

HUNT the Disk Water Snowline with 2D Hydrodynamic Simulations



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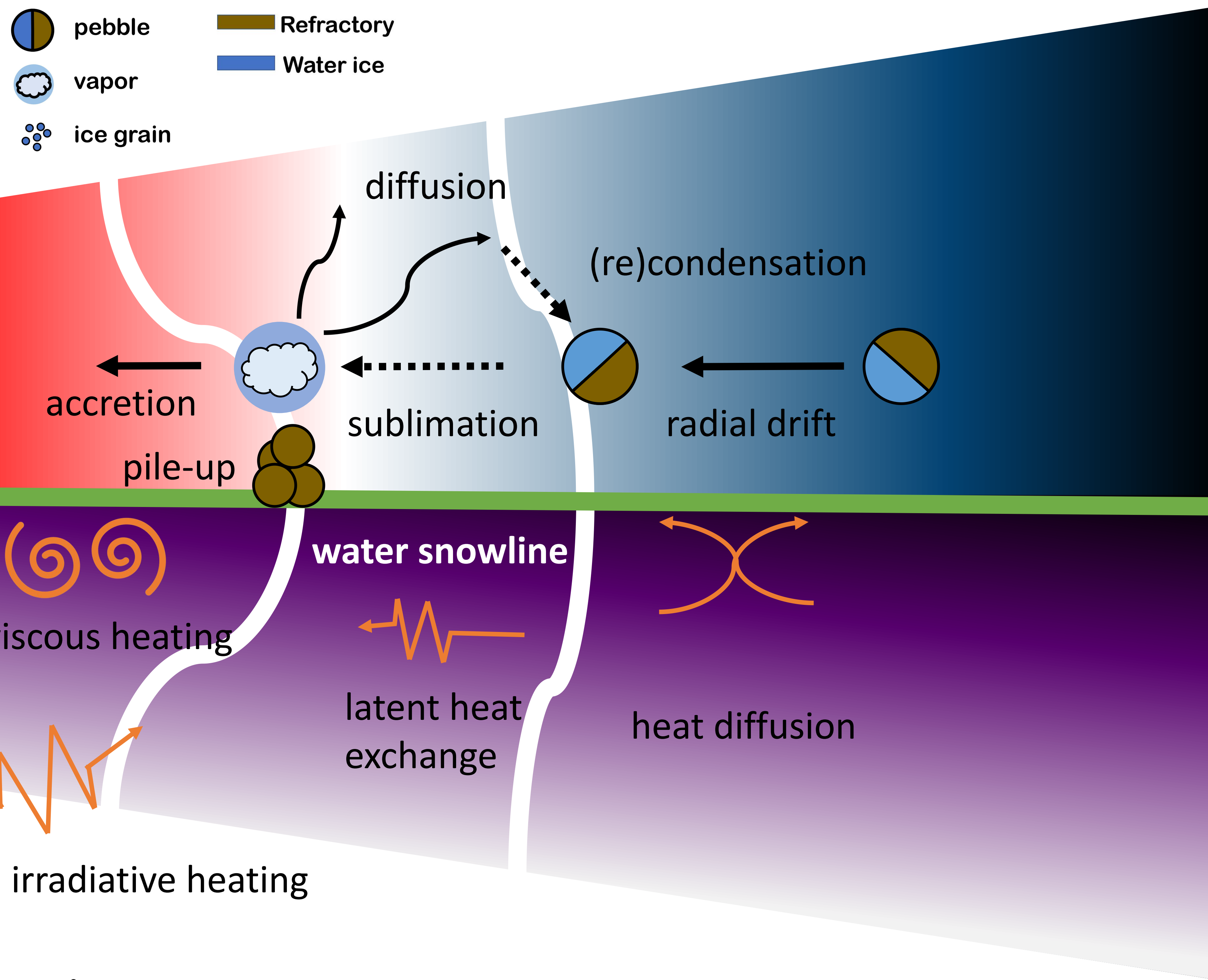
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Model:



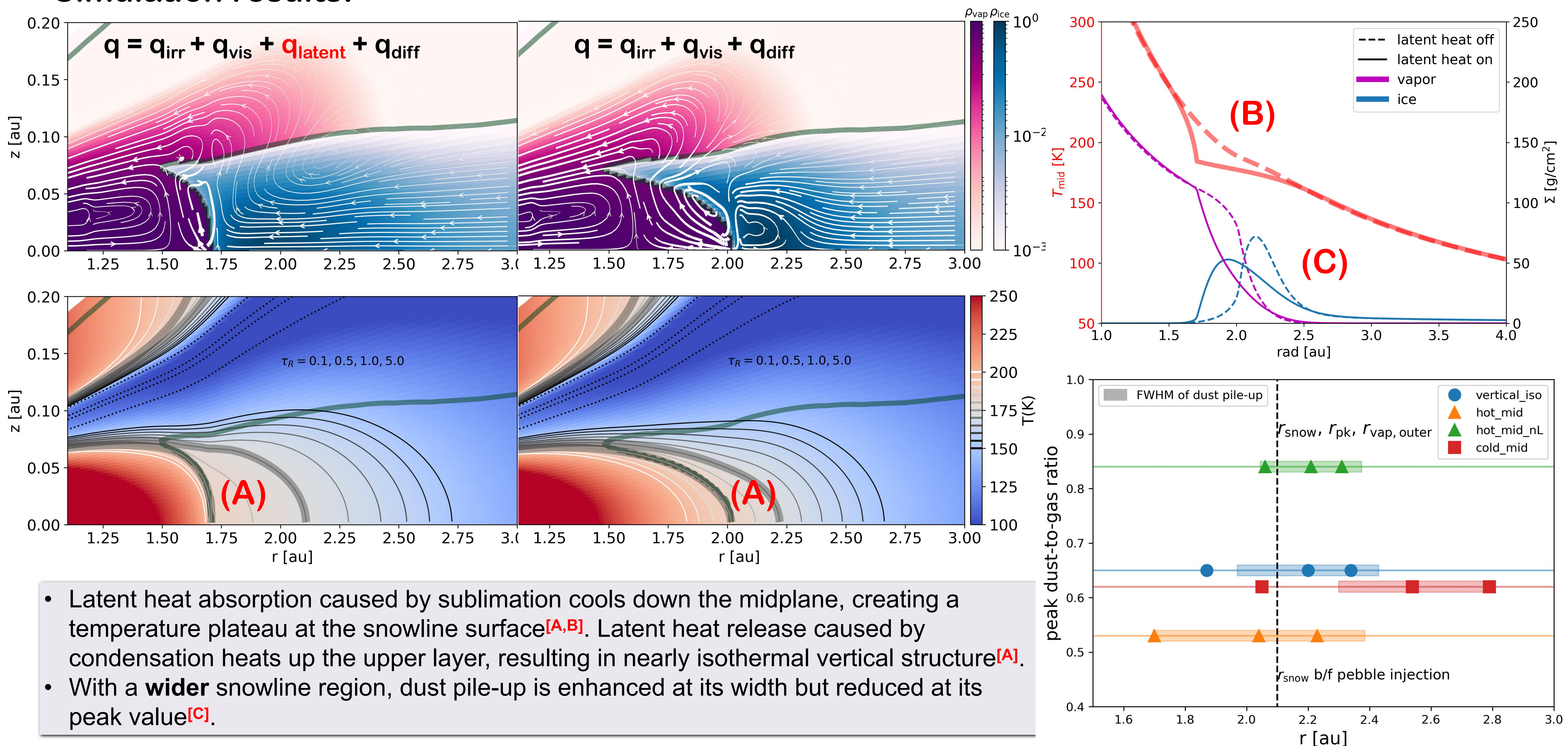
Motivation:

- **Snowline is 2D!**
- Water snowline is a promising place for **planetesimal formation** by enhancing dust-to-gas ratio with aerodynamic pile-up or vapor outward diffusion.
- The sublimation and recondensation of water (latent heat exchange) itself alter the thermal structure of the snowline.

Method:

- We conduct 2D multifluid hydrodynamics in the disk's R-Z plane with an advanced phase change module in Athena++ (Wang+2023).
- We adopt a 1+1D radiation transfer method to determine the T-structure, accounting for irradiative heating, viscous heating, latent heat exchange and radial diffusion. (Mori+2019)

Simulation results:



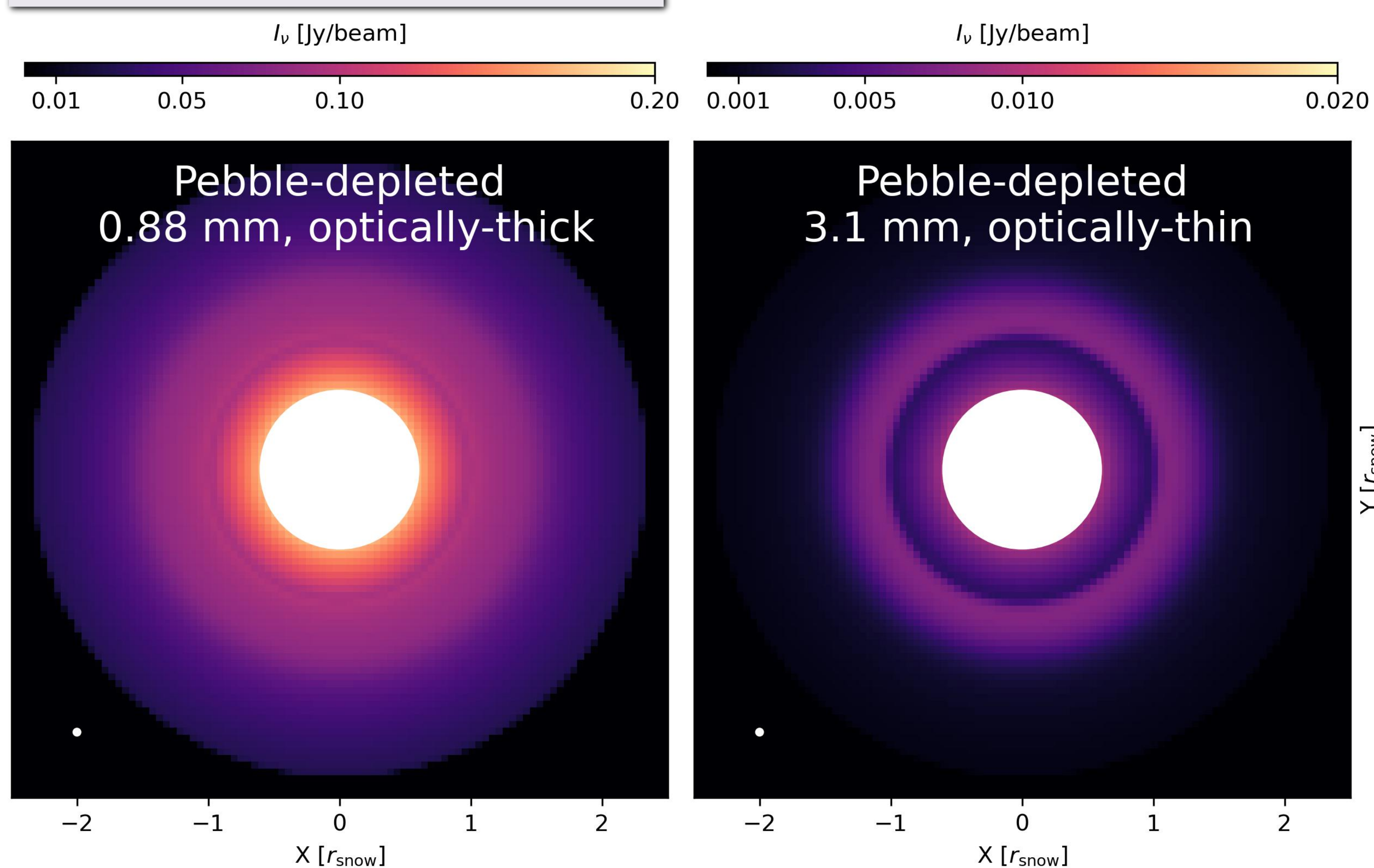
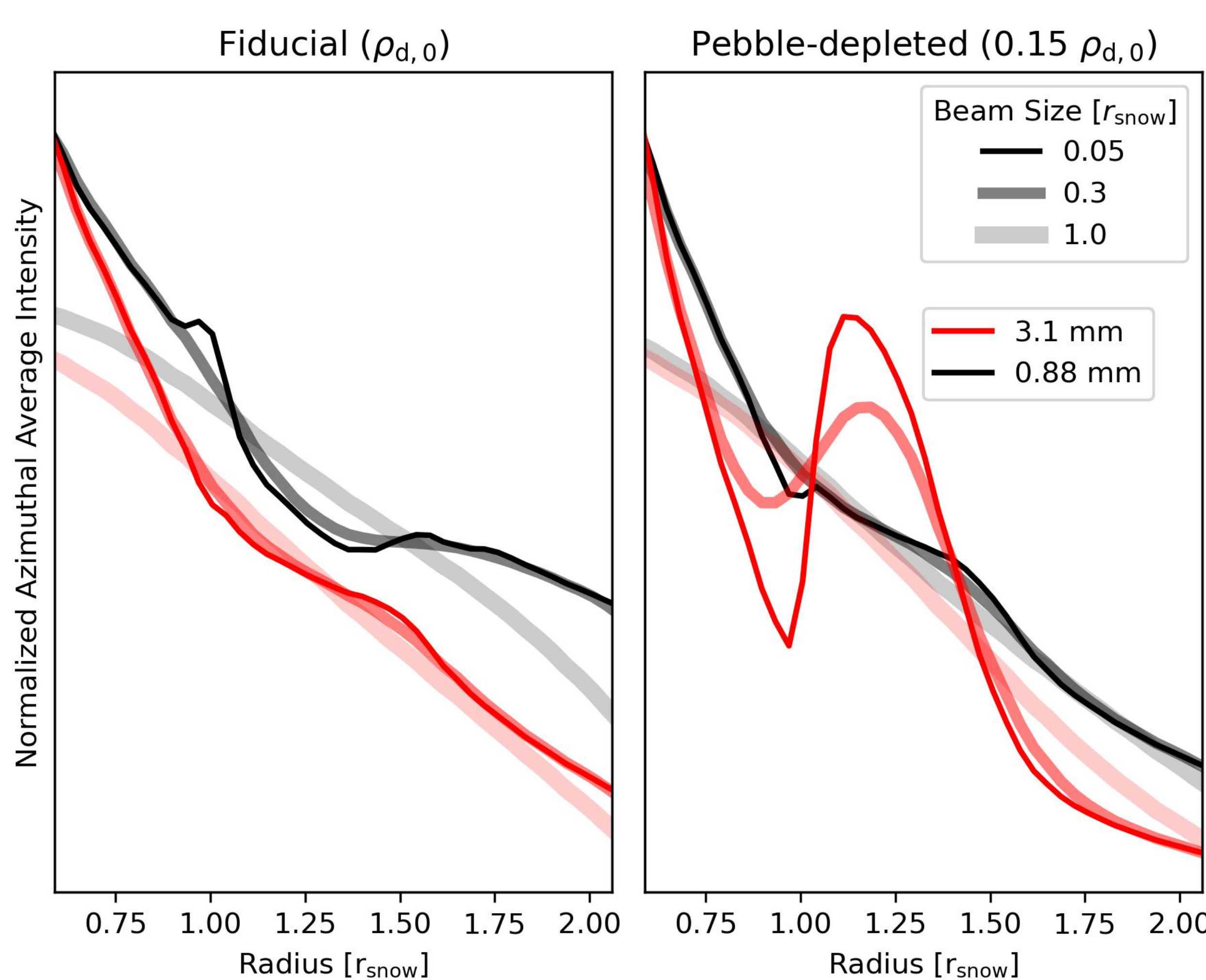
- Latent heat absorption caused by sublimation cools down the midplane, creating a temperature plateau at the snowline surface [A,B]. Latent heat release caused by condensation heats up the upper layer, resulting in nearly isothermal vertical structure [A].
- With a **wider** snowline region, dust pile-up is enhanced at its width but reduced at its peak value [C].

Synthetic images:

Different “looks” at multiple bands are available to distinguish a snowline:

Intensity plateau following the temperature.

Ring appears!



HUNT water snowline in outburst systems! 🌟

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