Core Accretion in MHD Simulations of Layered Protoplanetary Discs

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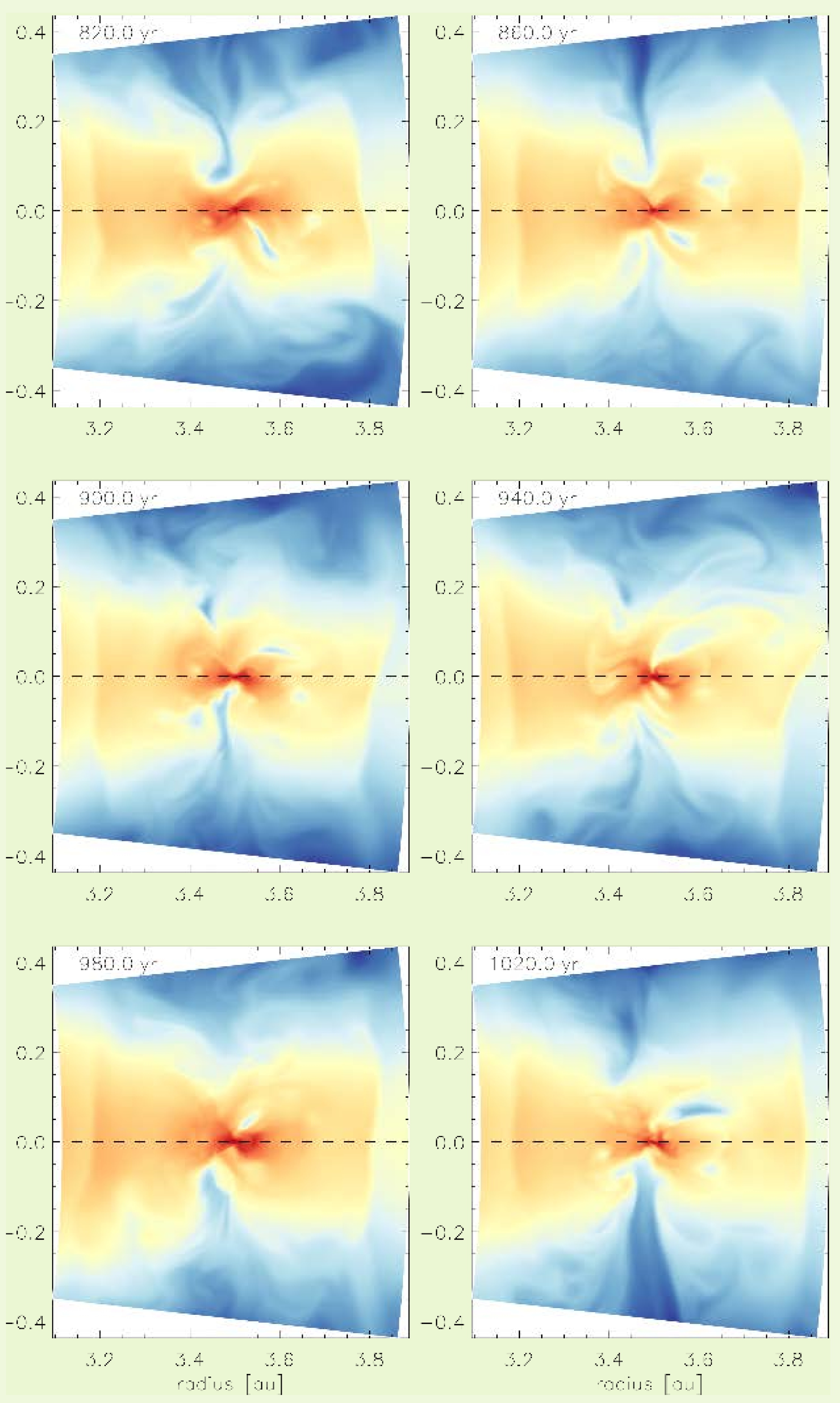
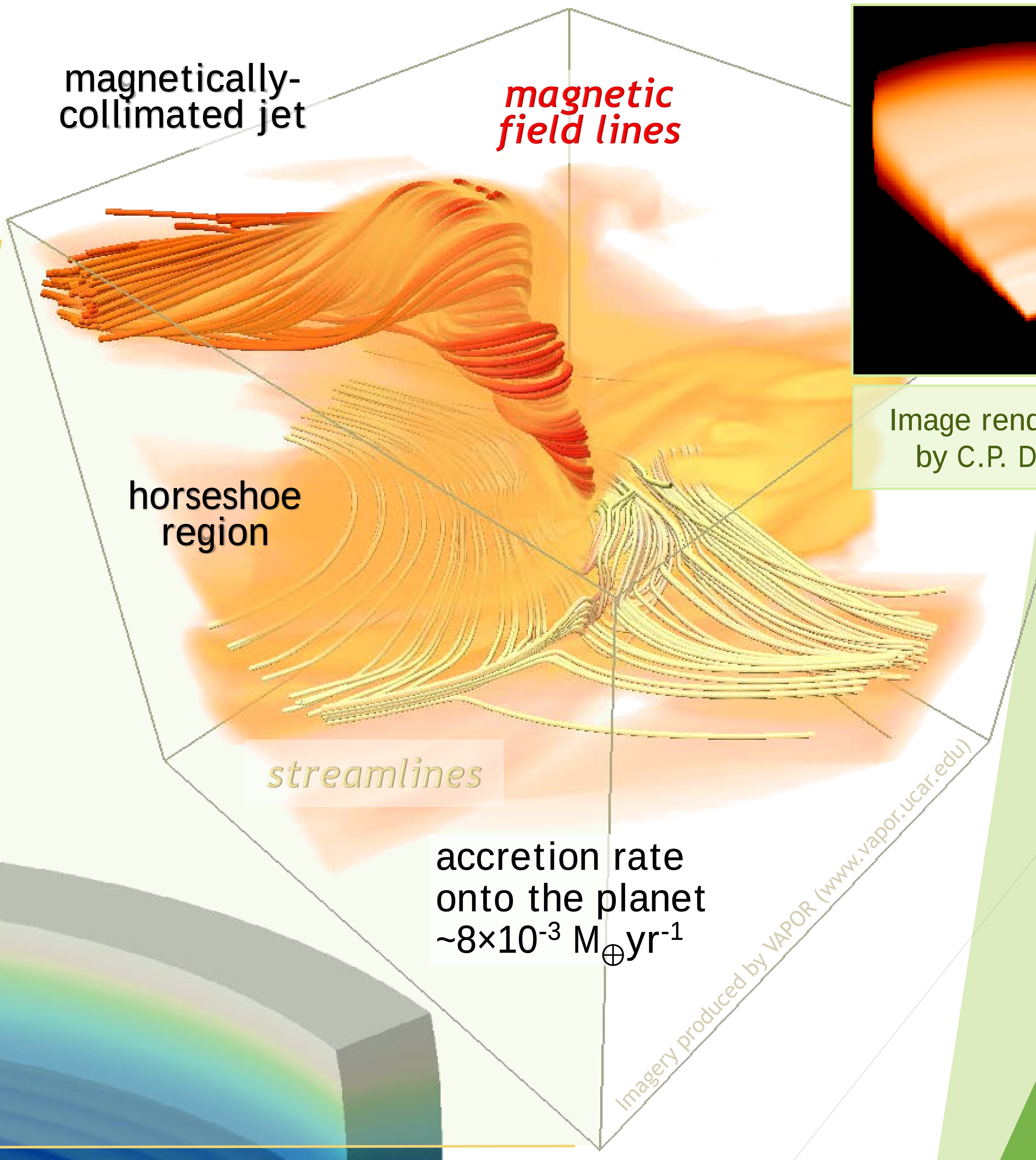
We perform magneto-hydrodynamic (MHD) simulations of a protoplanetary disc (PPD) section with an embedded planet core/protoplanet. The disc model assumes a self-consistent and dynamically evolving Ohmic resistivity, which is derived from a sophisticated ionisation model. Before the insertion of the core, the resulting configuration consists of a magnetically inactive dead zone and turbulent surface layers. When the embedded protoplanet of initially 100 earth masses has opened a gap in the disc, we study the ionisation structure and turbulent state of this region, including the circum-planetary disc (CPD), which has formed around the protoplanet. By determining accretion rates and analysing the flow structure in the vicinity of the planet, we address the important question of what limits the growth of gas giant planets in the classic core-accretion picture. In agreement with previous 3D hydrodynamic simulations, we find that the accretion flow is genuinely three-dimensional. This implies that the CPD does not serve as a conduit for the mass-transfer onto the planet.

***Get the full picture*: Gressel et al. (2013) ApJ 779:59 (22pp, 20 fig)**



Time sequence of edge-on slices of the gas density illustrating the stochastic, heavily time-varying nature of the CPD. While the low-density, tornado-like structures are all associated with inflow, the funnel seen in the lower half of the last panel is in fact a collimated outflow (see large picture).



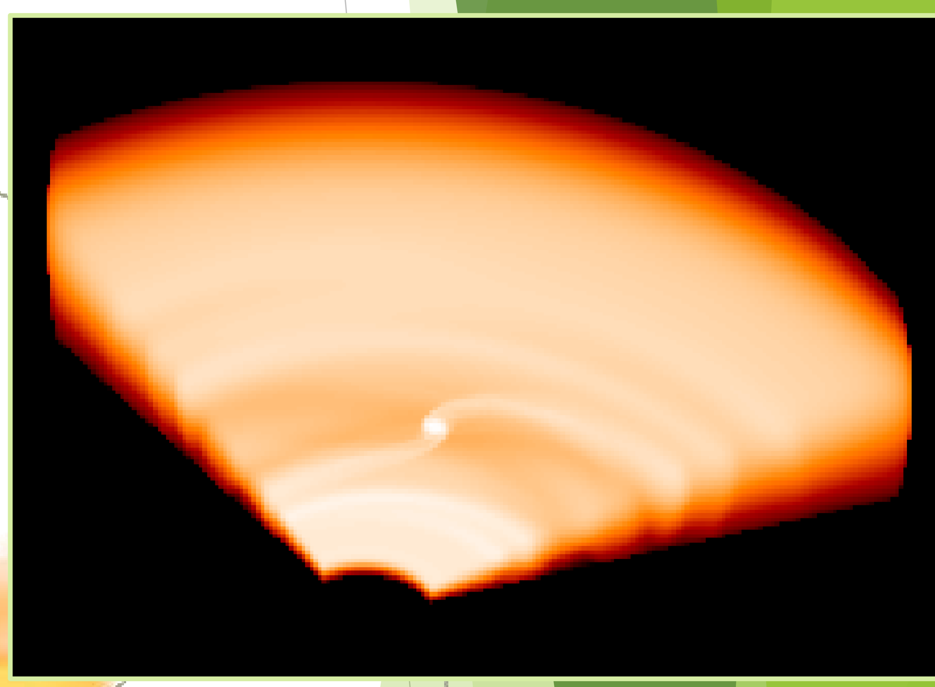
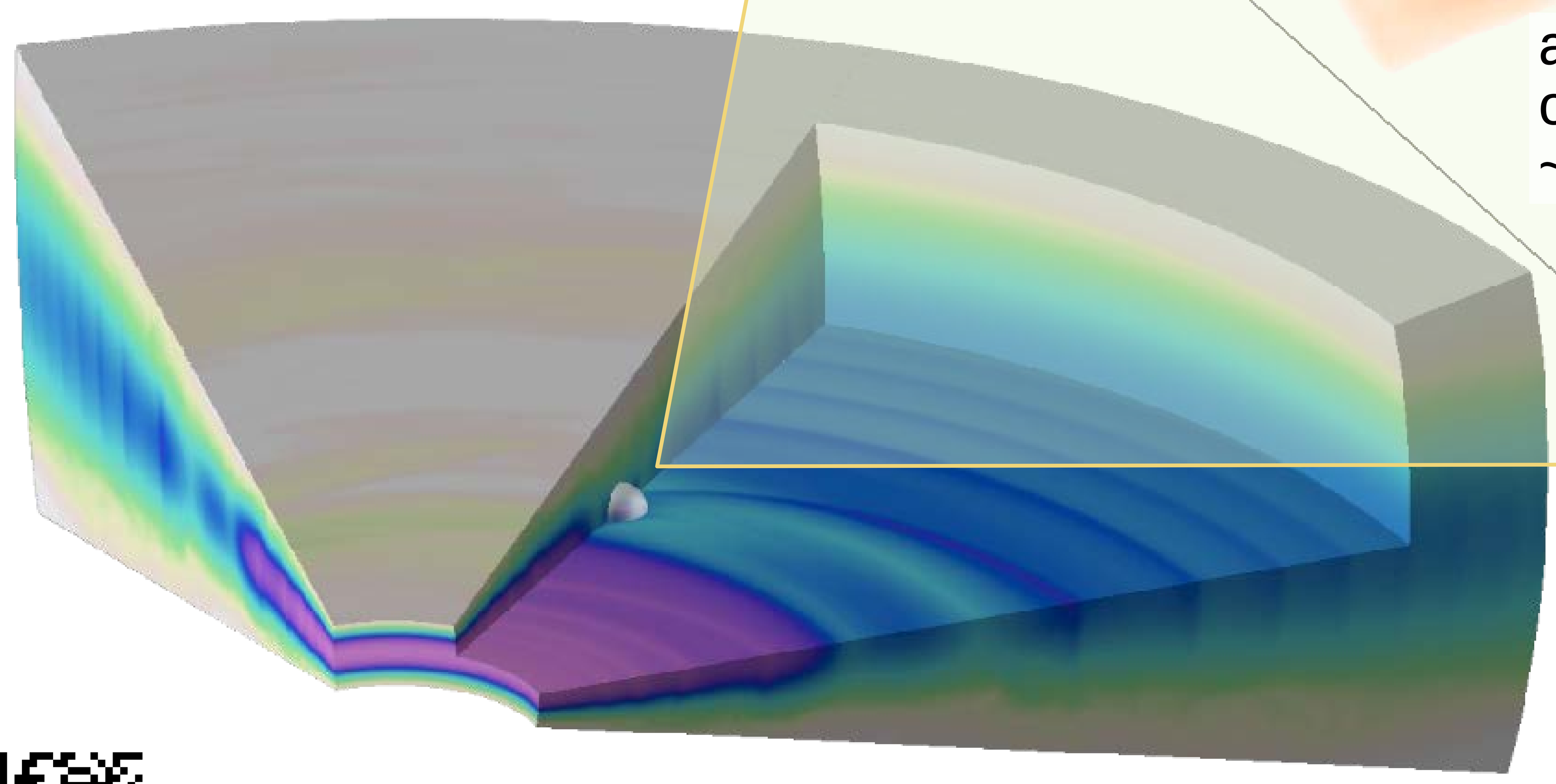


Image rendered using RADMC-3D by C.P. Dullemond (ZAH/ITA)



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