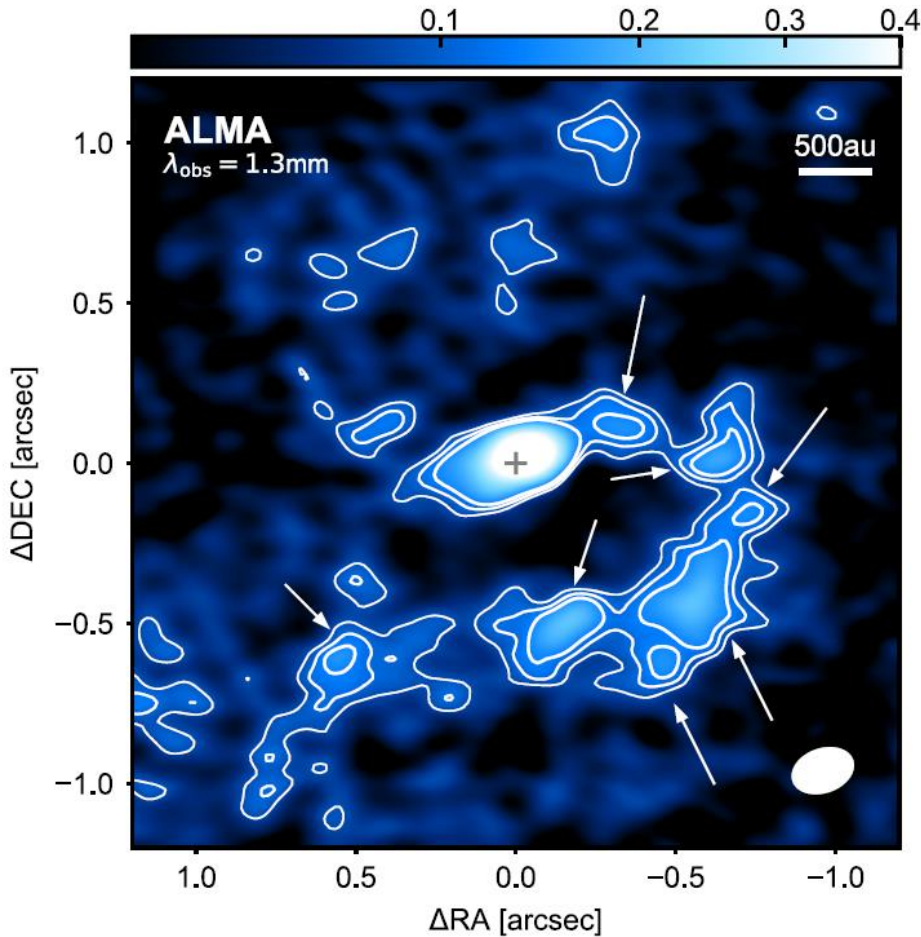
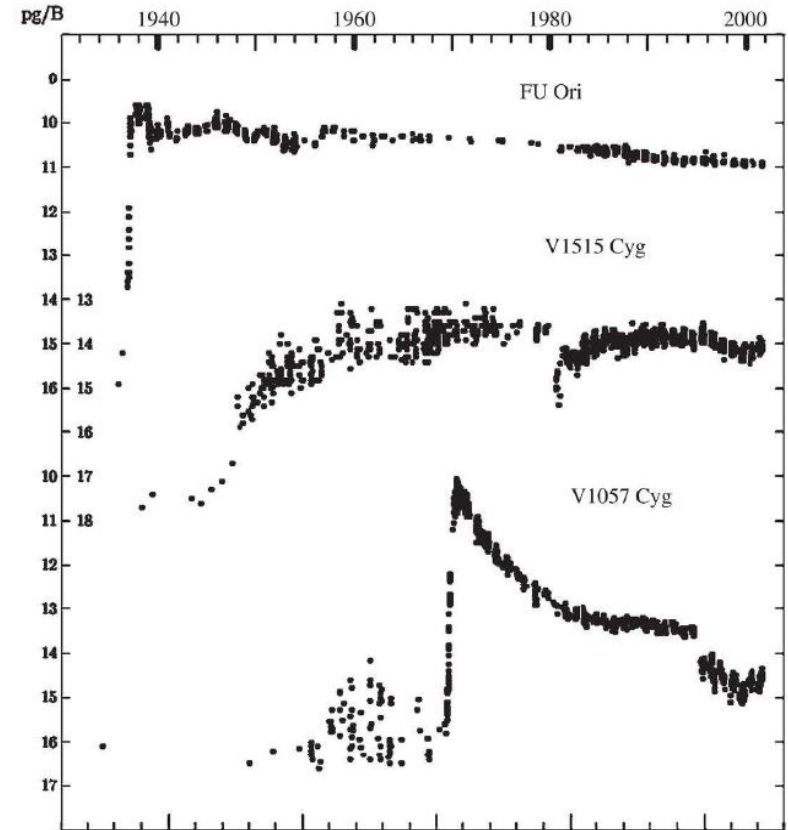


Distinguishing between different burst mechanisms.

Is this possible based on observations?



V960 Mon, Weber+2023



Hartmann 2009

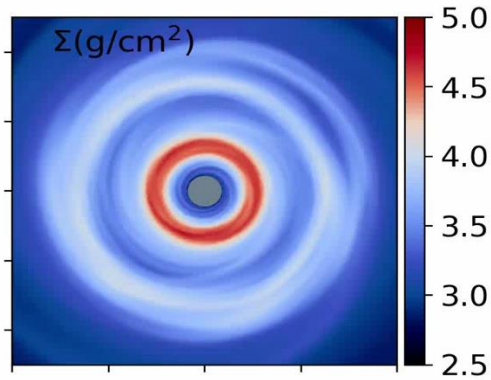
FUor bursts mechanisms for every taste

- **Thermal instability (TI)** (Lin & Papaloizou 1986, Bell & Lin 1994, Kadam et al. 2020, Nayakshin+2024)
- **Close encounters in binaries, stellar flybys**; (Bonnell & Bastien 1992; Pfalzner et al. 2008, Forgan & Rice 2010; Butchert+2023)
- **Magnetorotational instability (MRI)** (Armitage et al. 2001; Zhu et al. 2010, Bae et al. 2013; Vorobyov+2020; Kadam+2020);
- **Infall of gas clumps** (formed in the disk via GI) (Vorobyov & Basu 2005, 2010; Machida et al. 2011; Meyer 2017; Elbakyan+2026);
- **Infall of intercluster cloudlets** (formed God knows how) (Dullemond+2019, Demidova & Grinin 2023)
- **Tidal destruction of protoplanets**, (Nayakshin & Lodato 2012, Nayakshin & Elbakyan 2023).
- **Cascade mechanism** (flyby+TI+MRI) (Sklyarevskii & Vorobyov 2023)
- **Vertical convection in the disk** (Pavlyuchenkov et al. 2020; Held & Latter 2021).
- **Merger driven bursts** (Sergei's talk)

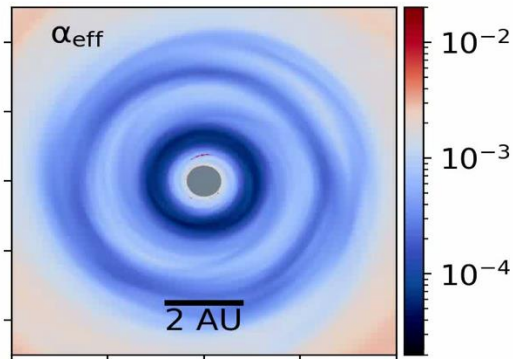
An MRI-triggered burst in the inner disk

(Kadam et al. 2019, 2020; also Thursday's talk)

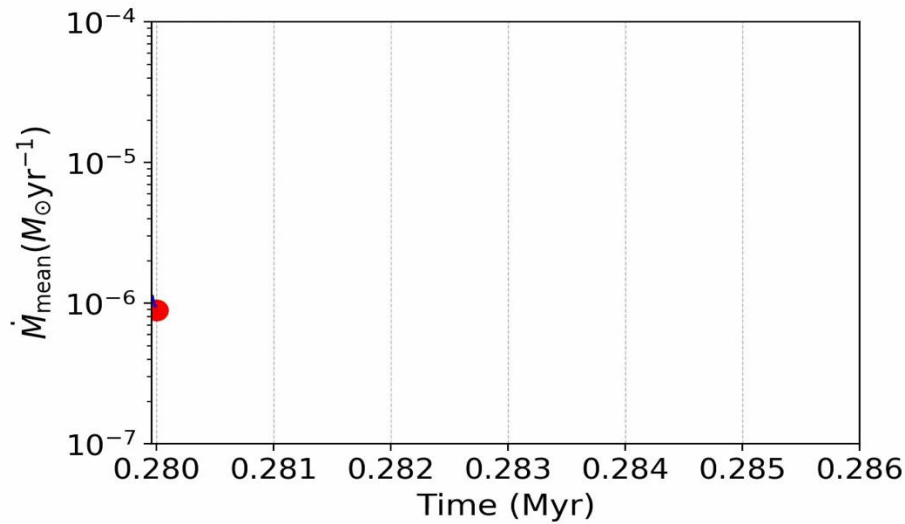
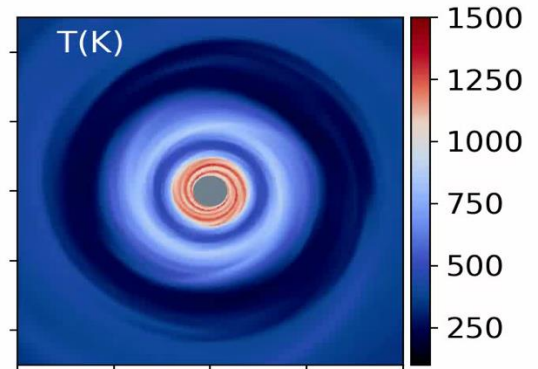
Gas surface density



alpha-parameter

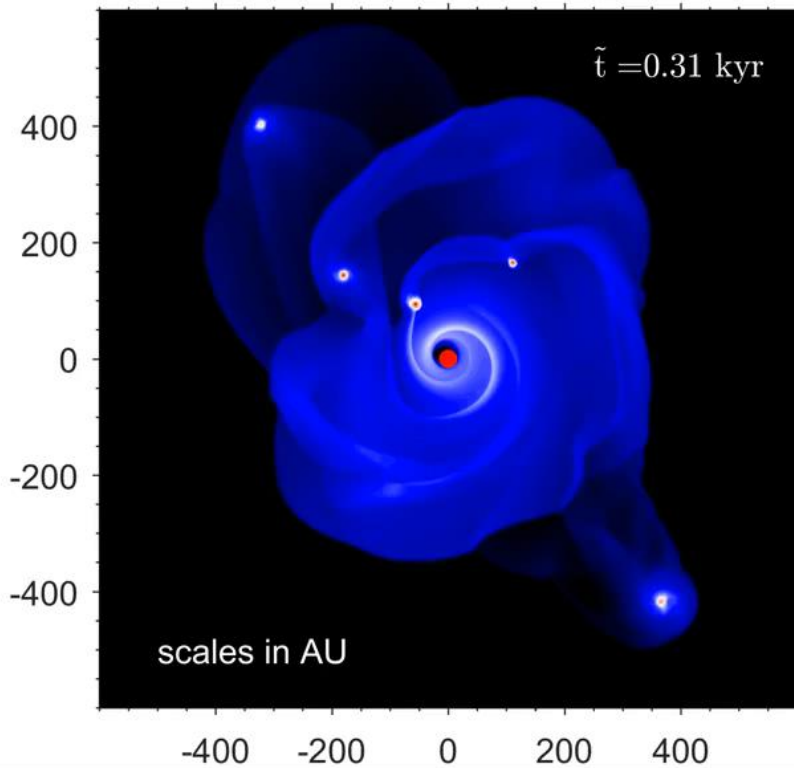


gas temperature

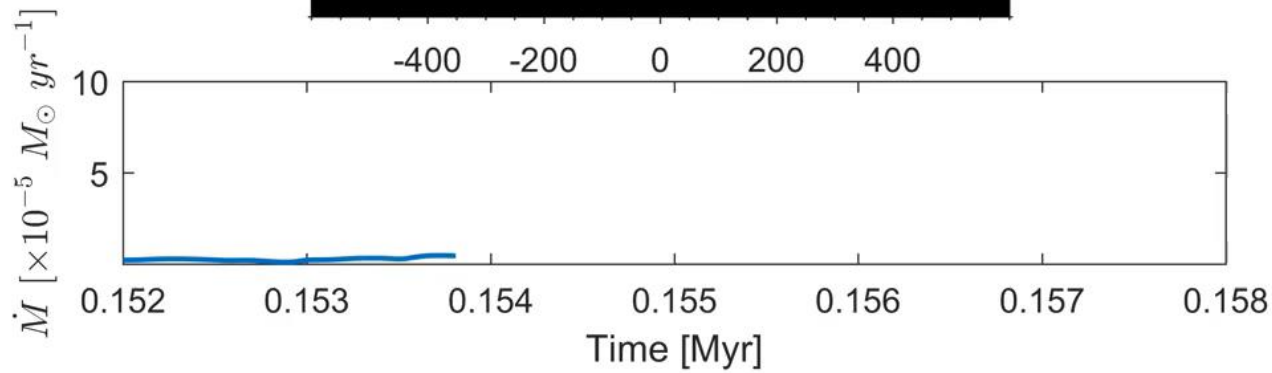


Tidal destruction of migrating clumps

(Vorobyov & Elbakyan 2018)

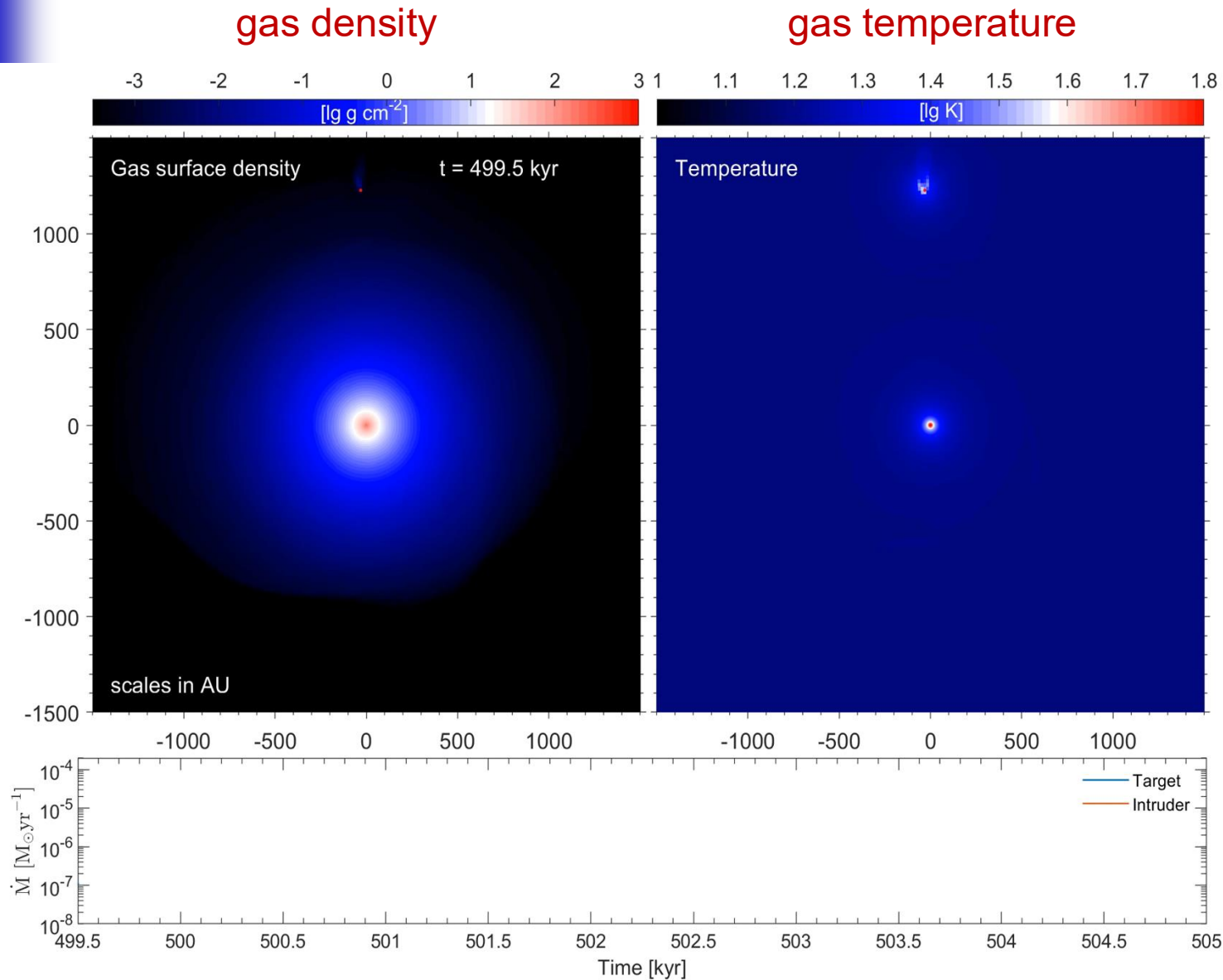


Gas surface density



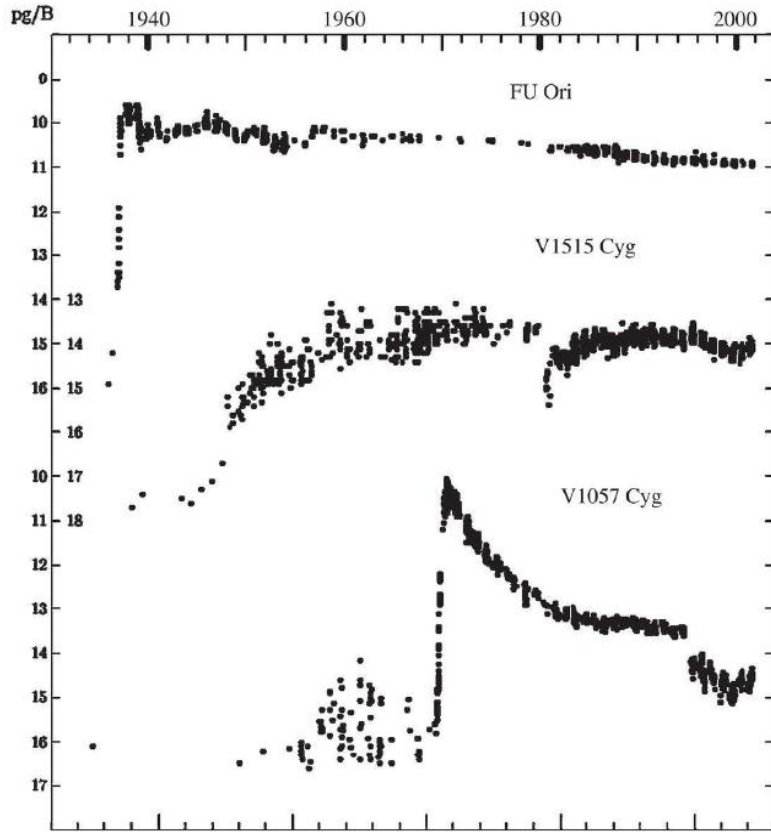
Mass accretion rate

Accretion burst on an intruder star (periastron ~ 70 au)



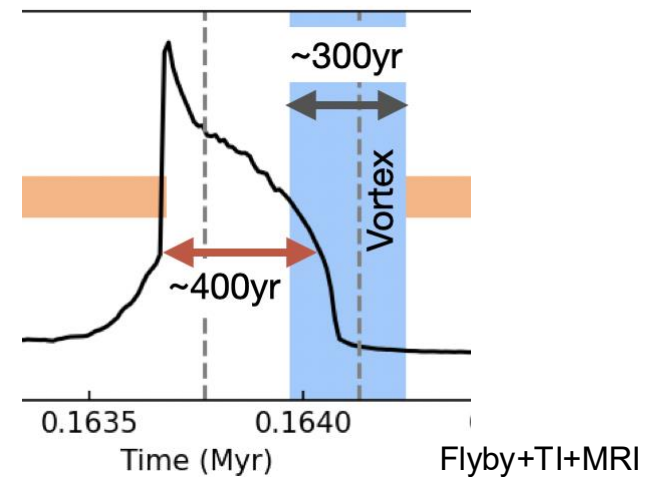
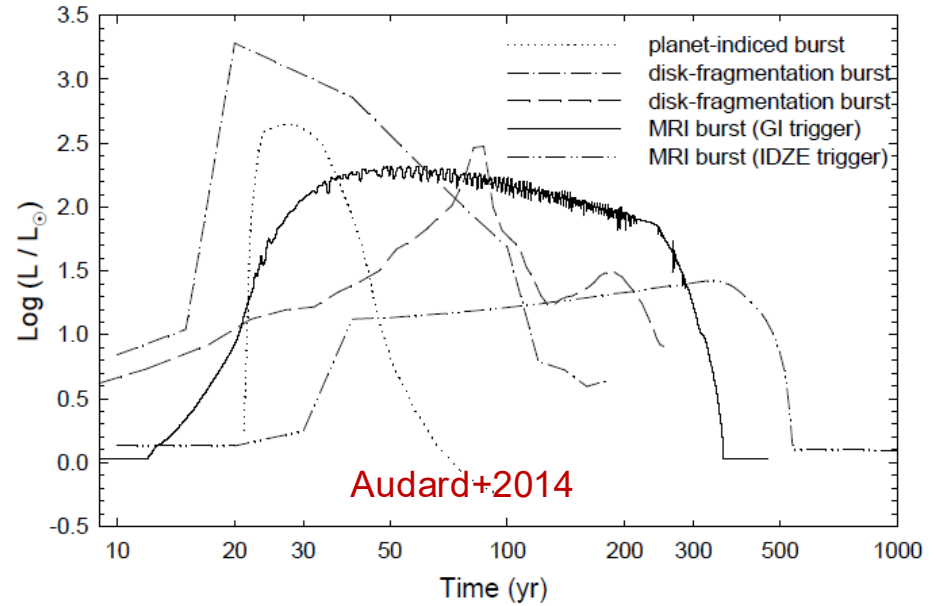
Discussion topics / open questions:

Can we distinguish the burst mechanisms based on the light curves?

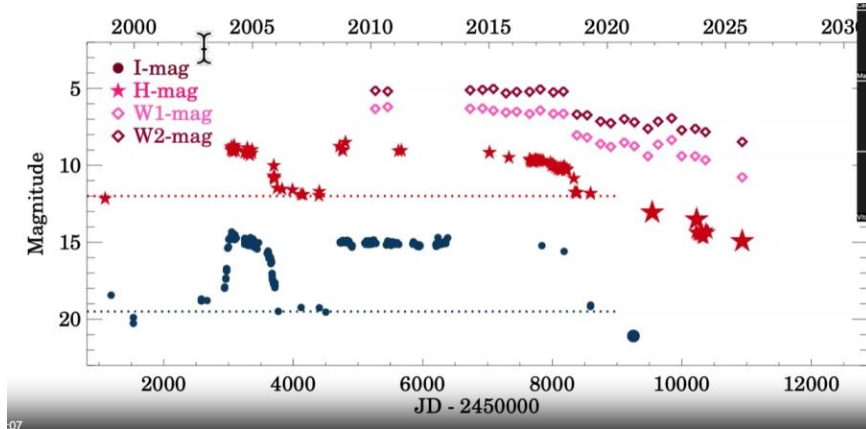


(a)

Hartmann 2009

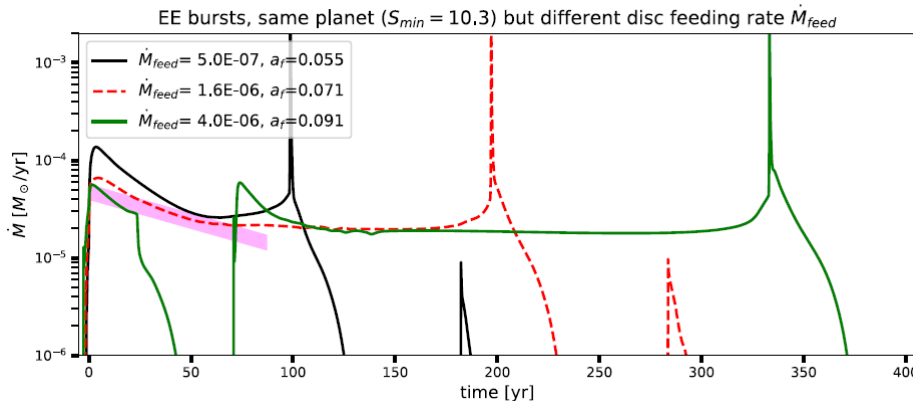
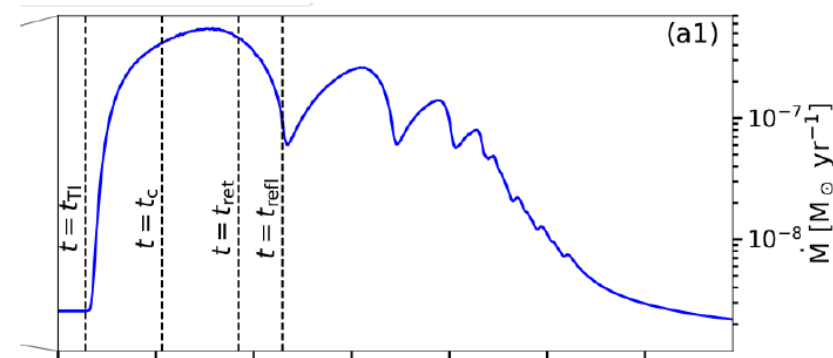


Is re-flaring a clue to identifying the burst mechanism?

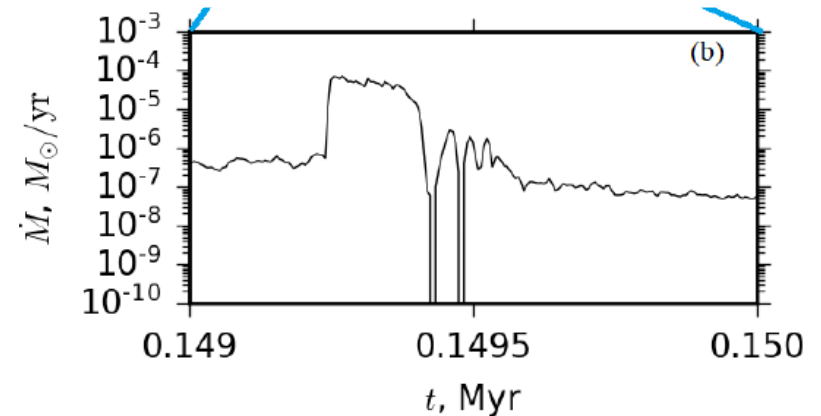


Peter's and Agnes's talks (V1647 Ori, V346 Nor)

Cecil & Flock 2024 (TI)

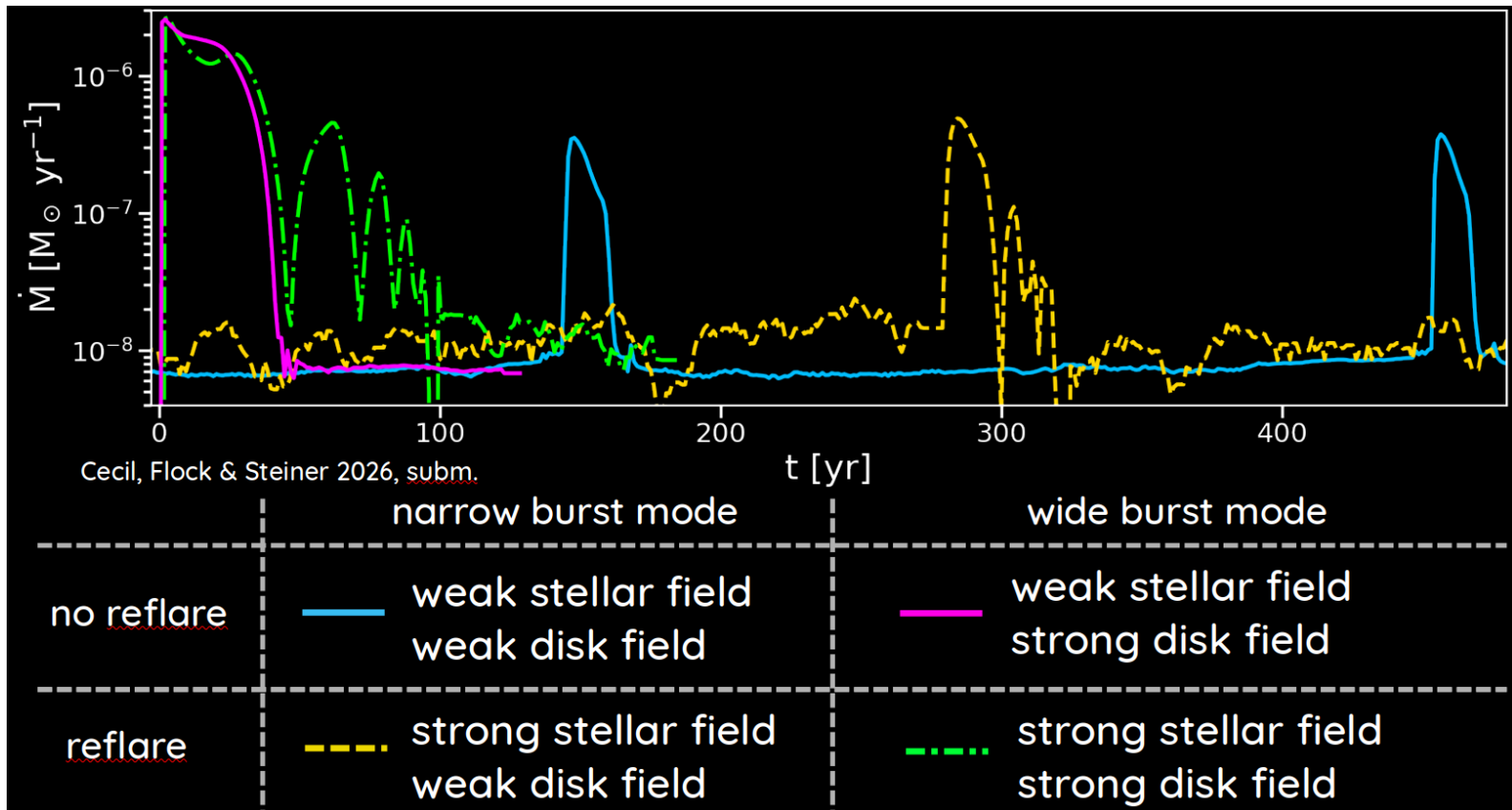


Nayakshin & Elbakyan 2024 (protoplanet disruption)



Vorobyov+2020 (MRI)

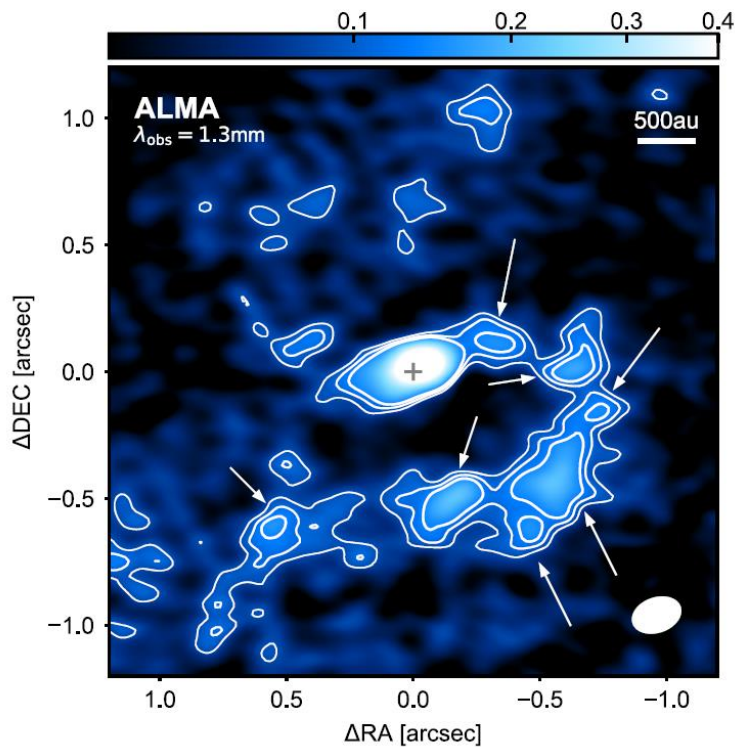
Are our models accurate enough to produce reliable mass accretion histories?



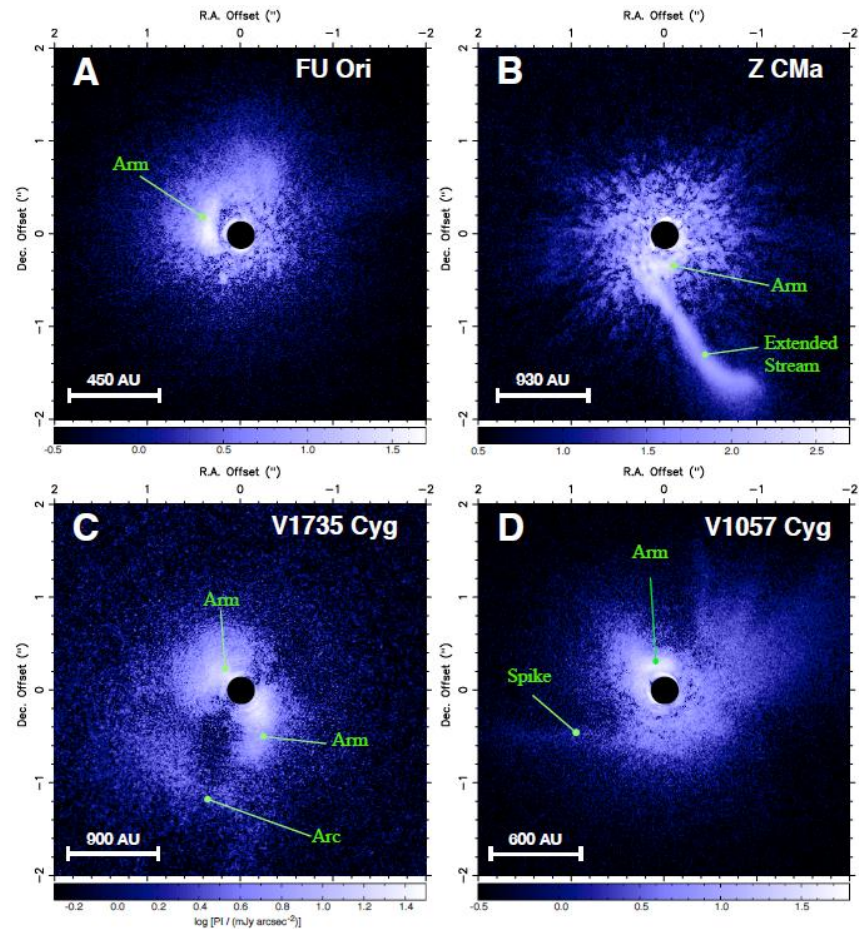
Michael's talks

Can we distinguish the burst mechanisms based on disk spatial morphology (gas, dust, both)

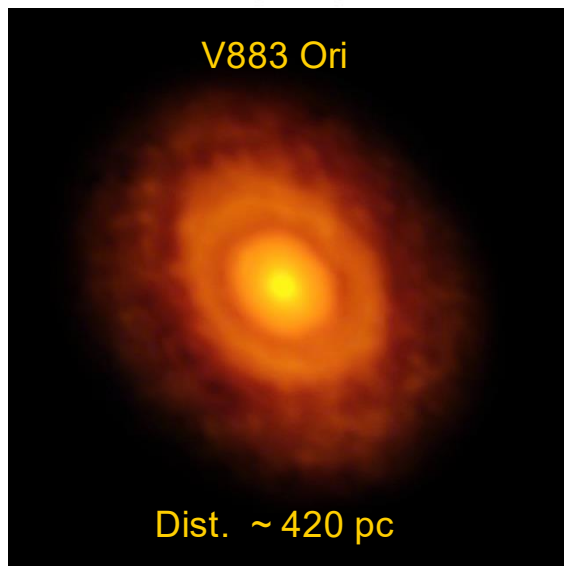
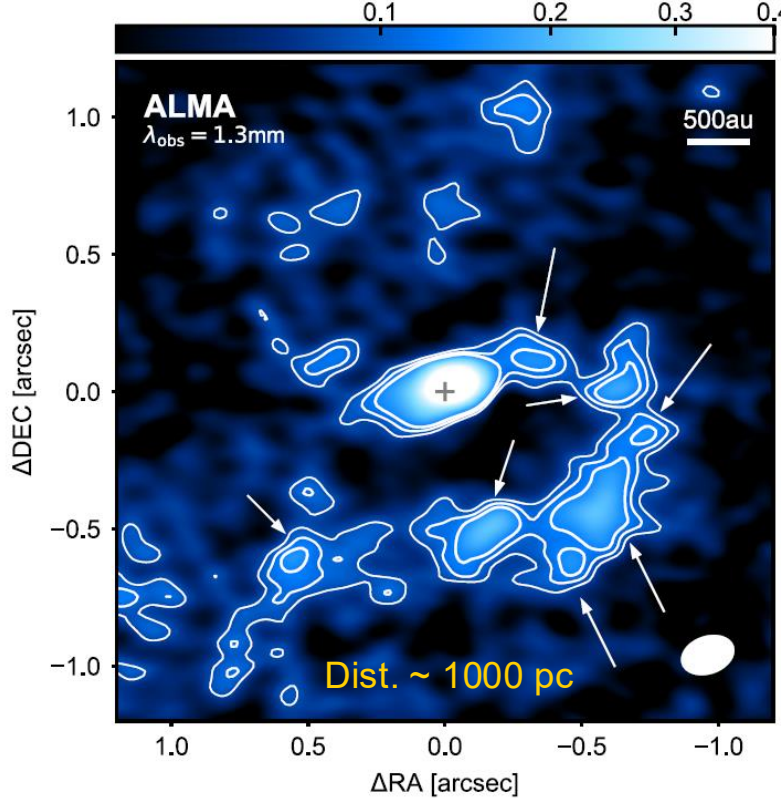
Do we have enough resolution / sensitivity? ALMA 2040?



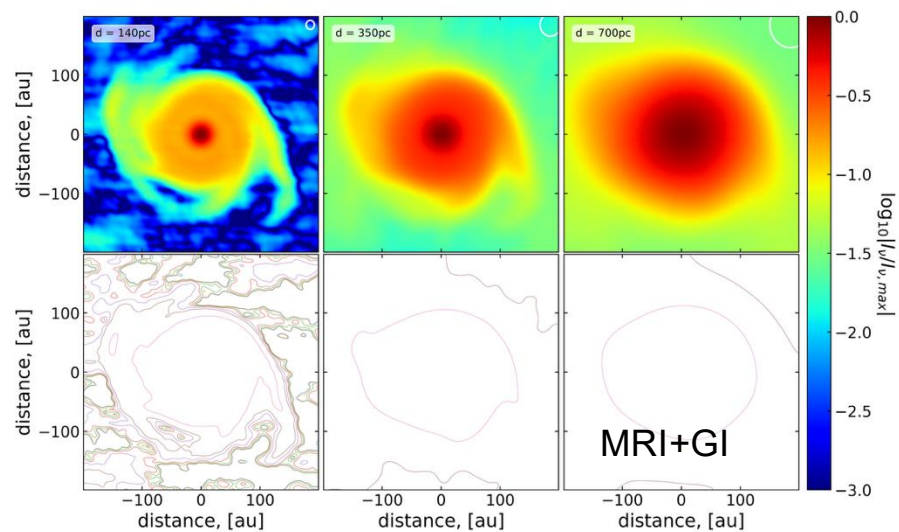
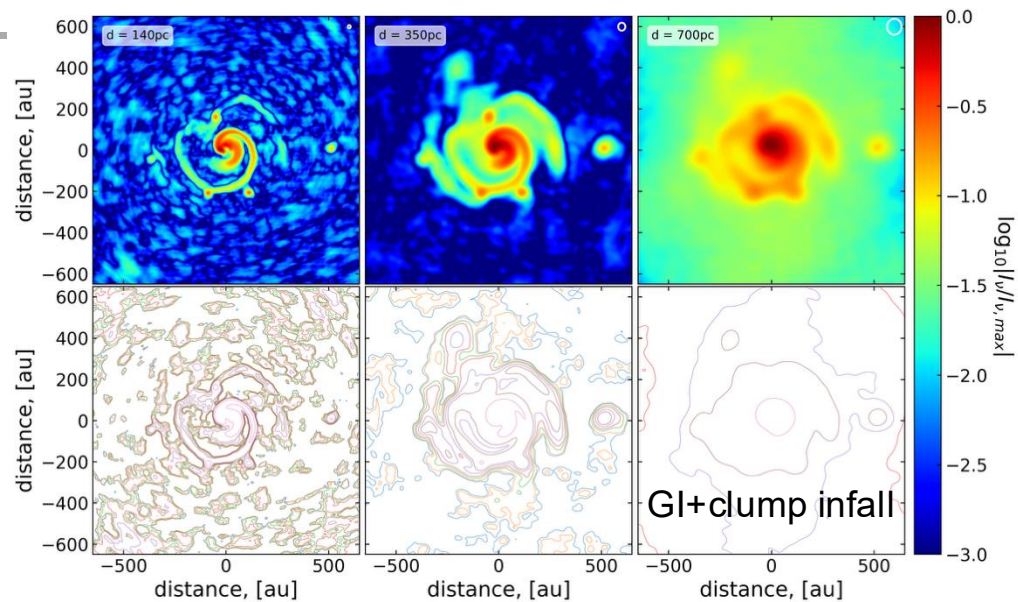
V960 Mon, Weber+2023



Liu+2016

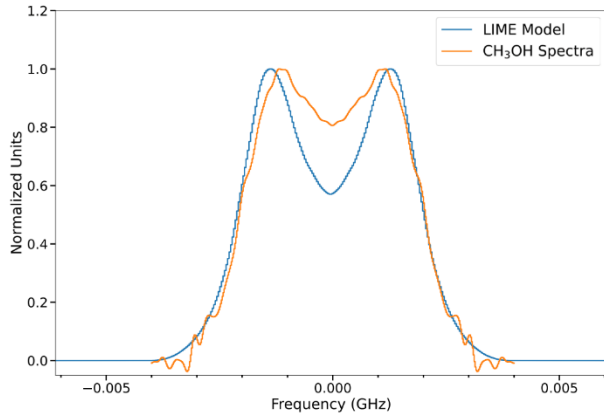


Alexandr's talk



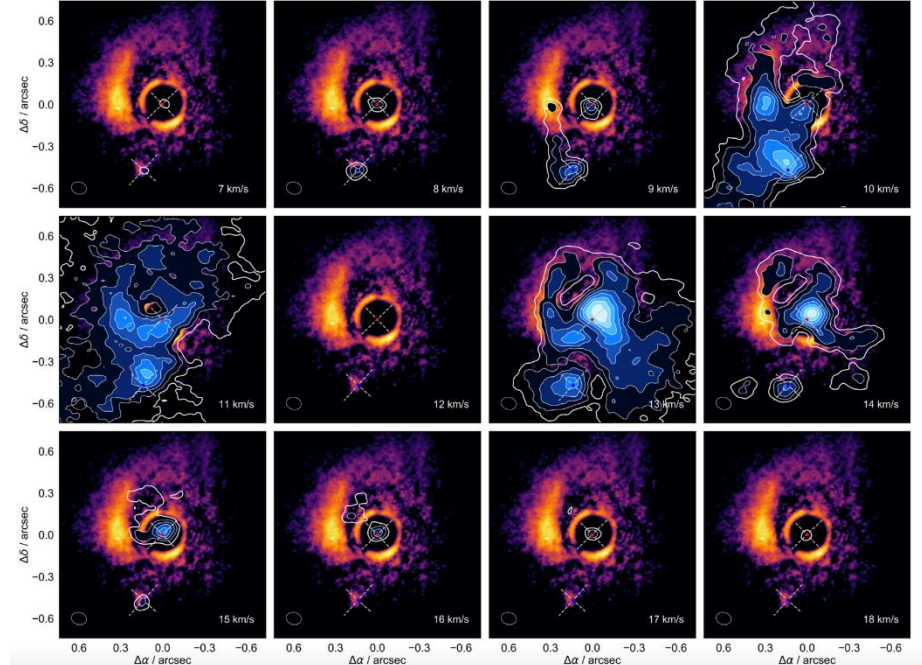
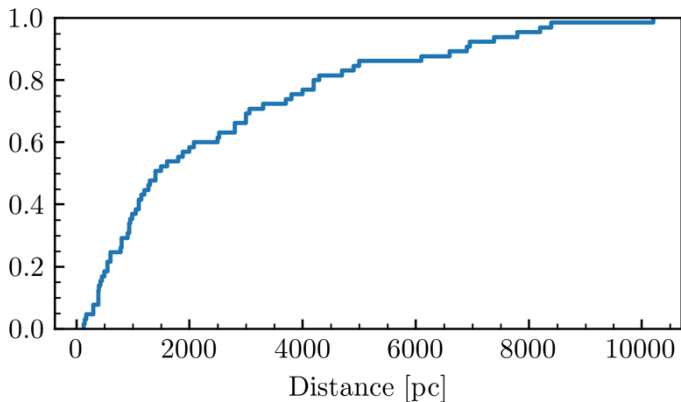
Can we distinguish the burst mechanisms based on

disk kinematics from molecular line emission?



V883 Ori looks Keplerian, no substructure of note in continuum (Tobin et al. 2023)

The challenge to doing better: FUors are far away!



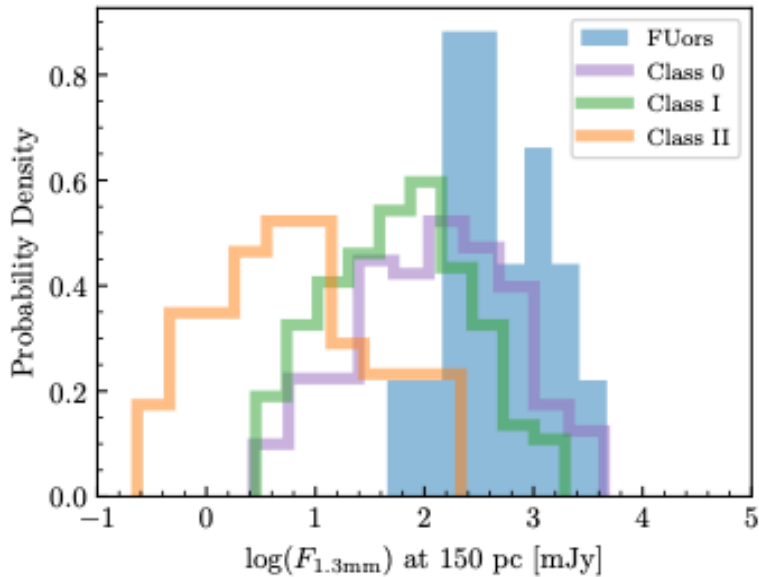
FU Ori has a streamer but otherwise the data are a bit of a mess (Perez et al. 2020, Hales et al. 2024)

Half are more than 1 kpc away
(OYCAT; Contreras-Pena et al. 2025)

20-25 within 1.5 kpc, accessible to
GRAVITY+/ALMA

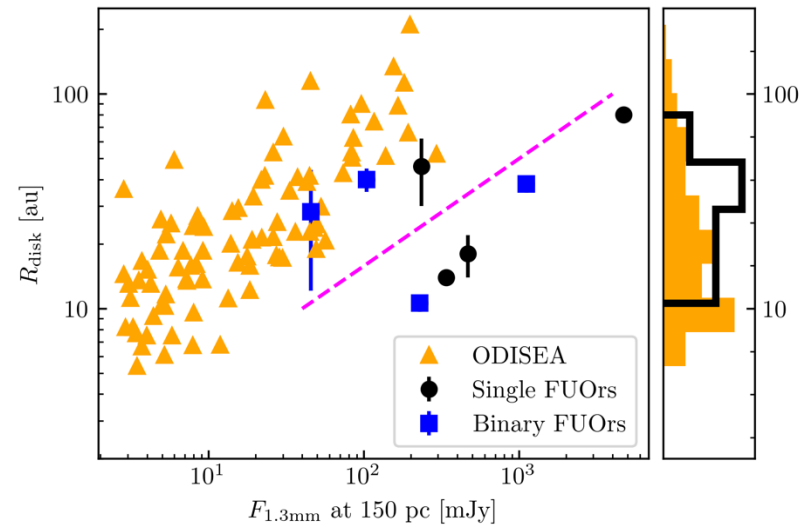
Can masses of FUors (star and disk) give us a hint?

FUor disks seem to be massive...



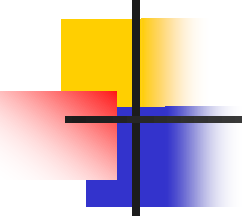
Data from Liu et al. (2018), Kospal et al. (2021), Tobin et al. (2020), and Manara et al. (2023)

... but are they compact?



Data from Dasgupta et al. (2025), Kospal et al. (2021), Perez et al. (2020), Cieza et al. (2016)

FUors seem to have a typical stellar mass distribution (Carvalho et al. 2026) and (outdated) multiplicity statistics suggest $\sim 30\%$ are multiples, consistent with non-outbursting population (Offner et al. 2023).

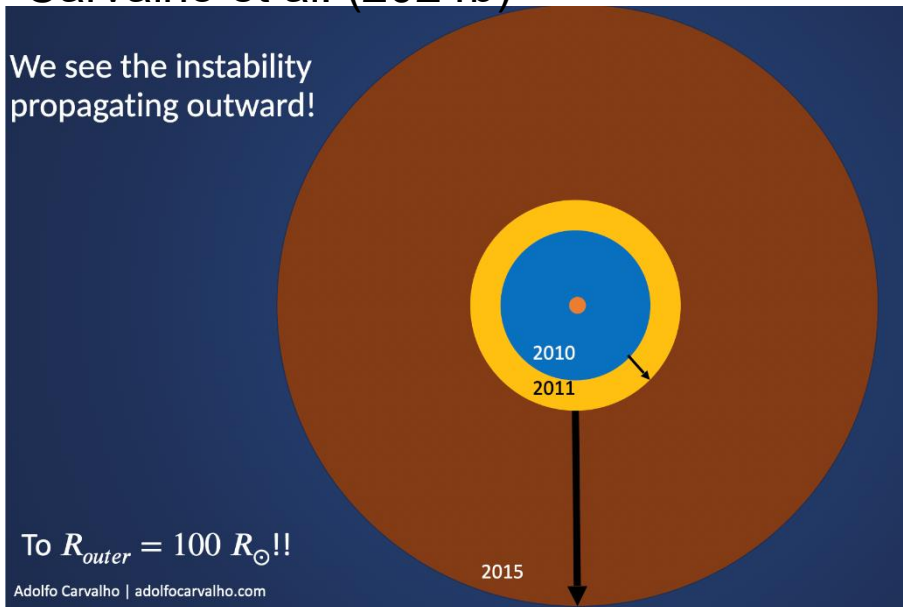


Almost every observational paper on bursts ends up comparing its results against a simple viscous α -model of a PPD... and finds an excellent agreement!

Does this mean that it all comes down to the level of turbulence in the inner disk?

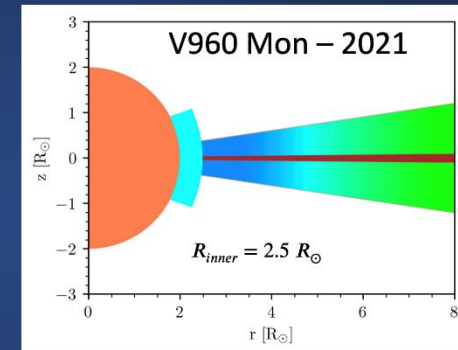
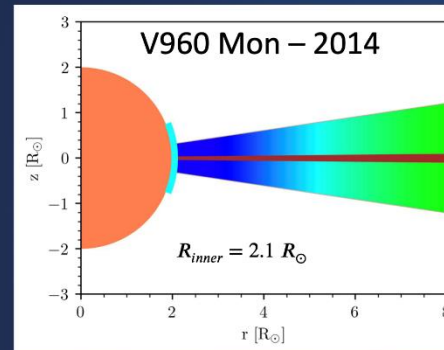
Are observations of inner-disk evolution useful to theorists? Do these provide constraints on trigger mechanisms, or only the accretion physics?

Kospal et al. (2015),
Carvalho et al. (2024b)



Carvalho et al. (2023a)

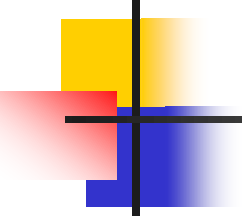
We see the inner radius of V960 Mon receded



And the recession followed the relation $R_{inner} \propto \dot{M}^{-2/7}$

Or do we only care about visible vs MIR outburst time mismatch?

Can submillimeter evolution of the disk in the first few months of the outburst tell us anything?



Is it possible to distinguish between different burst mechanisms
based on observational data?

Vote: YES / NO