Circumnuclear Disks: A Case for Star Non-formation

(Or Non-star formation)

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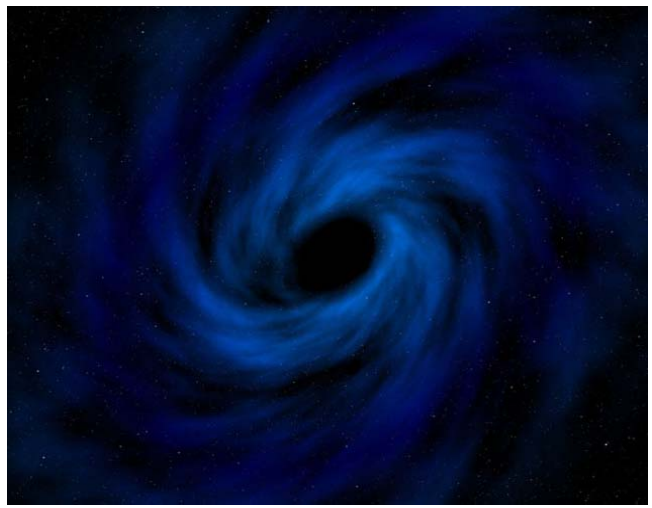
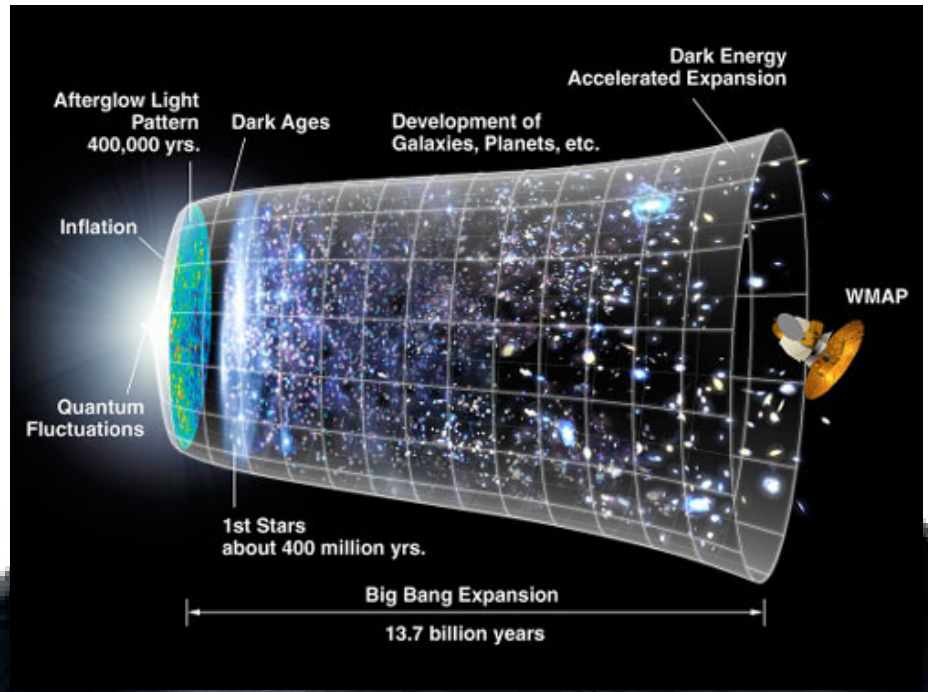


Co-starring

Outline

- AGN feedback in cosmology
- Тише едешь – дальше будешь
- Dynamics of the circumnuclear disk
- Brief conclusions

AGN Feedback



Our Goal

- Use cosmological Adaptive Mesh Refinement simulations to resolve the structure of the AGN environment on sub-parsec scales.
- Challenges:
  - Large dynamic range (>10^7)
  - Large range of relevant time-scales
  - High numerical fidelity is required
  - Complex physics

NB: we can only do this at z~3!

Тише едешь – дальше будешь

Scale

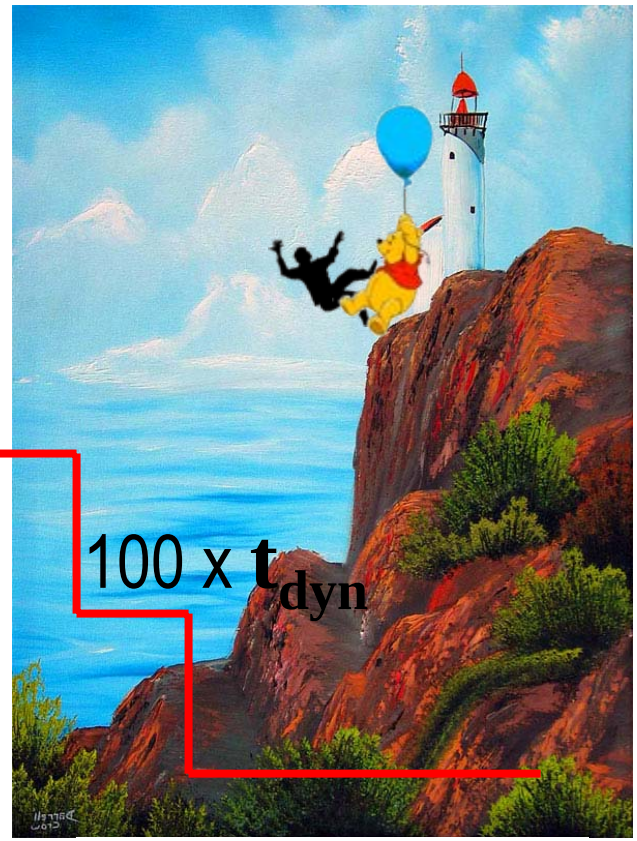
100 x t_{dyn}

ρ_{gas} low

t_{dyn} long

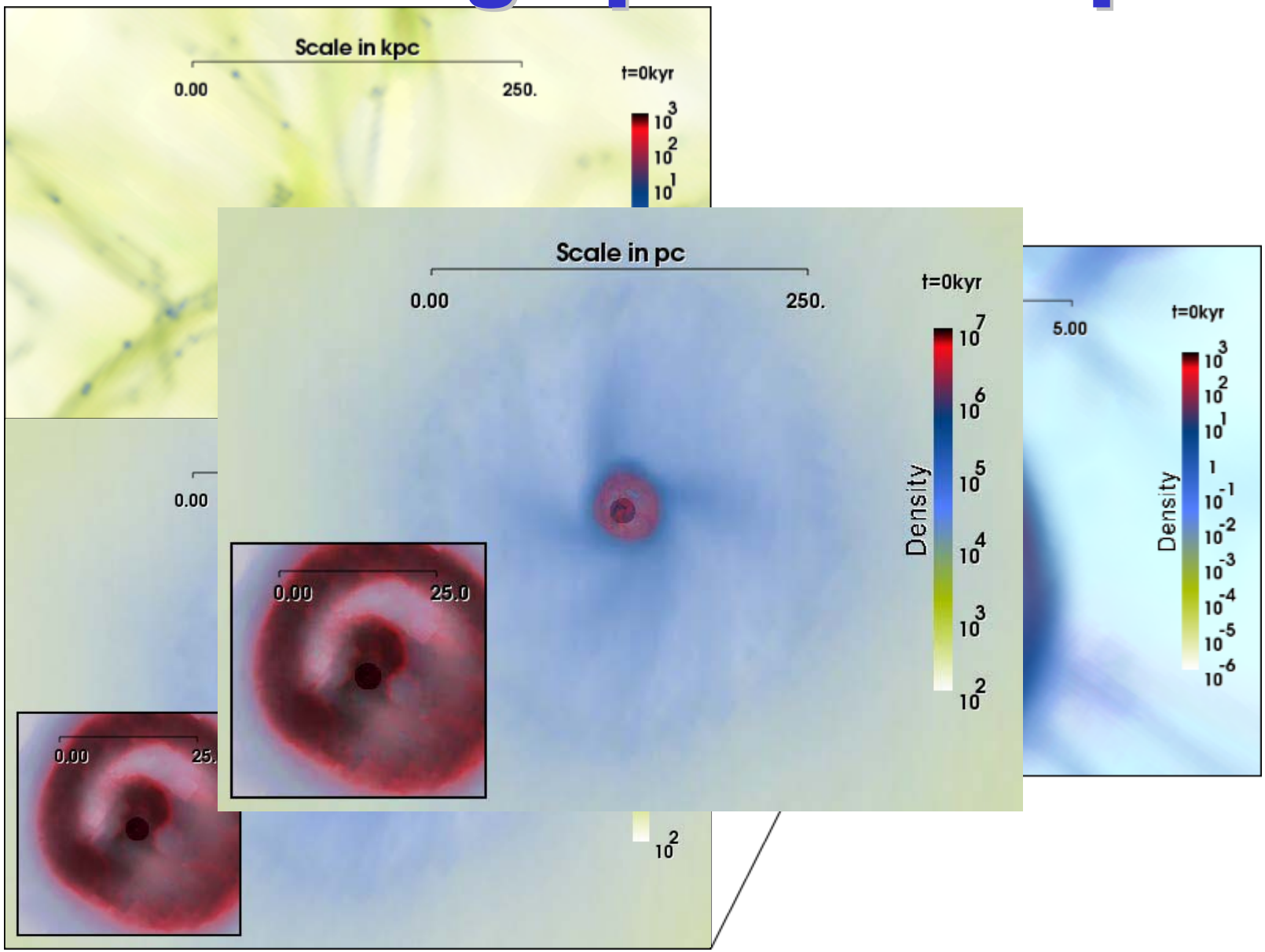
ρ_{gas} high

t_{dyn} short

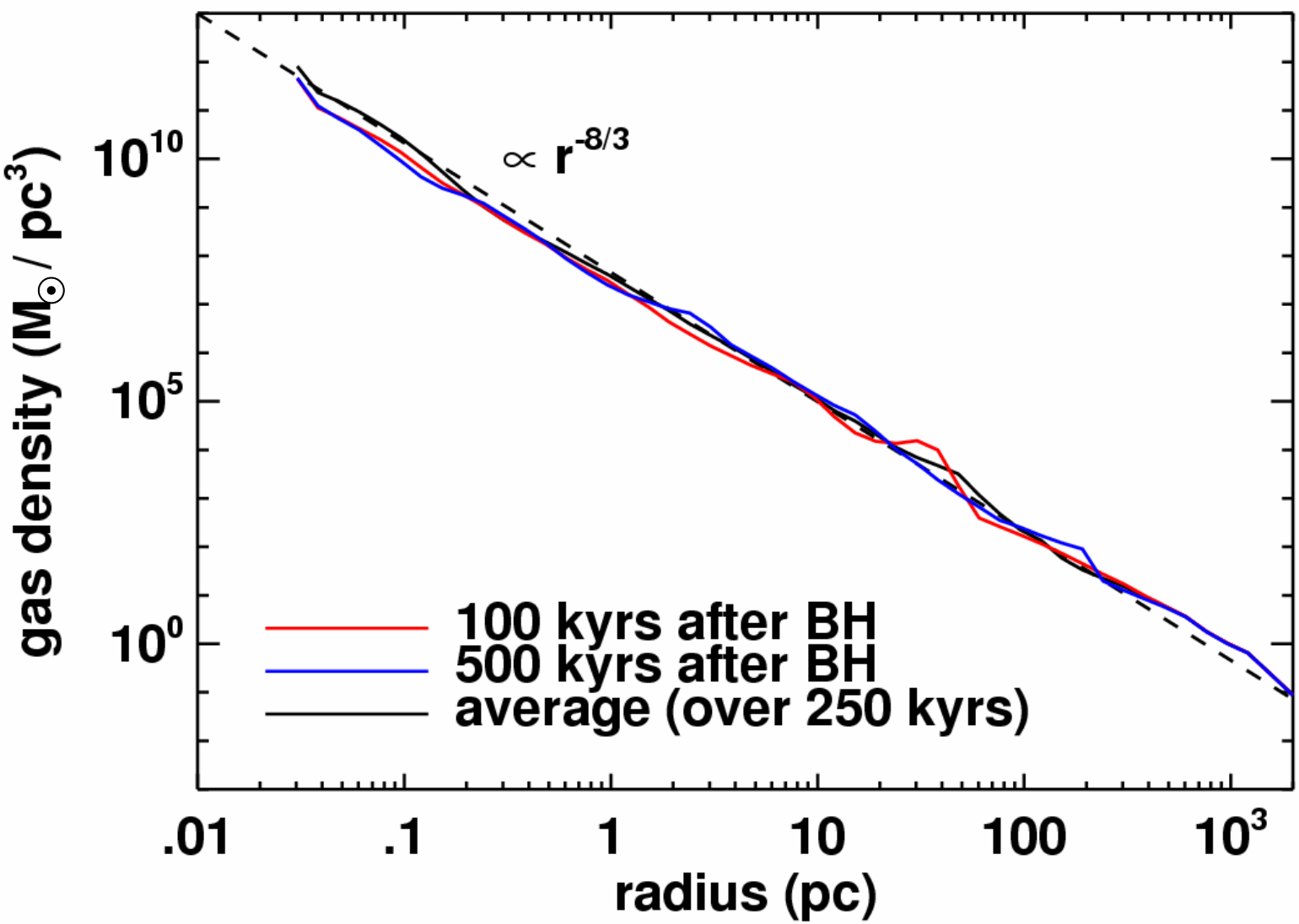


Time

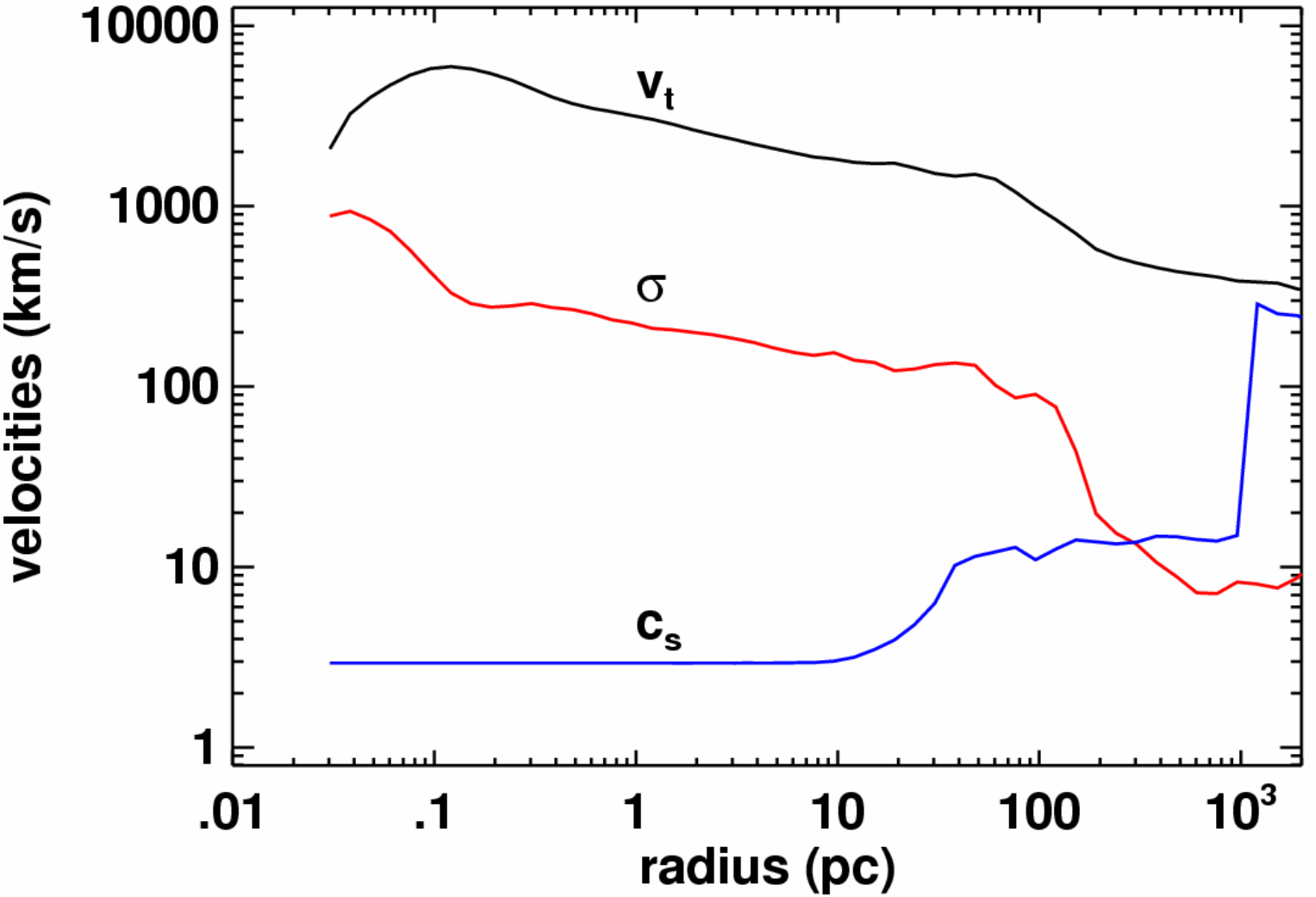
From Mega-pc to milli-pc



Quasi-Stationary State



Super-sonic Turbulent, Cold, Molecular Disk



Turbulent Diffusion of the Angular Momentum

$$\frac{\partial}{\partial t}(J_z) + \frac{1}{R}\frac{\partial}{\partial R}(R v_R J_z) = \frac{1}{2\pi R}\frac{\partial G}{\partial R}$$

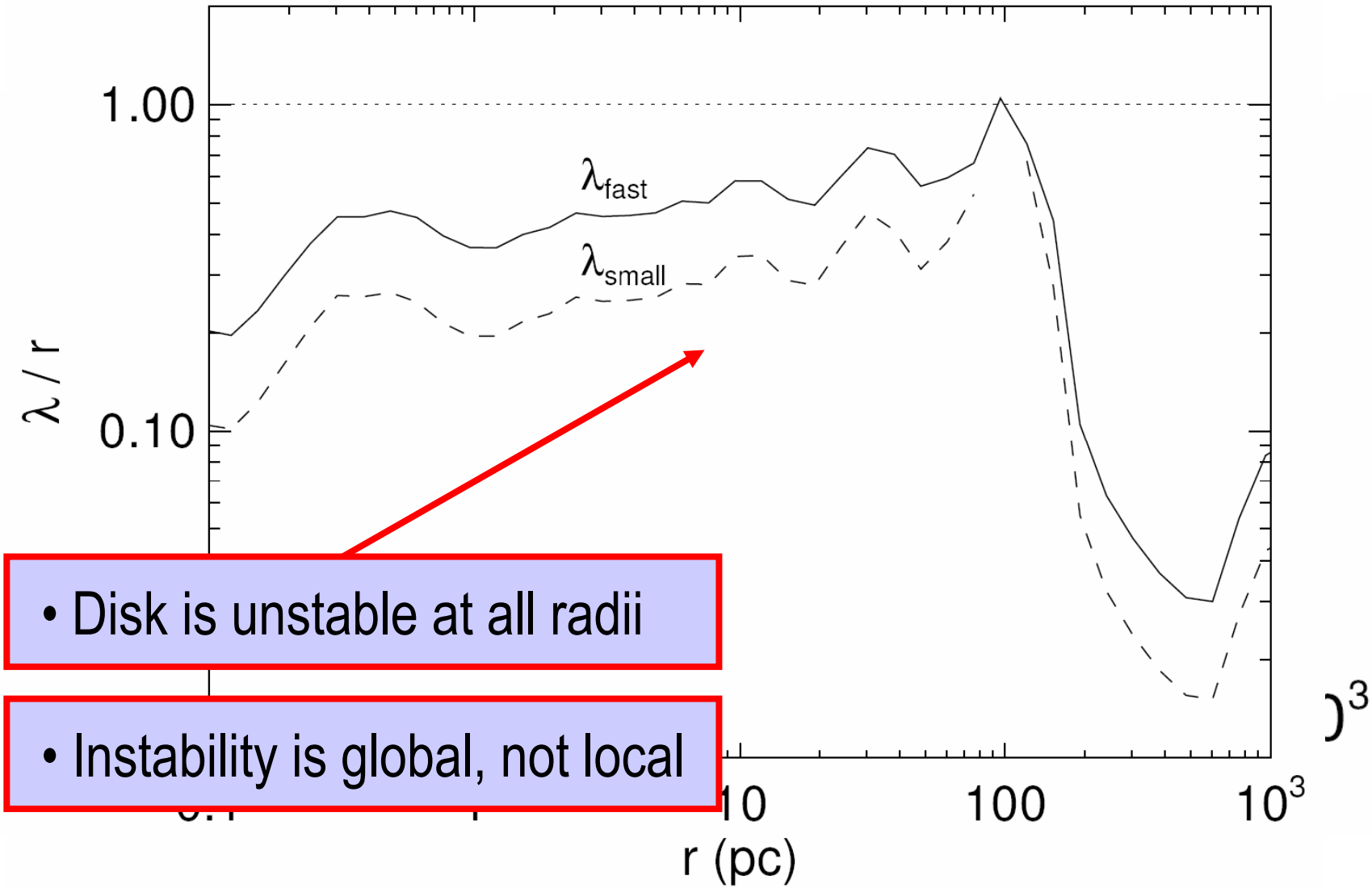
(Pringle 1981)

Turbulent viscosity

Viscous torque:

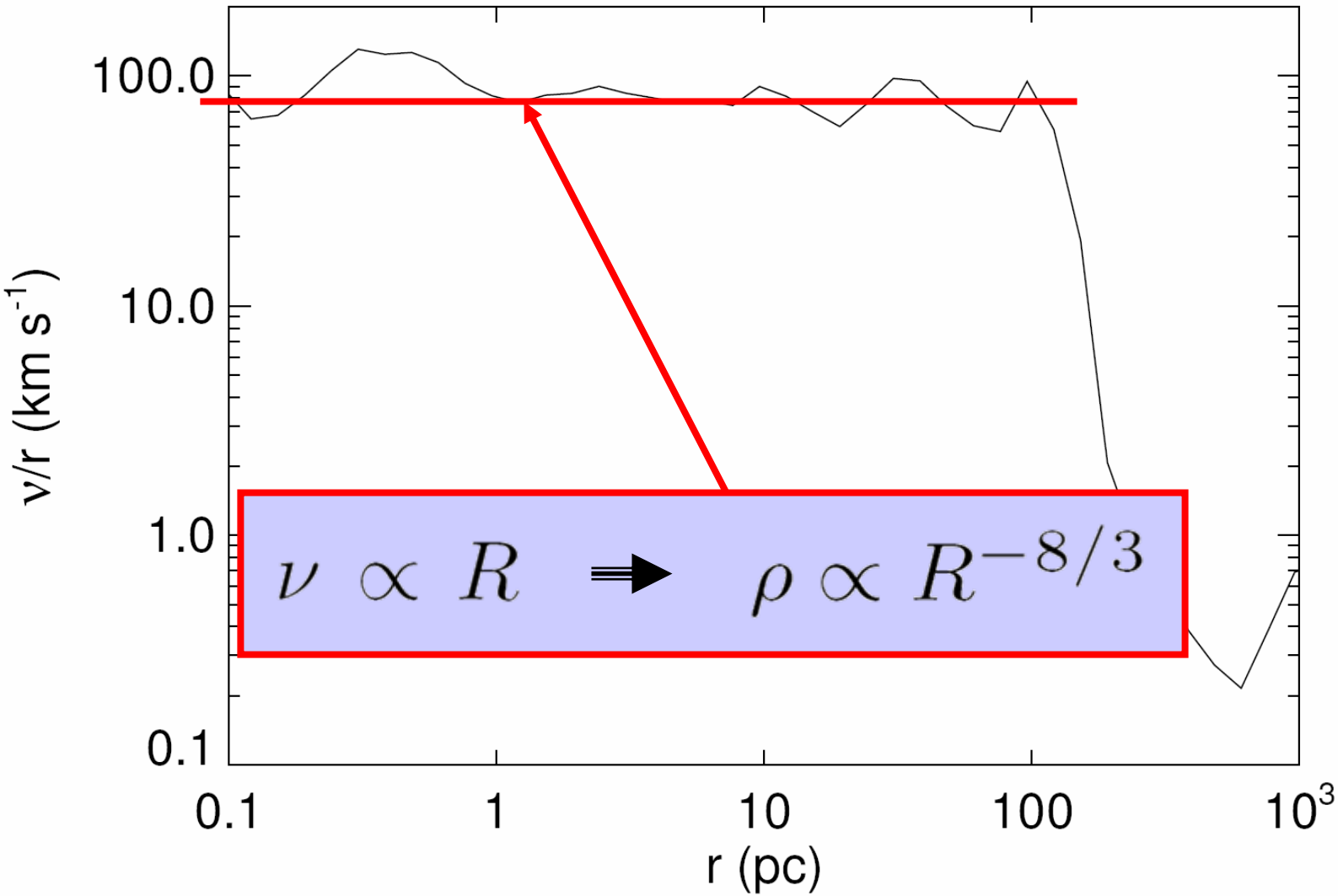
$$G(R,t) = 2\pi\nu\Sigma R^3 \frac{\partial \Omega}{\partial R}$$

Disk Stability



- Disk is unstable at all radii
- Instability is global, not local

Turbulent Viscosity



Conclusions

- A gas-rich circumnuclear disk reaches a quasi-stationary state that is characterized by a power-law density profile.

- The disk is globally unstable but locally stable; it does *not* fragment into stars *catastrophically*.

- The structure of the disk is entirely determined by the super-sonic turbulence in the gas.

The End