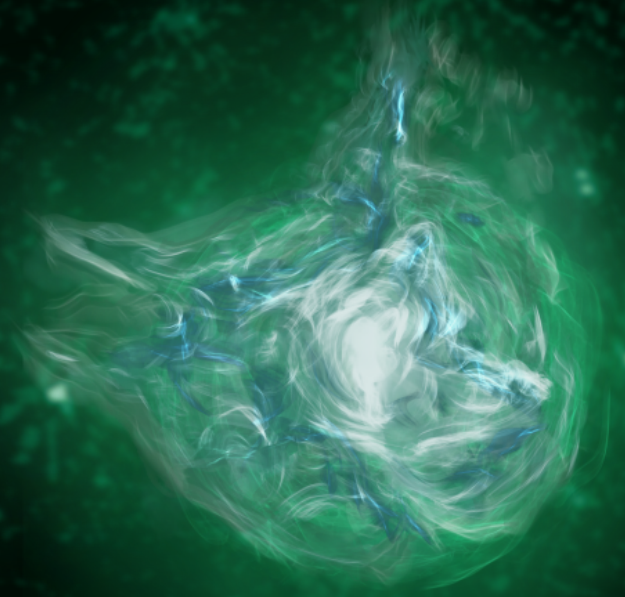
Perseus Cluster in LBA



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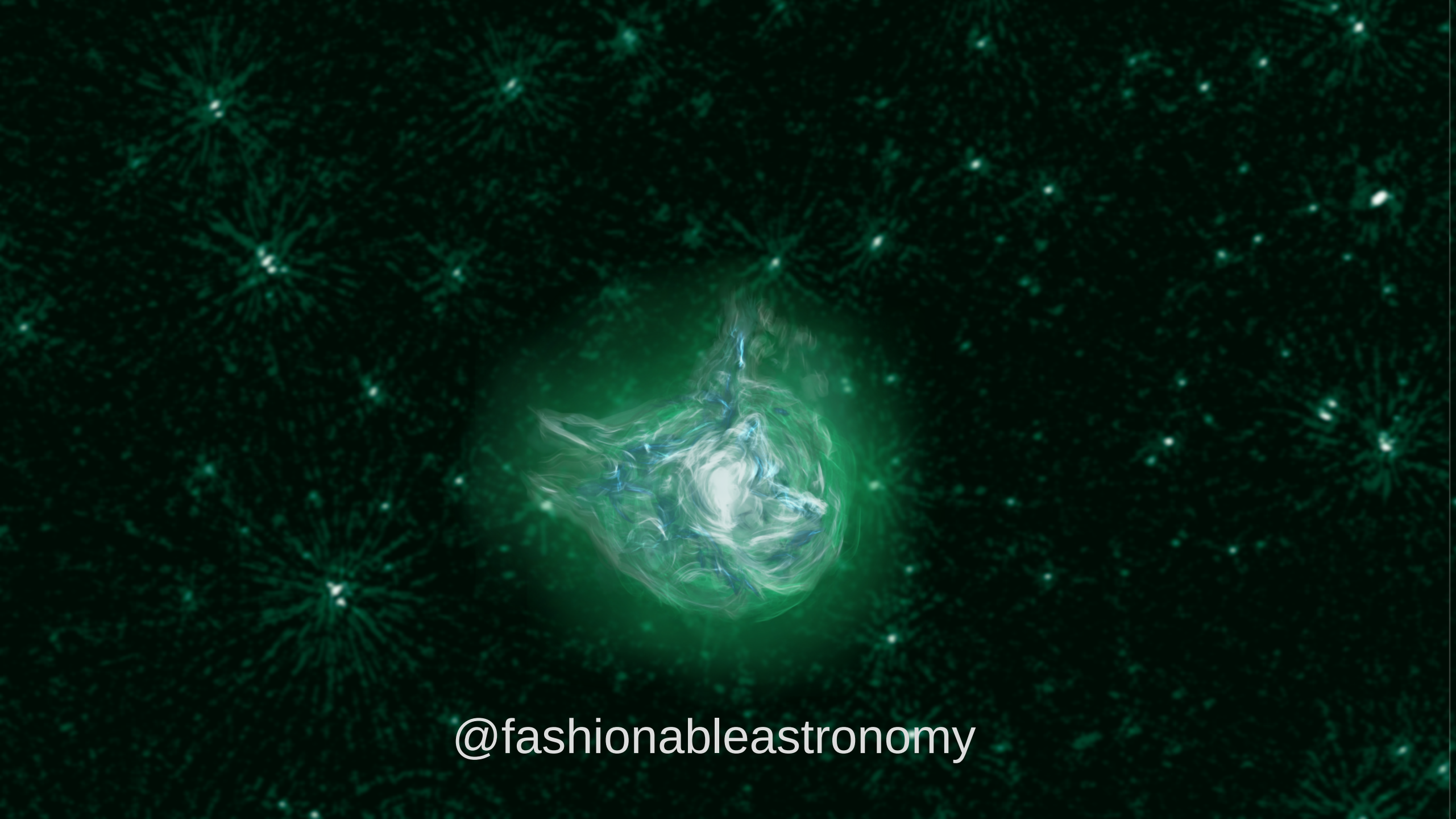

@fashionableastronomy

Perseus cluster

- Nearby (z=0.01077) and massive cluster ($M \sim 10^{15} M_{\odot}$)
- Classically considered archetype of relaxed / "cool-core"
- Observed from radio --> X-Ray


Image source: ESA/Euclid

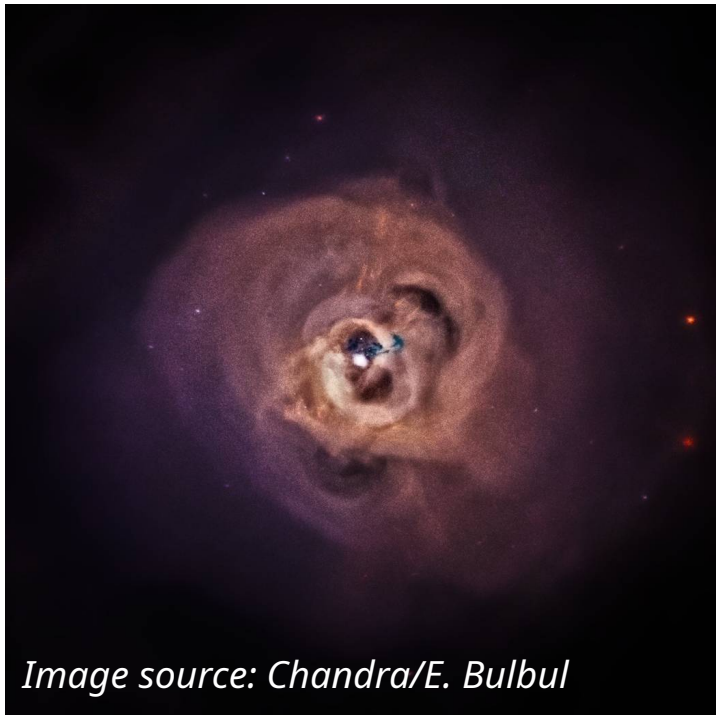


Image source: Chandra/E. Bulbul

Perseus cluster

- 50 years of radio observations
- 1975: WSRT observations reveal mini-halo

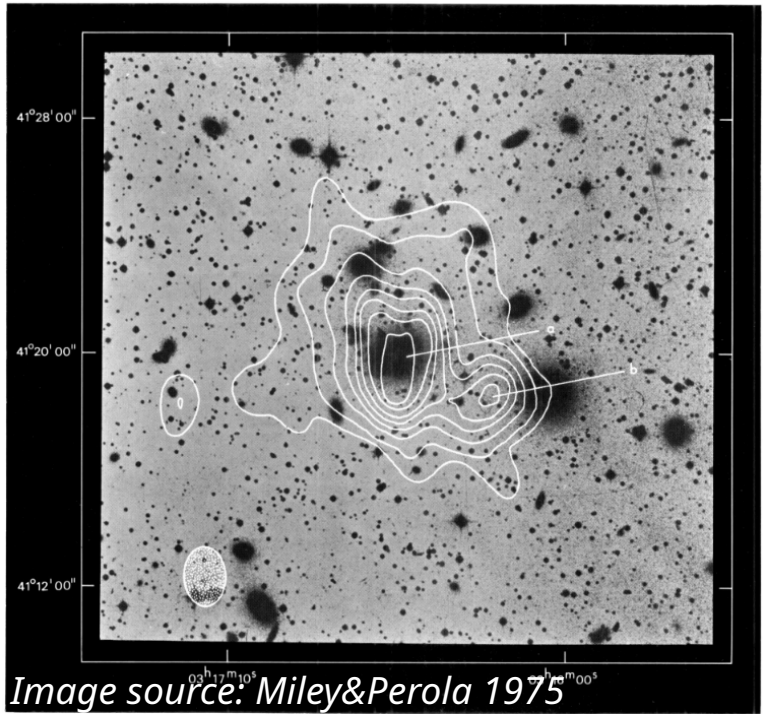


Image source: Miley&Perola 1975

Perseus cluster

- X-Ray observations:
- AGN in center (3C 84) blows bubbles in ICM
- "Cavities" filled with bright radio emission
  - Indicative of AGN feedback

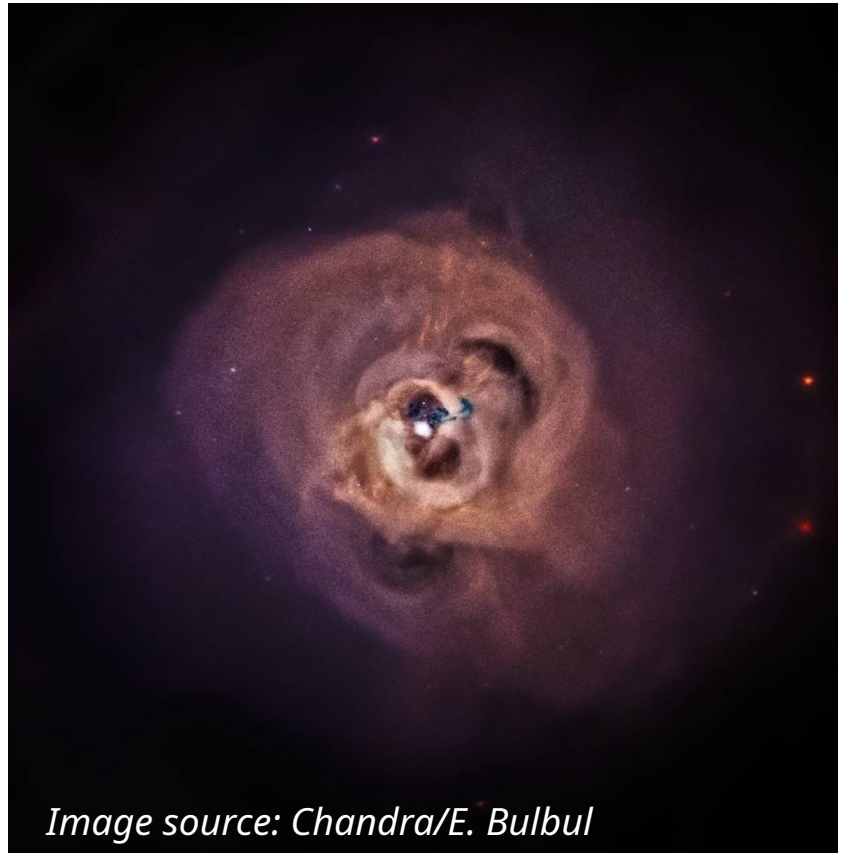


Image source: Chandra/E. Bulbul

Perseus cluster

- Tailed radio sources, in particular NGC 1265 and IC 310
- VLA P-band observations (Gendron-Marsolais et al. 2020) reveal sub-structure both in the core and in tailed radio galaxies
- Filaments

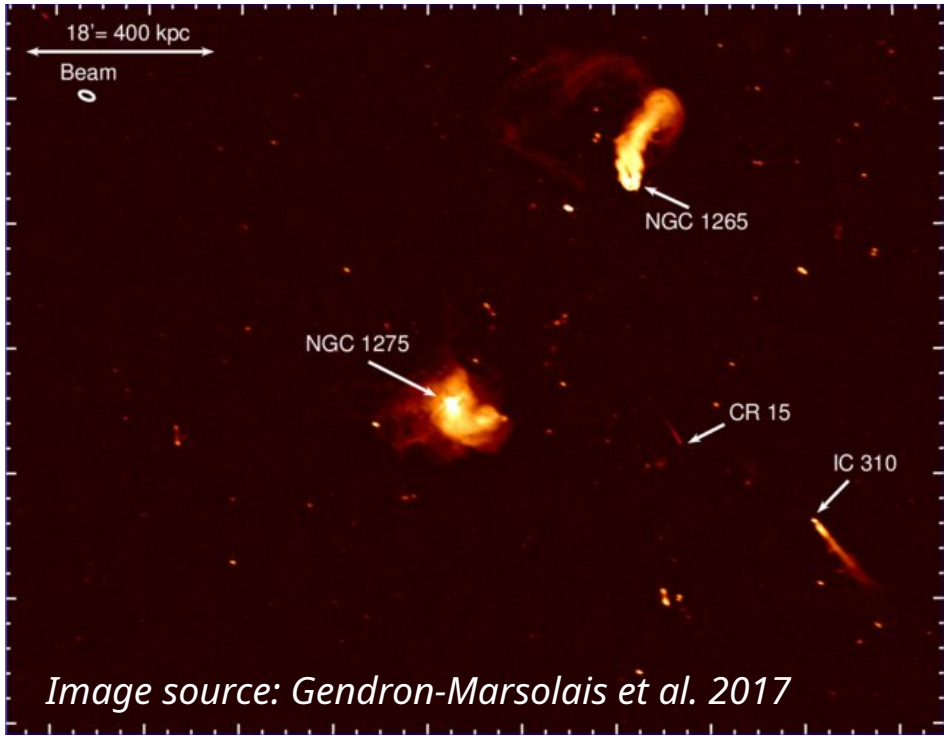
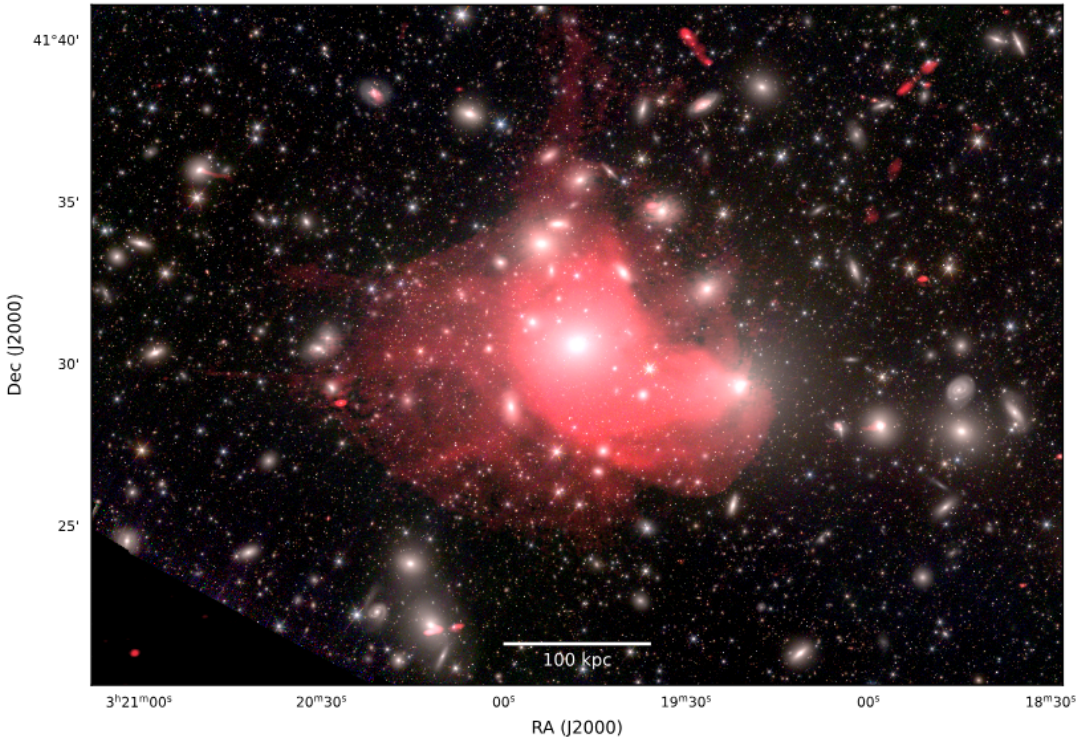


Image source: Gendron-Marsolais et al. 2017

HBA work

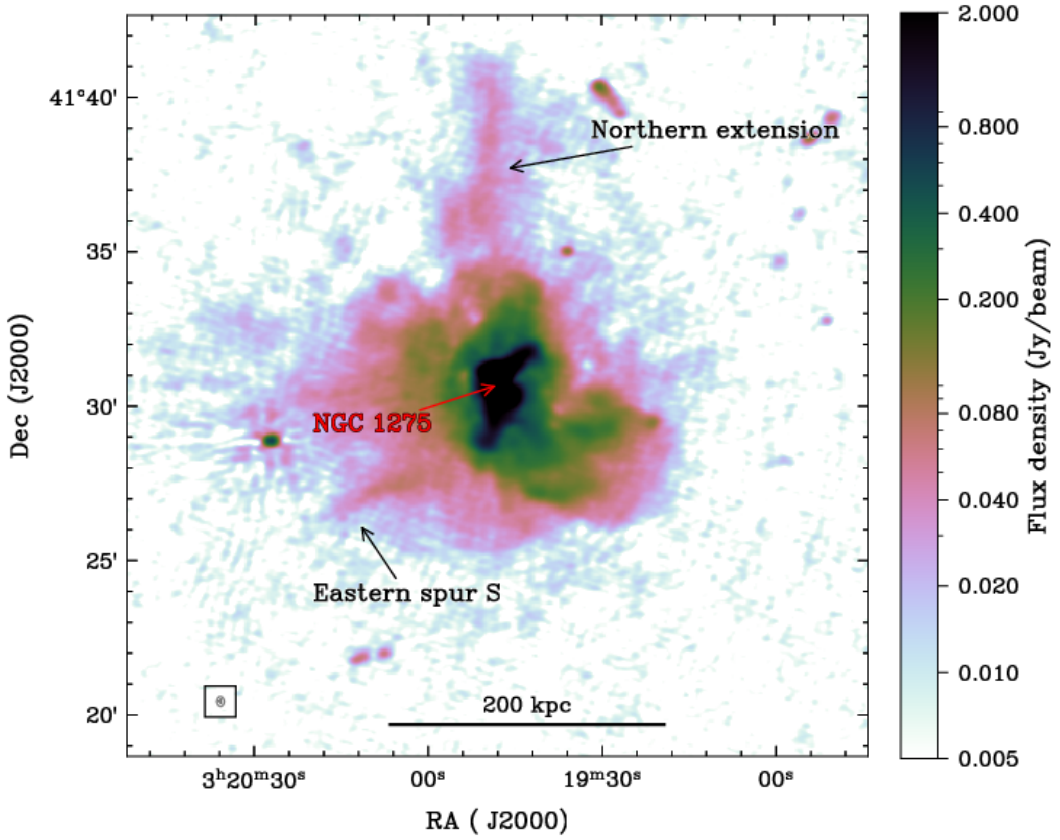
- Earlier work: HBA data
  - Detected giant radio halo, beyond mini-halo
  - Steep spectrum radio emission in X-ray cavities
  - Filamentary structures in ghost cavities
- Need low-frequency follow up: expect steep spectrum in giant radio halo



Van Weeren et al. (2024)

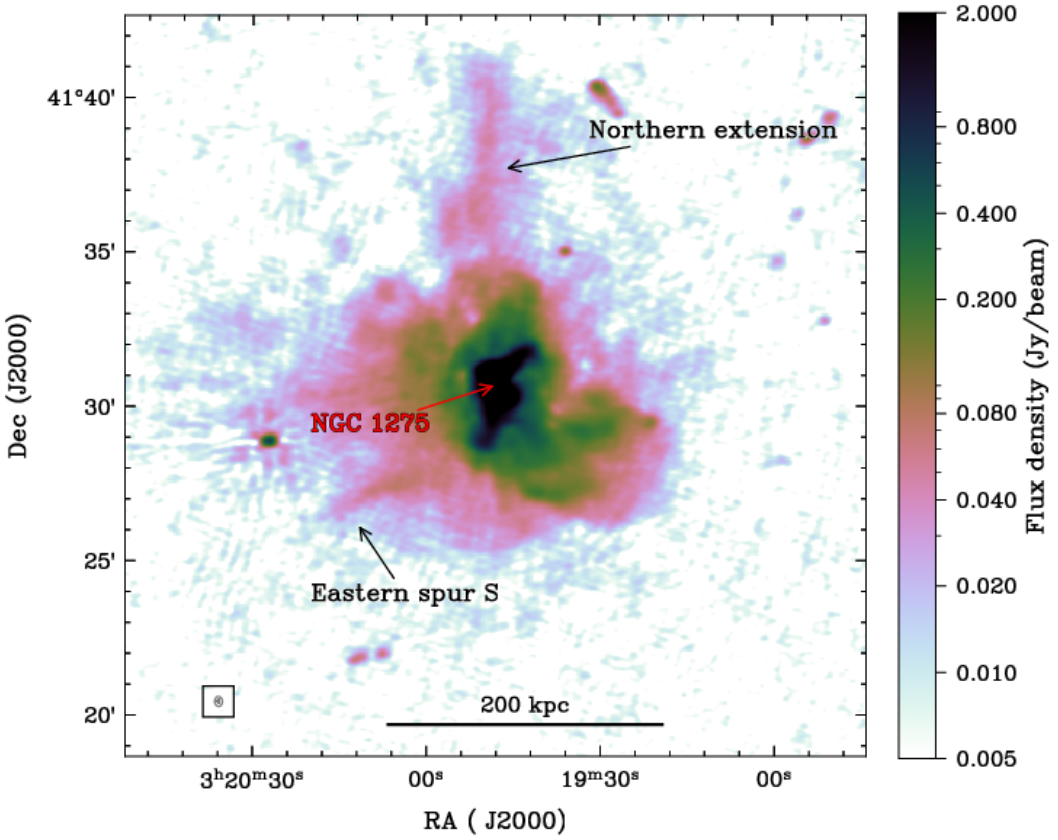
This work

- LBA follow-up
- Goal:
  - Detection of giant radio halo
  - Fossil plasma in cavities



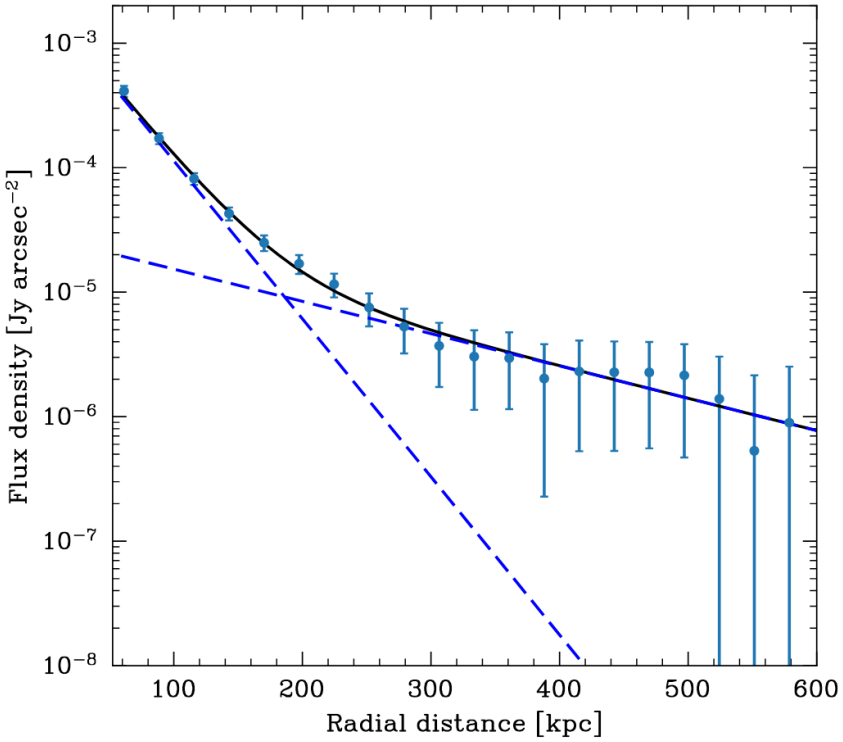
This work

- Two LBA observations
  - 4 hr + 8 hr (Dec 2020/Jan 2021)
- Ionosphere was rather bad
- High dynamic range required to detect diffuse emission near 3C 84
- Only used 6/12h of data



Large scale diffuse emission

- Evidence of Giant radio galaxy:
- Double exponential fitted to diffuse (source-subtracted) image
- (preliminary)
- Spectral index: $\alpha_{mH} = -1.20 \pm 0.12$ $\alpha_{GRH} = -1.30 \pm 0.15$
- Hint of spectral steepening in GRH



Ghost plasma

- Ghost cavities: Excavated regions in X-Ray plasma due to AGN feedback

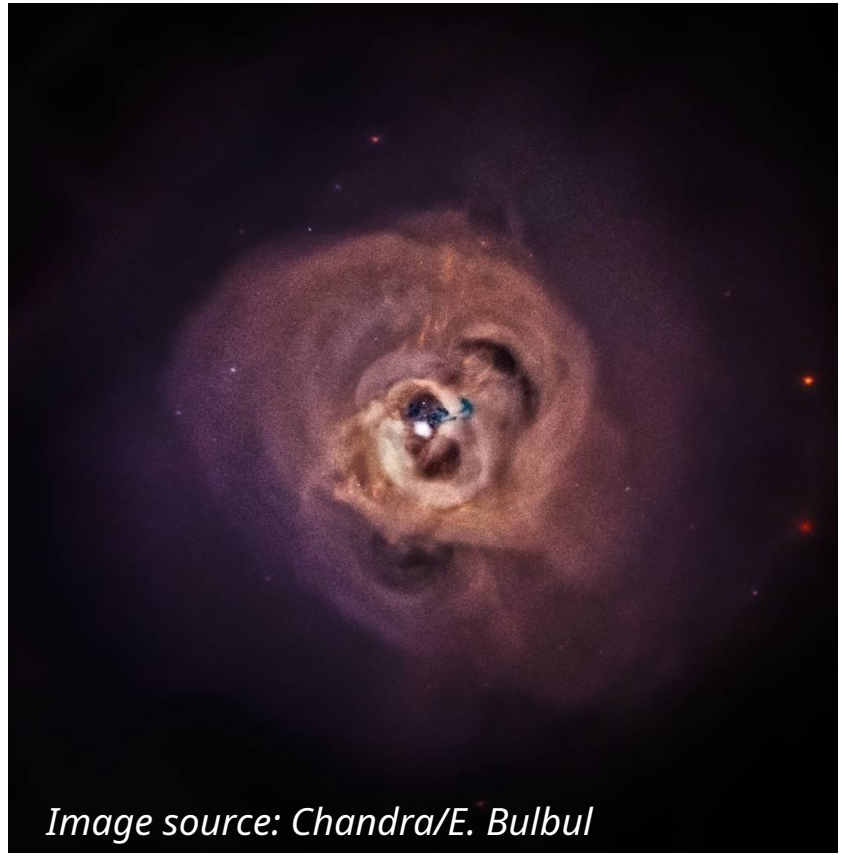
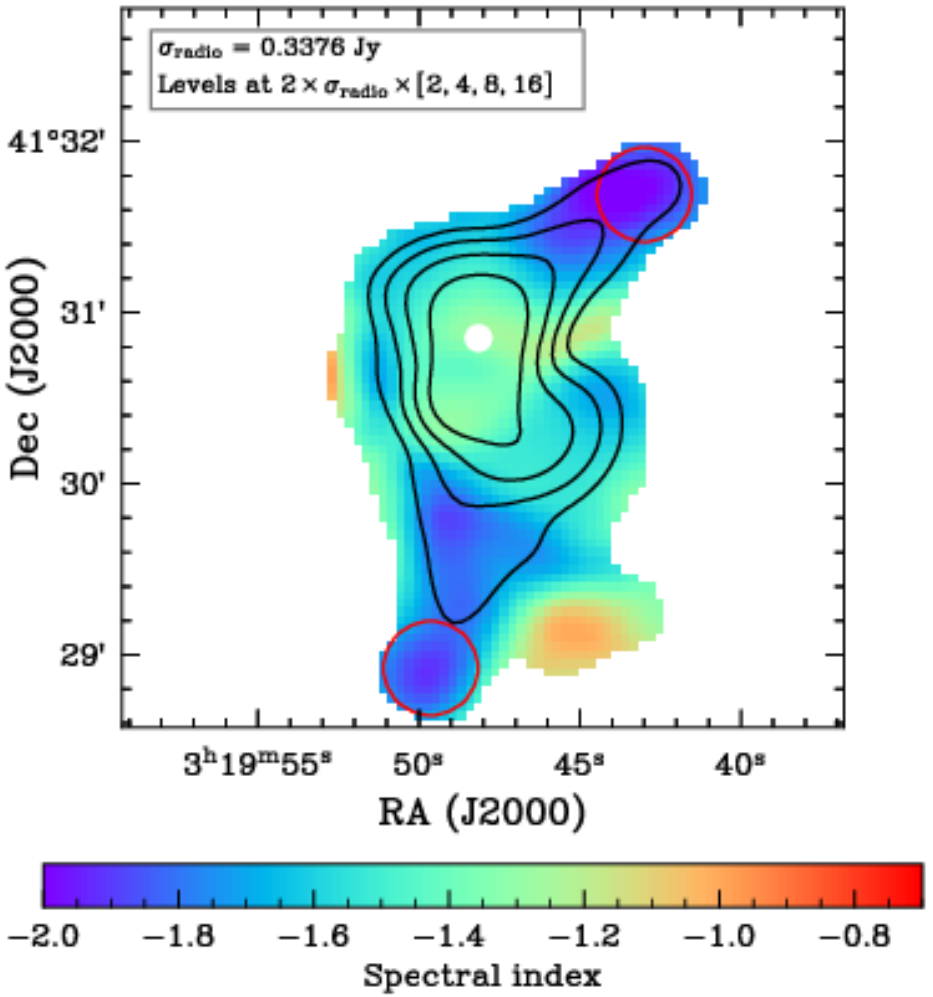


Image source: Chandra/E. Bulbul

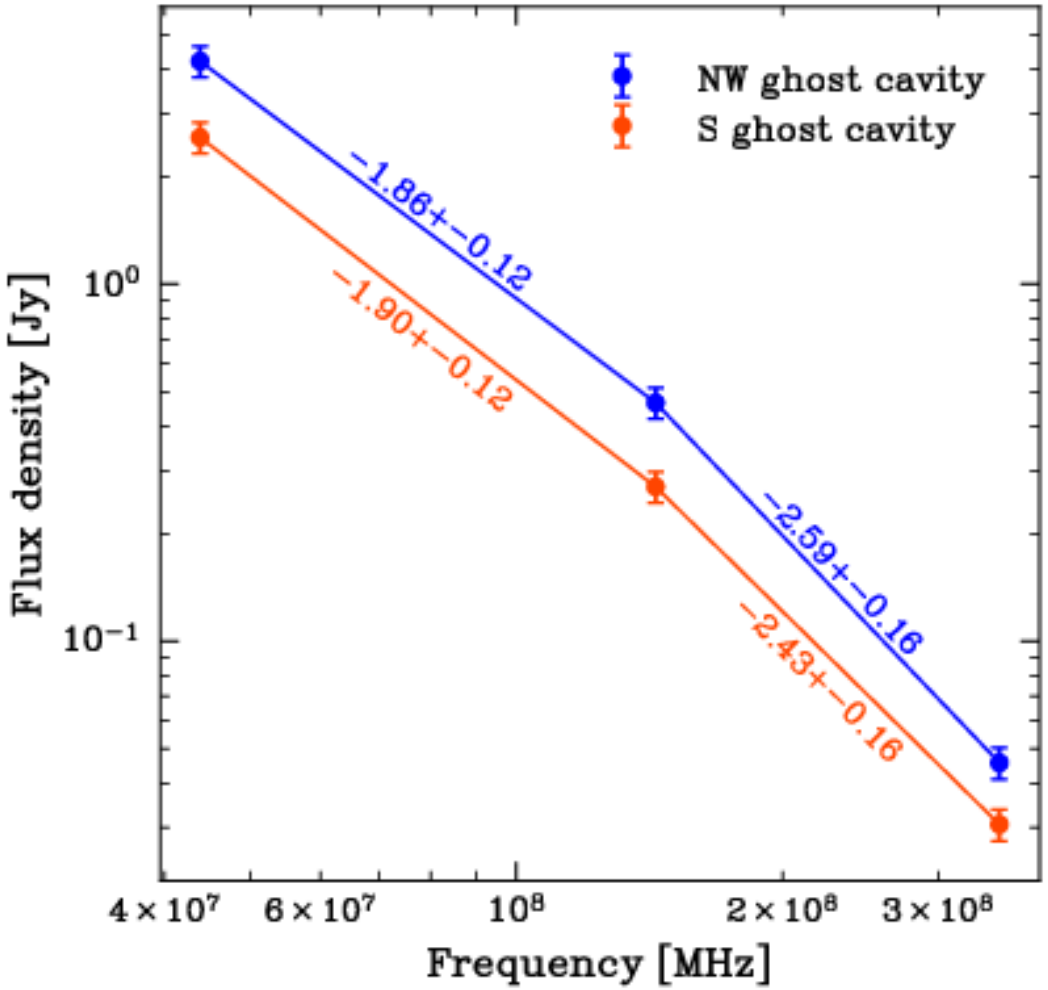
Ghost plasma

- Ghost cavities: Excavated regions in X-Ray plasma due to AGN feedback
- Steep spectrum emission in cavities



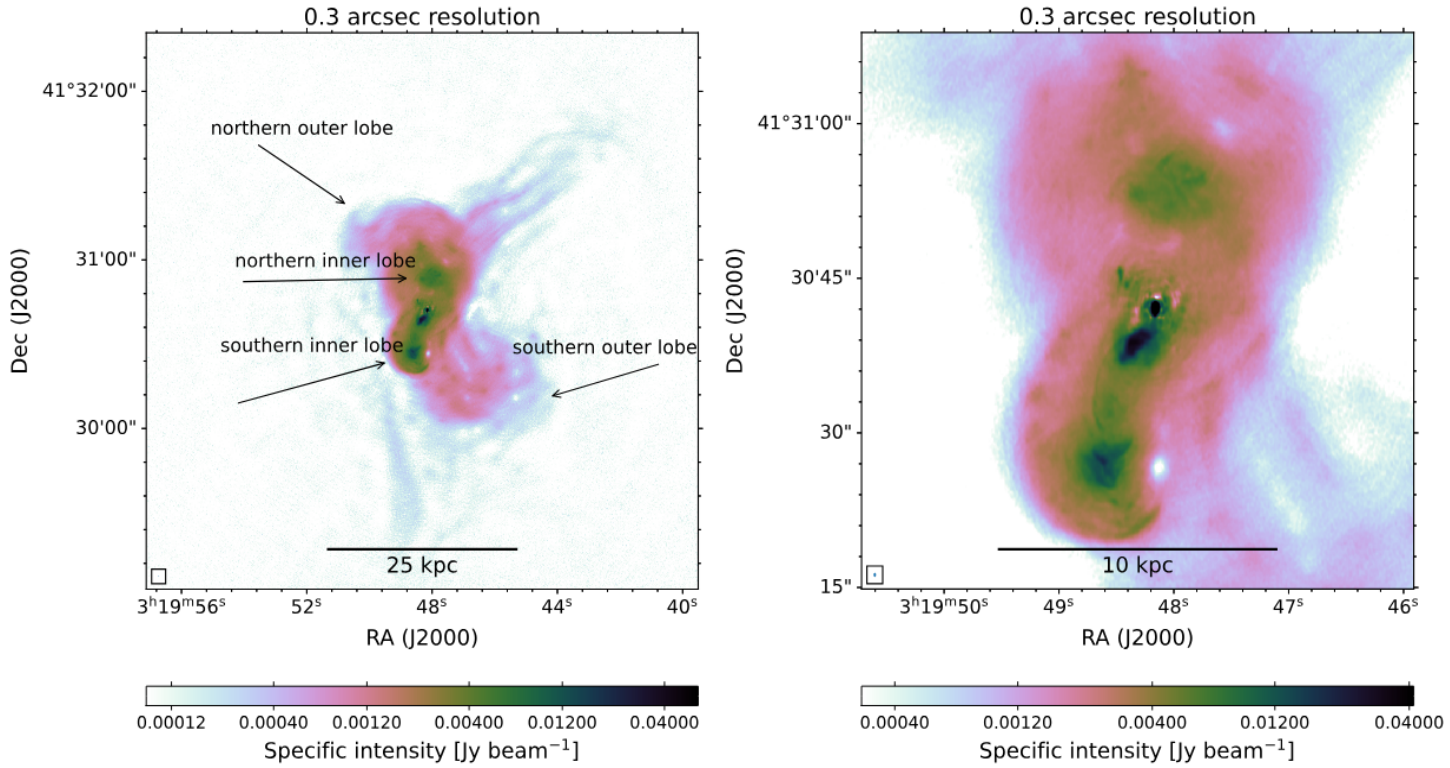
Ghost plasma

- Ghost cavities: Excavated regions in X-Ray plasma due to AGN feedback
- Steep spectrum emission in cavities
- Curved spectrum



Future outlook

- Decameter follow up for low-frequency curvature
  - Primarily Giant radio halo
- LBA long baselines
  - Recall A2255 (H. Edler in prep.)



Conclusions

- LBA observations of Perseus cluster
- Found evidence of steep giant radio halo
  - No spectral steepening beyond minihalo (yet…)
- Steep spectrum emission in X-Ray cavities
- Future work: Decameter? LBA LB?