High-resolution Accretion Disks of Embedded protoStars (HADES): Accretion flows onto embedded protostars

Brandt A. L. Gaches[1], Jonathan Tan[1,2], Anna L. Rosen[3], Rolf Kuiper[4]

[1] Chalmers University of Technology, [2] University of Virginia, [3] San Diego State University, [4] University of Duisburg-Essen

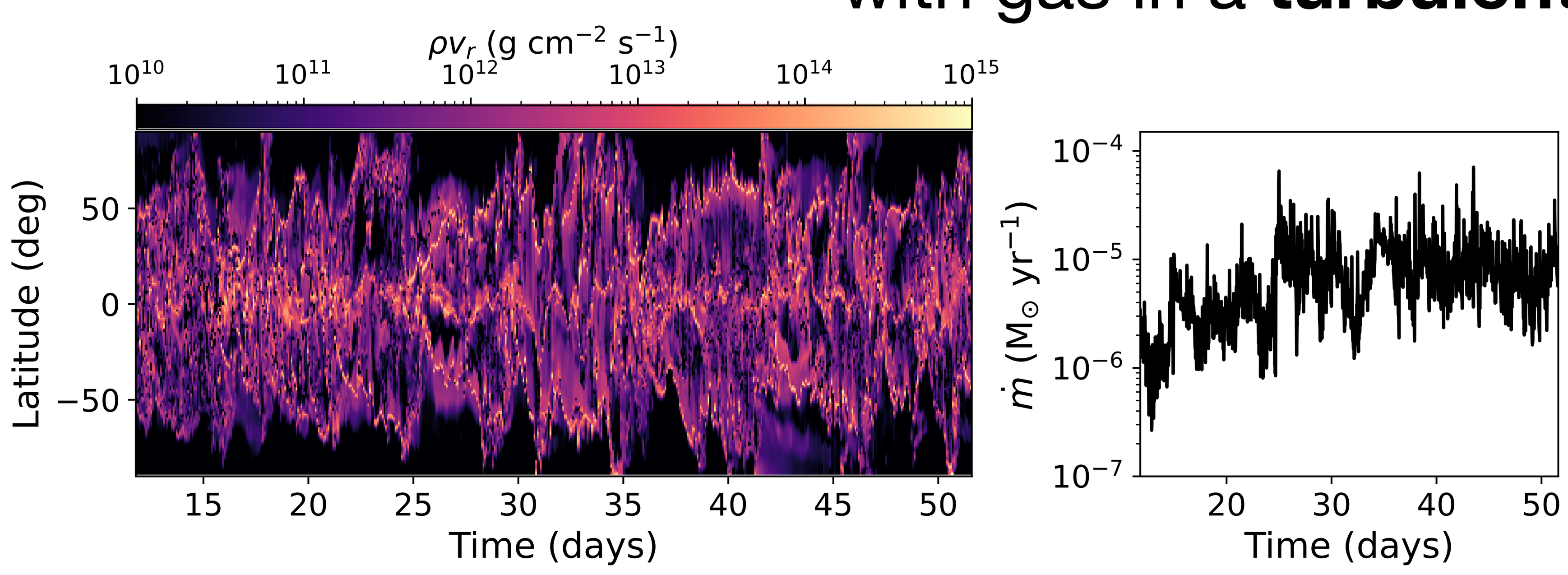
Background

How Class 0/I protostars accrete their mass is still debated. There are two main extremes of accretion, **magnetospheric accretion**, where gas flows from a truncated disk along magnetic flux tubes, and **boundary layer accretion**, when the surrounding disk directly impacts the protostar surface. High-resolution accretion simulations have typically focused on Class II systems, with low accretion rates and small disk masses. We introduce a suite of high-resolution simulations to **investigate accretion onto a solar mass protostar.**

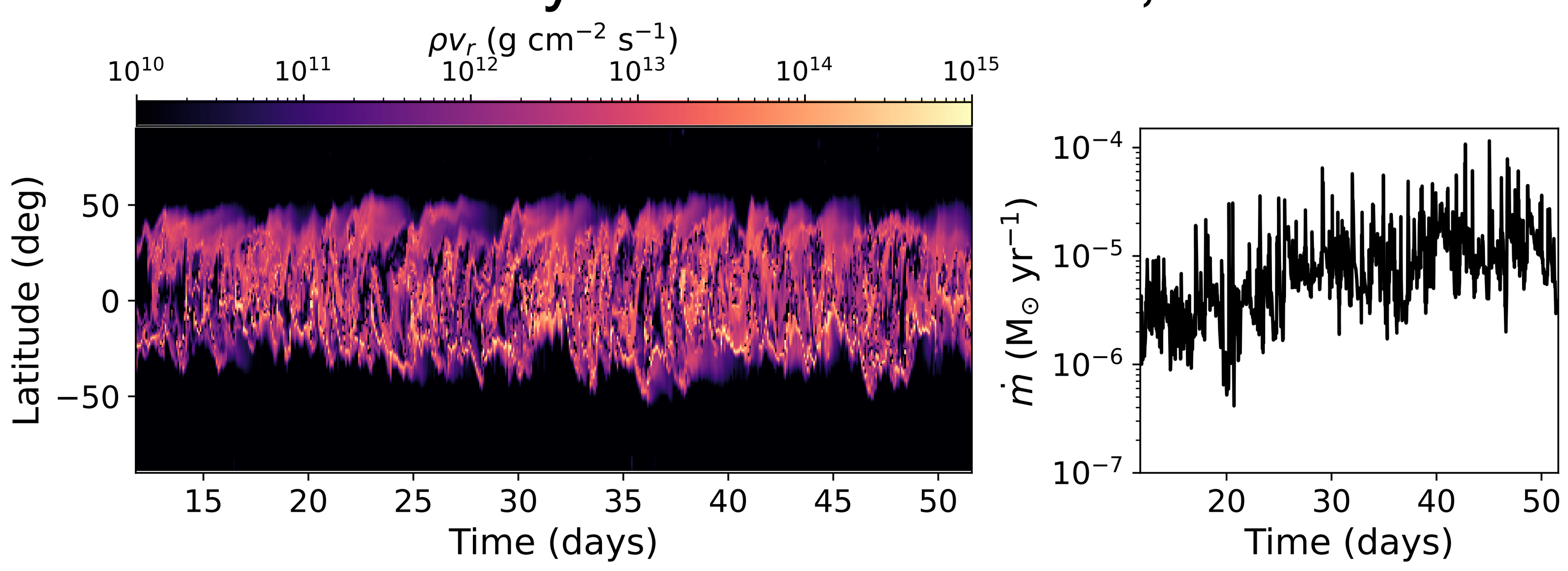
Take Away

Ultimately, the **magnetic field plays a dominant role** in the underlying accretion mechanism, similar to T-Tauri protostars. Regardless of the underlying mechanism there is **substantial amount of turbulence in the accretion flow**, resulting in a short bursts of high accretion and unstable accretion flows. For **moderately magnetised protostars,** the magnetically dominated cavity focuses and enhances accretion. For marginally or unmagnetised protostars, the accretion is highly variable, while for **kG-strength fields, magnetospheric accretion with periodic pulses occurs**.

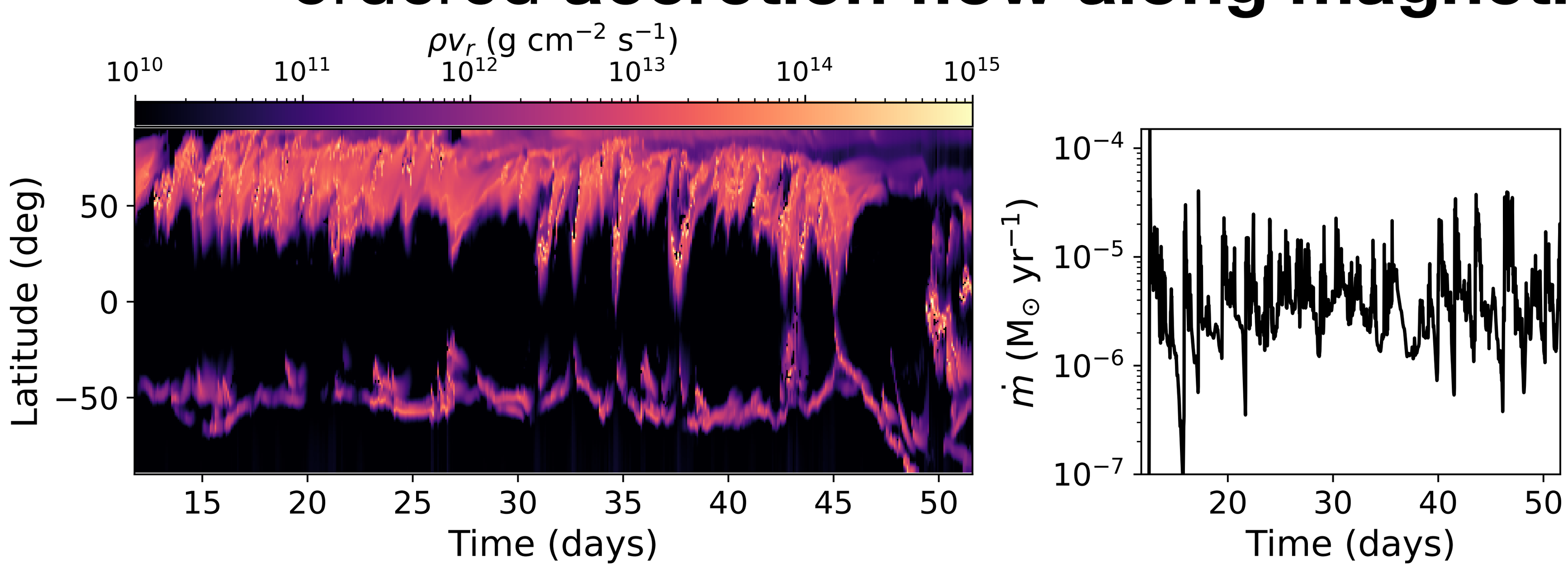
With no protostellar field, **gas flows uninhibited** to the surface, bombarding the protostar with gas in a **turbulent, highly variable flow.**

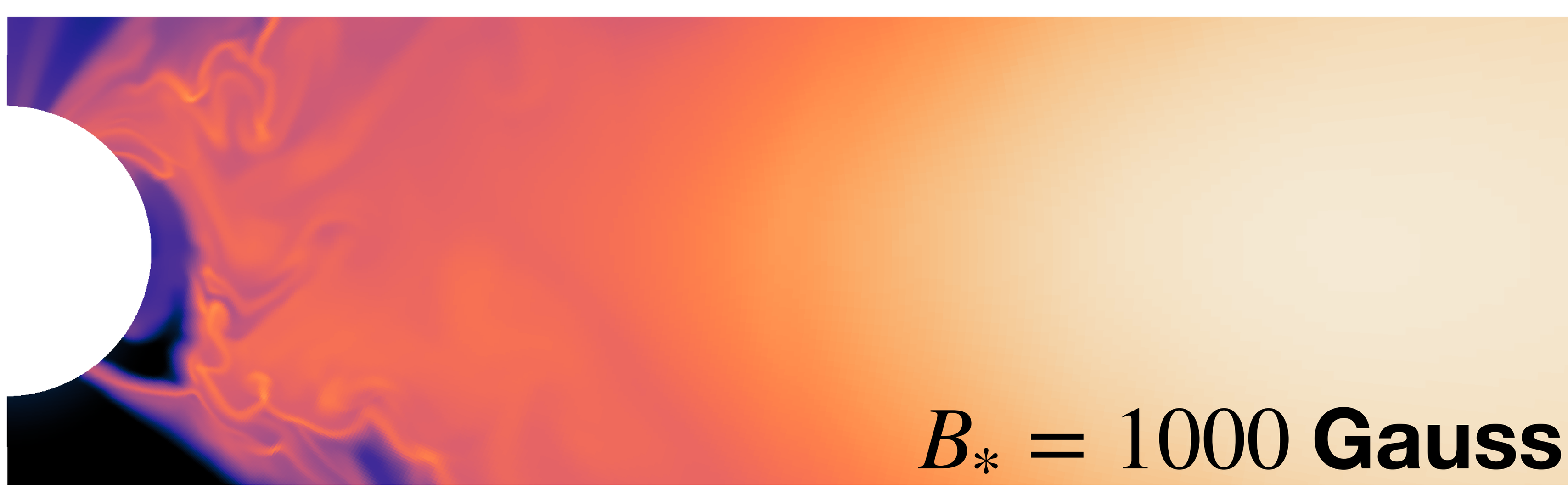


A moderate protostellar field produces a **strongly magnetically dominated outflow**. This cannot readily truncate the flow, but it **focuses and modulates it, enhancing accretion.**



For strong kG-strength fields, the **gas flow is finally truncated**. This leads to a modulated, ordered **accretion flow along magnetic flux tubes**, akin to classical T-Tauri stars.





Methods: The simulations are performed with the PLUTO MHD code in 2.5D spherical coordinates. The simulation includes optically thin atomic line cooling, X-ray heating, Ohmic dissipation, the Hall effect and viscosity. The protostar has a constant dipole magnetic field and the disk is threaded by a field with $\beta = 10^5$ at 1 AU initially.

If you're interested, come find me!

Accretion physics coming in **Gaches** et al. 2024 (in prep). Outflow properties coming in Chowdhury, **Gaches**, et al. 2024 (in prep).

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