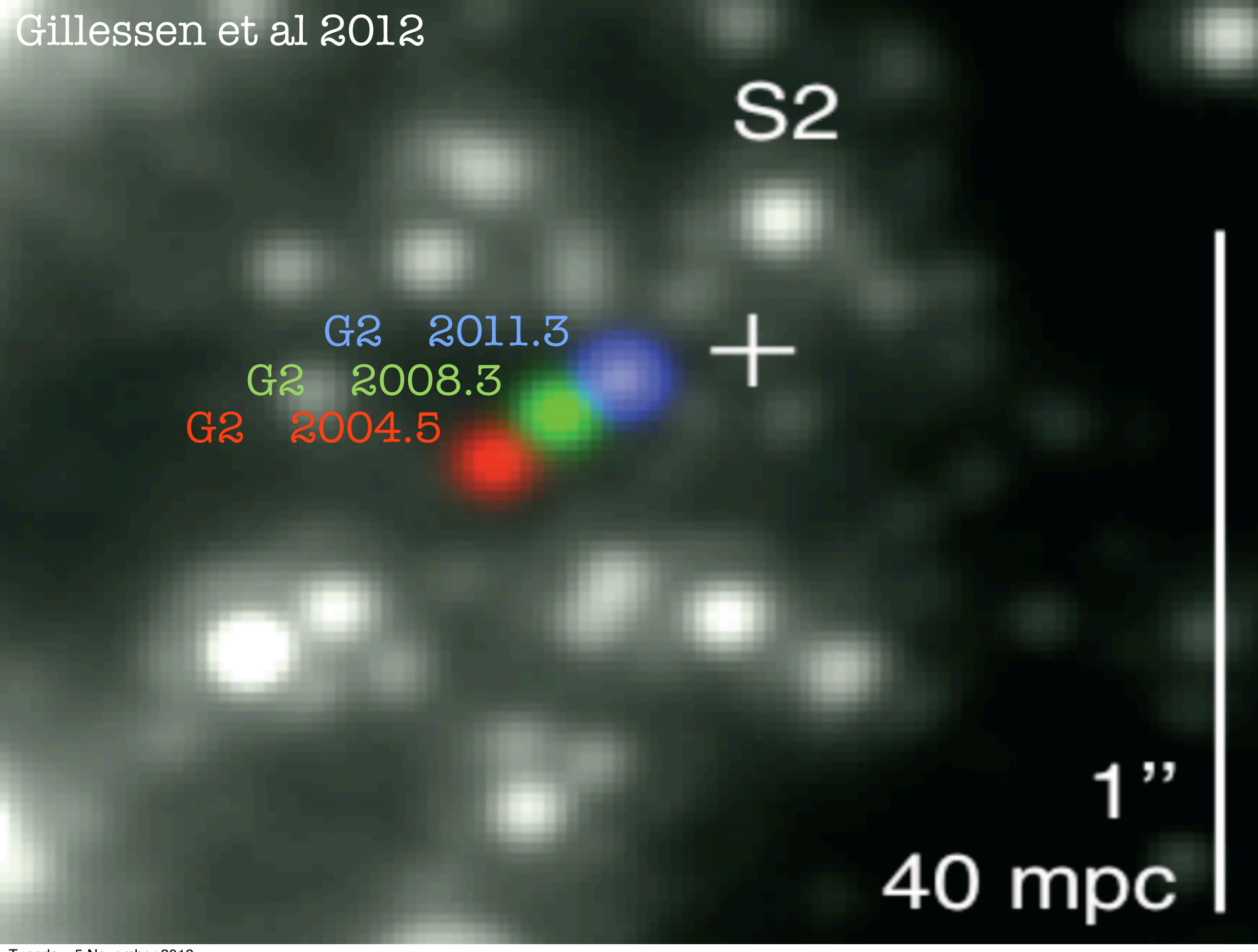
Sgr A* eats G2 - implications for scintillations

Mark Walker
(Manly Astrophysics)

Comet C/2012 S1 (ISON)

Adam Block/Mount Lemmon SkyCenter/University of Arizona

Gillessen et al 2012

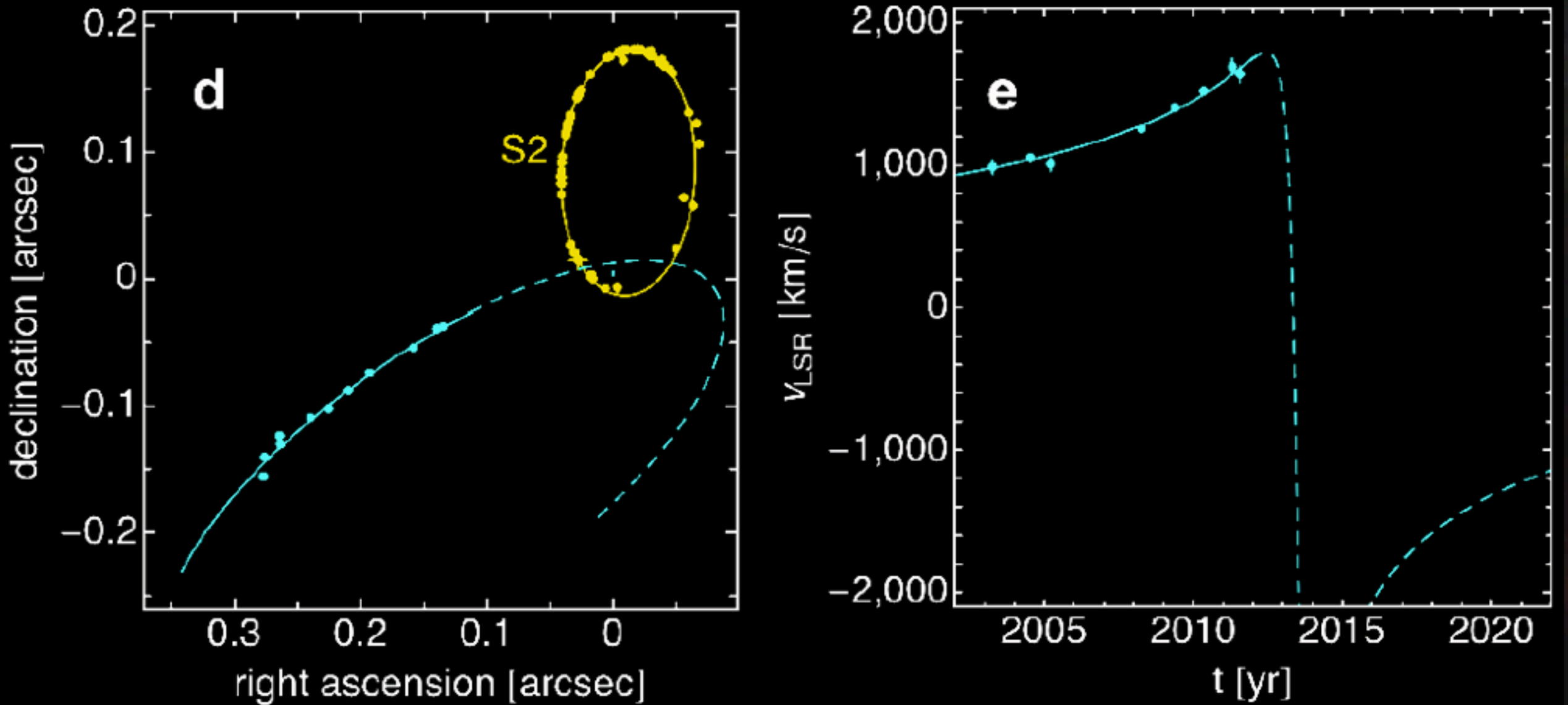


What might happen to G2 ...

Manly Astrophysics

M.Schartmann/MPE/ESO

The orbit of G2



Manly Astrophysics

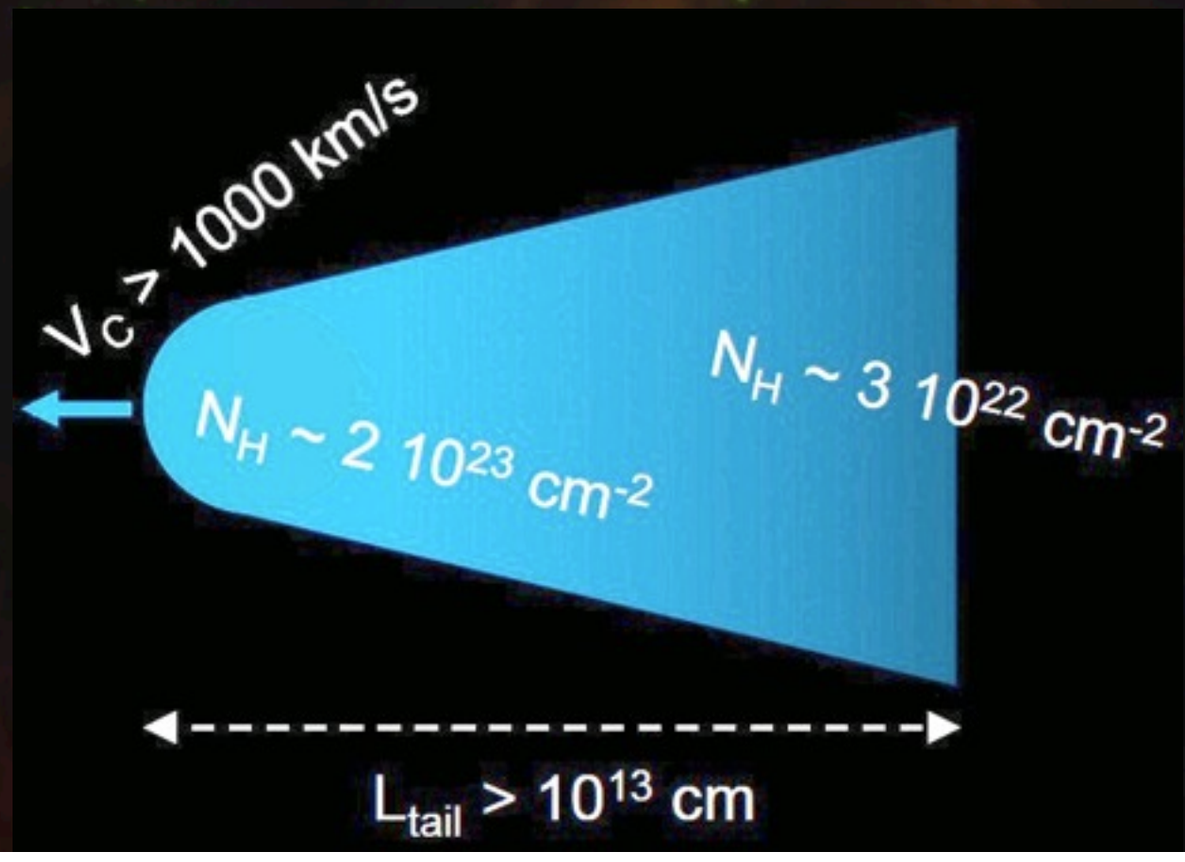
Gillessen et al 2012

Simplest interpretation of G2

- Origin, as for comets
  - "Oort cloud" of long-lived parent bodies
- Parents must be self-gravitating & stable
- Parents must not be too dense
  - UV radiation too weak to inflate a planet
  - Low temperature gas cloud
- Molecular clouds of mass ~ 10^{-5} $M_\odot$

Sgr A* is now our local AGN

- G2 is a single cloud moving at high speed
- Just add more clouds to get a quasar:
  - High continuum luminosity from accretion
  - Smooth, broad emission lines
- X-ray absorption events seen from individual BLR clouds (NGC1365: Maiolino et al 2010)



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- Just add more clouds to get a quasar:
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- X-ray absorption events seen from individual BLR clouds (NGC1365: Maiolino et al 2010)
- Can identify the NLR with the "Oort Cloud"
- Did nobody think of modelling BLR clouds as a new population of self-gravitating objects?

Modelling small molecular clouds

(with Mark Wardle)

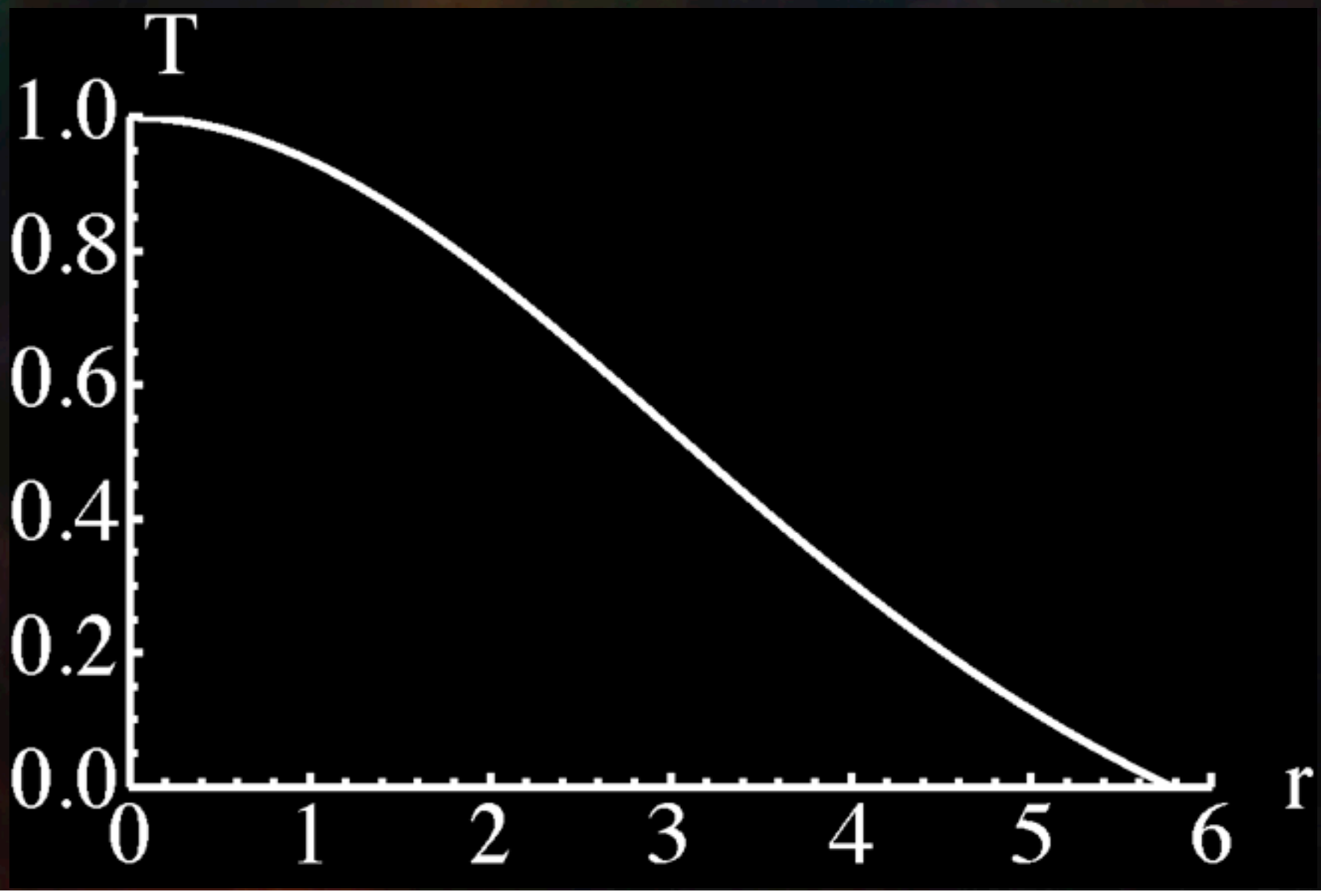
1. Composition: 75% H_2, 25% He
2. Hydrostatic equilibrium
3. Low radiative efficiency → Adiabatic convection

Equation-of-state for ideal gas:

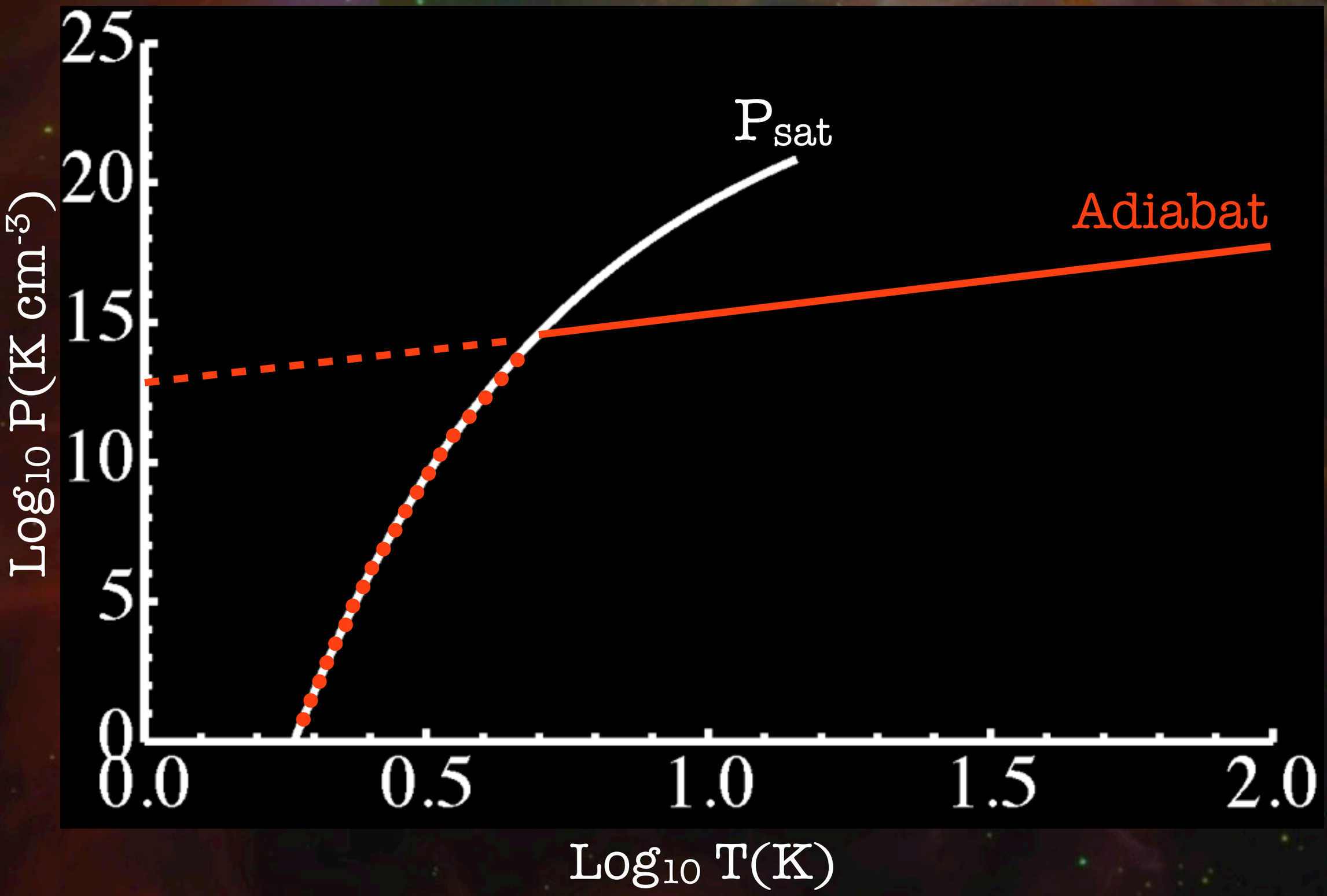
$P \propto \varrho^{5/3}$

$\varrho \propto T^{3/2}$

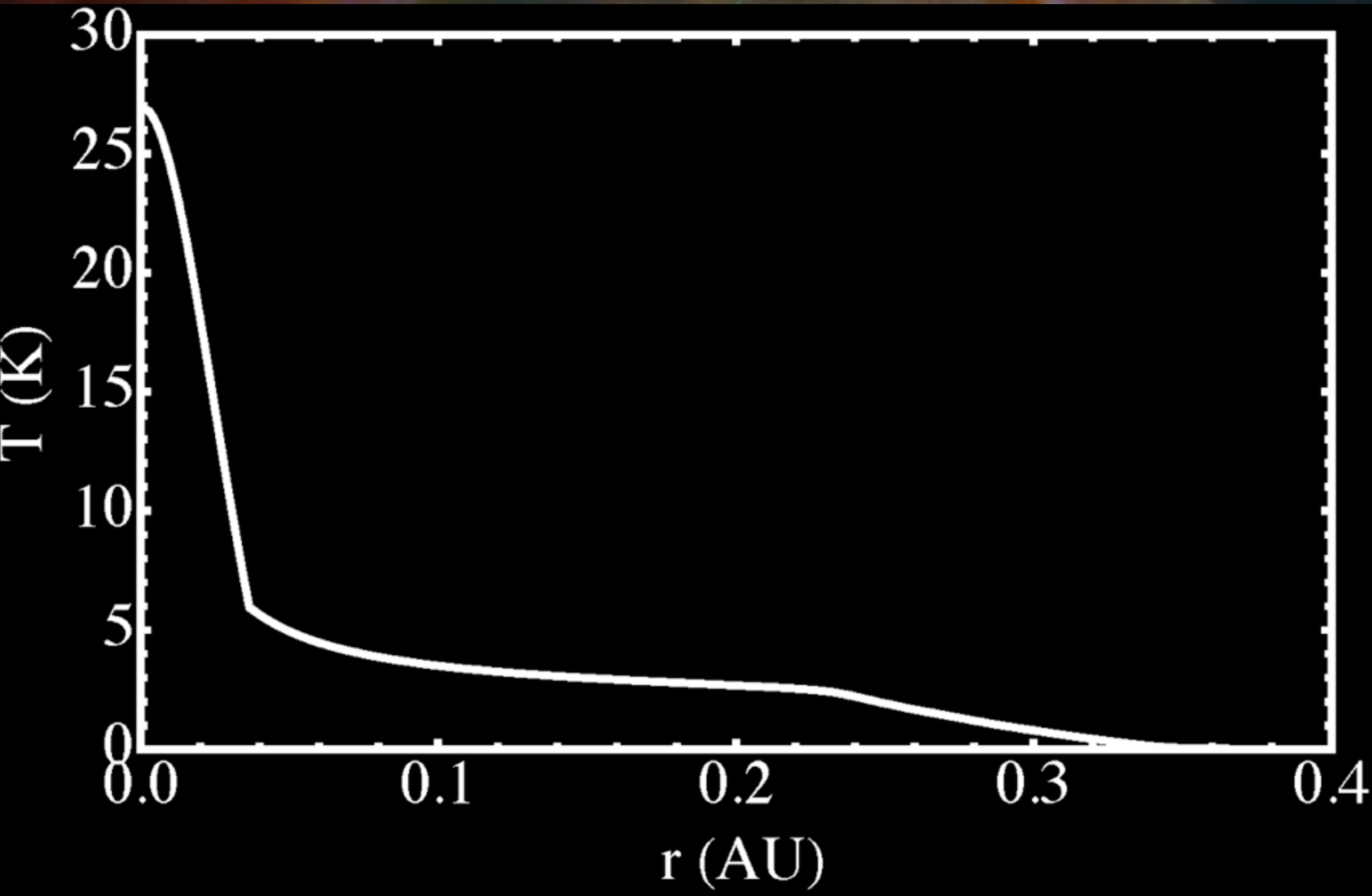
$P \propto T^{5/2}$



Solid-gas phase equilibrium for H_2



Example solution ($M = 10^{-5}\ M_\odot$)



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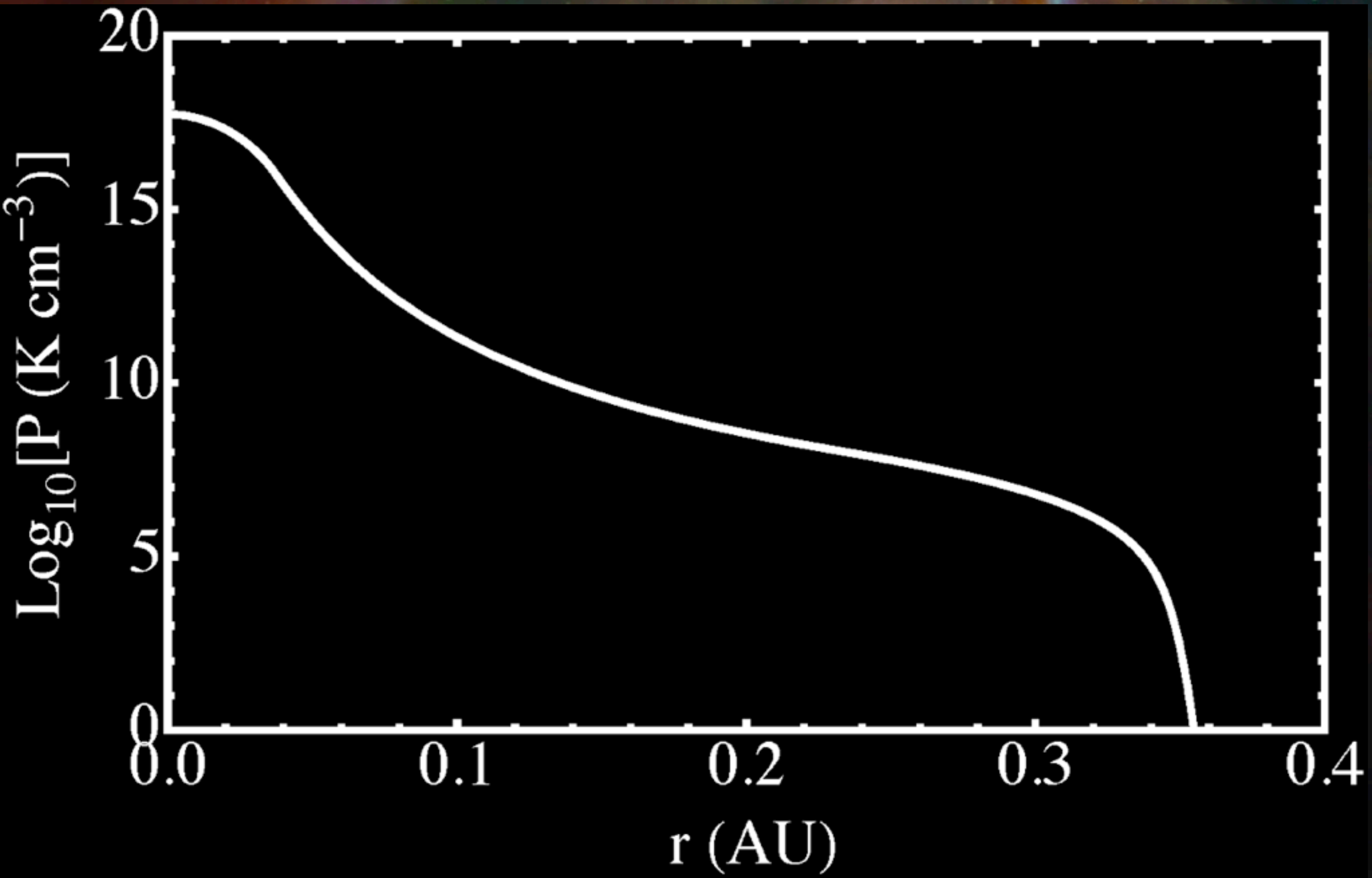
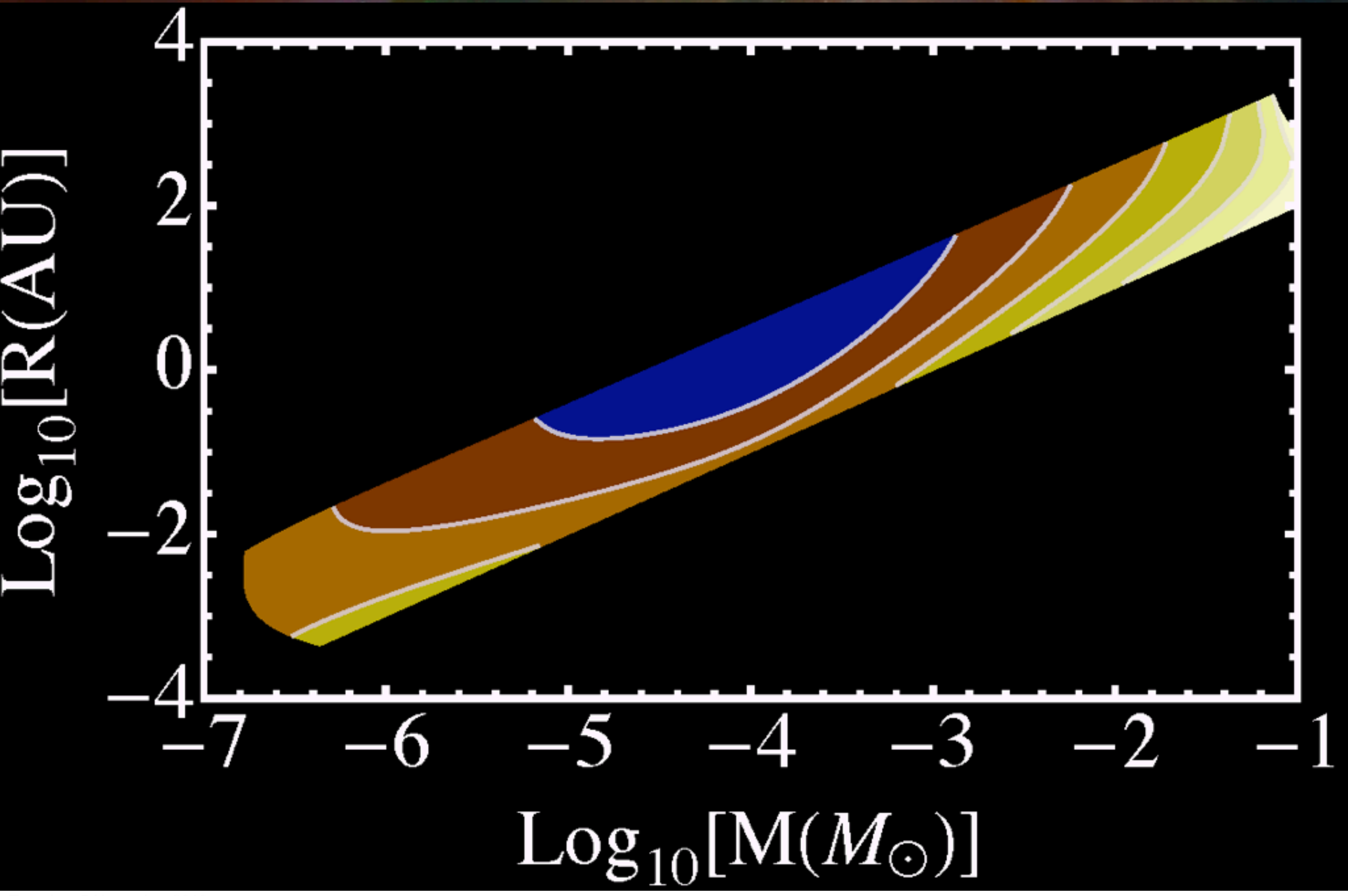
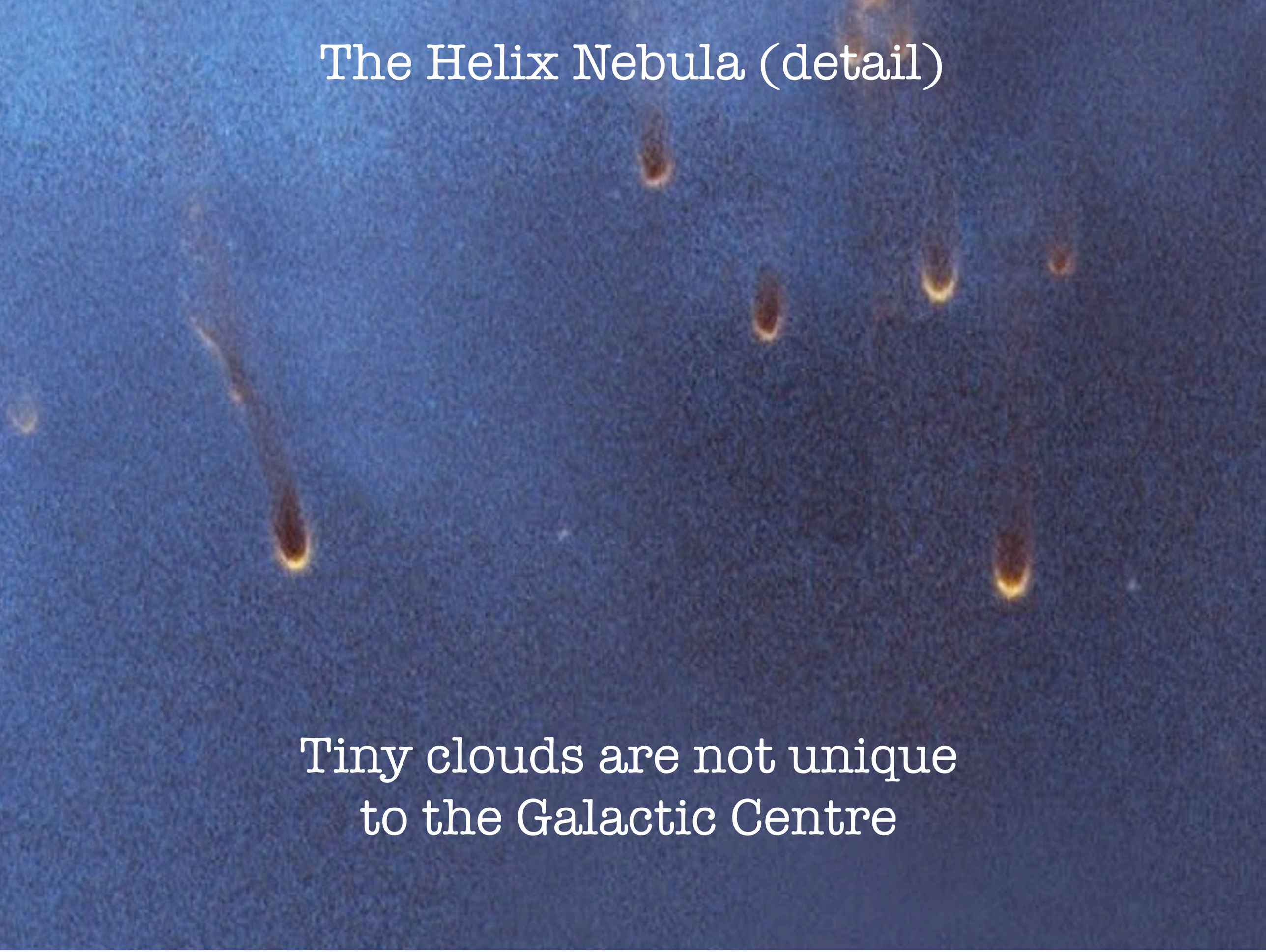


Solutions with minimal snowflake content

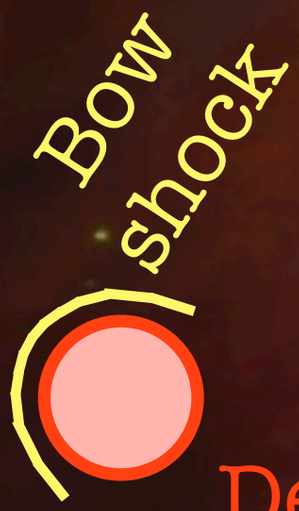


The Helix Nebula


The Helix Nebula (detail)
Tiny clouds are not unique
to the Galactic Centre

Supersonic motion through the diffuse ISM

(with Artem Tuntsov)



Dense ionised gas:
strong radio lens
→ Fiedler Events

Supersonic motion through the diffuse ISM

(with Artem Tuntsov)

Supersonic motion through the diffuse ISM

(with Artem Tuntsov)

- Strong, ordered B-field stretched out behind cloud
- Expect ionised gas and H_2 dust in magnetotail
  - Charged H_2 dust has a metallic skin
    - Both gas and H_2 dust can scatter radio-waves
- Difficult to explain J1819 and pulsar parabolic arcs (Dan Stinebring's talk, tomorrow) with H_2 dust:
  - Expect weak frequency dependence of scattering, but strong dependence observed
  - Expect high optical extinction if enough dust to cause radio scintillation

Summary

- G2 is the prototype BLR cloud
- Perturbed into current orbit from Galactic "NLR"
  - The NLR is an "Oort Cloud" of small, cold, self-gravitating molecular gas clouds
- Modelling shows such clouds are robust
- Precipitation of H_2 is structurally important
- Supersonic clouds shock-heat the diffuse ISM
  - Radio lenses & anisotropic scattering result
- Snow-cloud magnetotails may offer a natural explanation for the scintillations of J1819