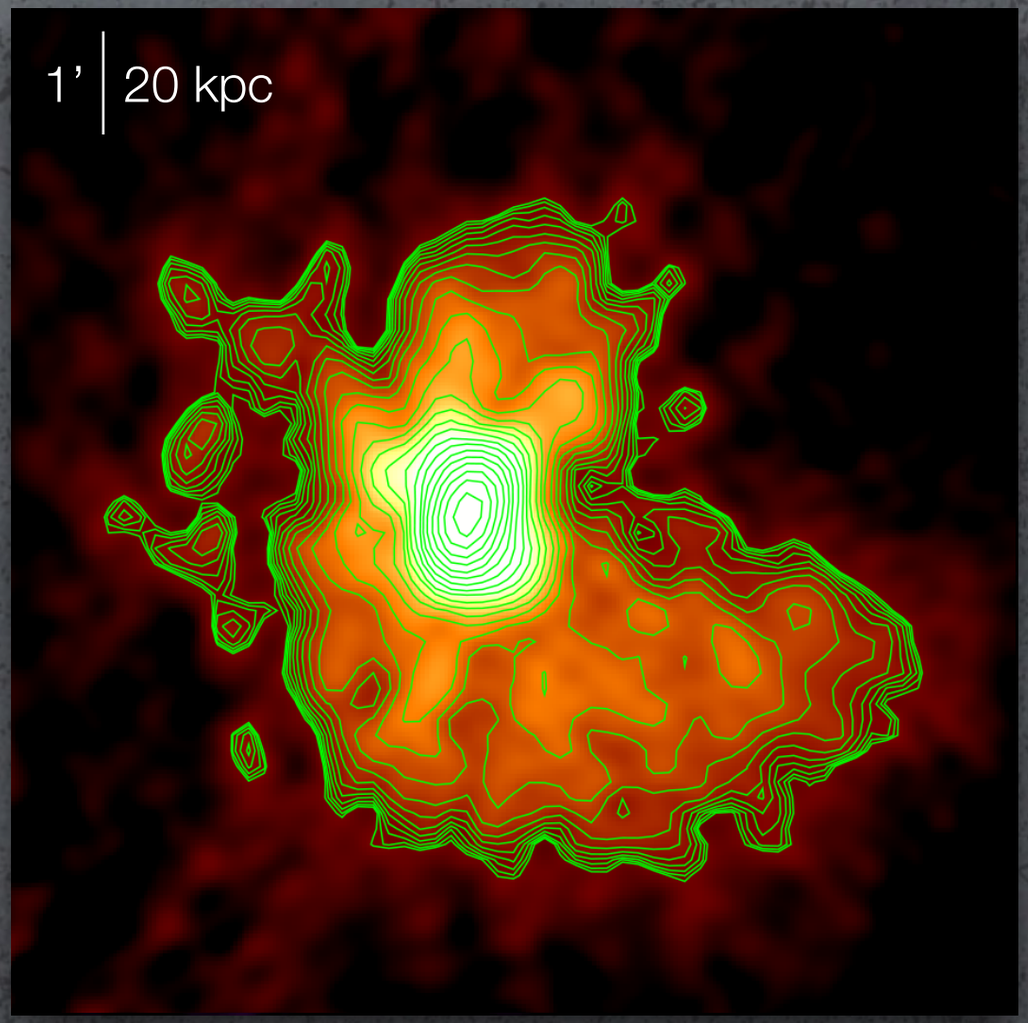
- Estimated age of the extended radio emission: 70 Myr

Comparison with X-rays

Perseus

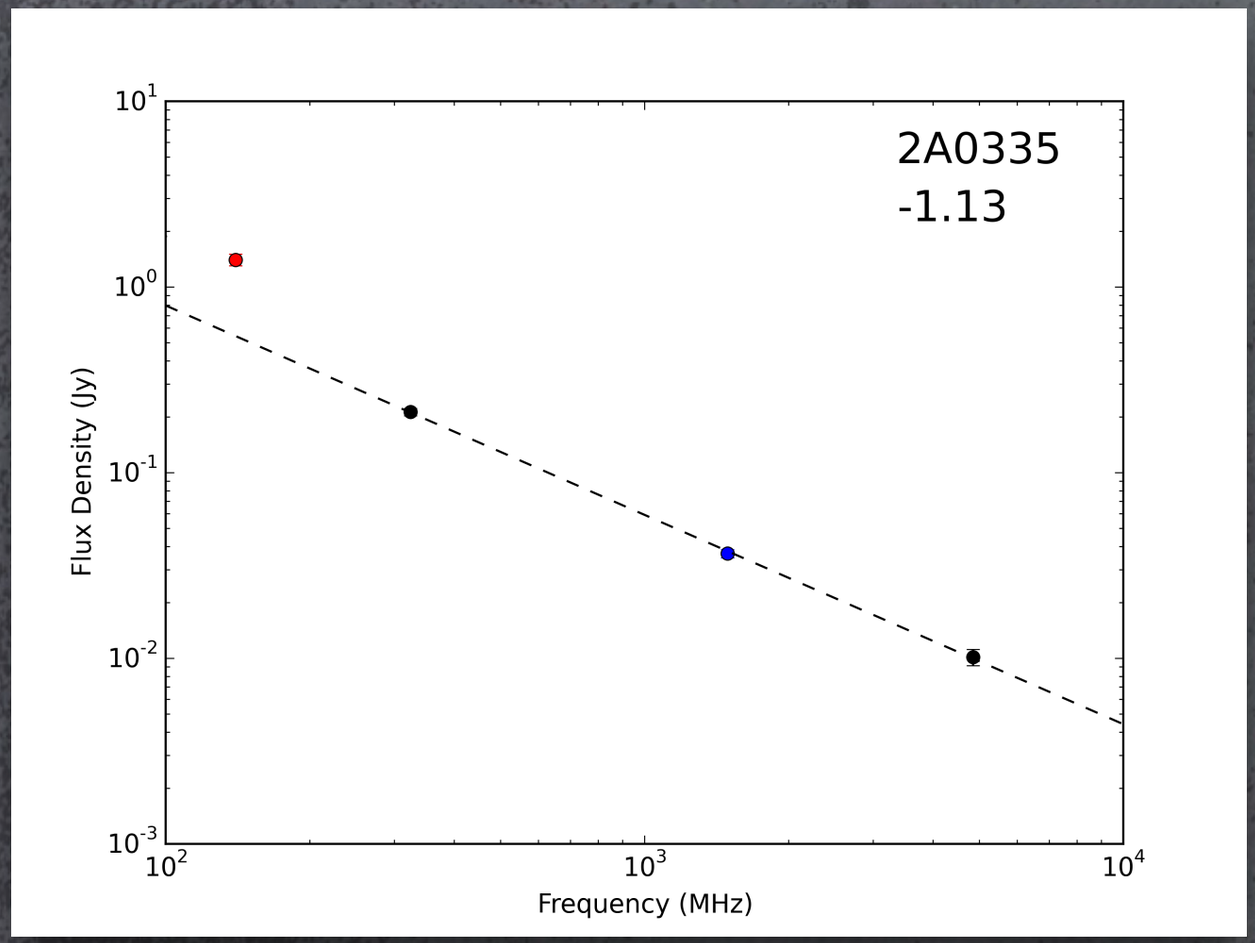


X-ray residual map with radio contours

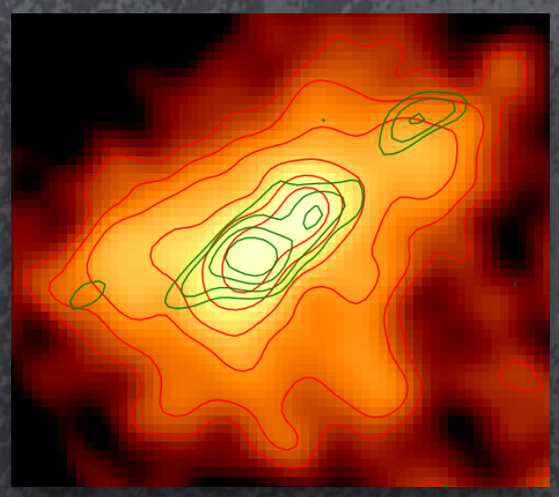


Reprocessed MSSS at 140 MHz
res. 21”
noise 20 mJy/beam

Measured/Expected Flux Ratio

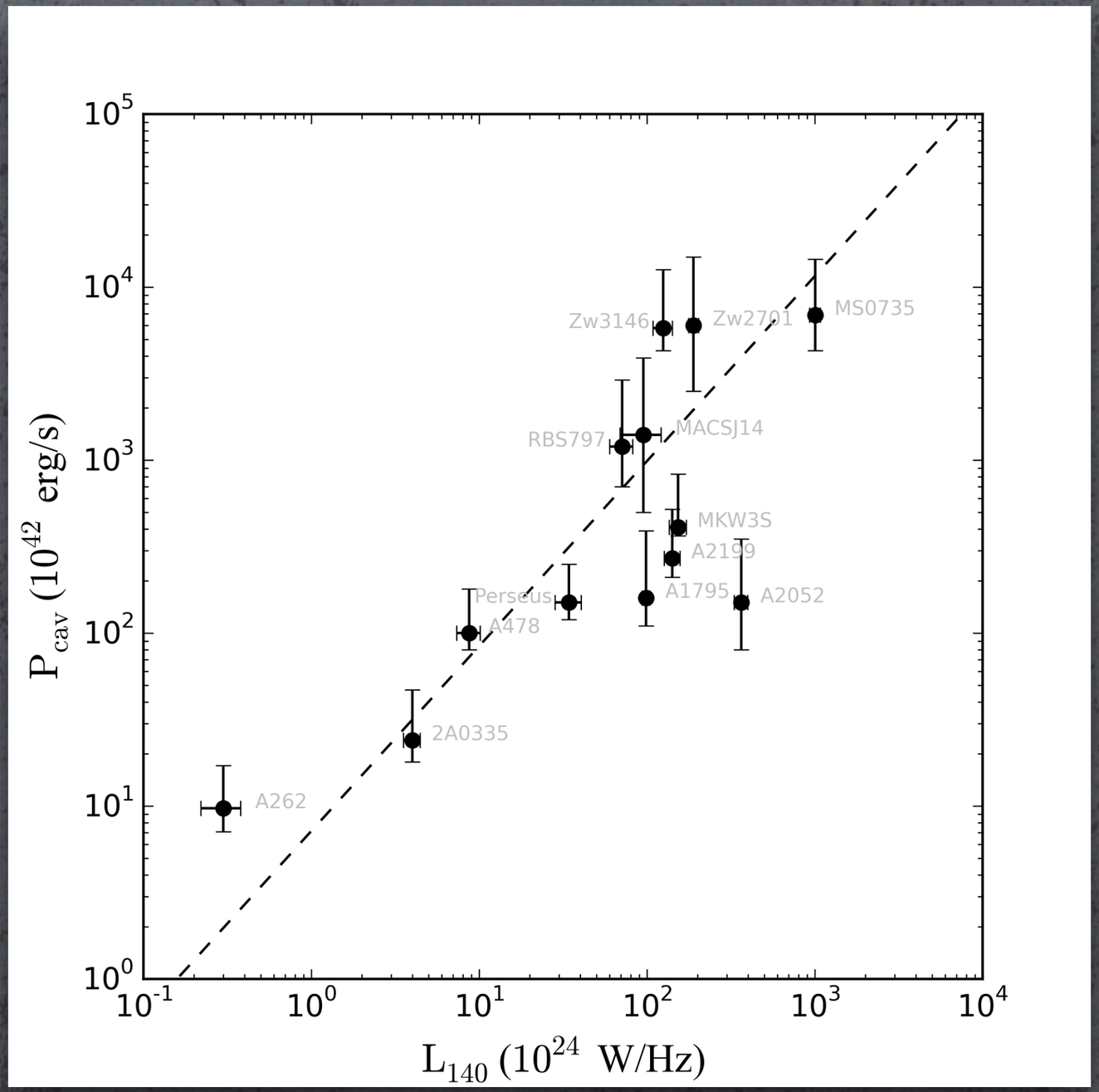


$$A = \frac{F_{140}}{F_{140,\mathrm{model}}}$$



Source	A-ratio
RBS 797	0.665 ± 0.059
MKW3s	0.678 ± 0.049
A262	0.764 ± 0.035
MS 0735.6+7421	0.814 ± 0.030
A2199	0.96 ± 0.34
MACS J1423.8	0.98 ± 0.20
Perseus	1.00 ± 0.26
A1795	1.45 ± 0.14
A2052	1.58 ± 0.79
Zw2701	2.089 ± 0.021
A478	2.19 ± 0.27
2A 0335+096	2.506 ± 0.070
Zw3146	6.40 ± 0.77

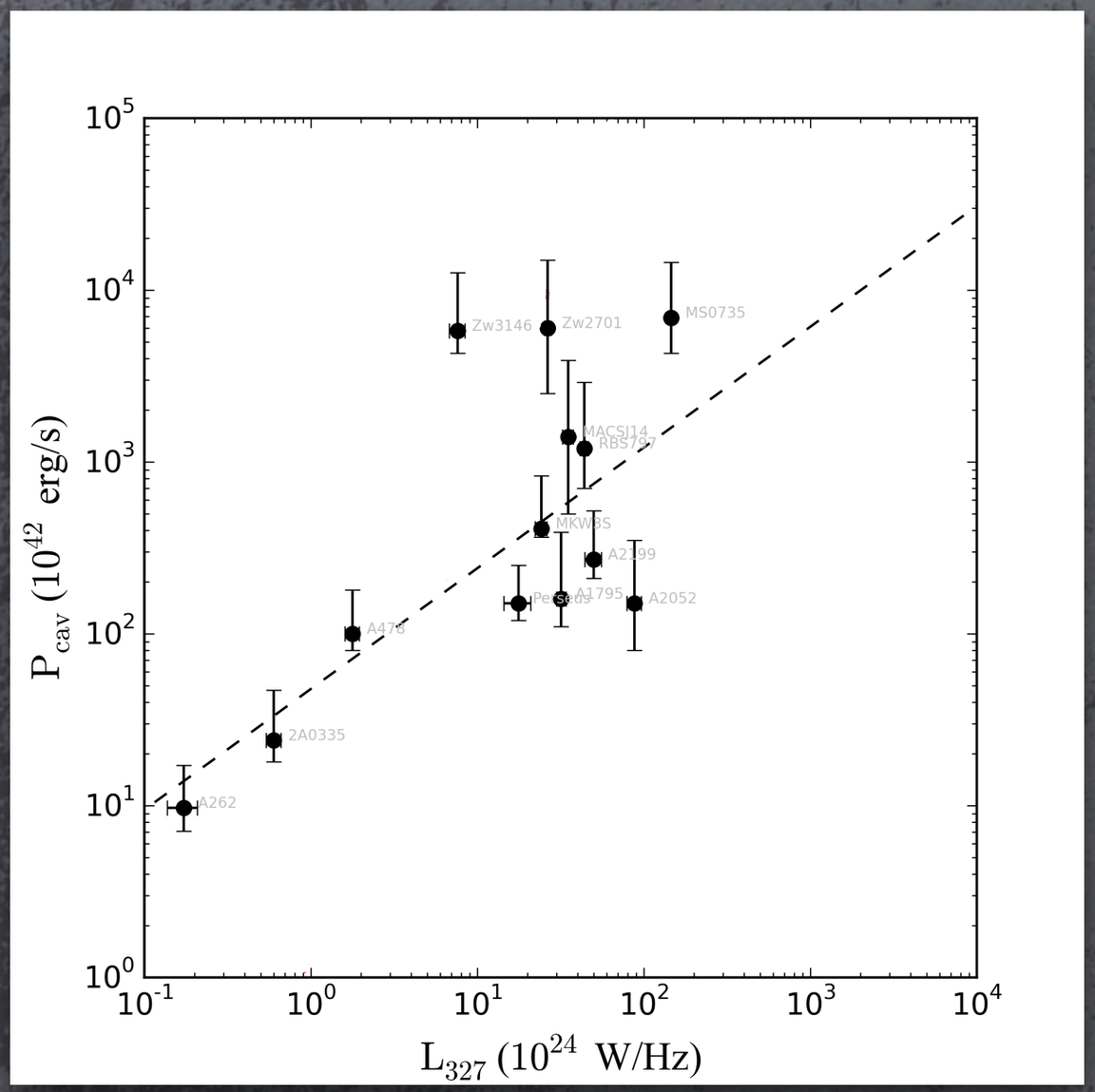
L_{140} as proxy for P_{cavity}



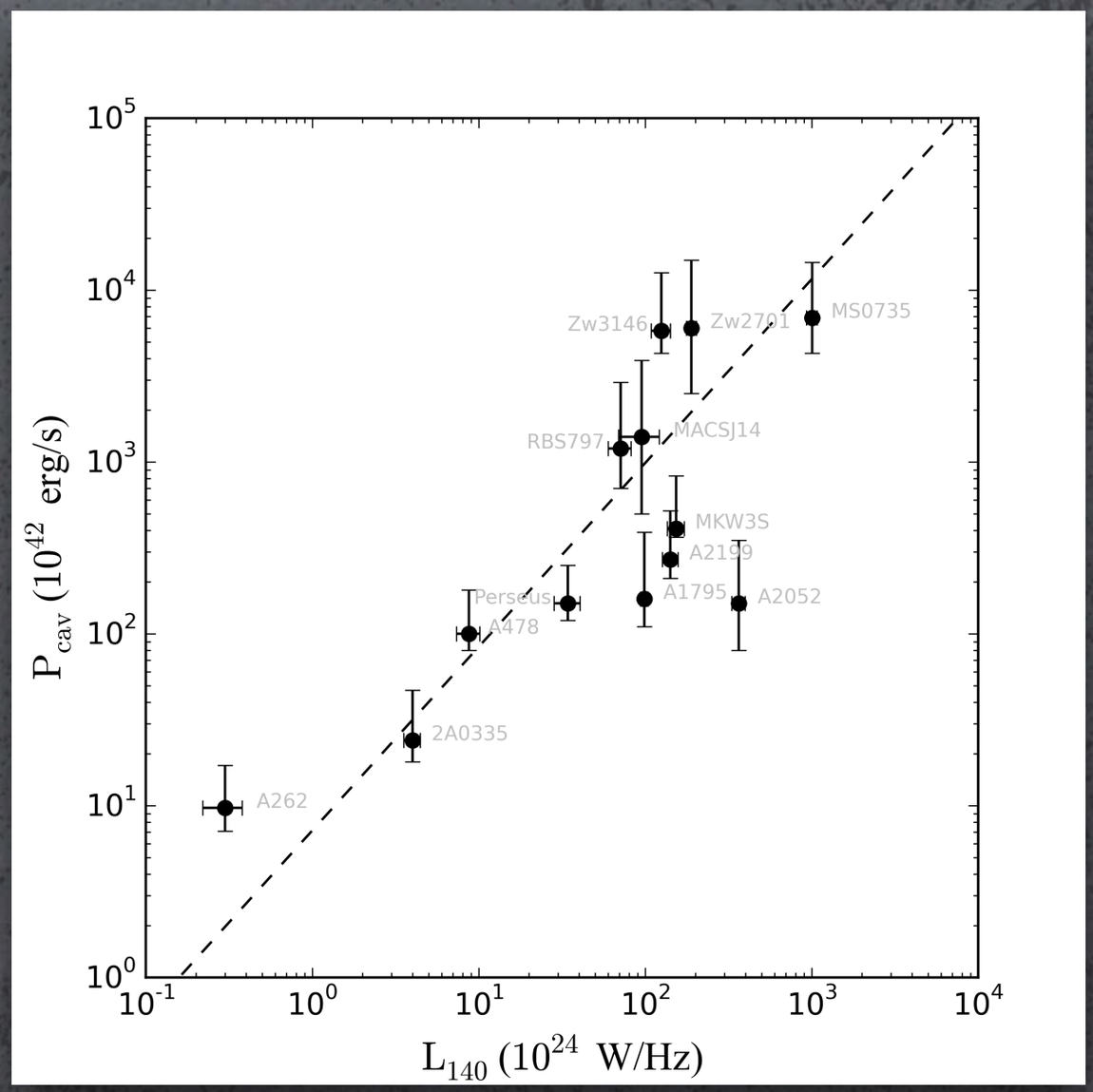
MSSS sample

slope 1.1 ± 0.2

L_{140} vs L_{330}



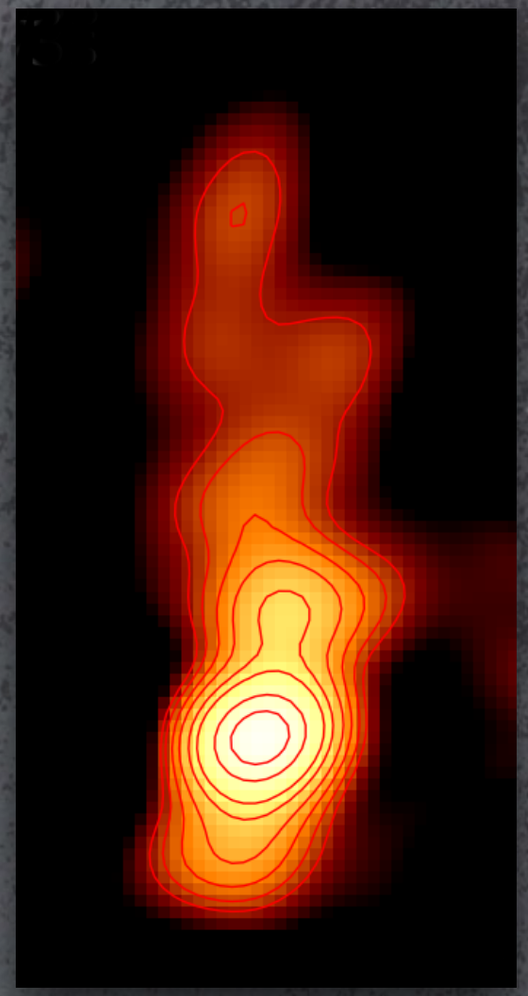
330 MHz



140 MHz

- correlation tighter at 140 MHz than at 330 MHz

Summary



- 100% of the sources detected
- 50% resolved
- 50% show extra flux at low frequencies (additional flux component)
- Reprocessed MSSS shows more extended emission, filling new cavities
- Stronger L_{radio} - P_{cavity} correlation at 140 MHz

Future

- Bigger sample from Tier 1 survey