Particle content, morphology and jet power: all jets are not equal

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Thanks to Judith Ineson (Southampton) and Martin Hardcastle (Herts)

see Croston+ 2018 (MNRAS 476 1614)
Motivation
All jets are not equal
All jets are not equal

Same jets!

Radiative mode
= High Excitation RG (HERG)

Jet mode
= Low Excitation RG (LERG)

(figure from Heckman & Best 2014 ARA&A 52 589)
Methods for inferring lobe particle content and energetics

Pressure comparisons

X-ray inverse-Compton emission from lobes
FRI energetics from pressure balance

FRII energetics from inverse-Compton emission

Ineson, JC et al. 2017 MNRAS 467 1586 & see Judith Ineson’s poster
A comprehensive view of radio-galaxy environments

LERGs (low accretion rate jets)

HERGs (high accretion rate jets)

Ineson, JC et al. 2015 MNRAS 453 2682 & see Judith Ineson’s poster
Systematic pressure comparison

see Croston+ 2018 (MNRAS 476 1614)
“FRII-like” energetics

NB. Ruled out by FRI IC limits in 7 cases

see Croston+ 2018 (MNRAS 476 1614)
Why can’t FRIs and FRIIs have the same energy balance?

- FRIs with FRII-like sub-equipartition fields ruled out by IC limits in 7 cases
- Substantial proton content in FRIIs would overpressurise lobes at midpoints and “pinch” points.

see Croston+ 2018 (MNRAS 476 1614)
Does particle content depend on morphology or accretion mode?

see Croston+ 2018 (MNRAS 476 1614)
Implications for feedback estimates
Implications for feedback estimates
Jet power and morphology

![Graphs showing jet power and morphology](image)

Hardcastle 2018 (MNRAS 475 2768)
Predicting environments from radio properties

It works if you choose your sample carefully...
Summary

Systematic X-ray study of radio-galaxy environments and energetics has taught us:

• FRI and FRII radio galaxies have **different particle content** and **energy balance**

• FRIs best explained by significant **proton contribution from entrainment/mixing**, not present in more "pristine" FRIIs

• This affects **relationship between jet power and radio observables** (but so do many other factors)

Vital to understand the make-up of your population (including life stages!) before trying to infer jet power or feedback effects

see Croston+ 2018 MNRAS 476 1614 & 2017 MNRAS 470 1943