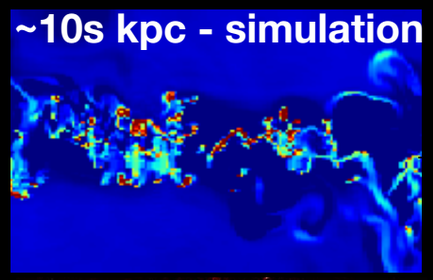
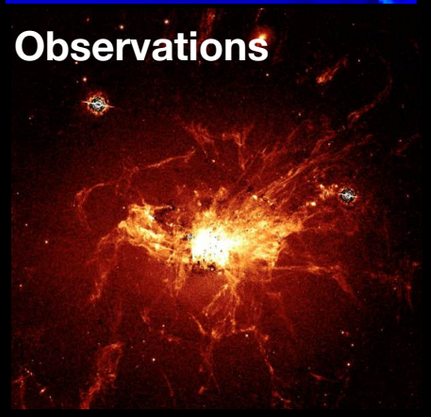
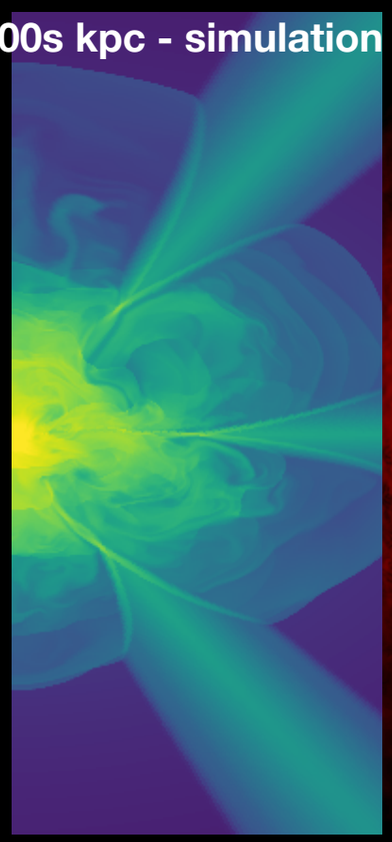
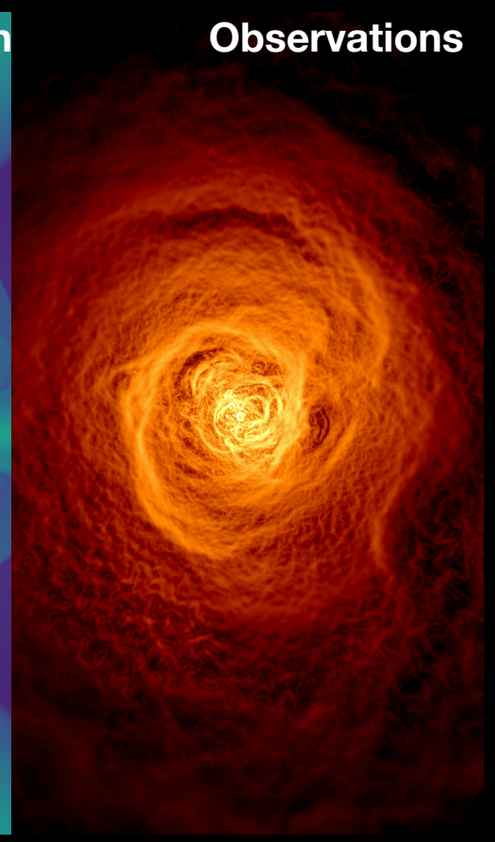




Circumgalactic medium – a laboratory for astrophysical fluid dynamics

Multiphase gas in the circumgalactic medium





Prakriti Pal Choudhury, IISc

Collaborators:

Prateek Sharma

Eliot Quataert

Hitesh Kishore Das

Fluids day 2020, ICTS

What kinds of fluids do we talk about in Astrophysics?

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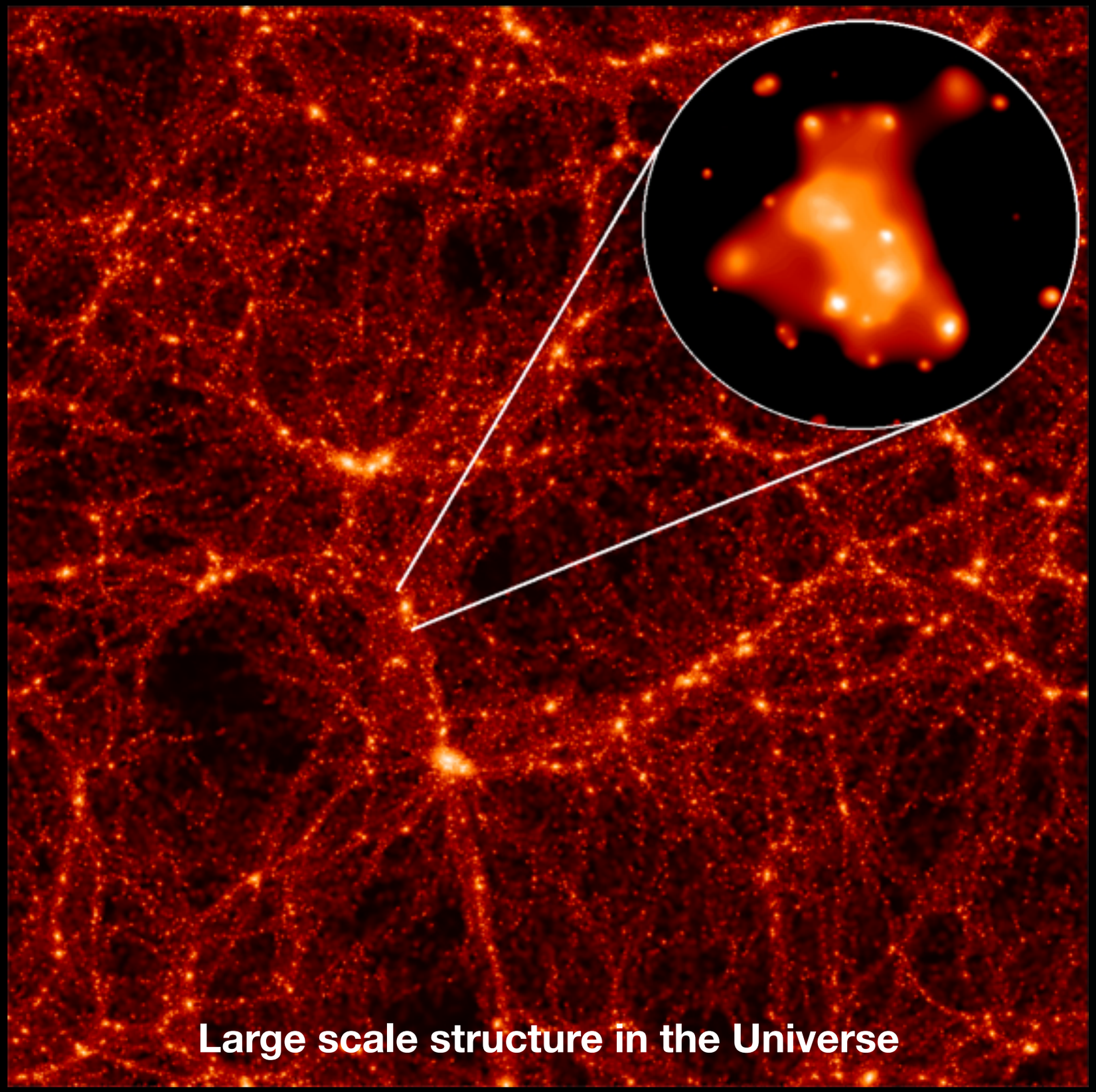

Large scale structure in the Universe

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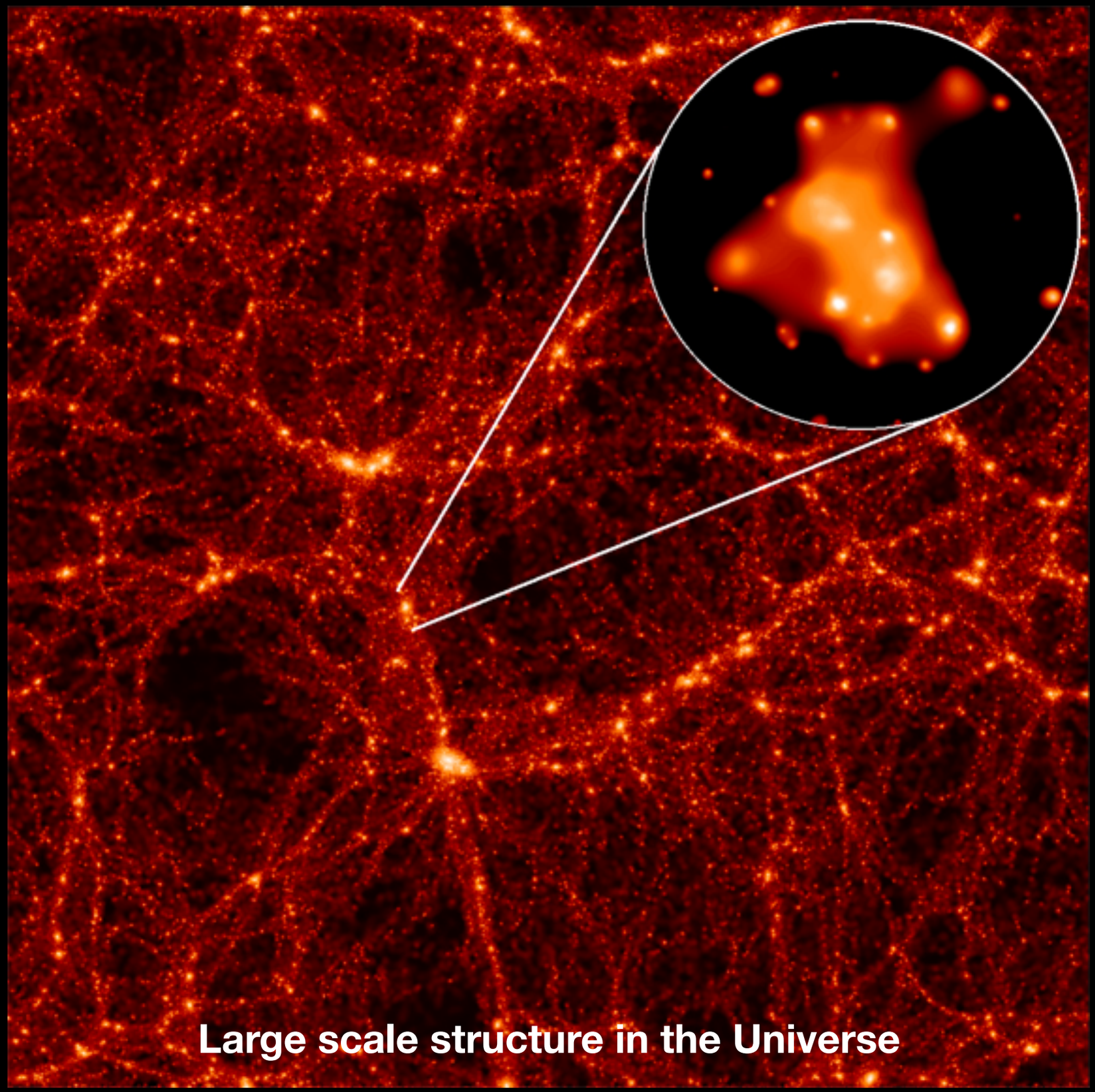

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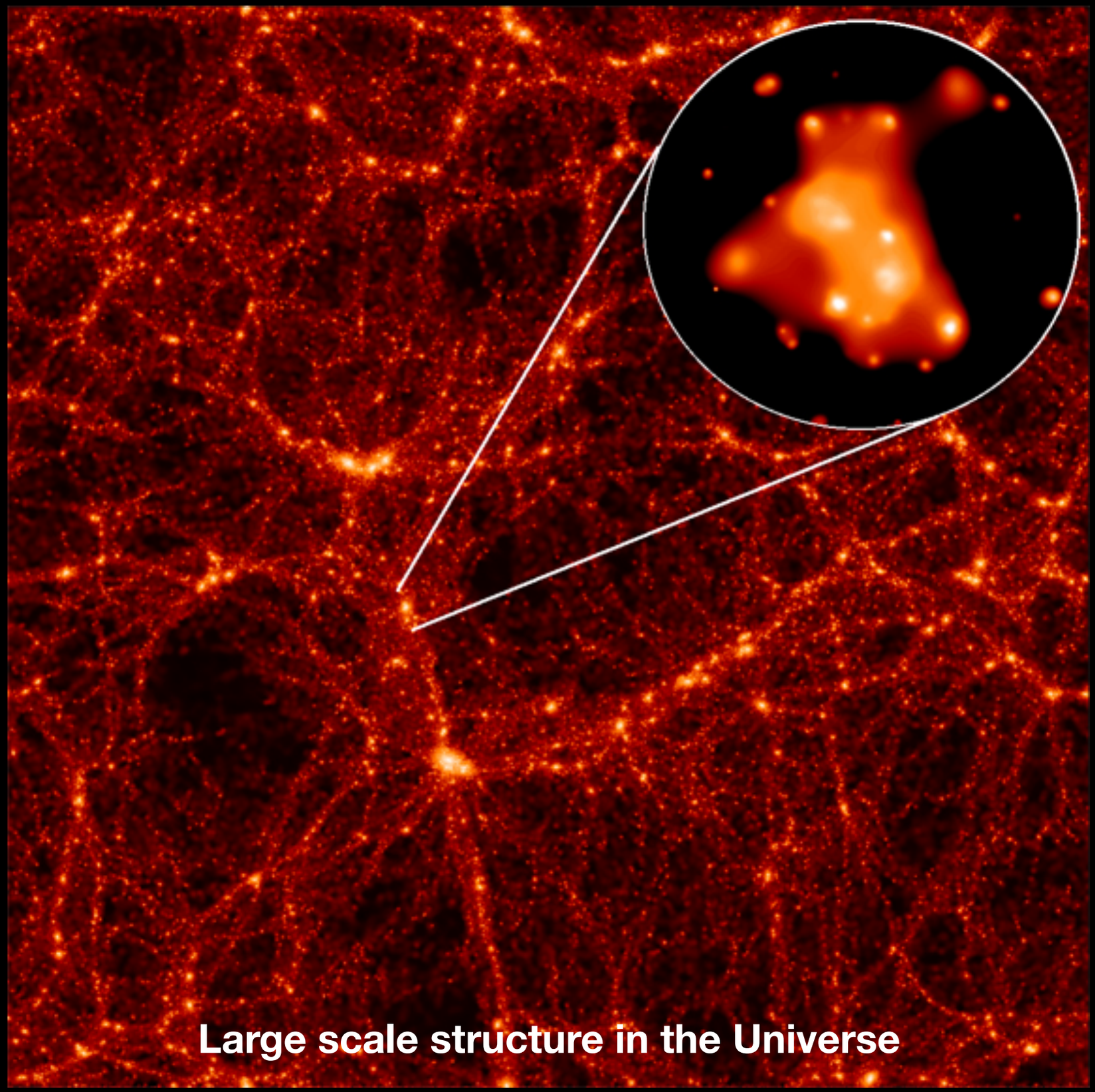

Large scale structure in the Universe

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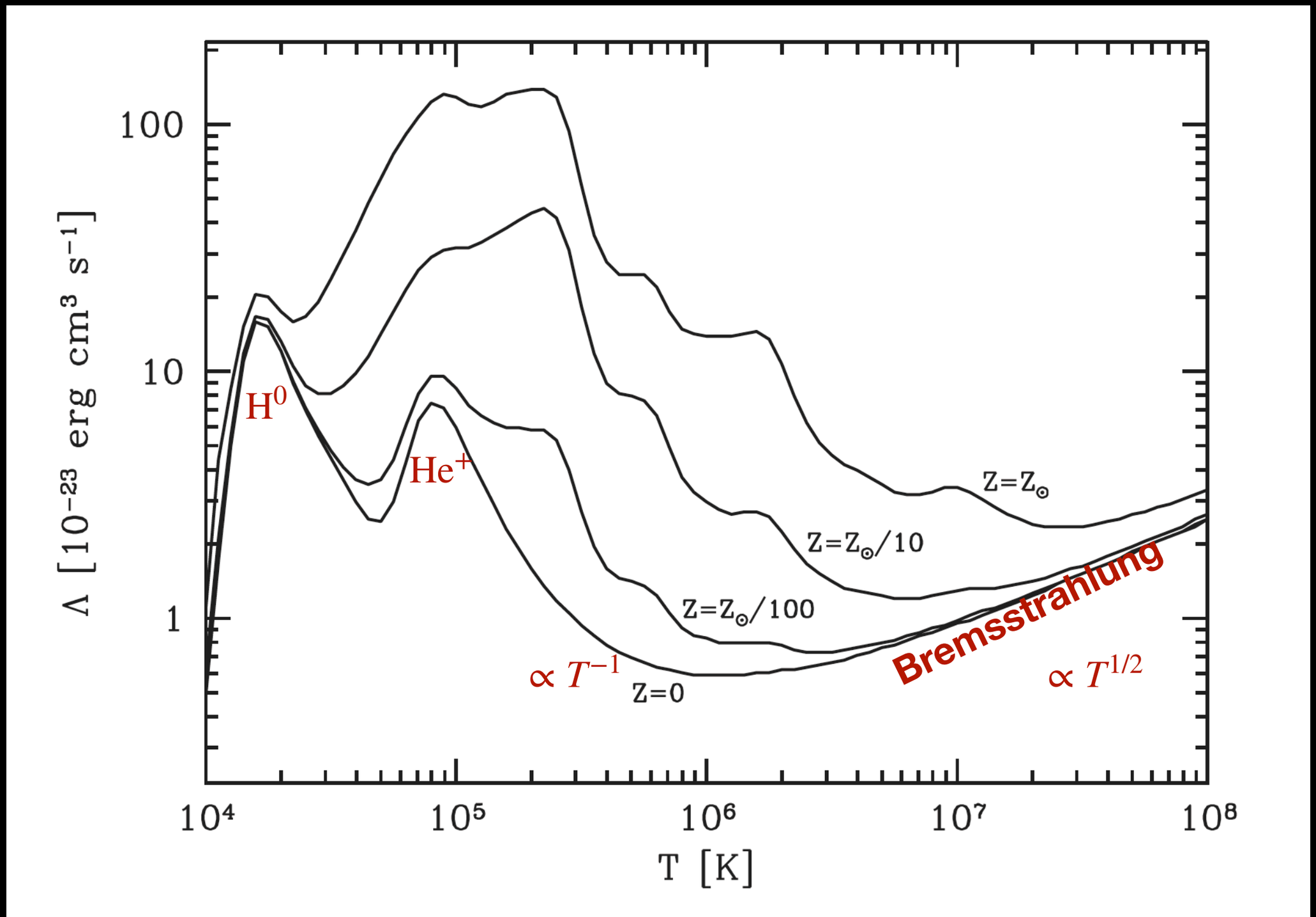
Gas: falls into dark matter potential wells & radiatively emits

Directly observable at multiple phases (temperatures)

The radiative cooling of hot gas and condensation

$$\zeta = (\rho/\mu m_p)^2 \Lambda(T,Z) \qquad t_{\rm cool} = E/\zeta$$



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$\gtrsim 10^{14}\ M_\odot$

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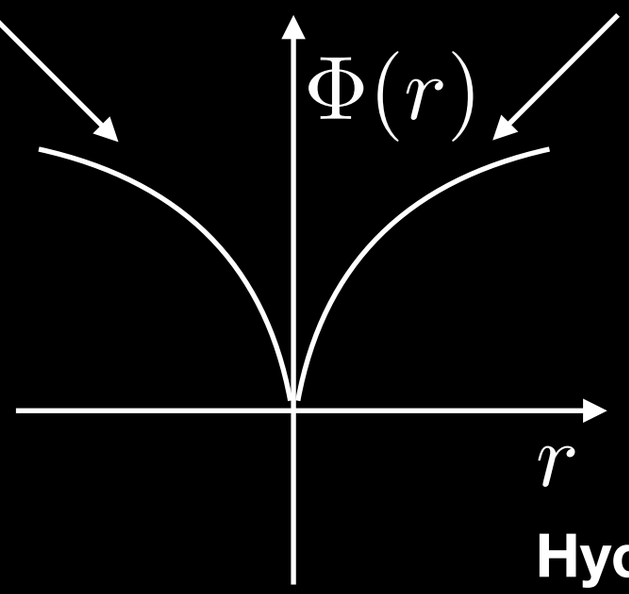
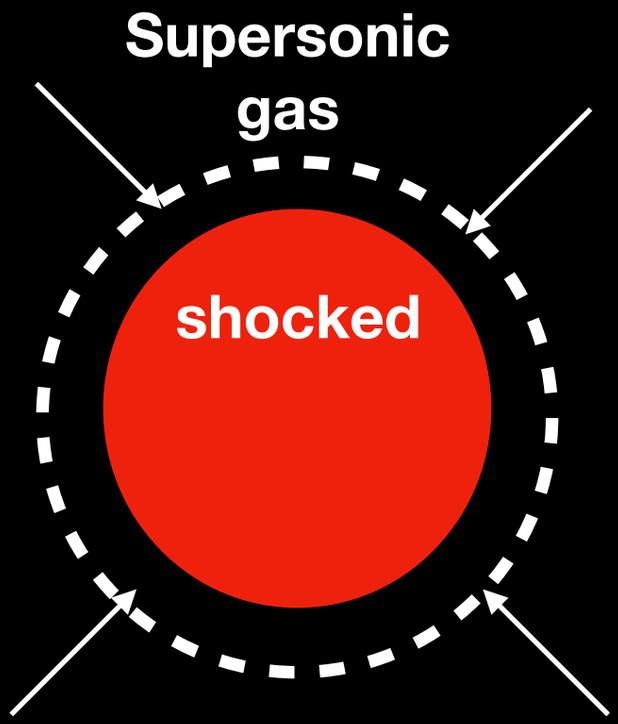
Set by gravitational potentials of the knots



$$\frac{dp}{dr} = -\rho g$$

Hydrostatic equilibrium



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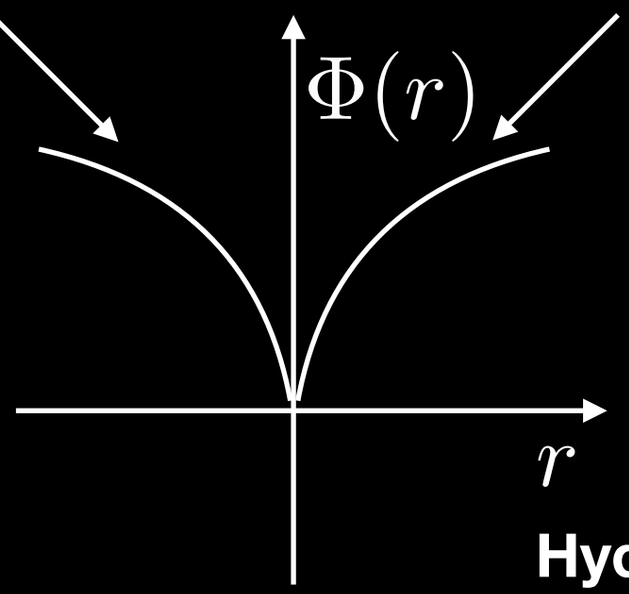

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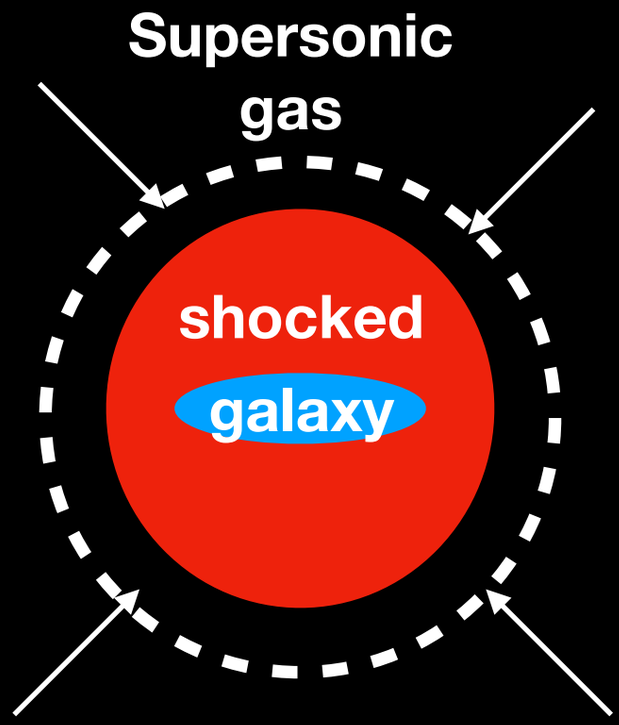

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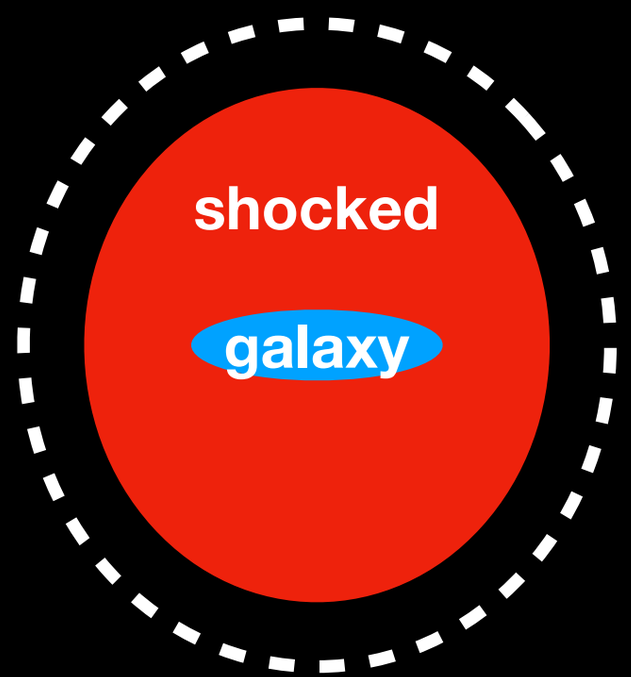

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$$t_{\rm cool} \lesssim t_{\rm Hubble}$$

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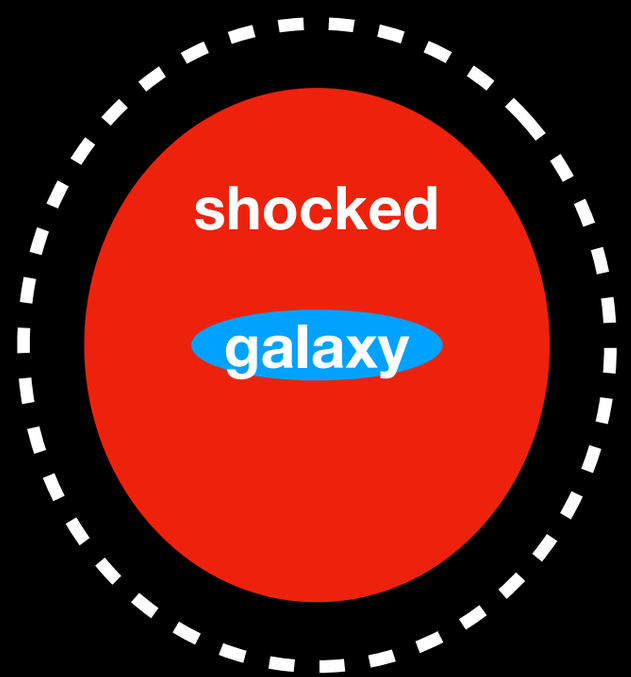

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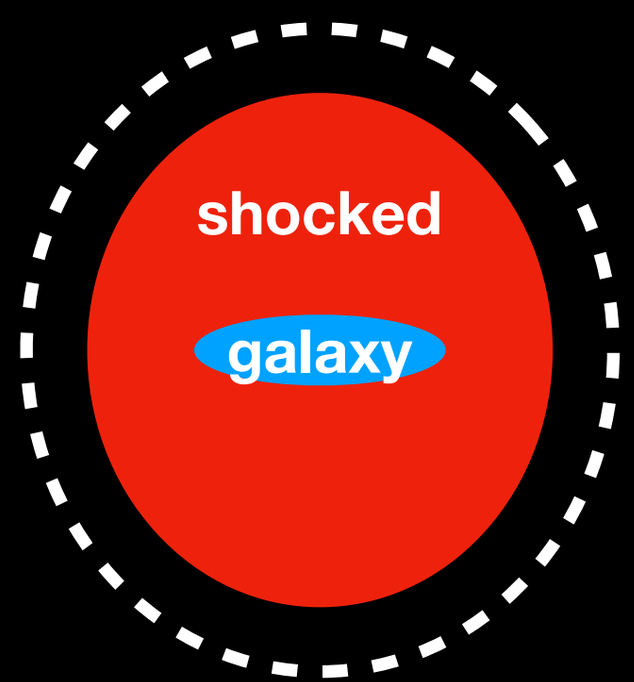

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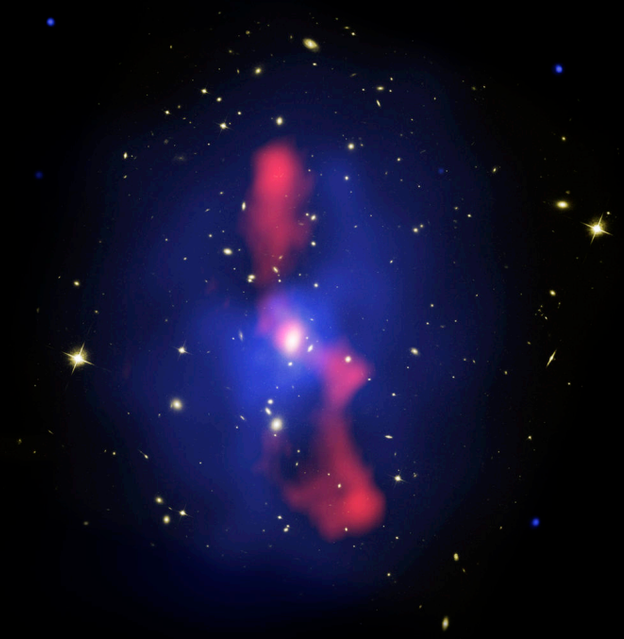
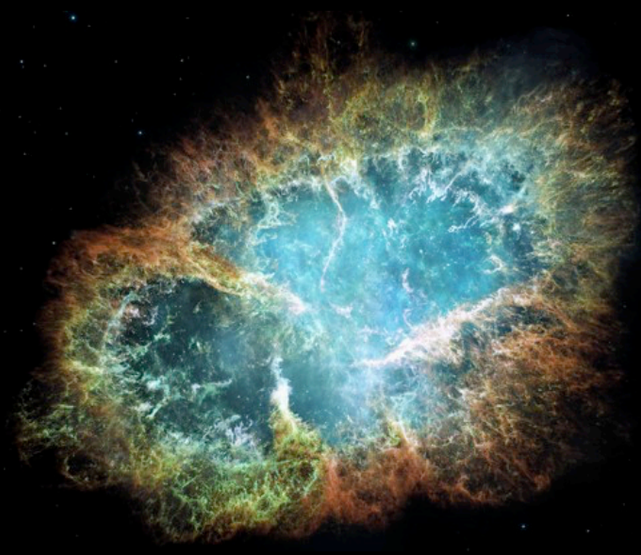


Energy feedback mechanisms



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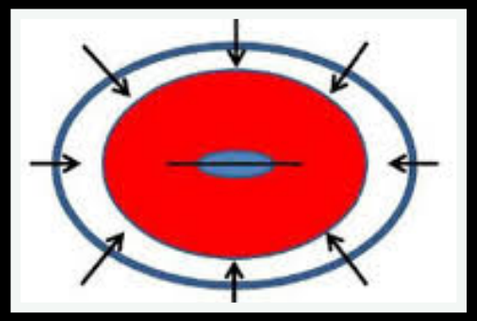

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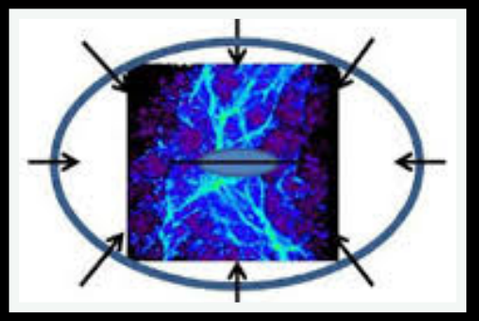

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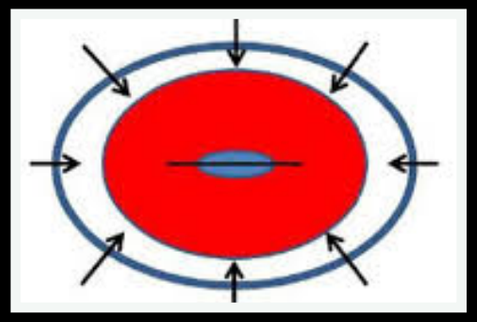

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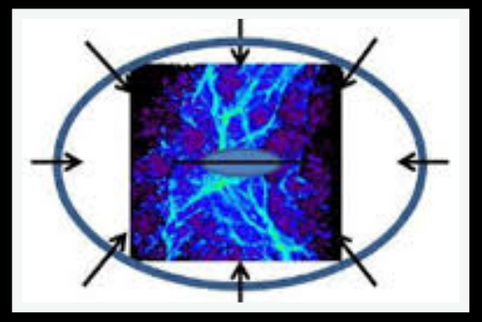

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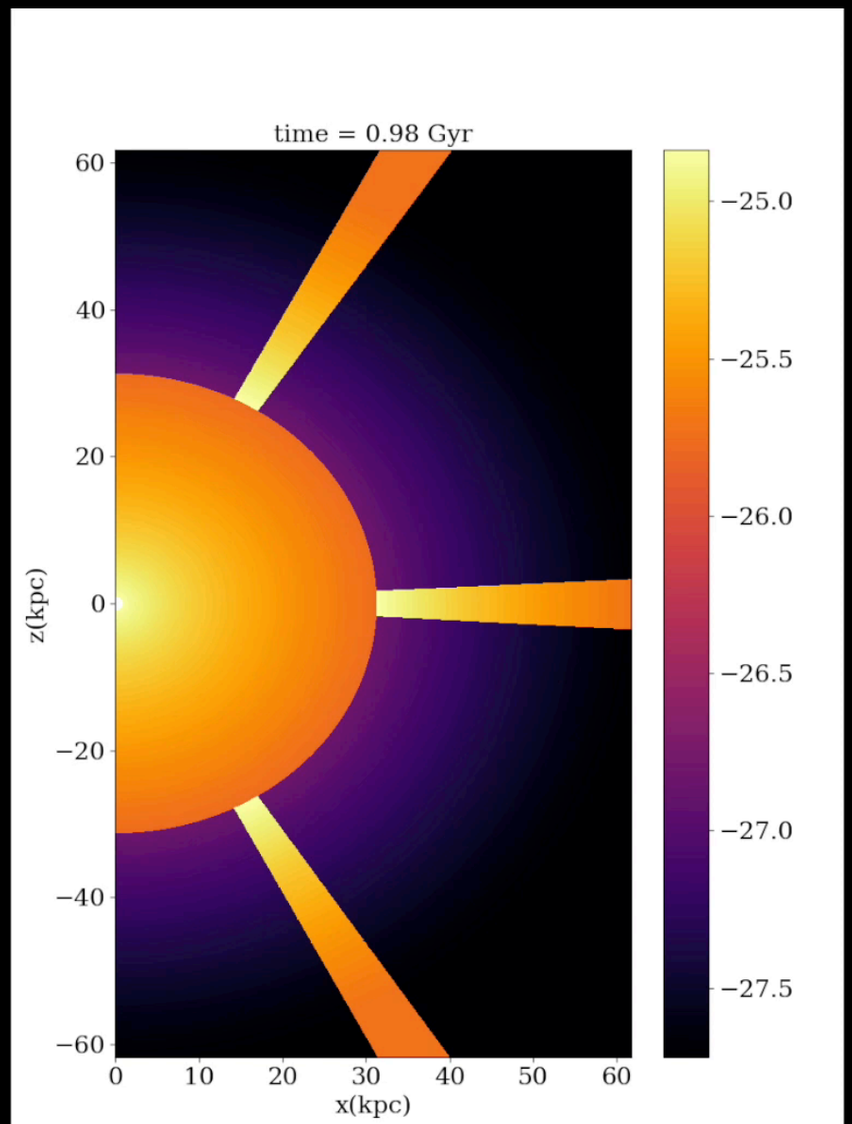

Choudhury+ 2020 [in prep]

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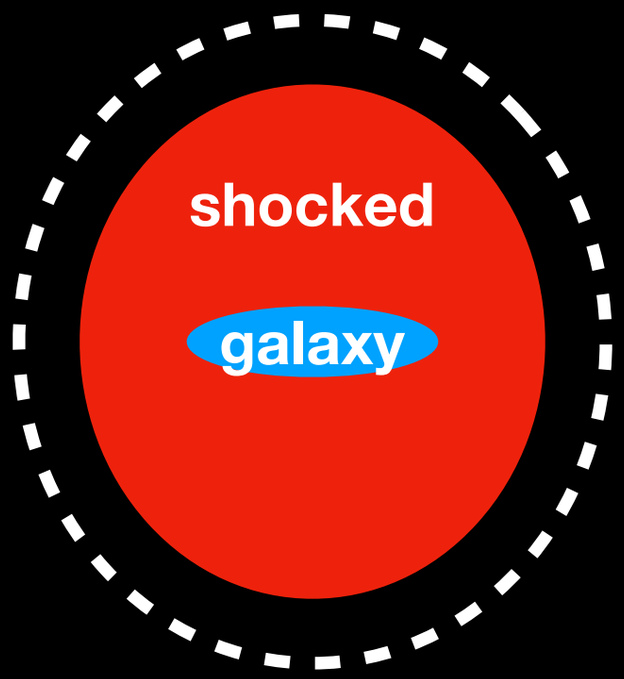

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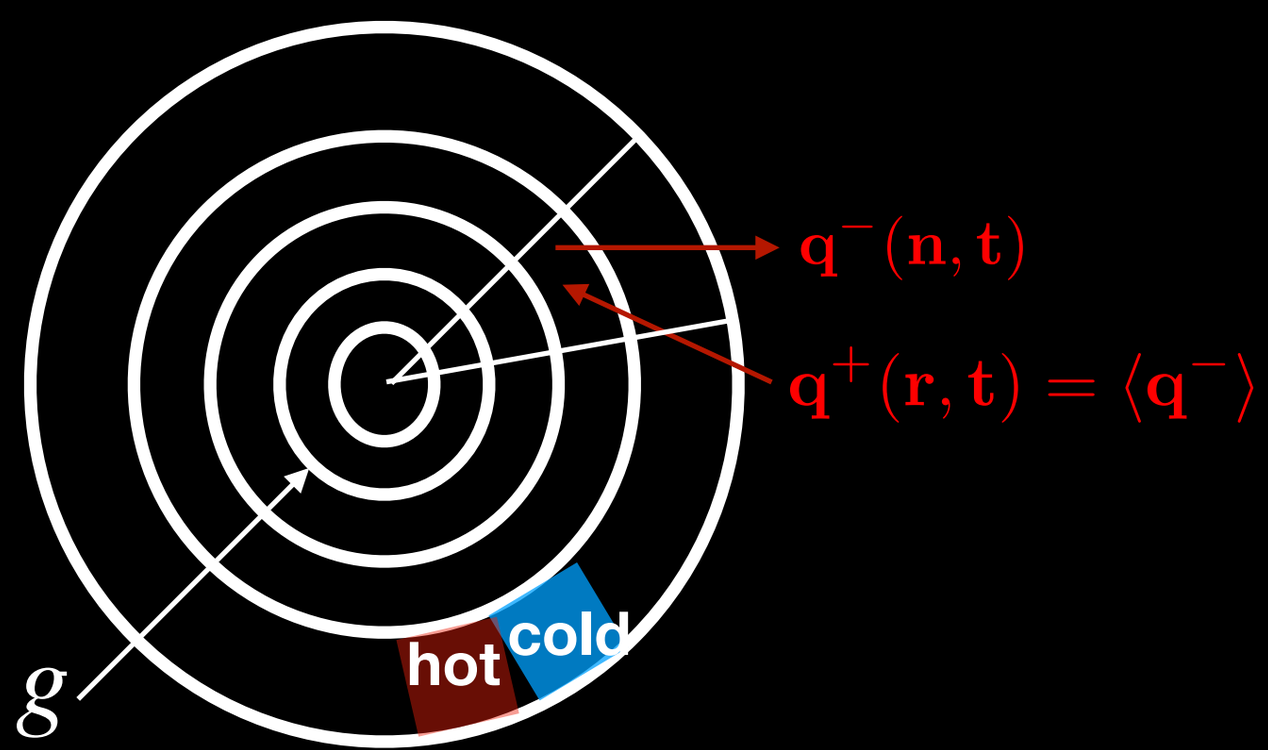

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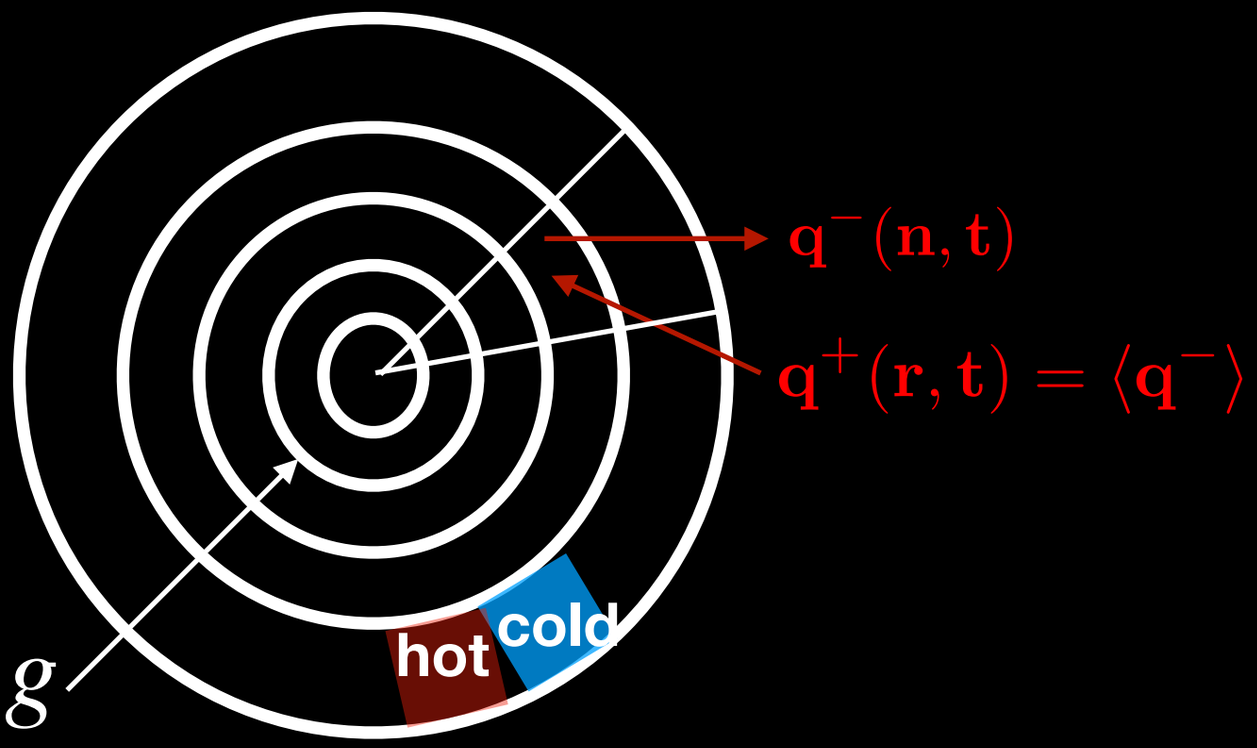

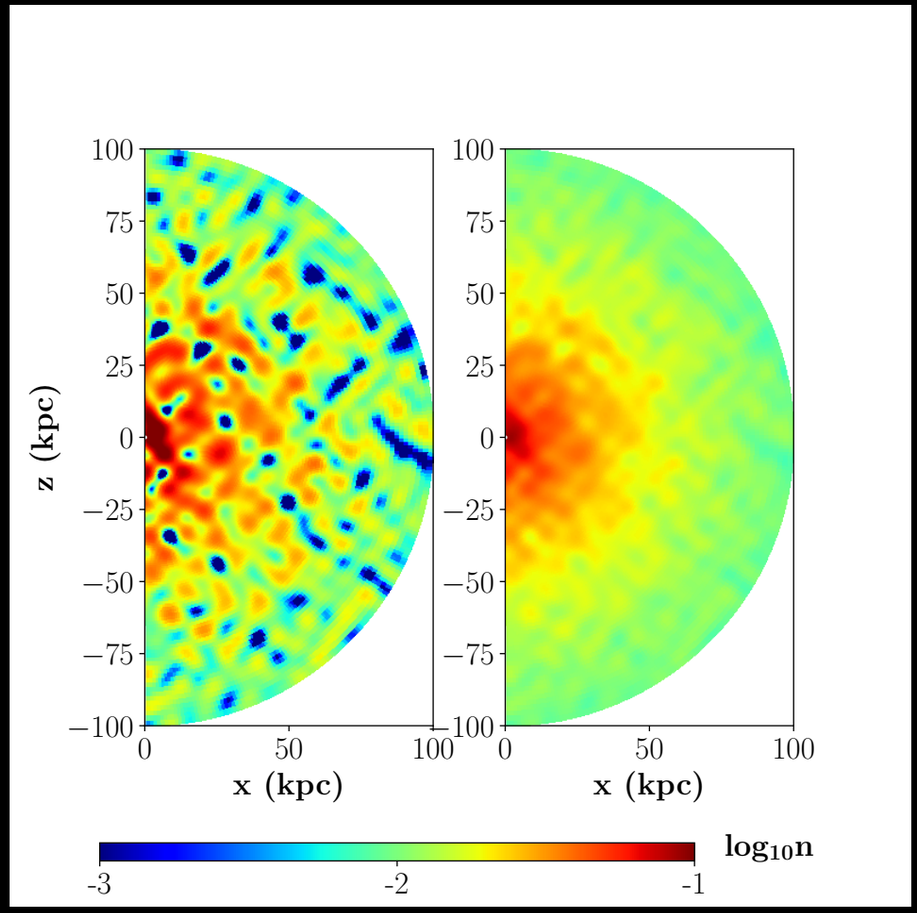

Choudhury+2019

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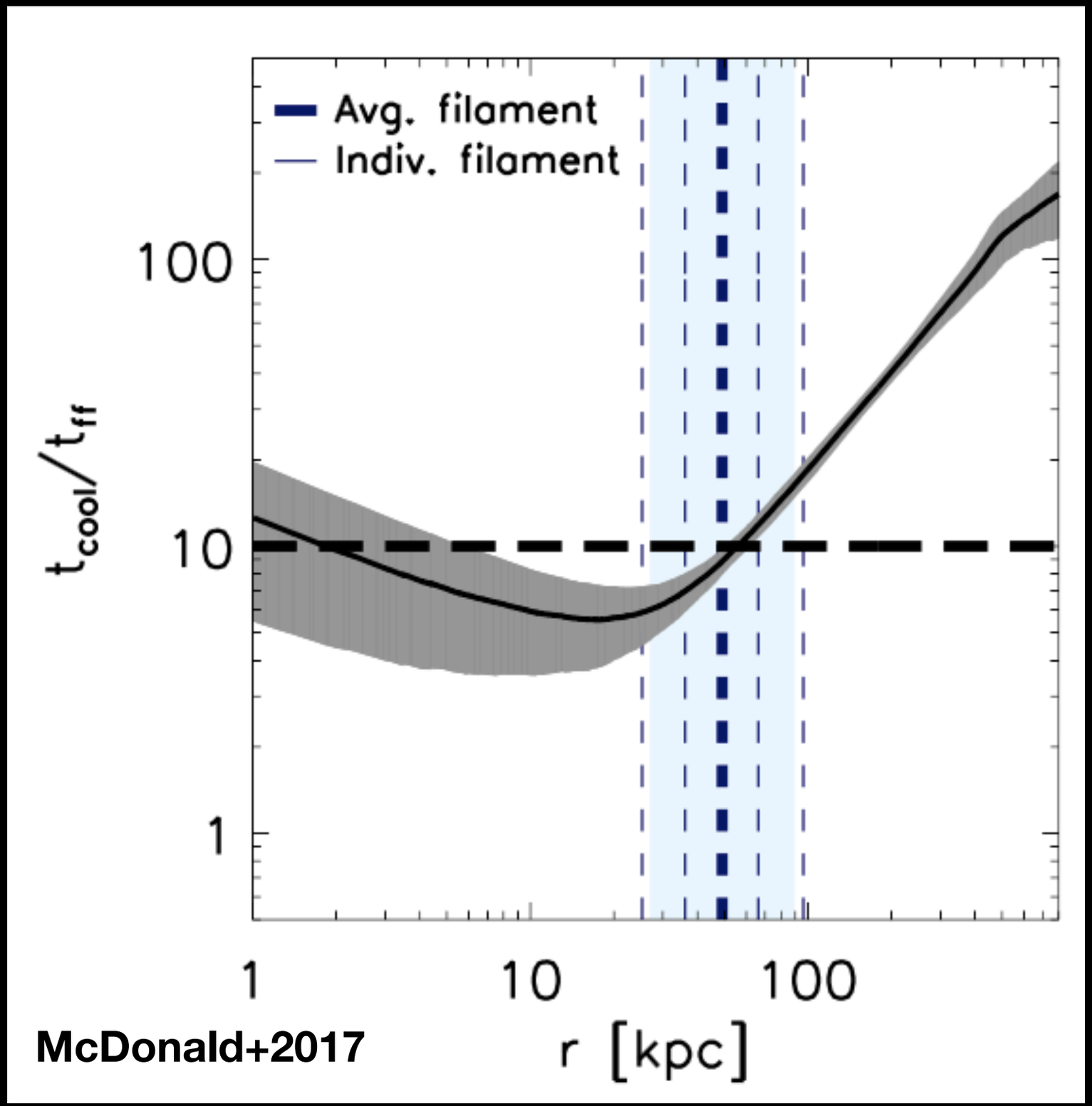

McDonald+2017

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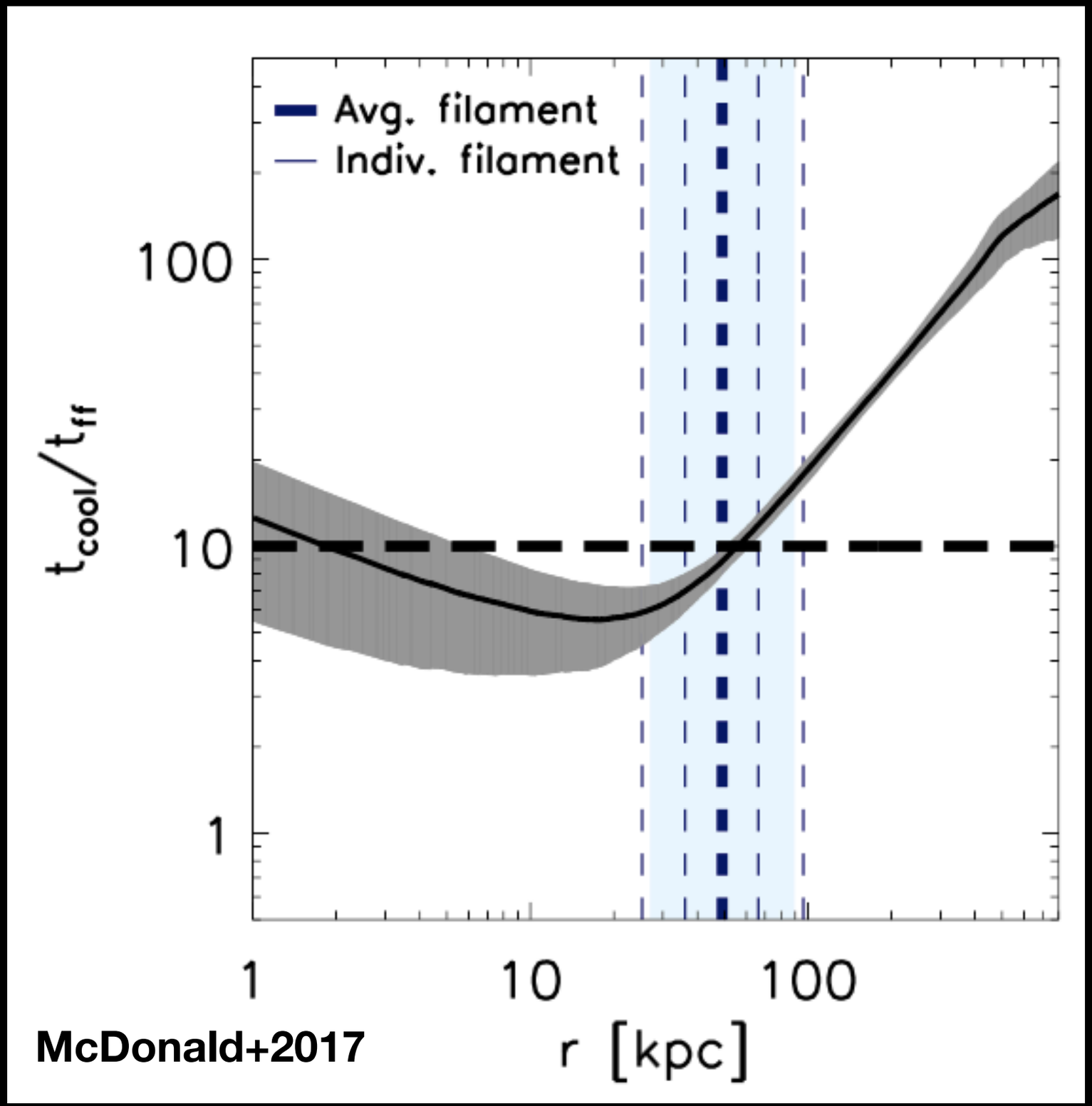

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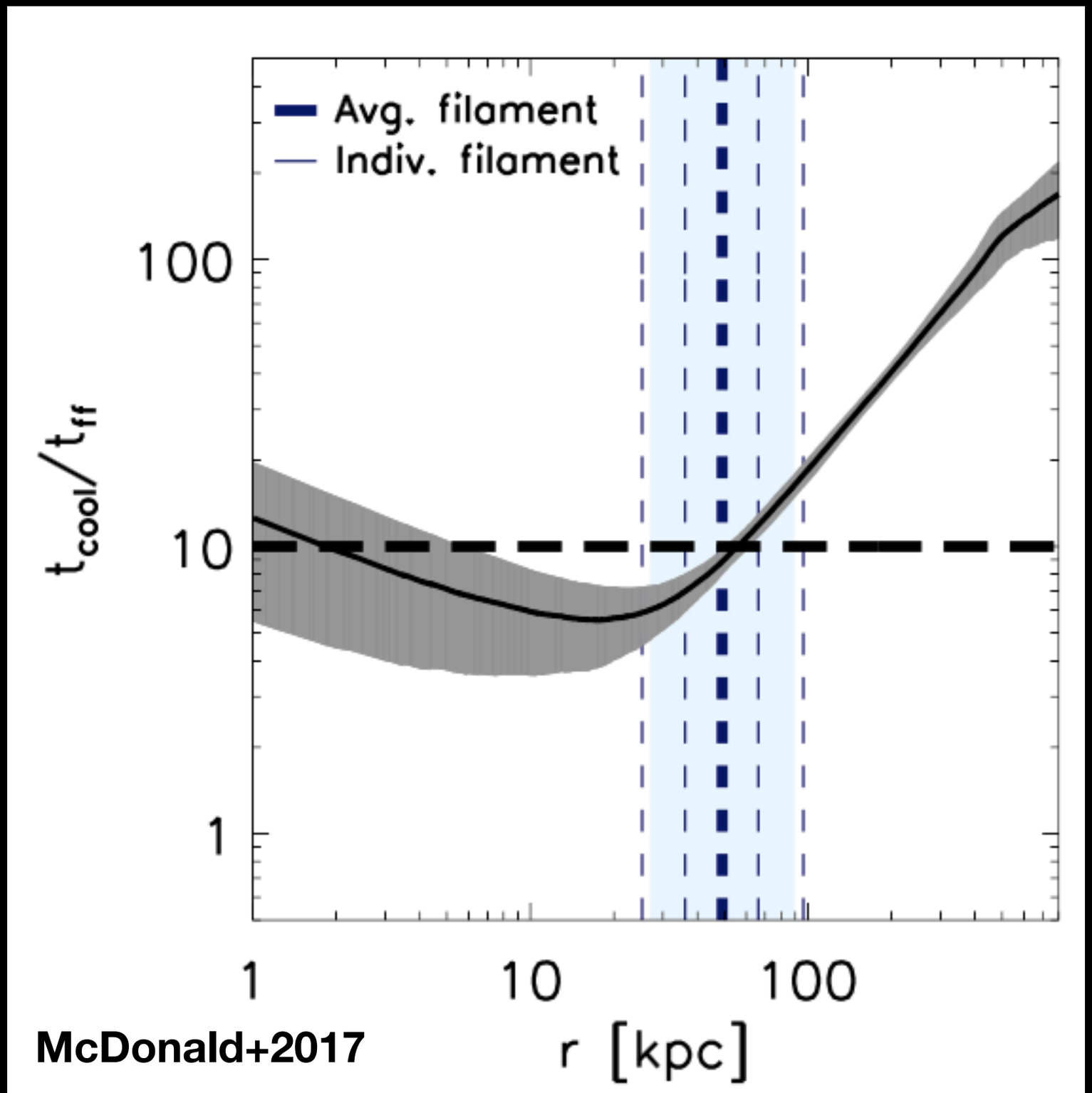

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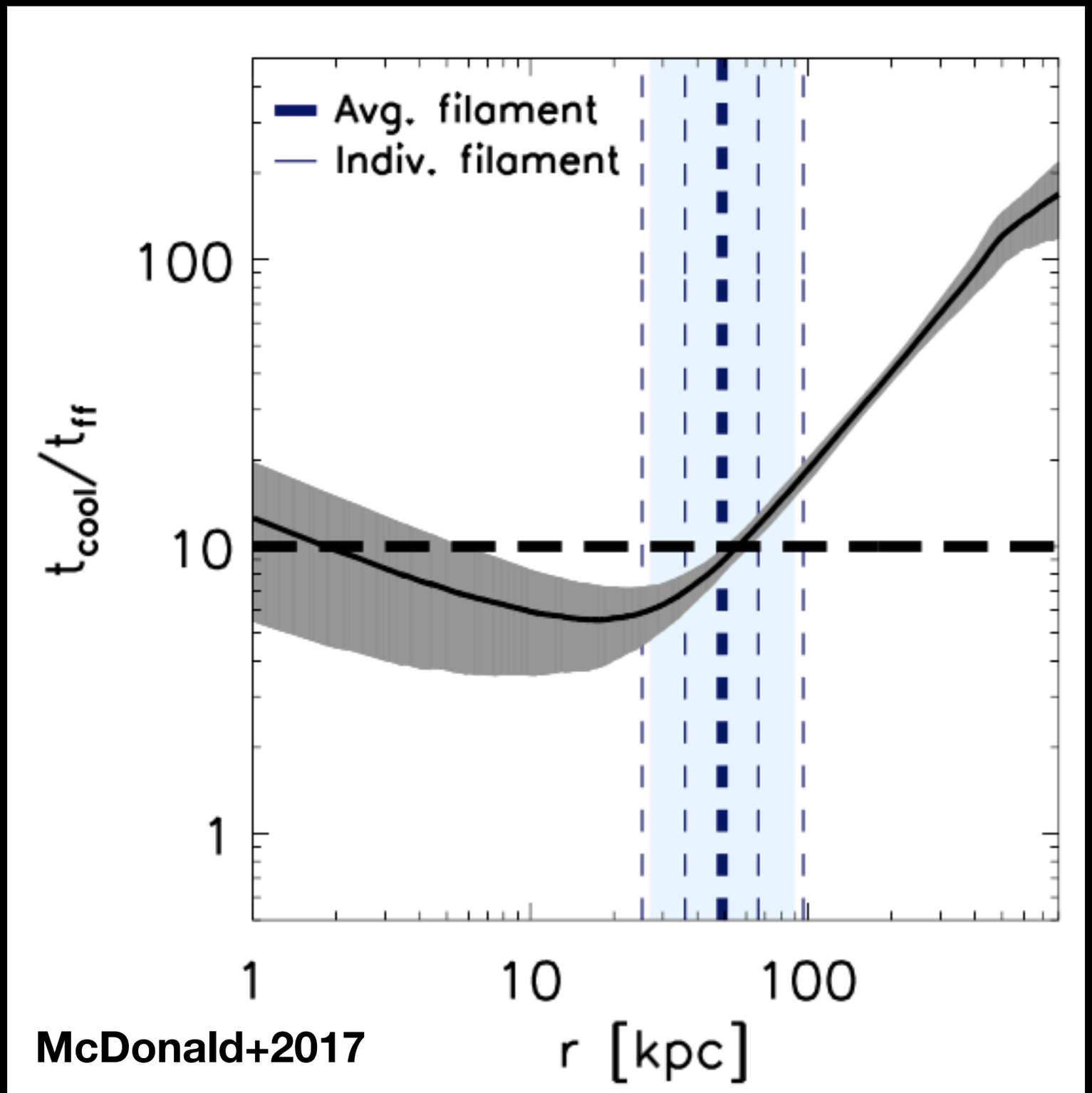

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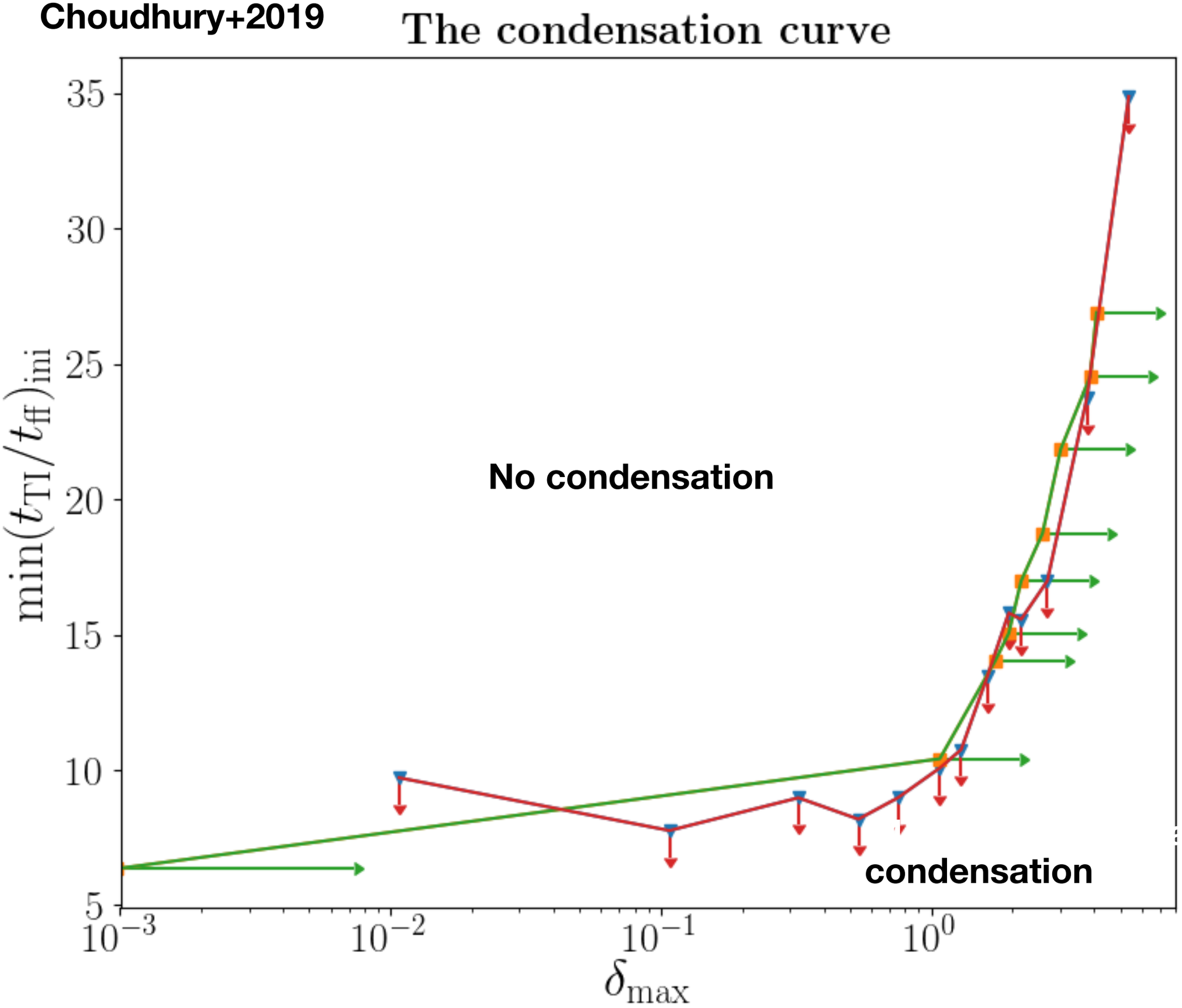
McCourt+, Sharma+2012

Choudhury+2019



ROLE OF ENTROPY (INDEX) IN CONDENSATION

$$K = p/\rho^{\gamma}$$

Shocked gas moves to a higher adiabat.

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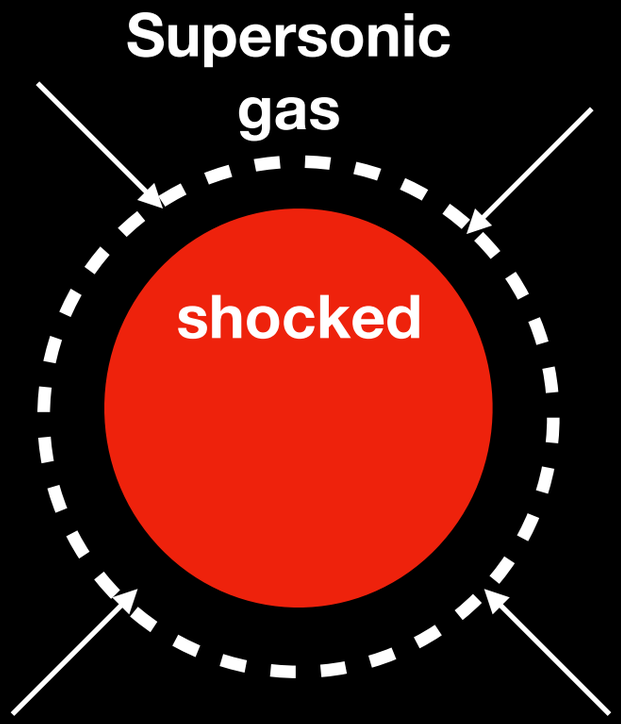

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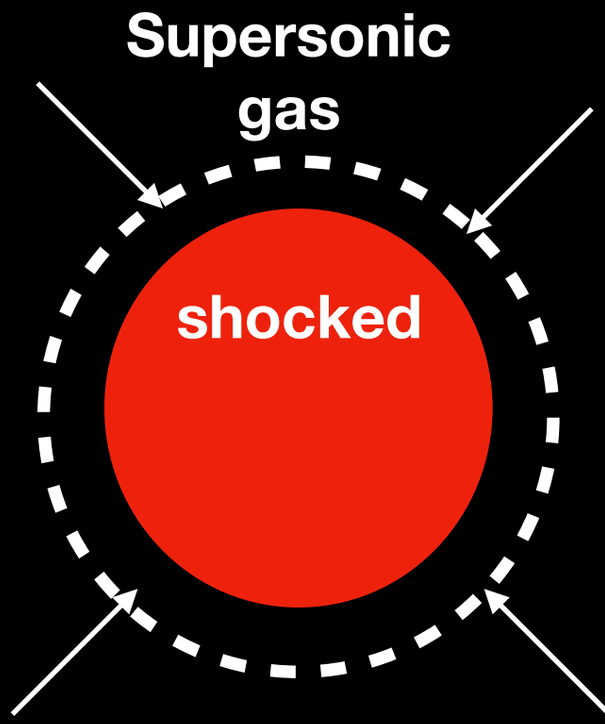

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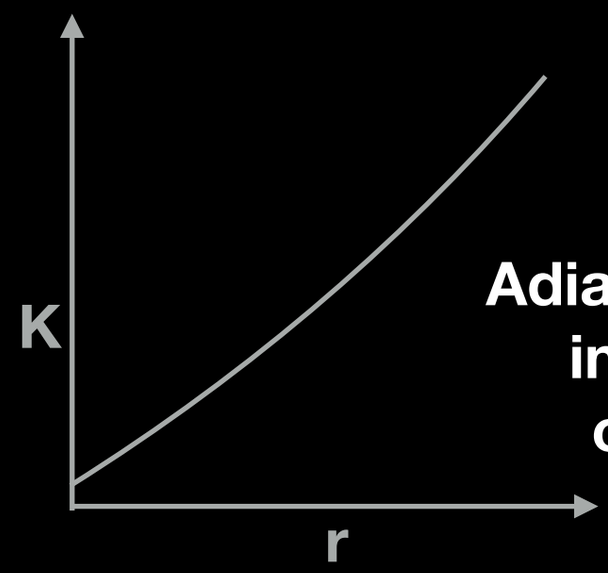

Adiabatic compression in the absence of cooling/heating

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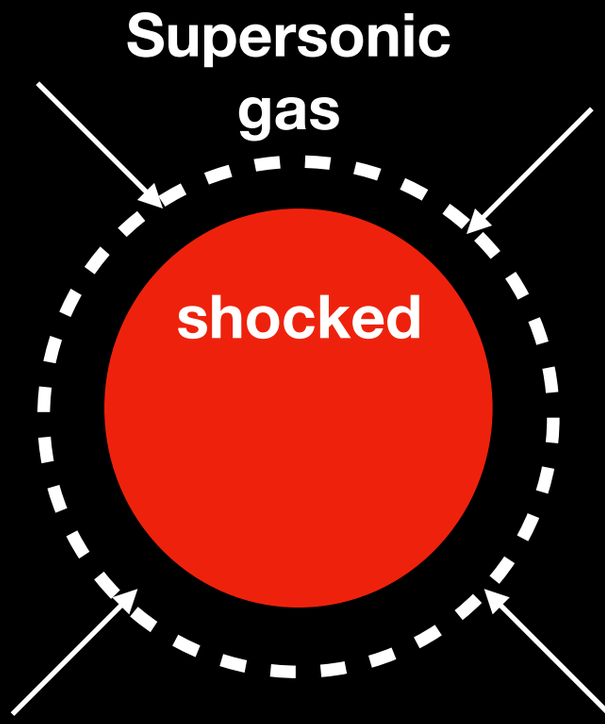

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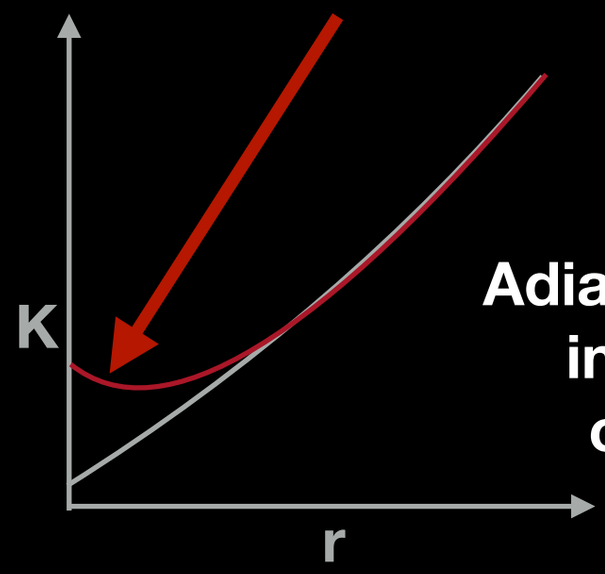
Cooling/heating rewrites the profile



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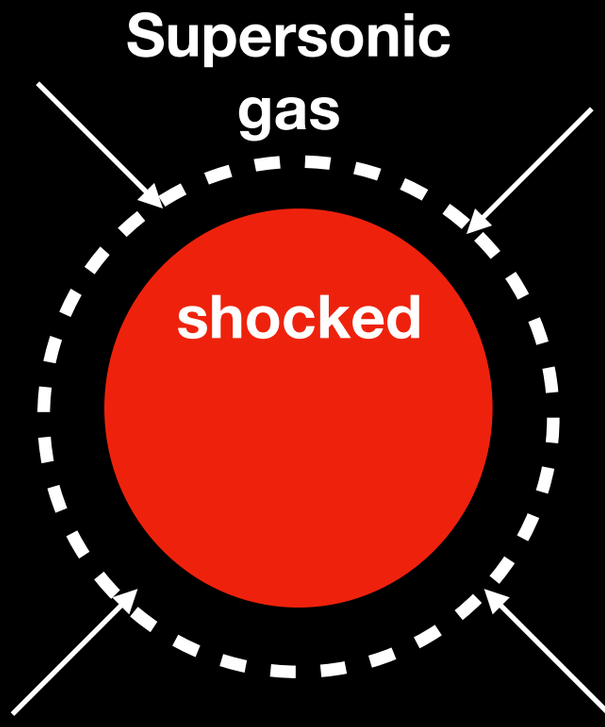

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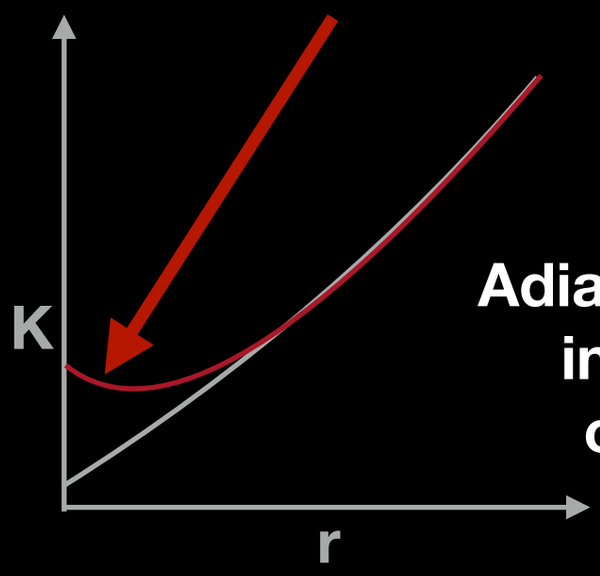
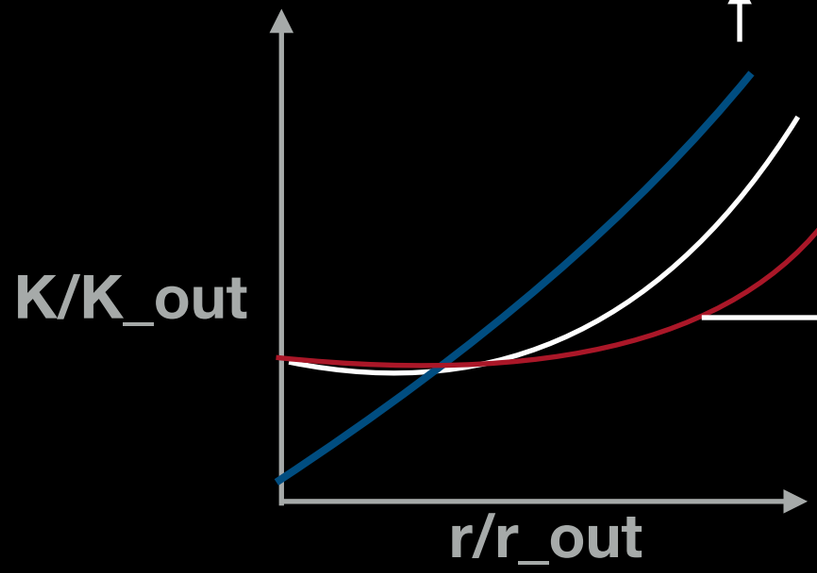


Adiabatic compression in the absence of cooling/heating

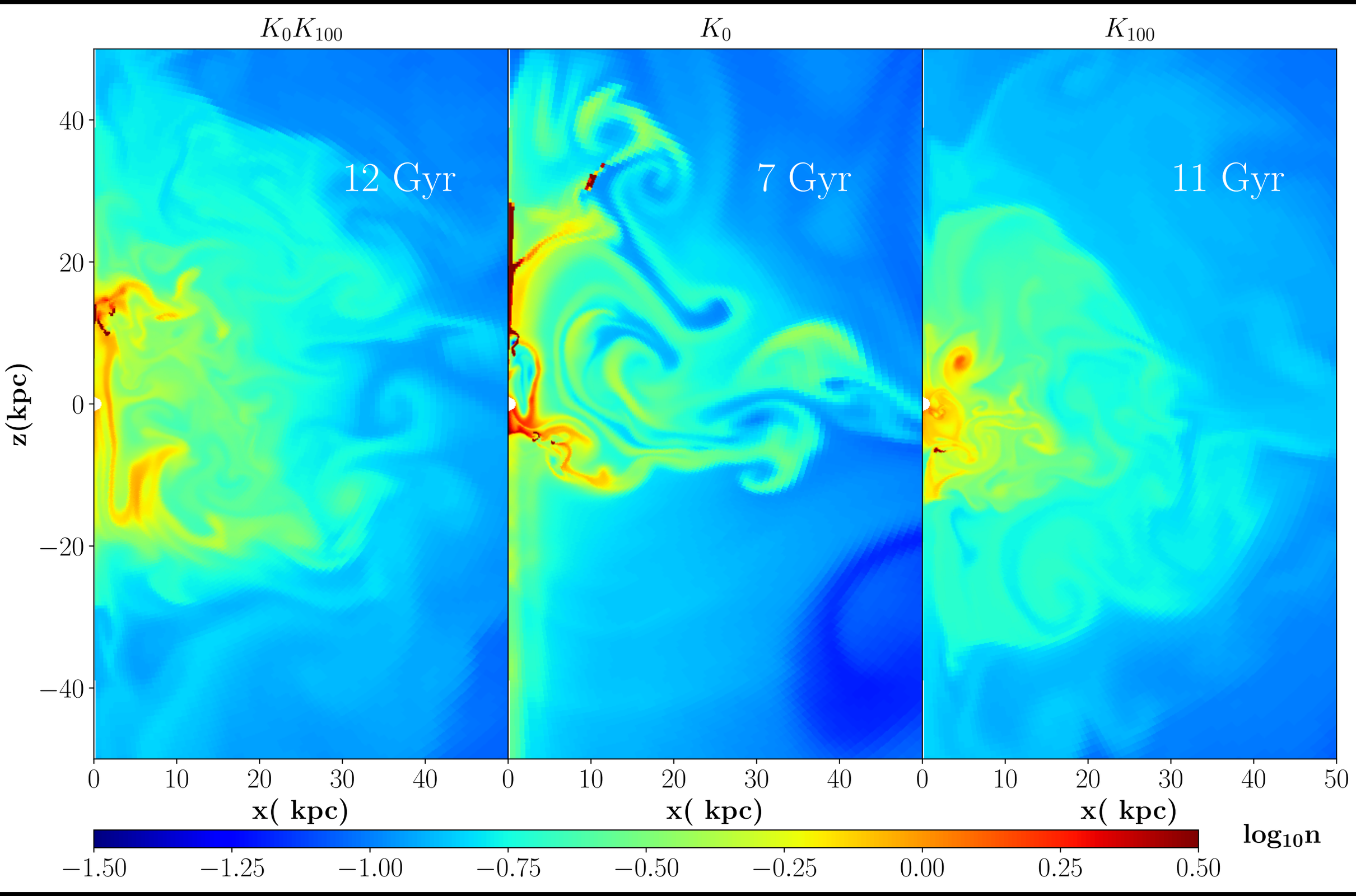
Pure power-law-cosmological infall

Real ICMs with dissipative processes

ICM with extended core

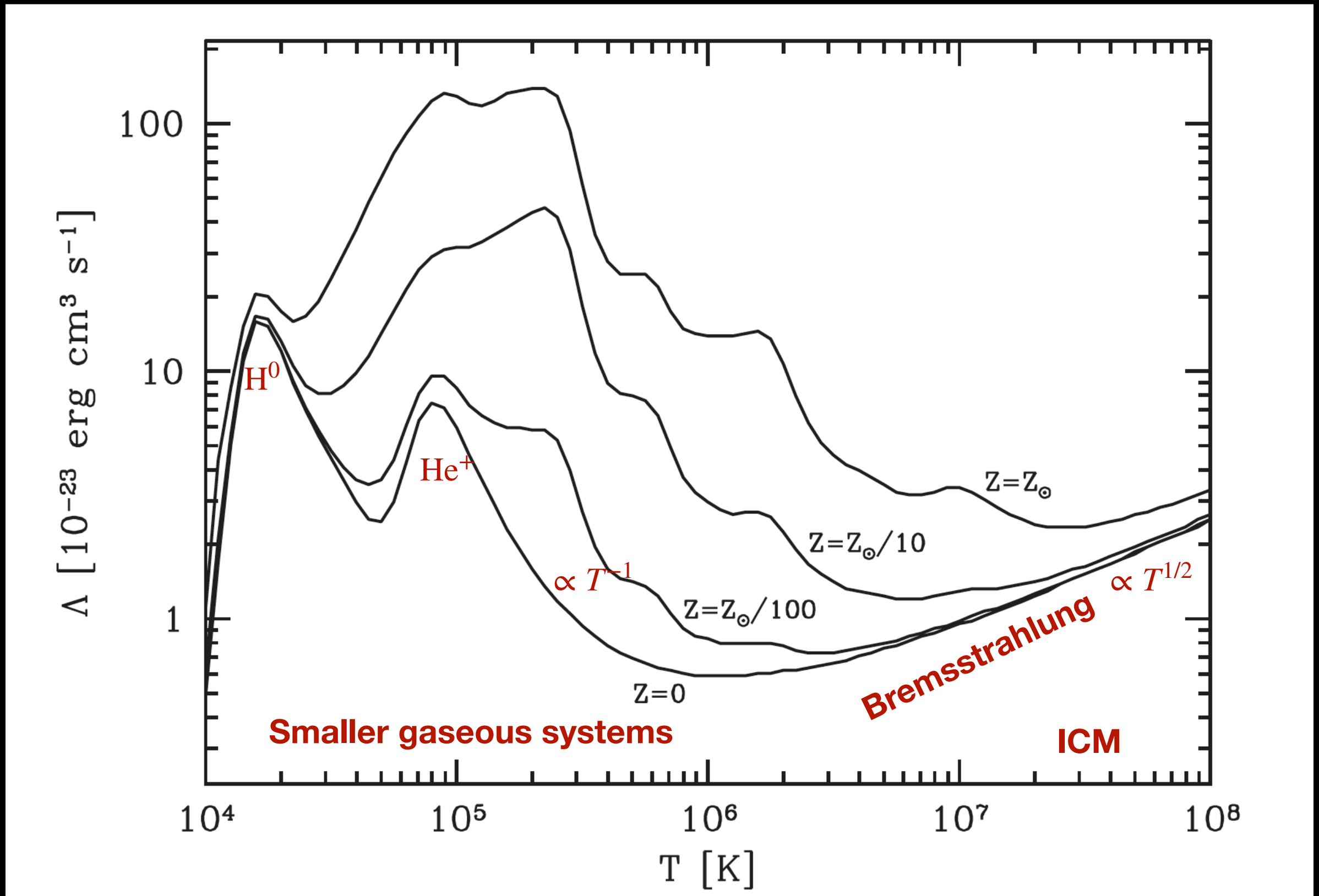


Typical ICM | **Extended core** | **No core**

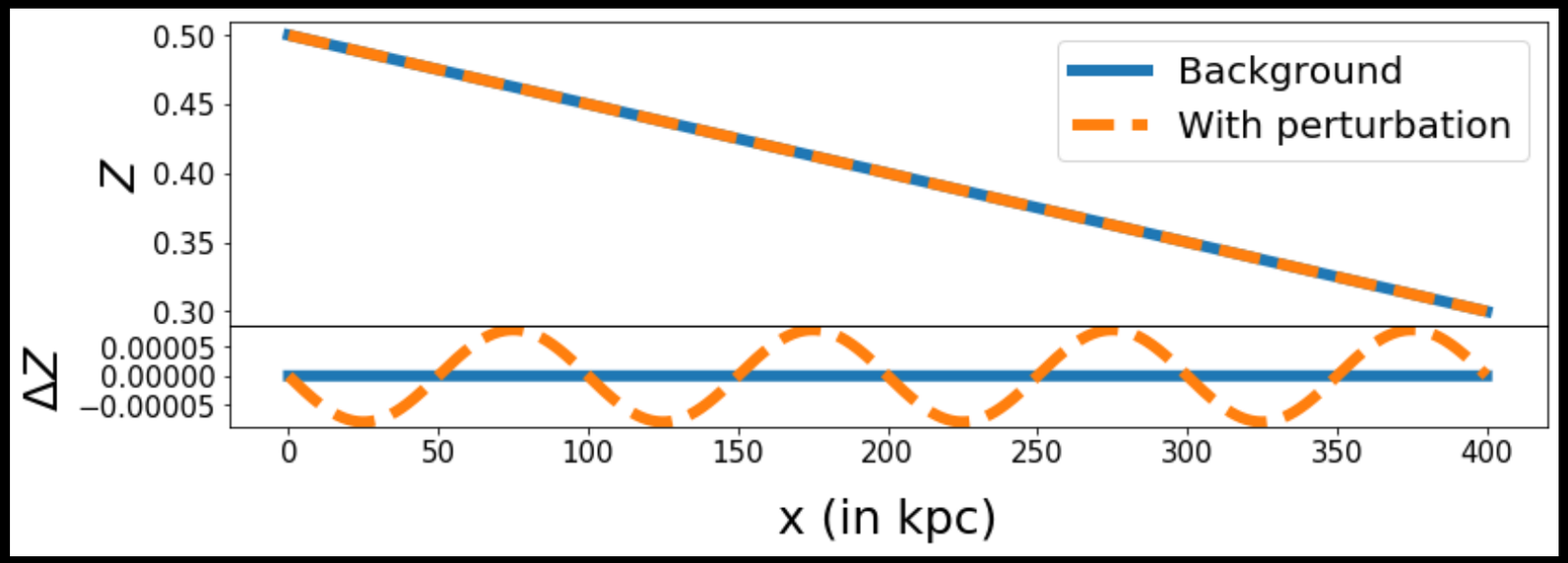


Choudhury+2019 (Voit+ first discuss the effect of entropy profiles)

VARIATION OF METALLICITY AND GASEOUS SYSTEM SIZE



ROLE OF METALLICITY IN LOCAL THERMAL INSTABILITY



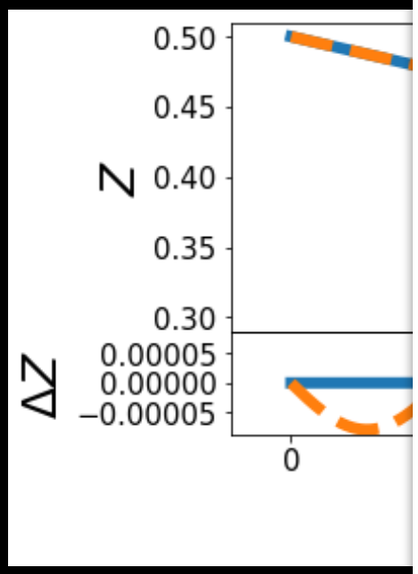
Linear growth rates have no explicit dependence on

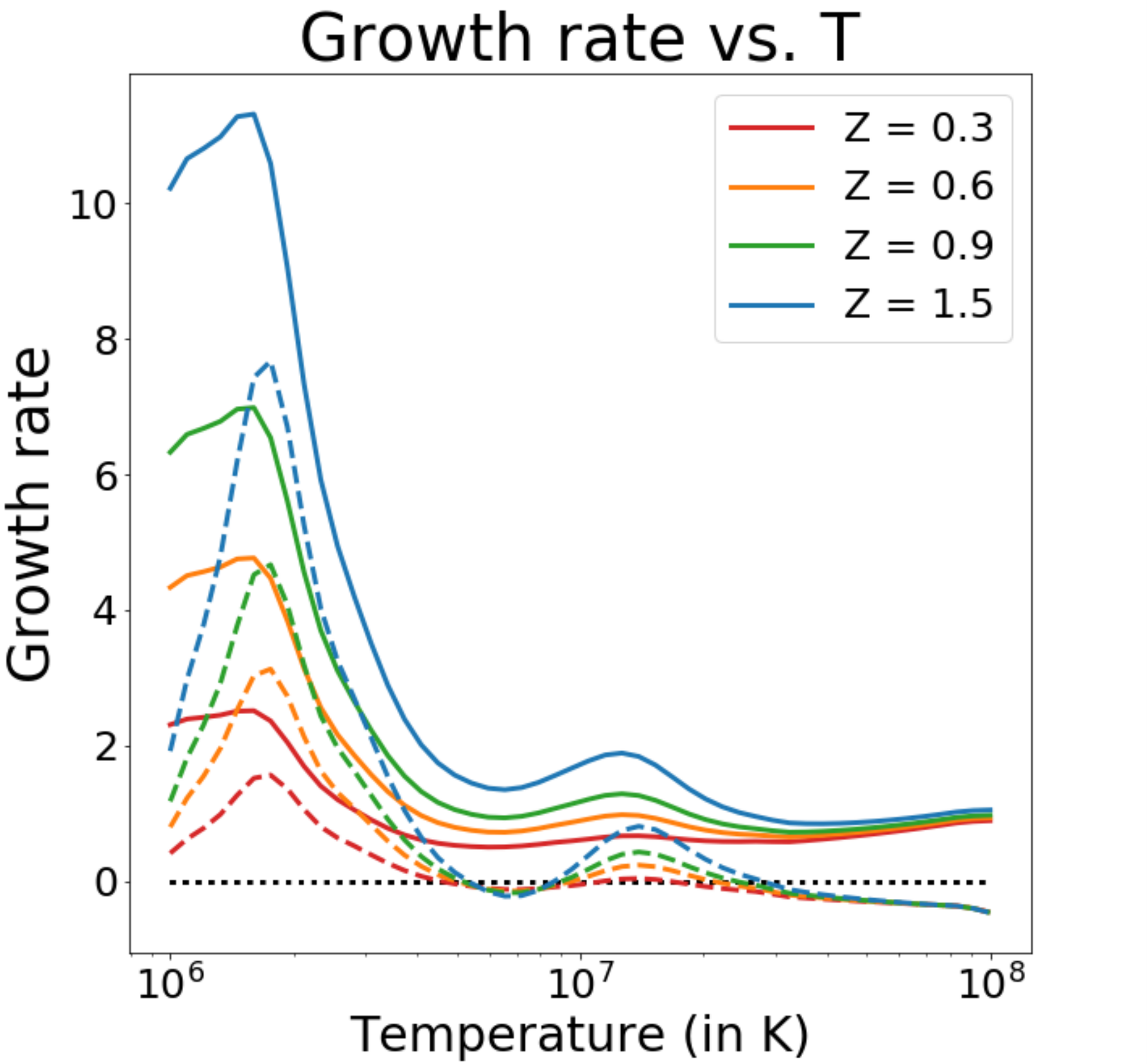
$$\Lambda_Z = \partial\Lambda(T, Z)/\partial Z$$

$$\partial Z/\partial r$$

Das+2020 [in prep]

ROLE OF METALLICITY IN LOCAL THERMAL INSTABILITY





s have
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$Z)/\partial Z$

$/t_{\mathrm{TI}}$

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Local thermal instability - conditions and constraints - observables

- **Cooling time to free-fall time**
- **Entropy**
- **Metallicity**