PROTOSTELLAR DISKS AS SITES OF EARLY PHASE PLANET FORMATION (?)

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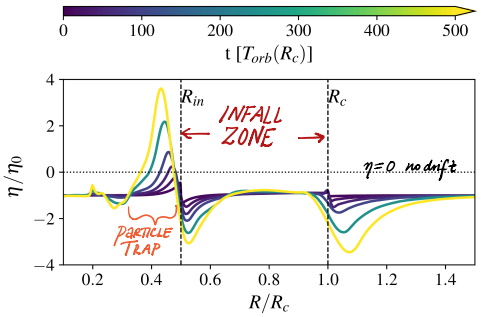
Questions or comments? contact me by email or set up a zoom with me here



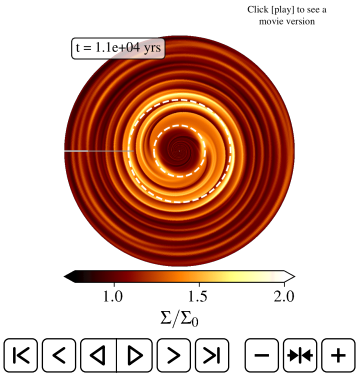
Local vs global pressure gradient η/η_0, see: Chiang+Youdin2010

Short Answer:
Disks dominated by non-isotropic infall have favorable conditions for dust trapping, transport, and coagulation.

PRELIMINARY RESULTS

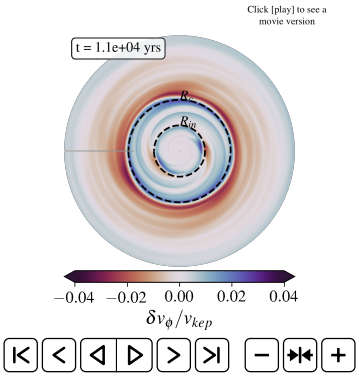
Robust (gas) structure formation

- infall leads to large local δP and Rossby Wave Instability (RWI) see: Bae+2015
- RWI $\rightarrow$ spiral waves, vortices!
- Spirals induce more low-level δP at $R < R_{in}$ and $R > R_c$



Dynamical consequences

- Large $\eta = (v_\phi - v_K)/v_K$ deviations at R_{in} and R_c - dust trapping and concentration zones within infall zone?
- At level of a few percent could be detectable by ALMA gas kinematic observations - see: Armitage+2020



Turbulence and Transport

- Reynolds stresses can induce $\alpha \sim 10^{-4} - 10^{-3}$ within $10^3 - 10^4$ years
- α is not constant across the disk - profile peaks within infall zone.

UP NEXT

- Timescales and conditions for long-term trapping and sustained particle growth in early phase disks and how they vary with infall properties
- Prospects for solids grown in infall induced pressure bumps
- Investigate distinguishable signatures of past infall
- 3D effects of filamentary infall with misaligned angular momentum

VIRTUAL POSTER KEY

Author+year — hyperlink to a reference
word — hyperlink
▶ figures with video controls can play as movies in Adobe Acrobat

PREMISE

Protostellar cores in simulations (e.g. Kuznetsova+2020 Kuznetsova+2019 Kuffmeier+2018) and observations (see: Tobin+2010 Yen+2019 Pineda+2020) show that infall of material is anistropic and episodic - due to filamentary nature of the star-forming environment.

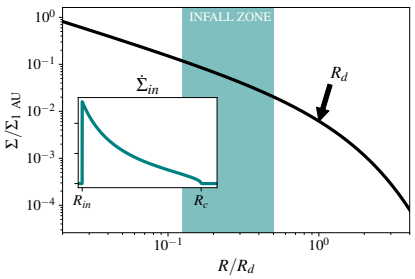
Consequences for disk formation:

- Disks may not grow outward with time like TSC+1984
- Filamentary infall = annular mass deposition.
- Stochastic angular momentum accretion leads to shifts in the *landing radius* R_c.

2D MODEL

Adapted from Cassen+Moosman 1981

to allow for annular $\dot{\Sigma}_{in}$ within variable $R_{in} < R < R_c$ where $R_c = j_{in}^2/GM$



$\dot{\Sigma}_{in} \propto \dot{M}_{in}/4\pi R_c R\sqrt{1 - R/R_c}$
$v_{in} = [v_r, v_\phi] = [-\sqrt{GM/R}, \sqrt{GM/R_c}]$

NUMERICAL SETUP

vertically isothermal · </> FARGO
2D cylindrical · $\dot{M}_{in} = 10^{-6} M_\odot\ \mathrm{yr}^{-1}$

Resolution criterion: need to be able to resolve variations on the order of c_s^2/R everywhere in your disk