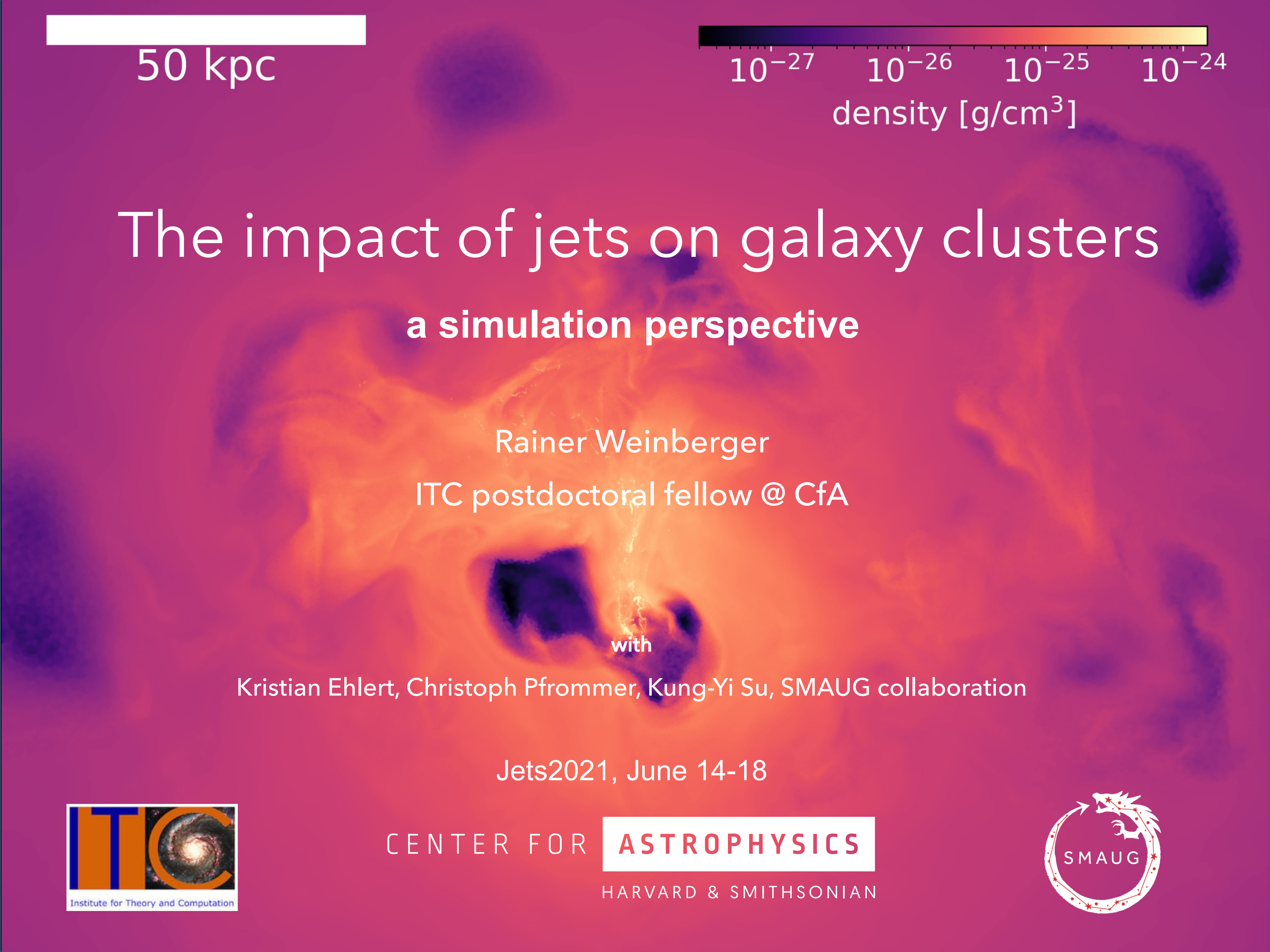

The impact of jets on galaxy clusters

a simulation perspective

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with

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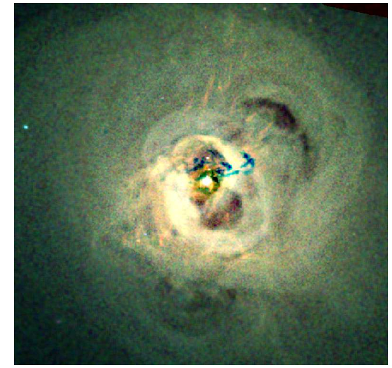
Jets2021, June 14-18

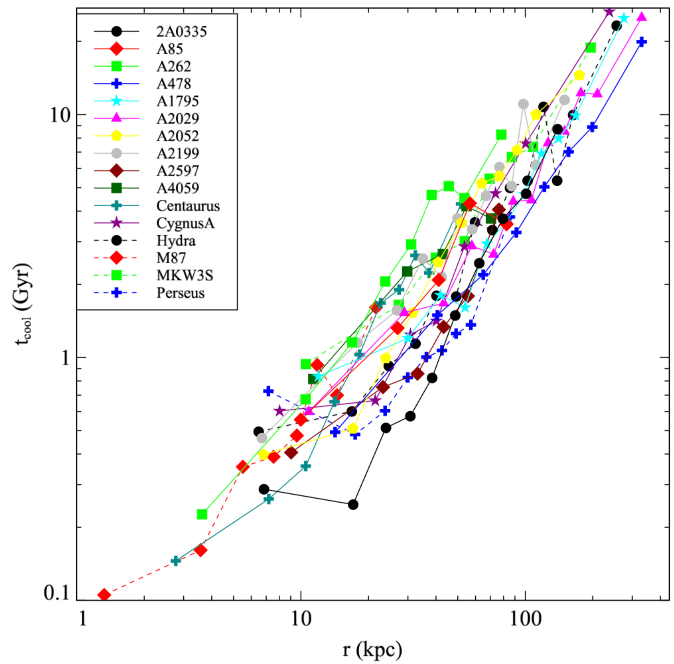
Institute for Theory and Computation

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

SMAUG

Fabian 2012





Dunn & Fabian (2006)

The cooling flow problem

Basic problem

The star formation rate in cool-core galaxy clusters is smaller that expected from their temperature and cooling luminosity

cooling flow:

$$\frac{L_{\rm cool}}{u_{\rm th}} = \frac{10^{44}\ {\rm erg\ s^{-1}}}{10^{15}\ {\rm erg\ g^{-1}}} \sim 10^3\ {\rm M_\odot\ yr^{-1}}$$

star formation:

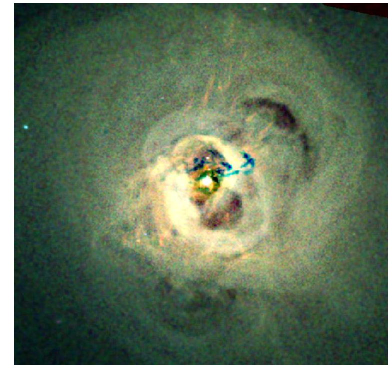
$$\mathrm{SFR} \sim 10\ {\rm M_\odot\ yr^{-1}}$$

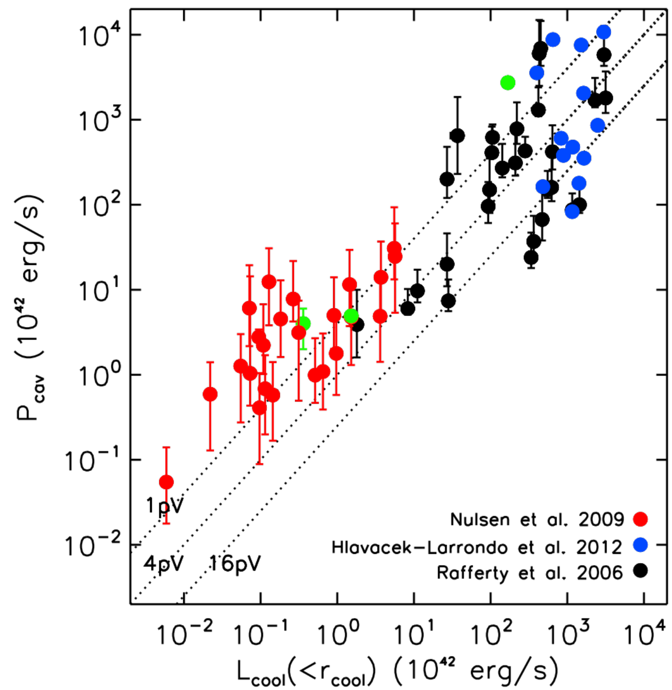
The cooling flow problem

Heating source

- Lobes inflated by AGN jets
- Energy correlates with cooling luminosity
- Energetically, jets can offset the cooling
- Can this work locally?
- How is the energy distributed?

Fabian 2012



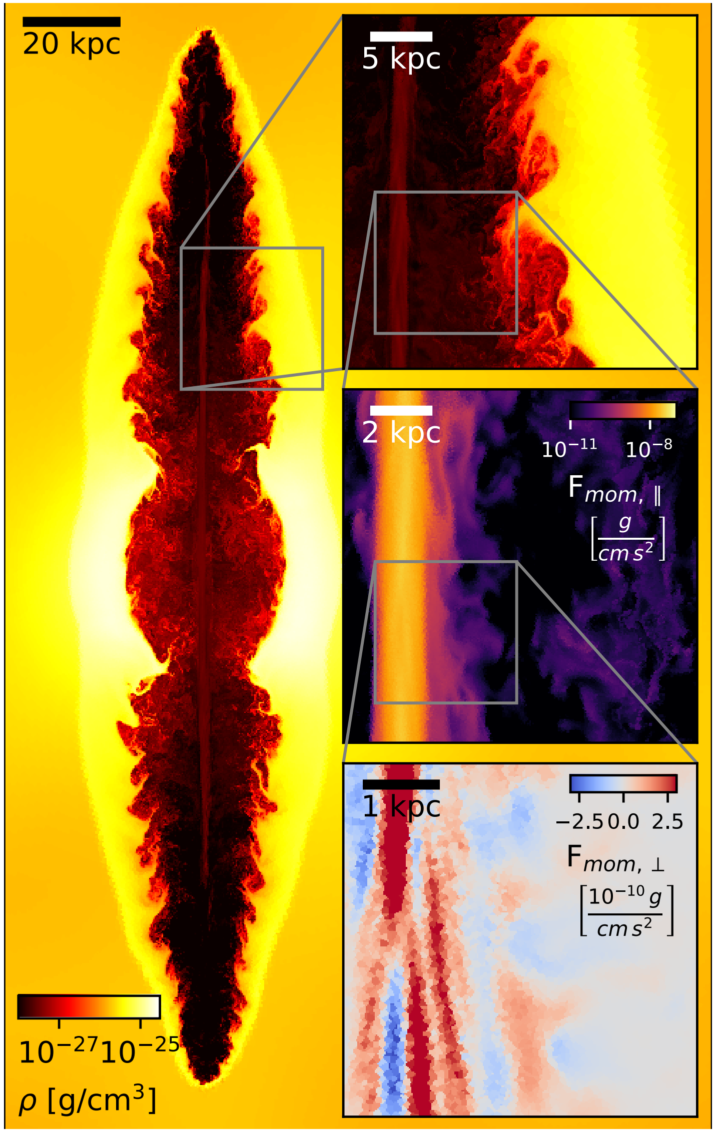


Fabian (2012)

Jet propagation

through the ICM

- Collimated, light, hydrodynamic jet
- Pressure equilibrium with the surrounding
- 0° opening angle, no precession
- Propagation numerically converged.
- Momentum flux resolved

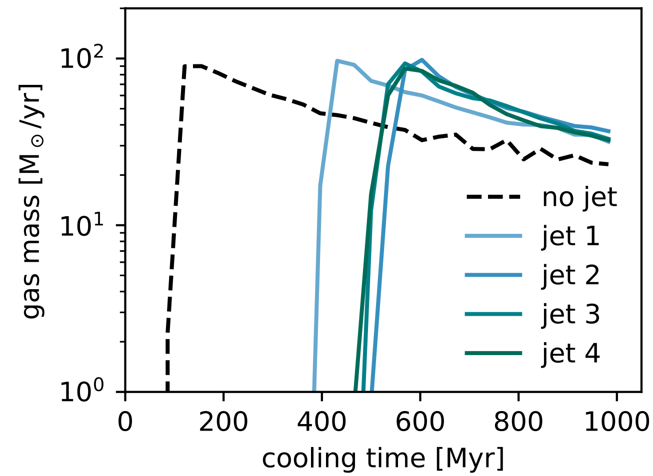


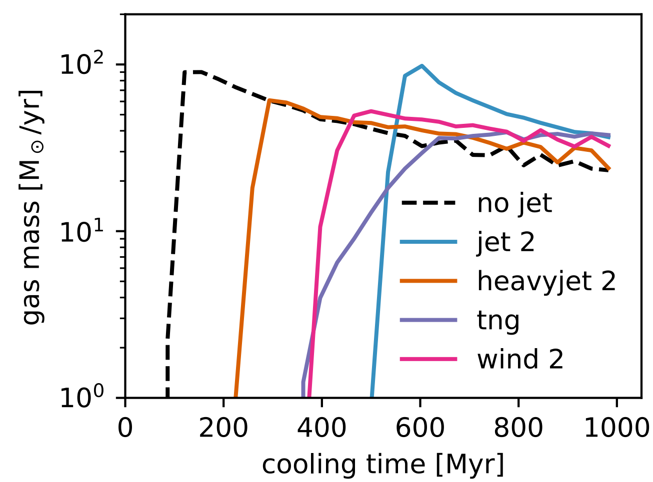
RW et al. (in prep)

Response to jet

in the ICM

- Fixed power jet in cooling halo
- Histogram of cooling times after 50 Myr
  - The onset of the cooling flow
- Jet delays the cooling flow
- Dependent on jet properties
  - Density
  - Opening angle (jet vs wind)



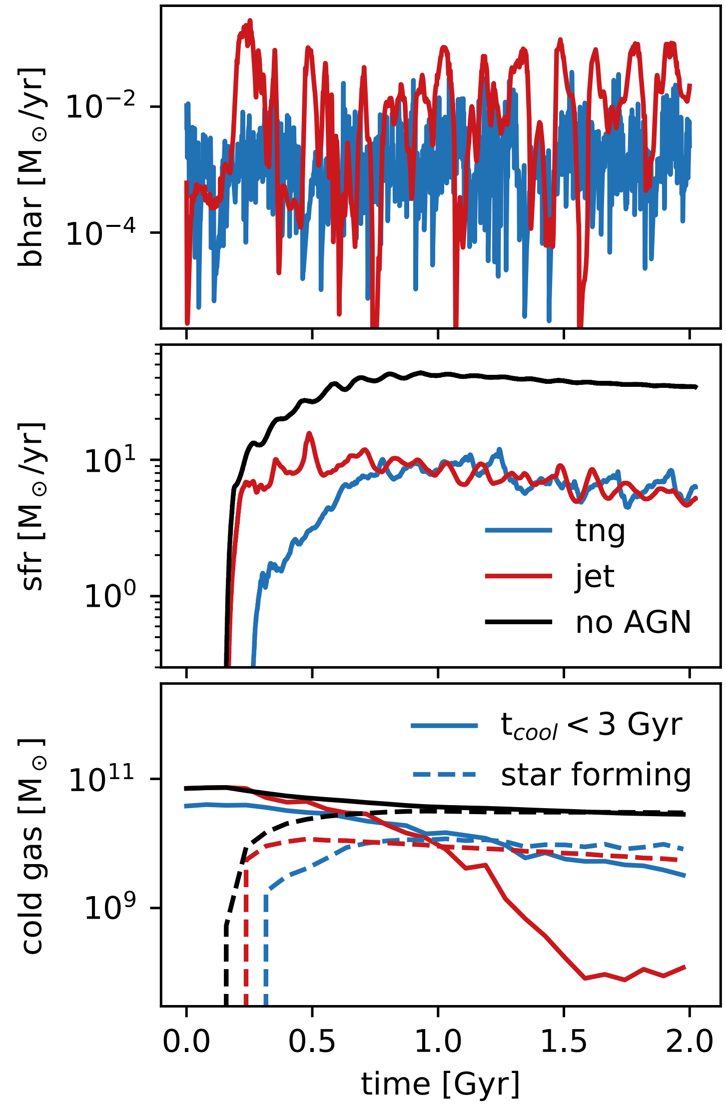


RW et al. (in prep.)

Self-regulation

with the ICM

- Comparison with established kinetic wind AGN feedback model from IllustrisTNG
- Jet able to suppress star formation to a similar degree
- Acting on the non-star-forming component
- Different time-variability



RW et al. (in prep.)

Conclusion

- Light hydrodynamic jets reduce cooling flows
- No precession, opening-angle or similar effects required
- Feedback effects in cosmological simulations are not unique