

Planet formation in the era of ALMA

Richard Booth (IoA, Cambridge)

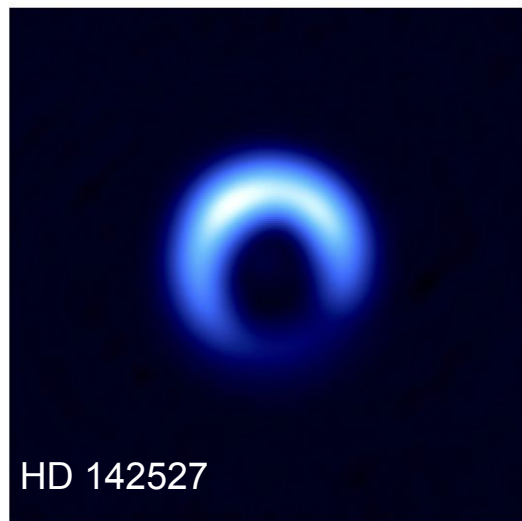
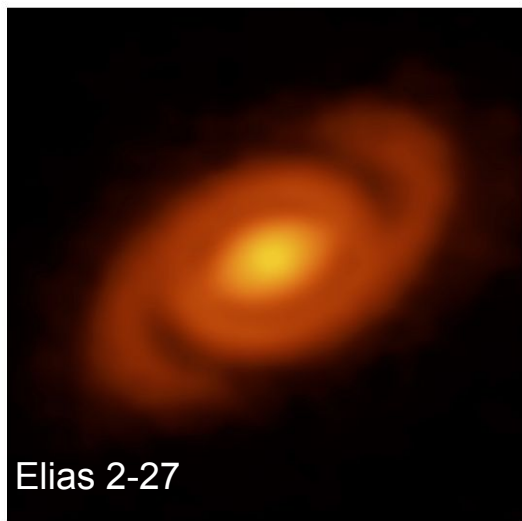
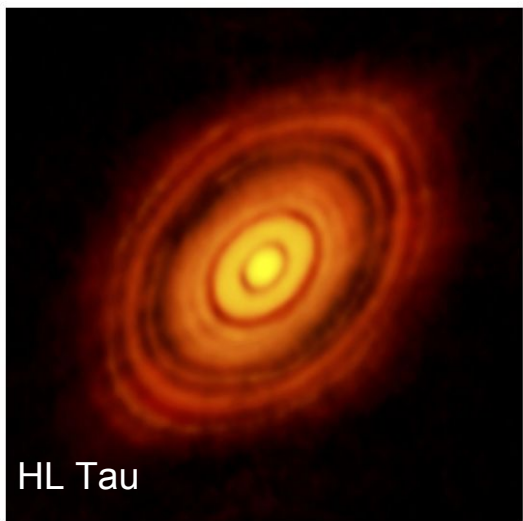
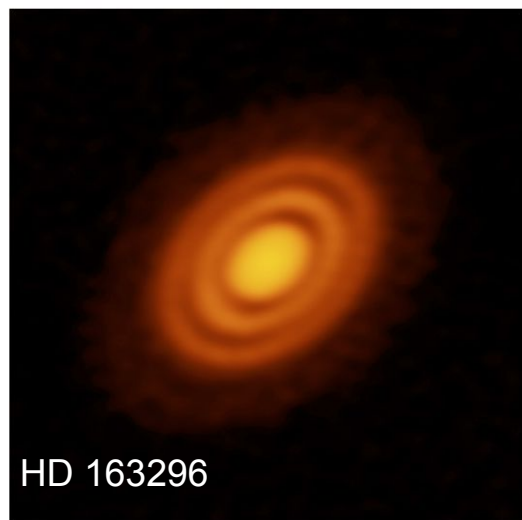
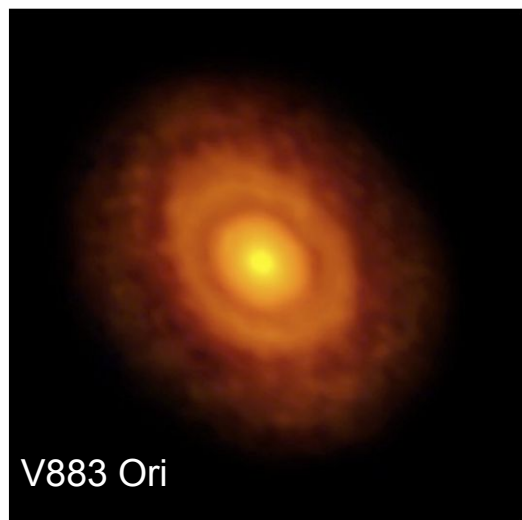
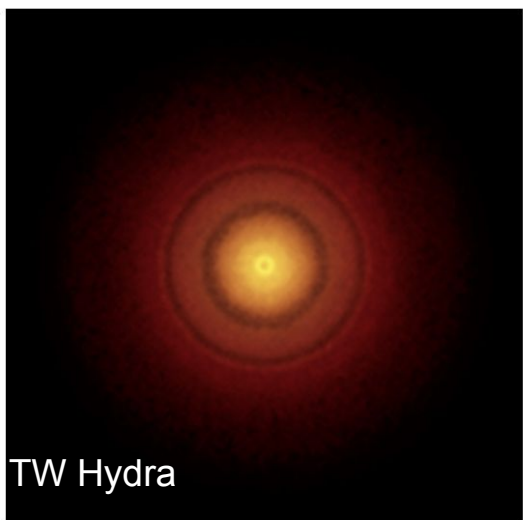
Collaborators: Cathie Clarke, John Ilee, Farzana Meru, Nikku Madhusudhan,
Pooneh Nazari, Giovanni Rosotti, Andrew Winter

Plan for the talk

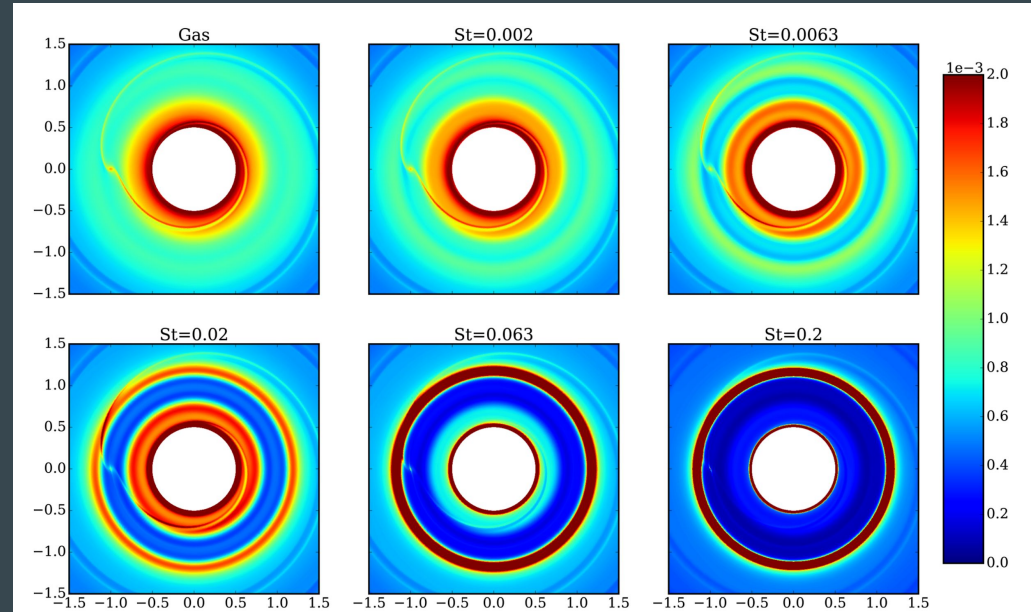
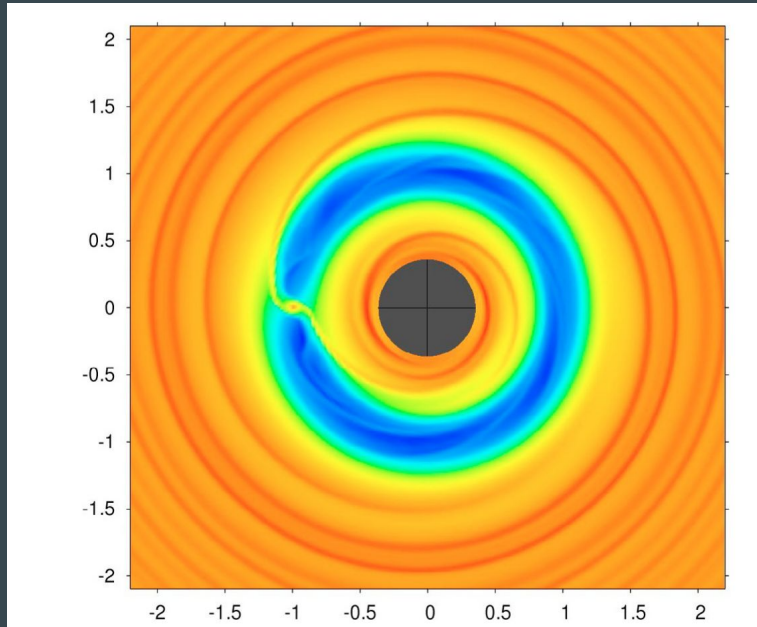
Structures in discs

CI Tau: Origin of the hot Jupiter's eccentricity

Link between formation and composition

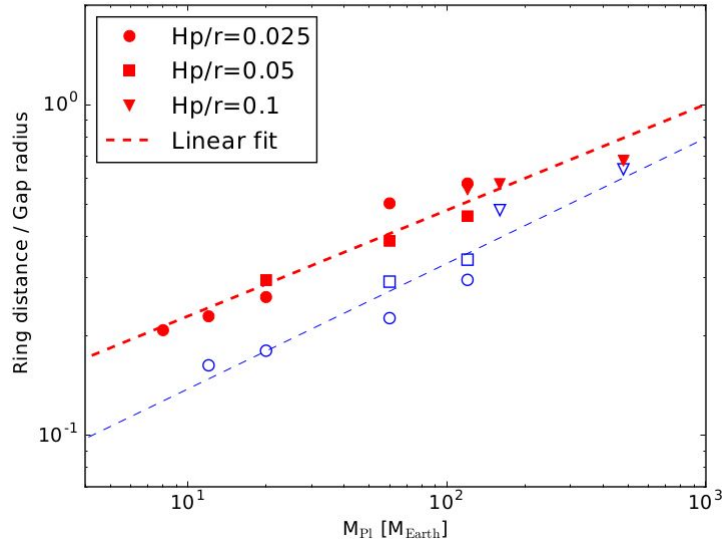


Simulations of gap opening: gas and dust

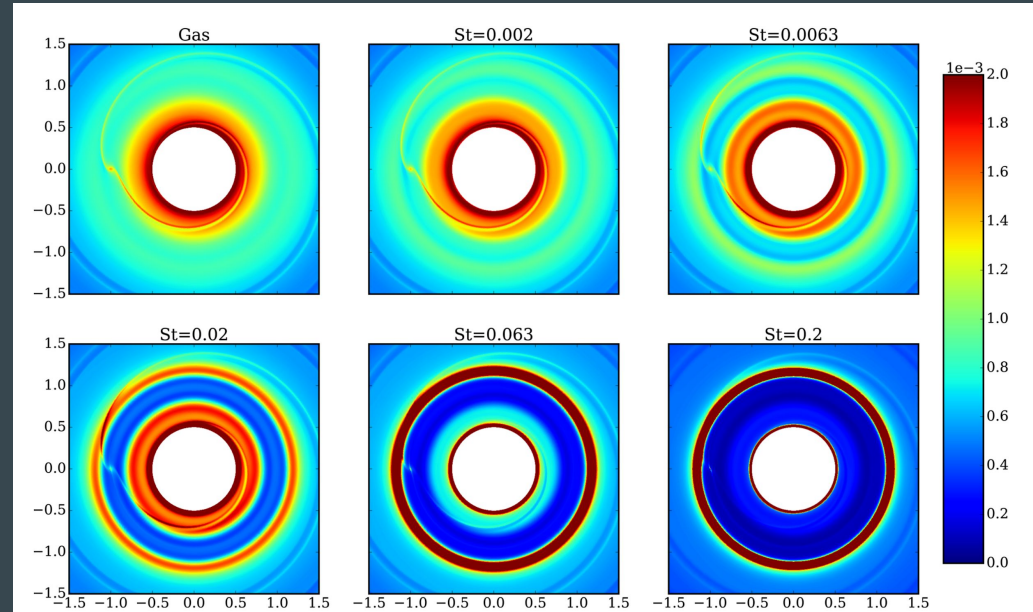


Rosotti et al. 2016

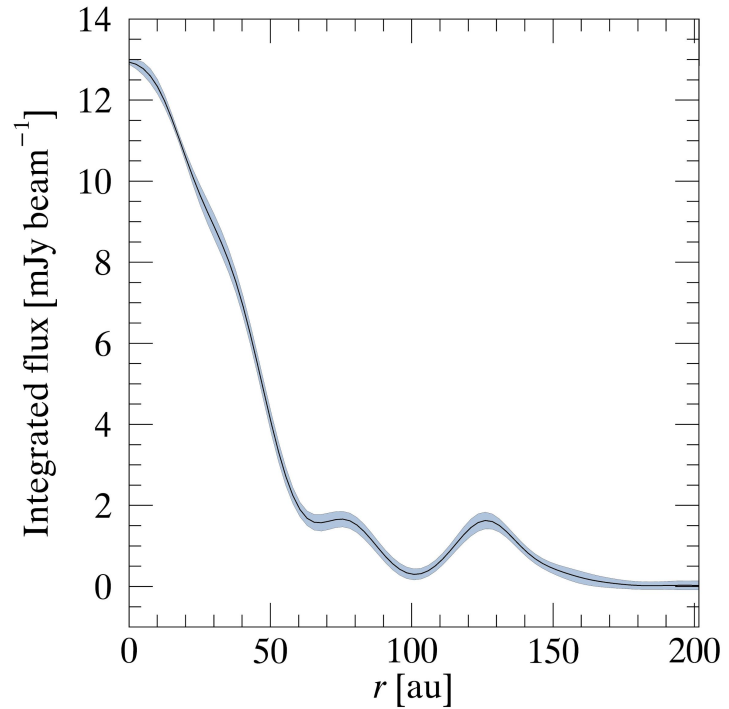
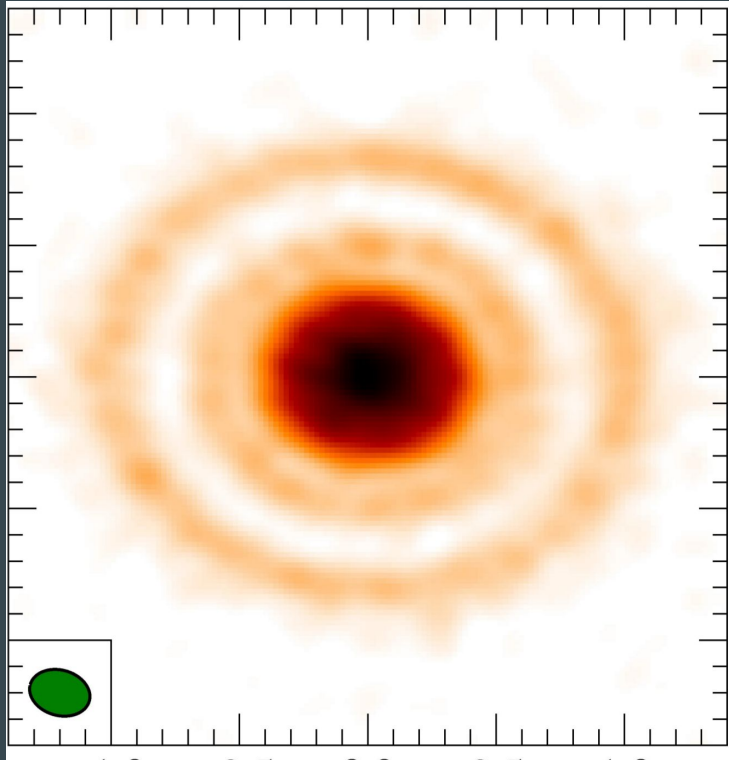
Simulations of gap opening: gas and dust



Rosotti et al. 2016



AS 209: multiple gaps, one planet?

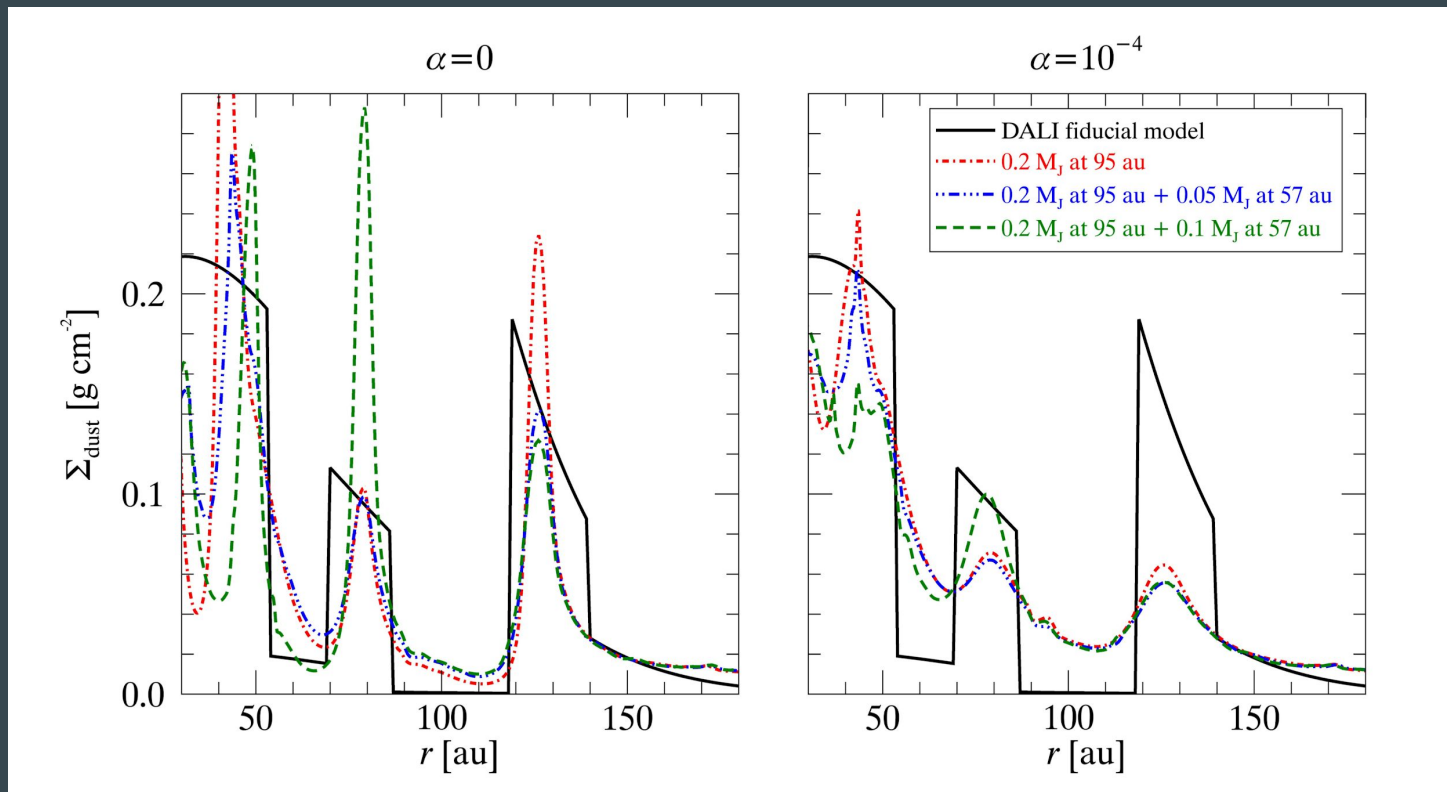


AS 209: multiple gaps, one planet?

MCMC inference of
density structure
(deconvolution)

Deep gaps!

Low viscosity required



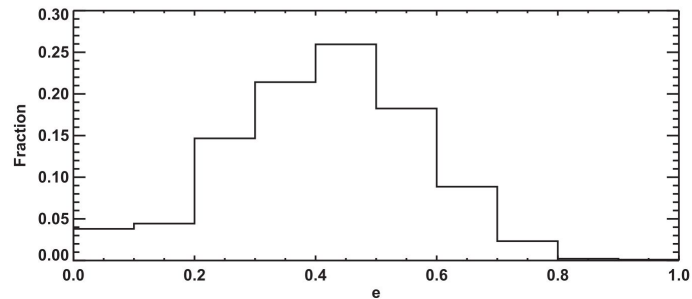
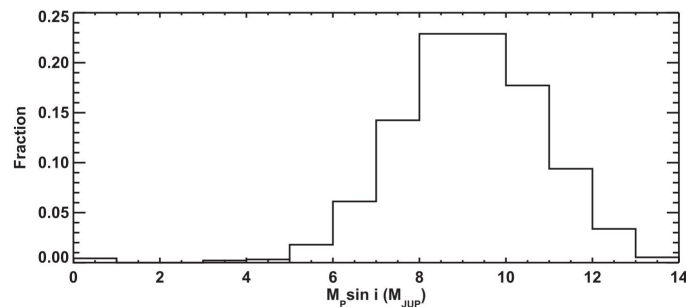
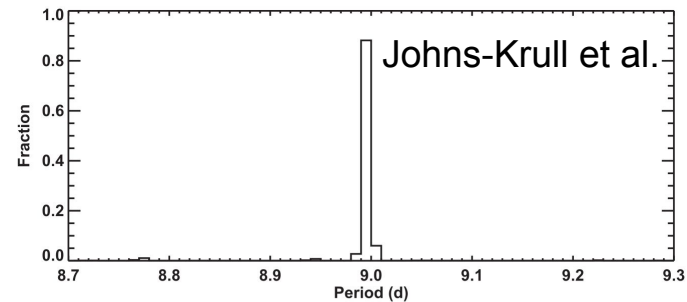
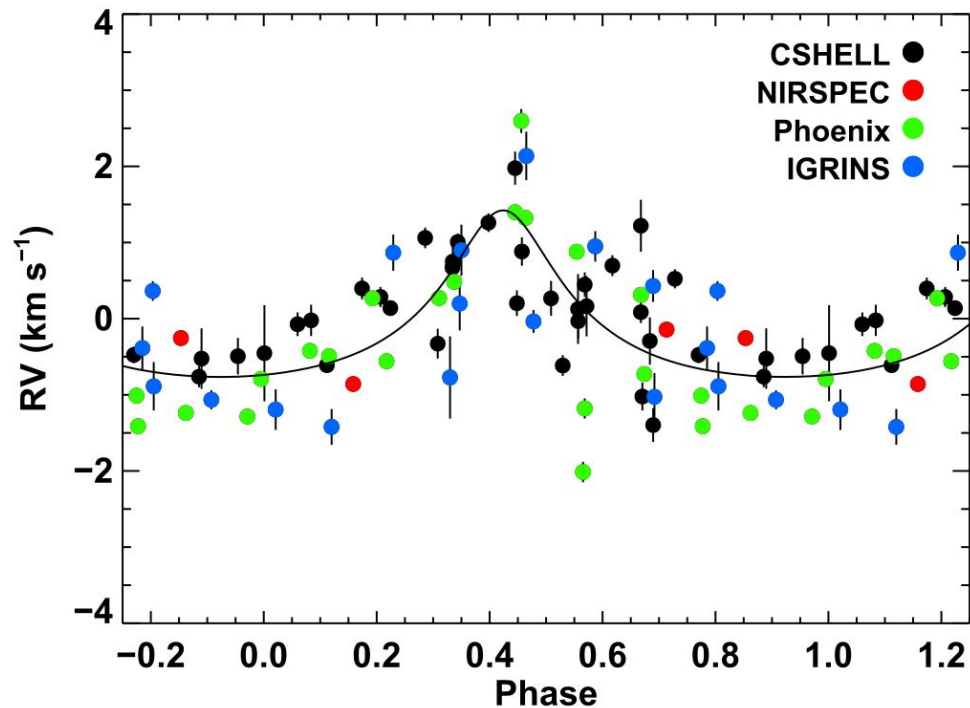
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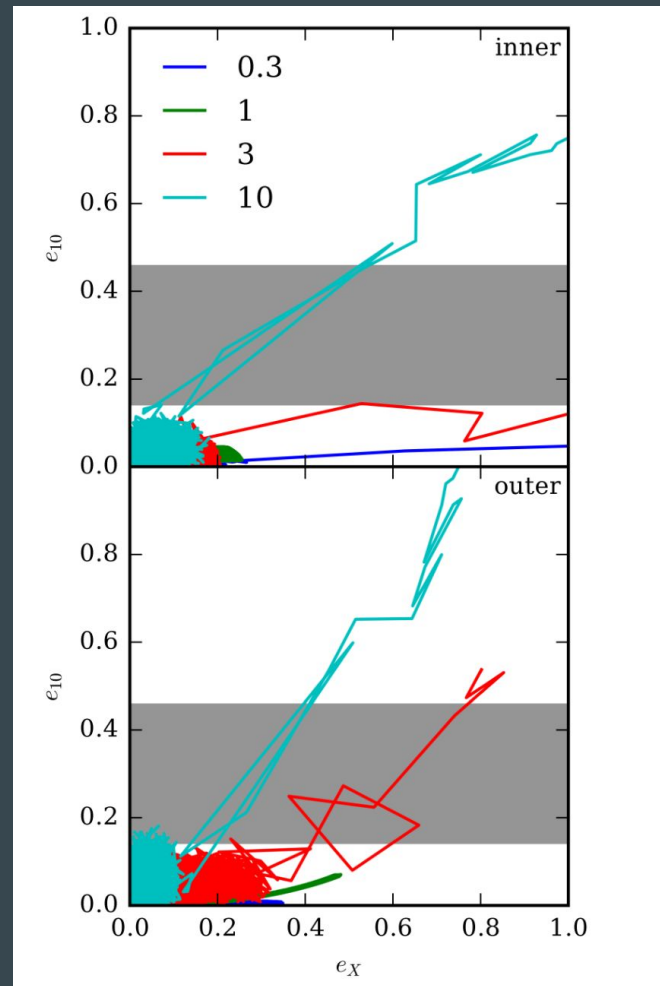
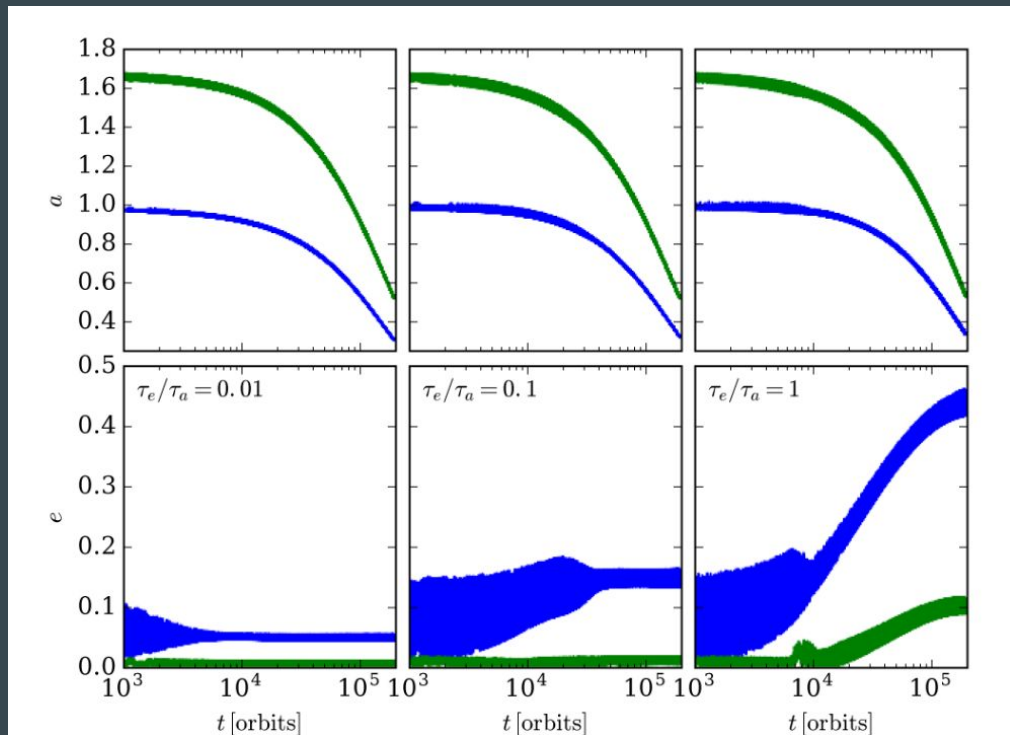
Link between formation and composition

CI Tau: The disc hosting an eccentric planet



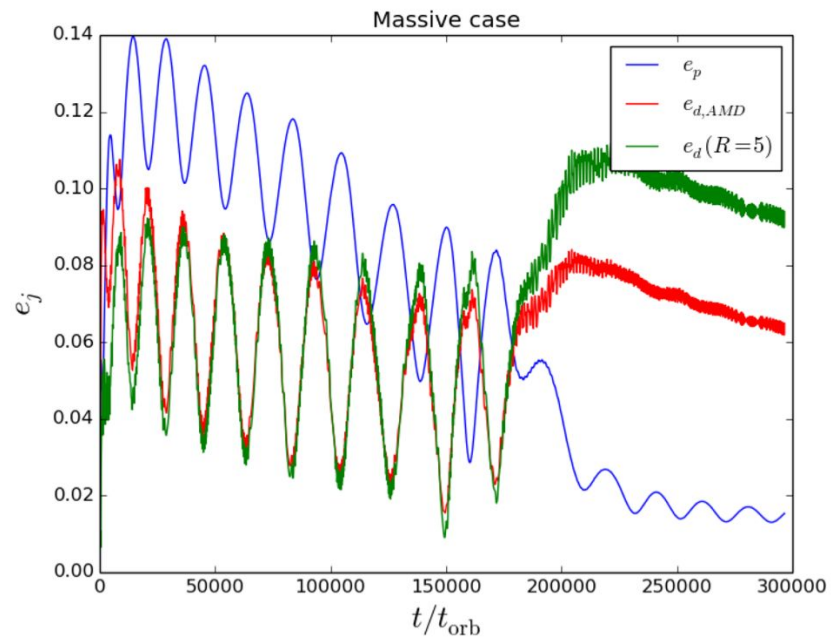
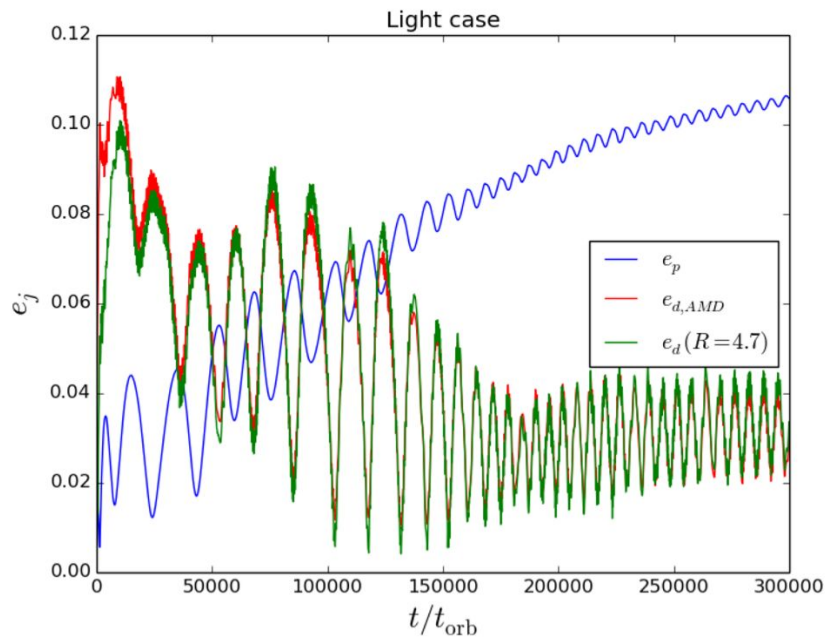
Eccentricity from planet scattering?

Eccentricity excitation by a $3M_J$ companion



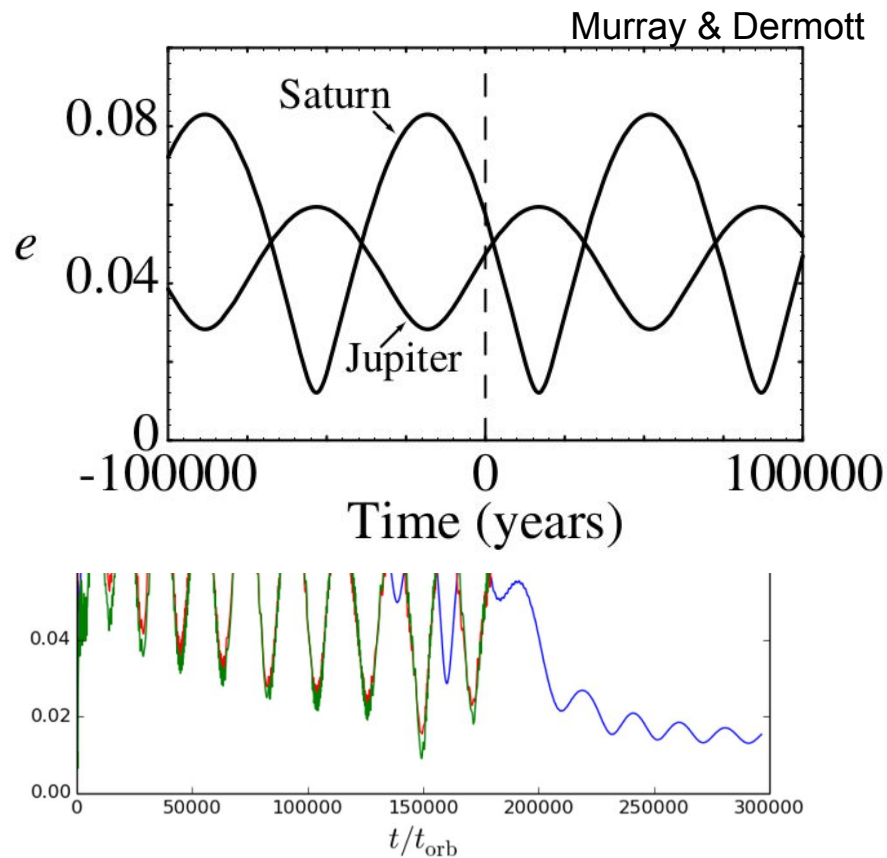
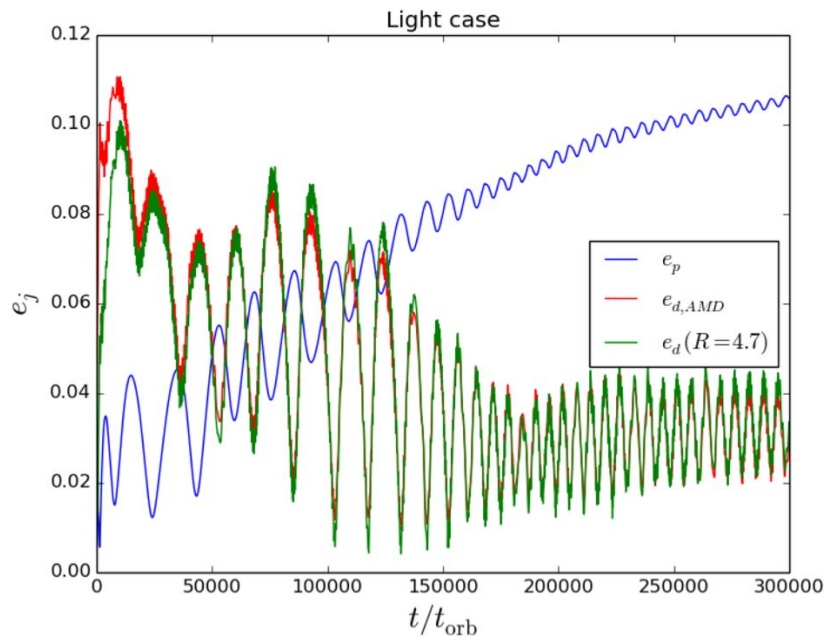
Eccentricity from planet-disc interaction?

Planet in blue, disc in green / red



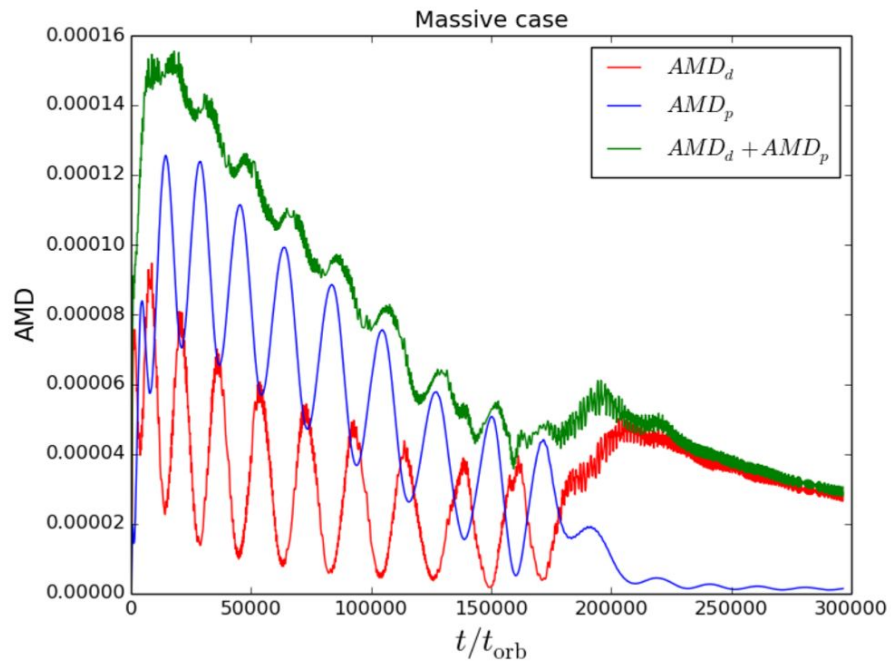
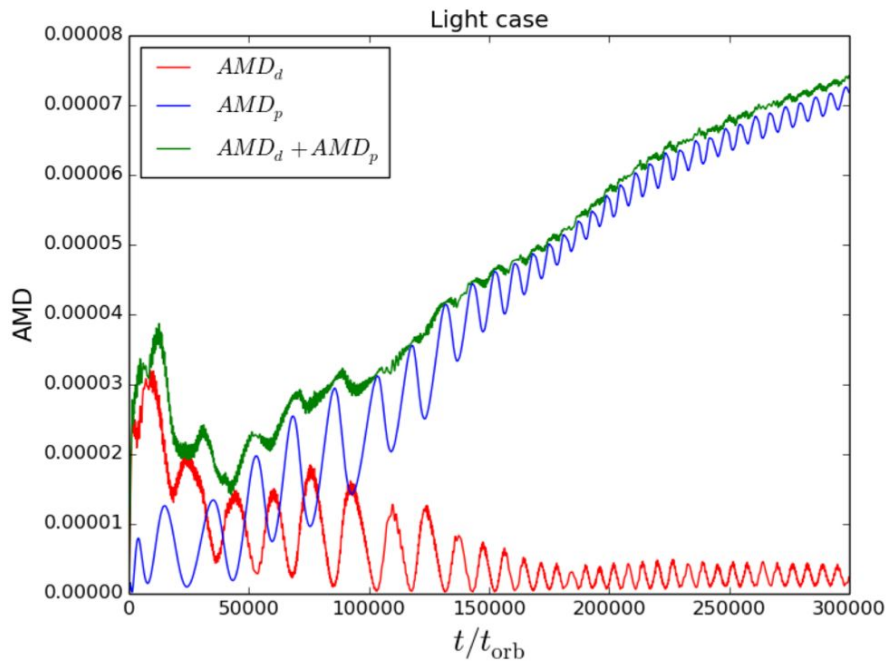
Eccentricity from planet-disc

Planet in blue, disc

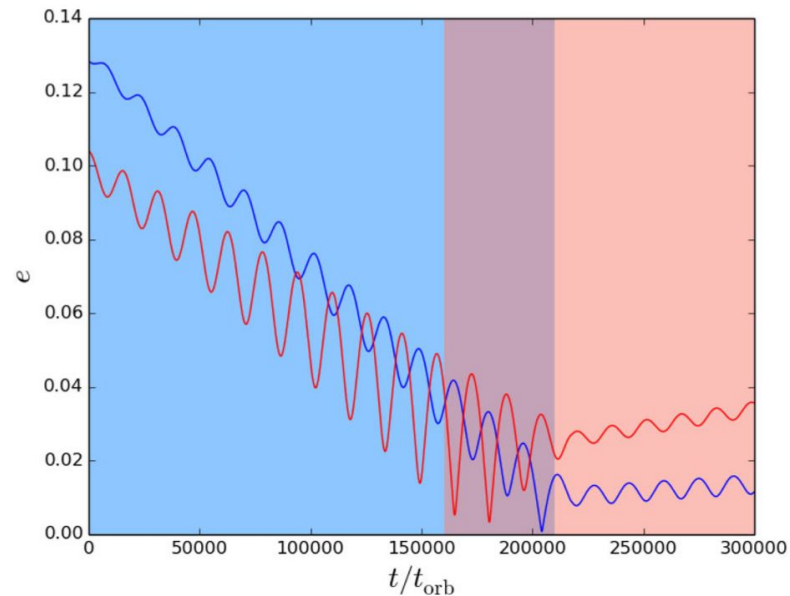
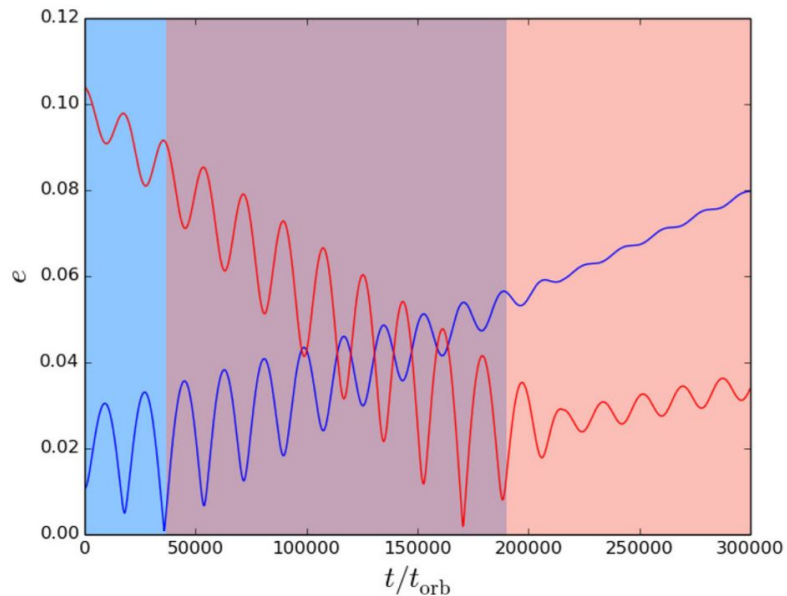


Angular momentum deficit

Conserved during oscillations



Secular model with growth and damping



Plan for the talk

Structures in discs

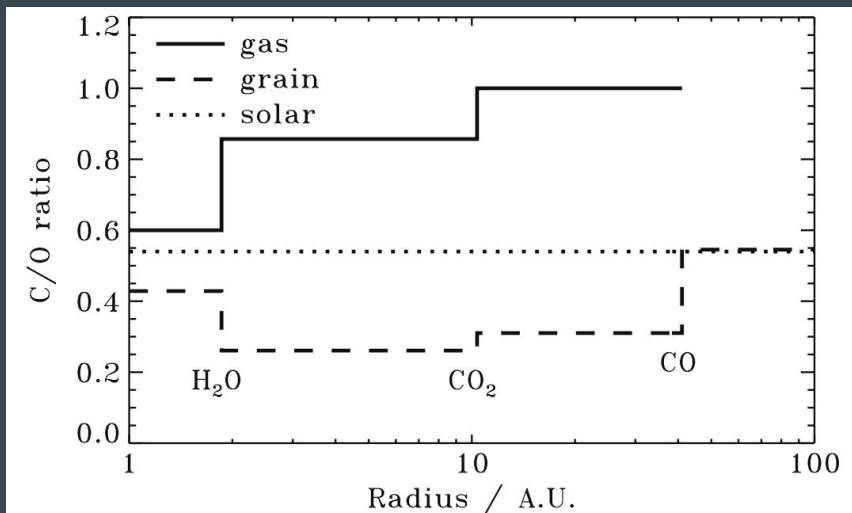
CI Tau: Origin of the hot Jupiter's eccentricity

Link between formation and composition

Chemical composition of planets

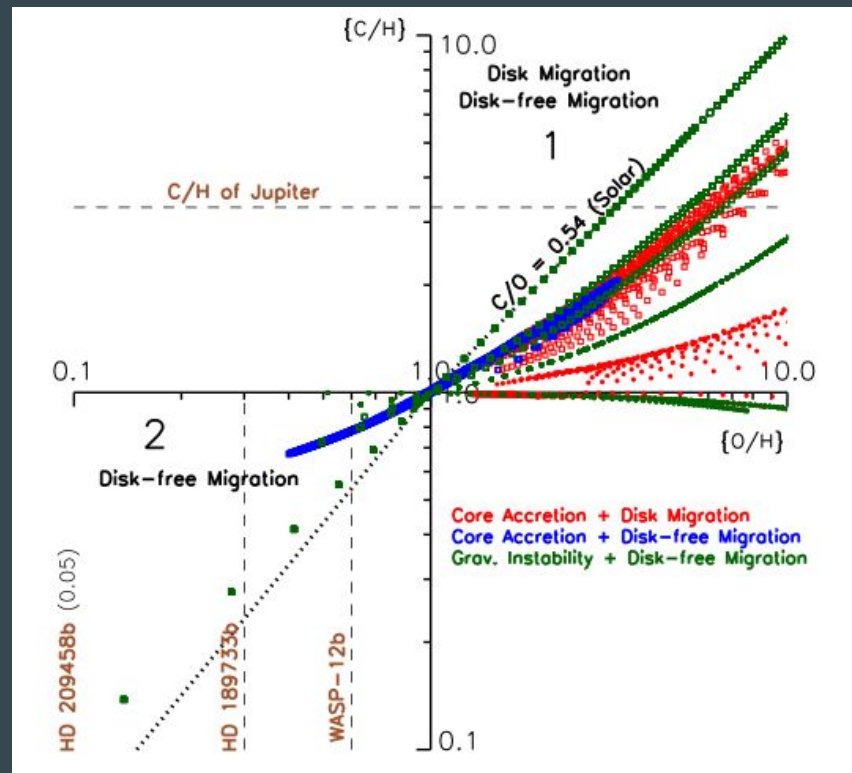
C/O ratio constrains gas/solids

Disc abundance



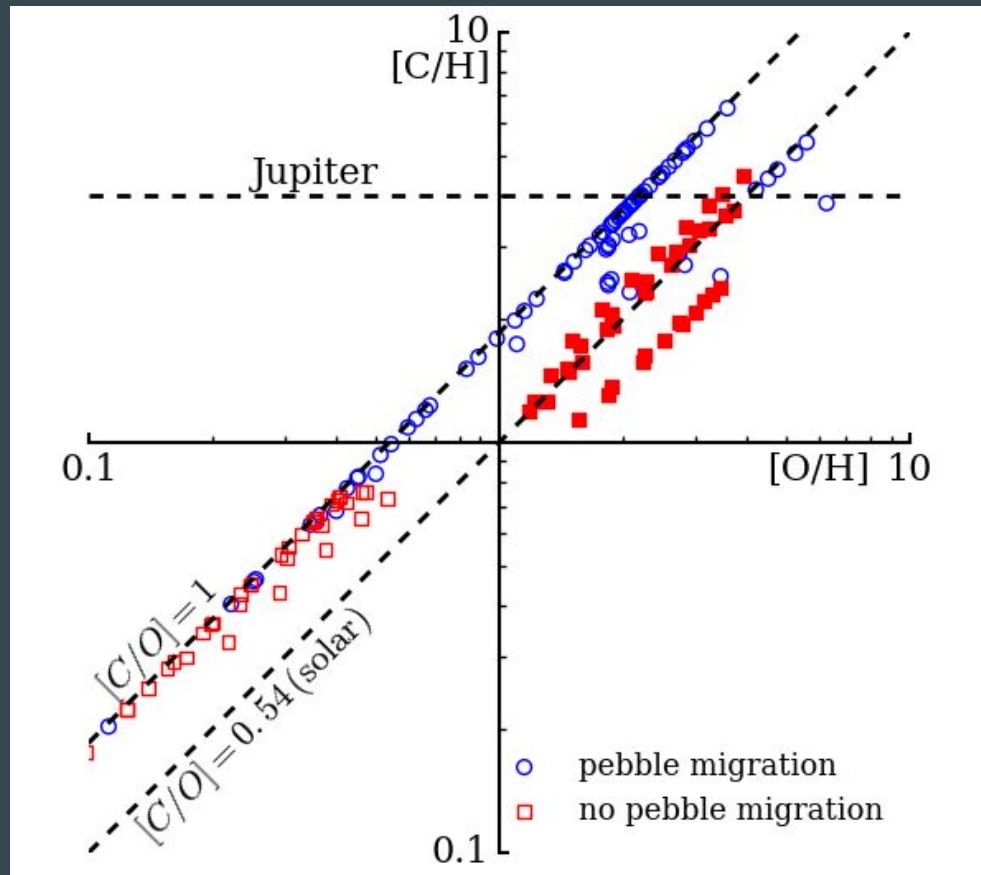
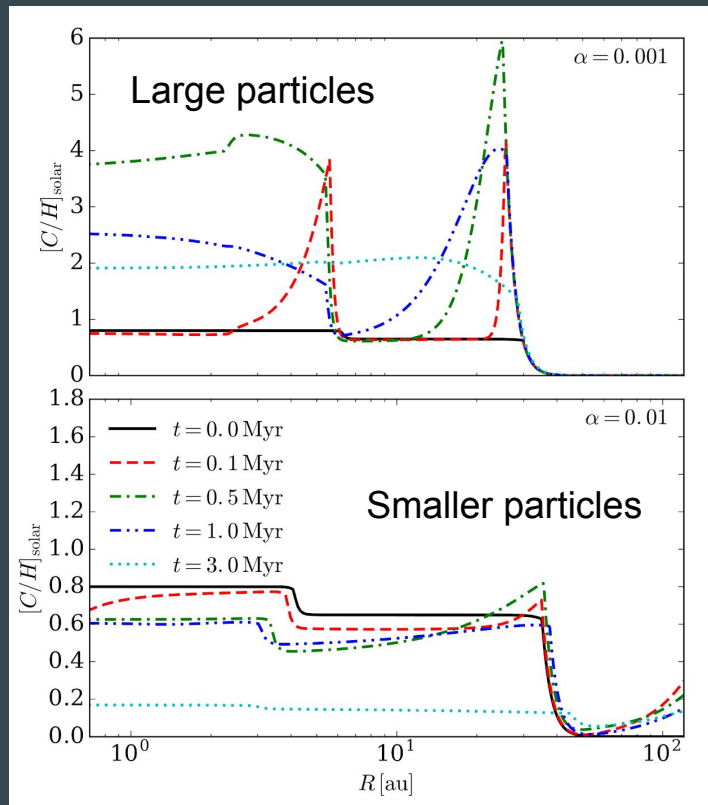
Oberg+ (2011)

Planet abundances

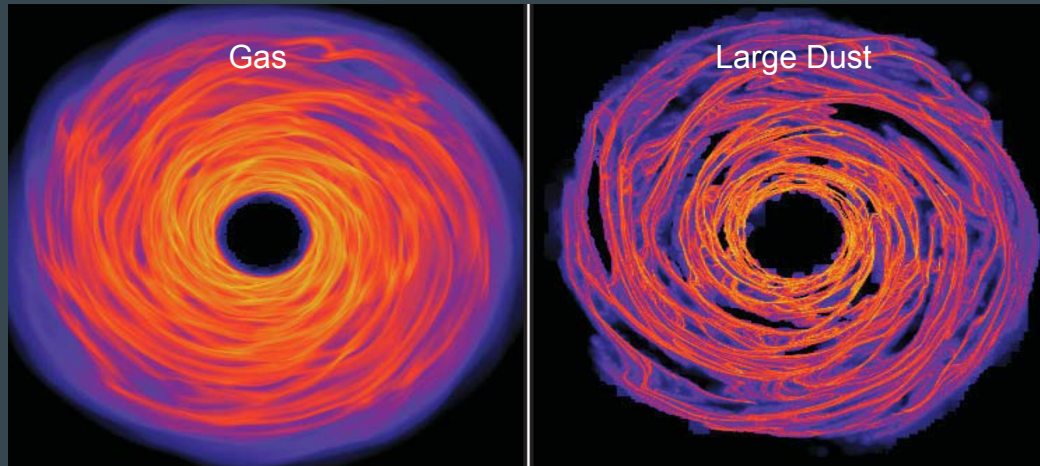


Madhusudhan+ (2014)

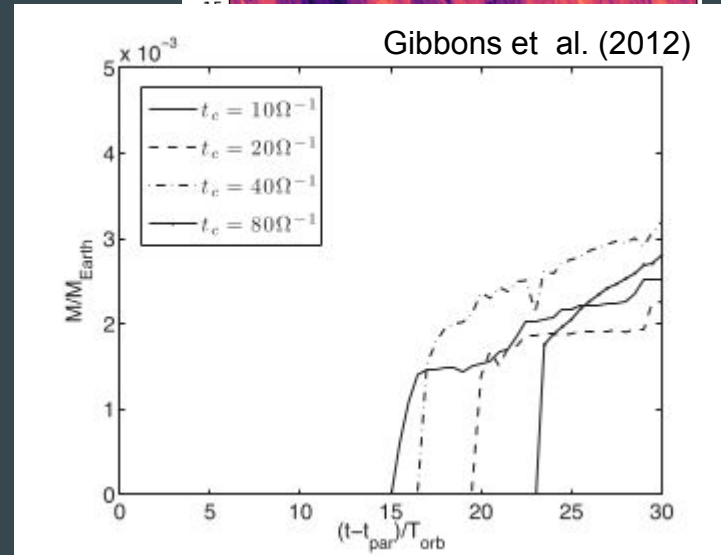
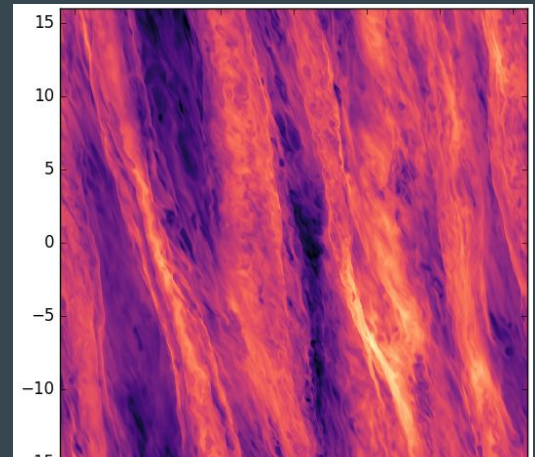
Role of dust evolution



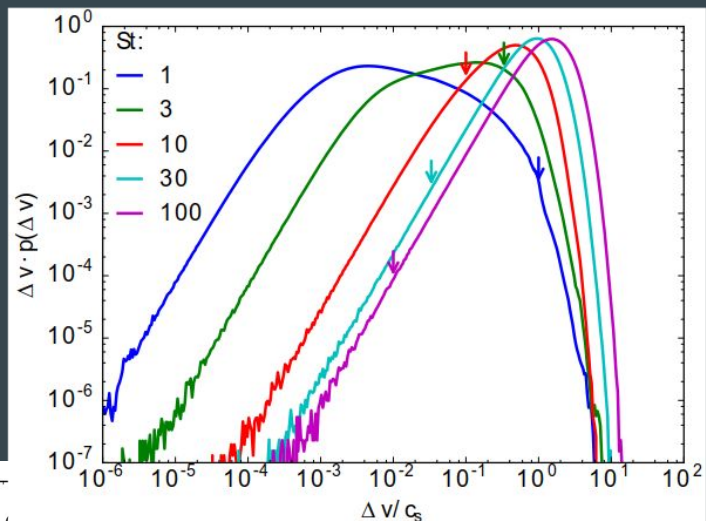
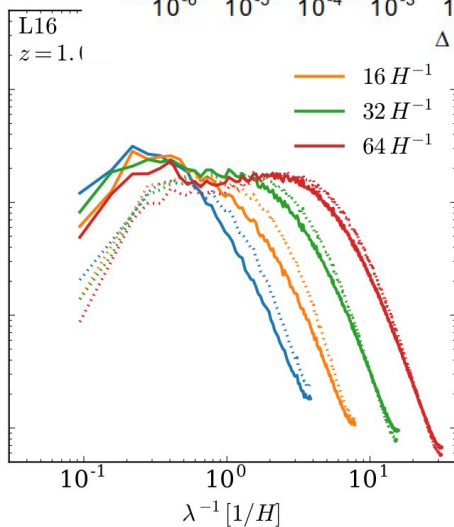
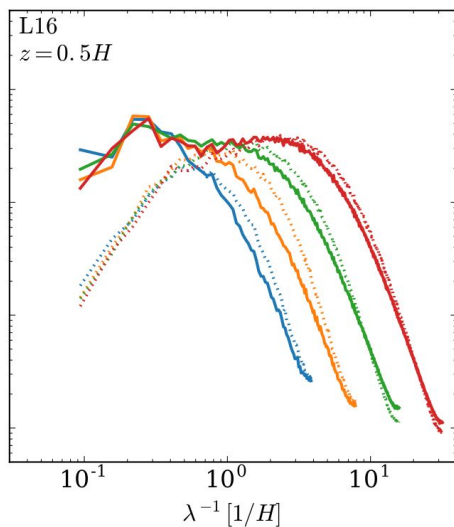
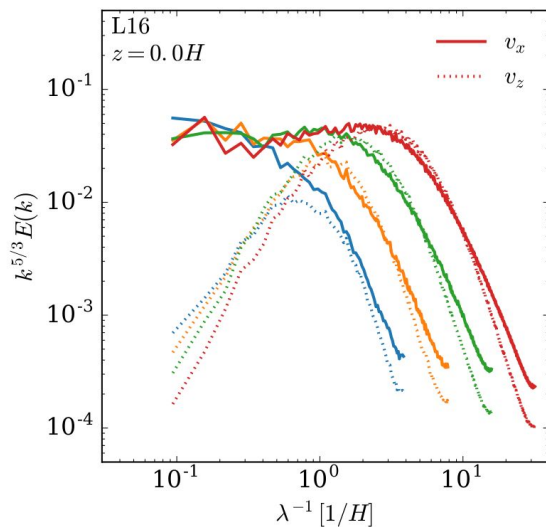
Dust dynamics in self-gravitating discs



Booth & Clarke (2016)

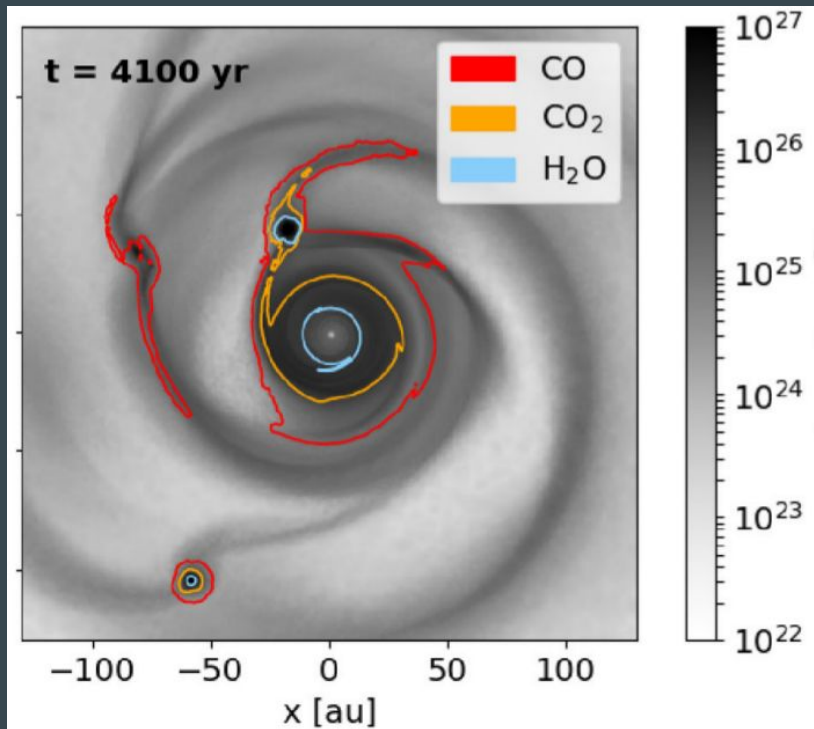


Turbulent dynamics of dust in self-gravitating discs

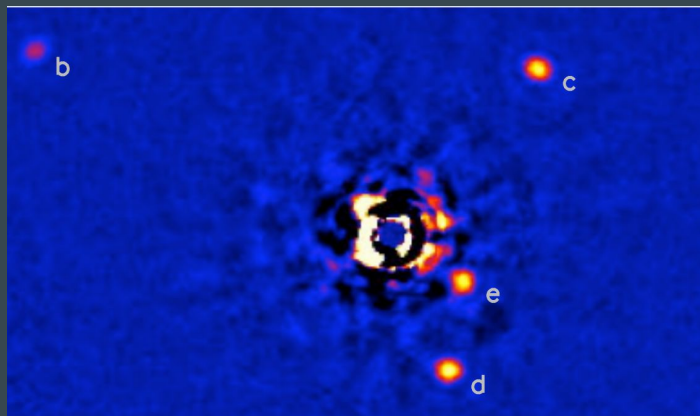
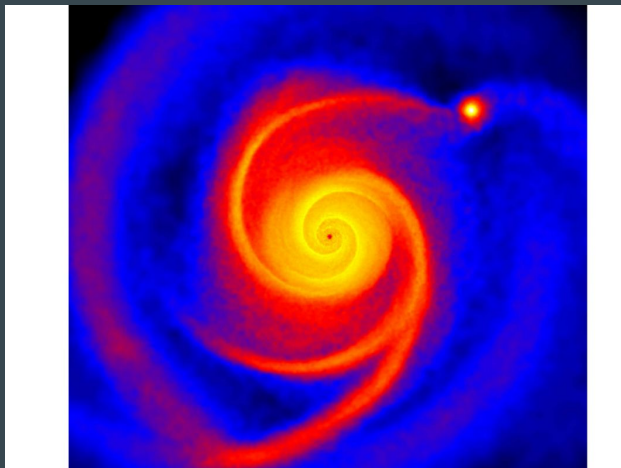


- $16 H^{-1}$
- $32 H^{-1}$
- $64 H^{-1}$

Numerical simulations of gravitational instability



Ilee et al. (2017)



HR 8799, Marois et al. (2010)