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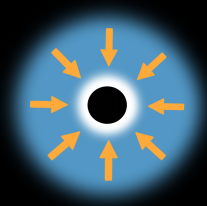
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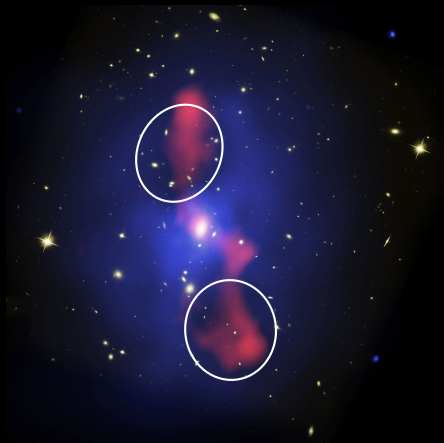- discrepancy between radio lobes and X-ray cavities

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- discrepancy between radio lobes and X-ray cavities

- utilization of neural networks (CADET)
  - finding new cavities - 5 newly found

Homework

Estimate P_{jet} and P_{Bondi} in galaxy NGC 4649

Example: MS0735, Credit: NRAO

Homework - equations

Jet power

$$H = \frac{pV}{\gamma - 1} + pV \quad V = \frac{4\pi}{3} r_l r_w^2$$

$$\gamma = \begin{cases} 5/3...\text{non-relativistic} \\ 4/3...\text{relativistic} \end{cases}$$

$$p = nkT$$

$$P_{\text{jet}} = \frac{H}{t_{\text{age}}} \qquad t_{\text{age}} = \frac{R}{c_s}$$

Bondi power

$$r_{\text{Bondi}} = \frac{GM_{\text{BH}}}{c_s^2}$$

$$c_s = \sqrt{\gamma kT / \mu m_p}$$

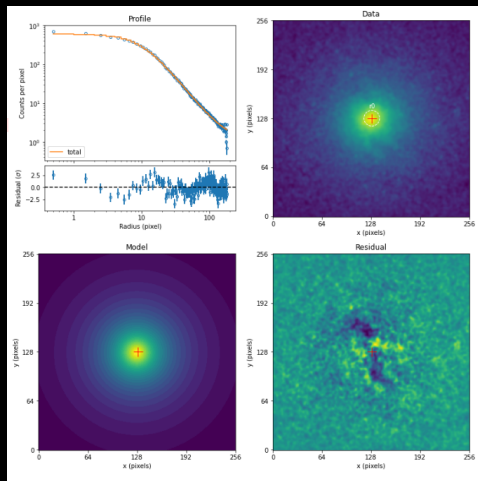$$\dot{m}_{\text{Bondi}} = \pi \lambda \rho r_{\text{Bondi}}^2 c_s$$

$$\mu \approx 0.62 \quad \lambda = 0.25$$
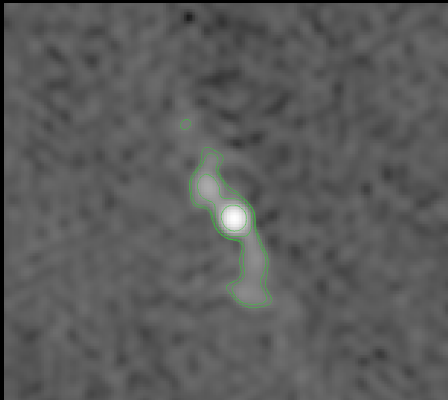
$$P_{\text{Bondi}} = \eta \dot{m}_{\text{Bondi}} c^2$$

$$P_{\text{jet}} \approx P_{\text{Bondi}} \qquad \eta = ?$$

Homework - data

- residual X-ray image (https://ds9.si.edu)

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- VLA image

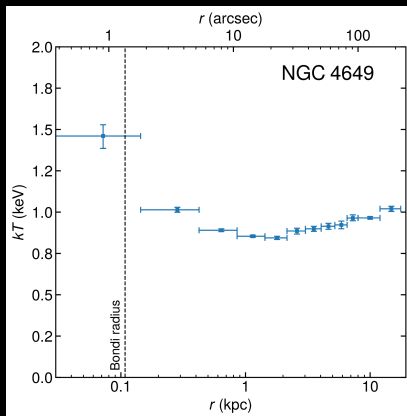## Homework - data

- residual X-ray image (https://ds9.si.edu)

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- residual X-ray image (https://ds9.si.edu)

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- temperature profile

- SMBH mass (internet)

- distance & position of galaxy centre

        (https://ned.ipac.caltech.edu/)

Homework - steps

1) estimate & compare sizes of cavities and radio lobes in DS9
   – for VLA data use $5\times$RMS error contours
2) calculate cavity volumes & galactocentric distances in kpc
3) estimate pressure around cavities & calculate their entropy H
   – hint: use pressure at the distance of the cavity centre
4) calculate cavity ages and their cavity powers & sum them into P_{jet}
   – compare jet powers from X-ray cavities and radio lobes
5) calculate c_s in the centre & find SMBH mass on the internet
6) calculate Bondi radius & Bondi accretion rate
7) estimate efficiency η