Sgr A* eats G2 - implications for scintillations

Mark Walker
(Manly Astrophysics)



Adam Block/Mount Lemmon SkyCenter/University of Arizona

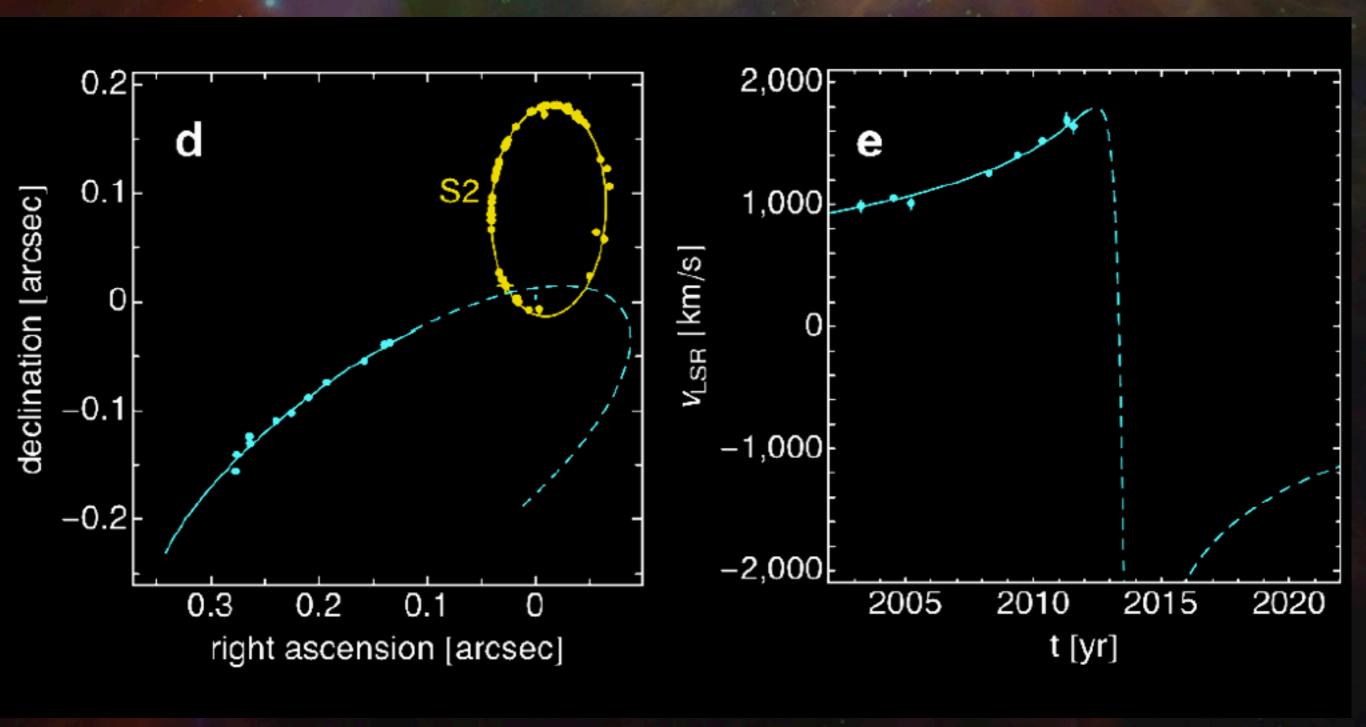
Gillessen et al 2012 **S2** G2 2011.3 G2 2008.3 G2 2004.5

What might happen to G2 ...



M.Schartmann/MPE/ESO

The orbit of G2



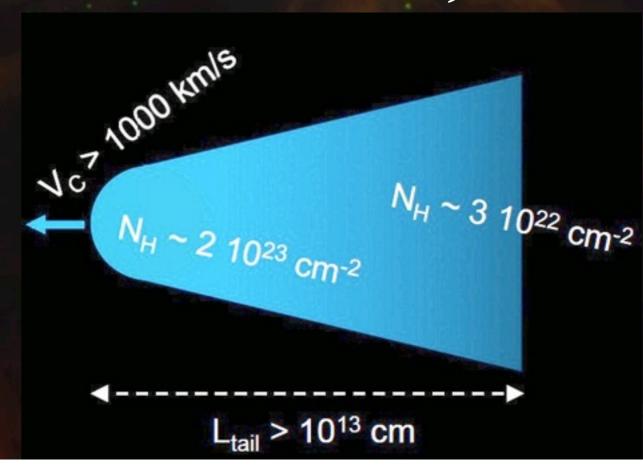
Gillessen et al 2012

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
- \odot Molecular clouds of mass $\sim 10^{-5}~{
 m M}_{\odot}$

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)



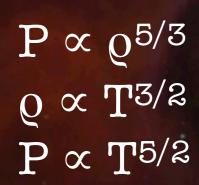
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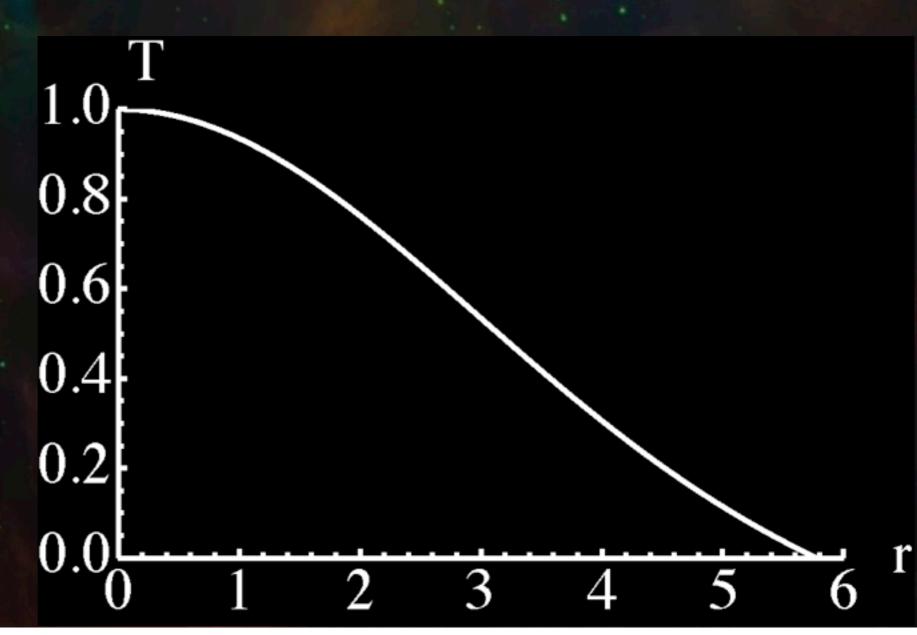
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- Just add more clouds to get a quasar:
 - High continuum luminosity from accretion
 - Smooth, broad emission lines
- X-ray absorption events seen from individual BLR clouds (NGC1365: Maiolino et al 2010)
- Can identify the NLR with the "Oort Cloud"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

Modelling small molecular clouds

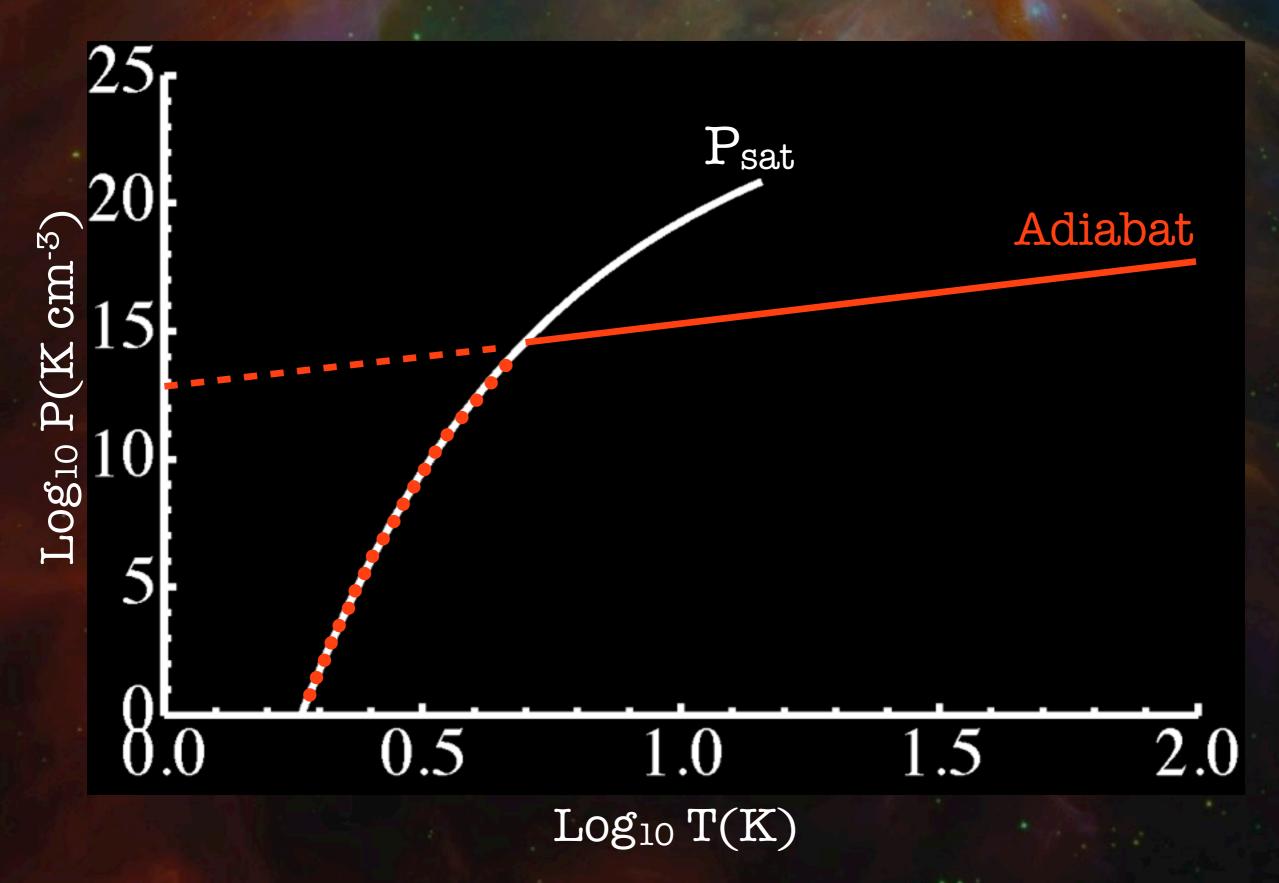
(with Mark Wardle)

- 1. Composition: 75% H₂, 25% He
- 2. Hydrostatic equilibrium
- 3. Low radiative efficiency → Adiabatic convection Equation-of-state for ideal gas:

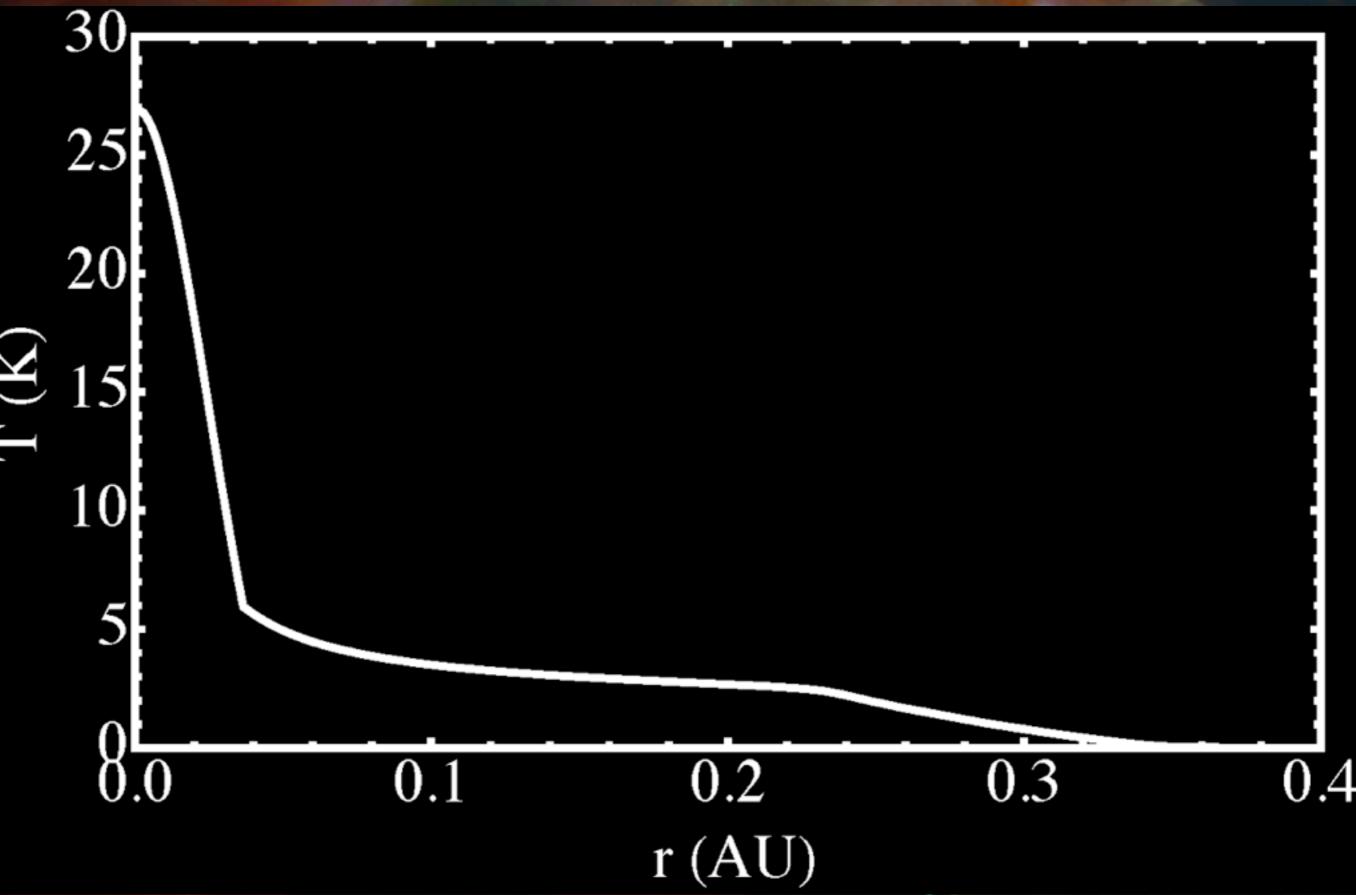




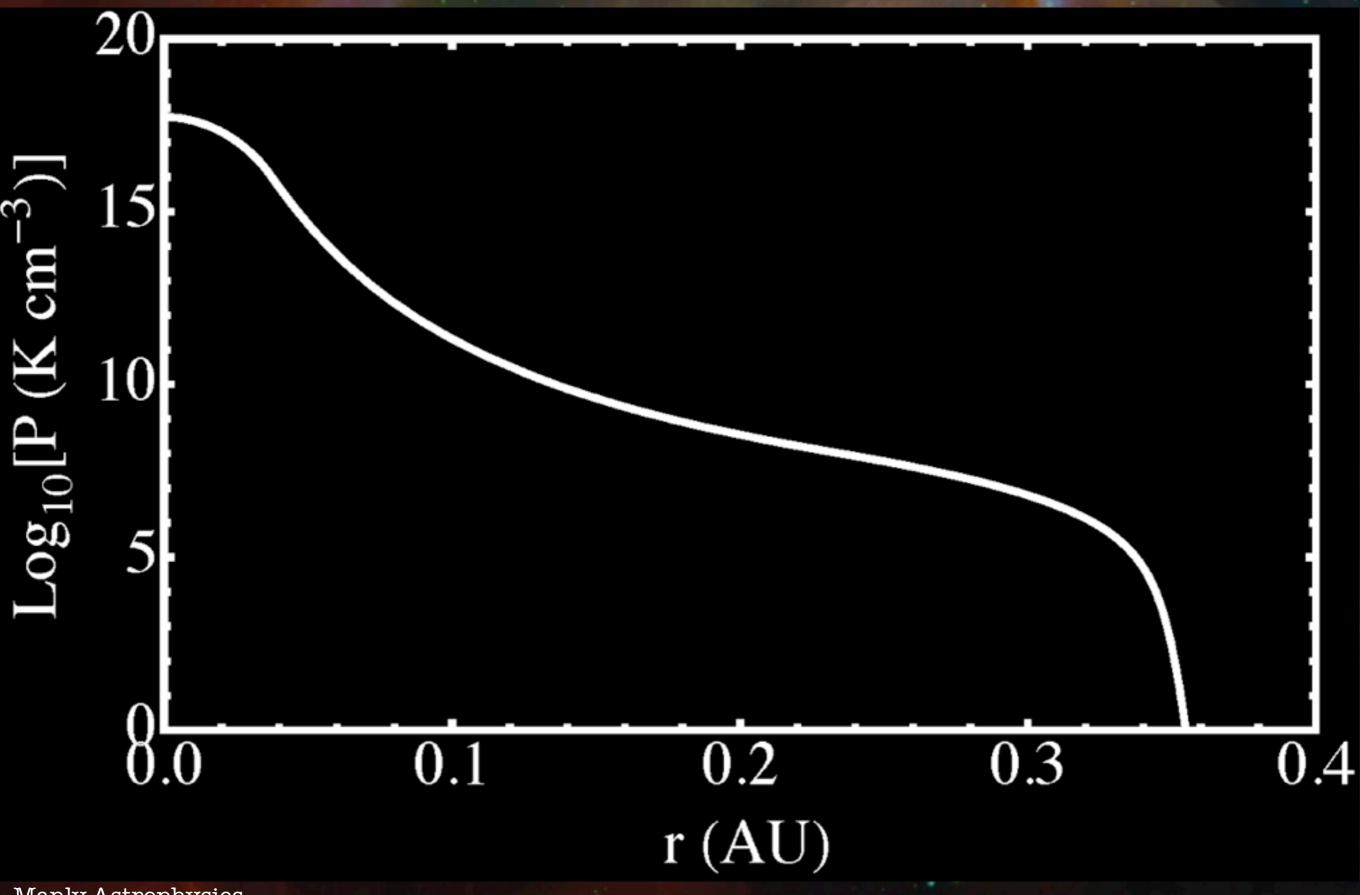
Solid-gas phase equilibrium for H₂



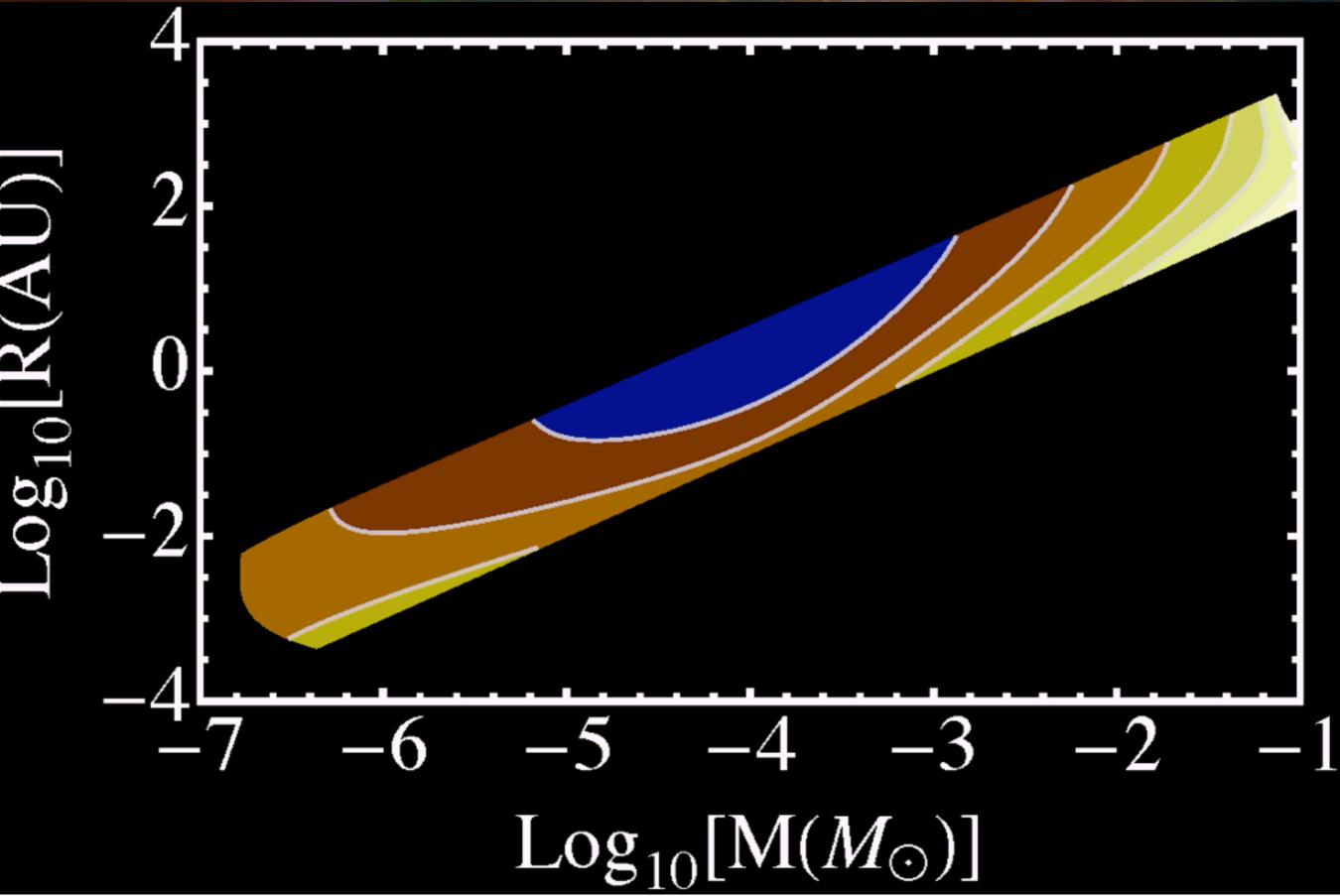




Example solution ($M = 10^{-5} M_{\odot}$)



Solutions with minimal snowflake content





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)

- Strong, ordered B-field stretched out behind cloud
- Expect ionised gas and H₂ dust in magnetotail
 - Charged H₂ dust has a metallic skin
 - Both gas and H₂ dust can scatter radio-waves
- Difficult to explain J1819 and pulsar parabolic arcs (Dan Stinebring's talk, tomorrow) with H₂ 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 H₂ 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