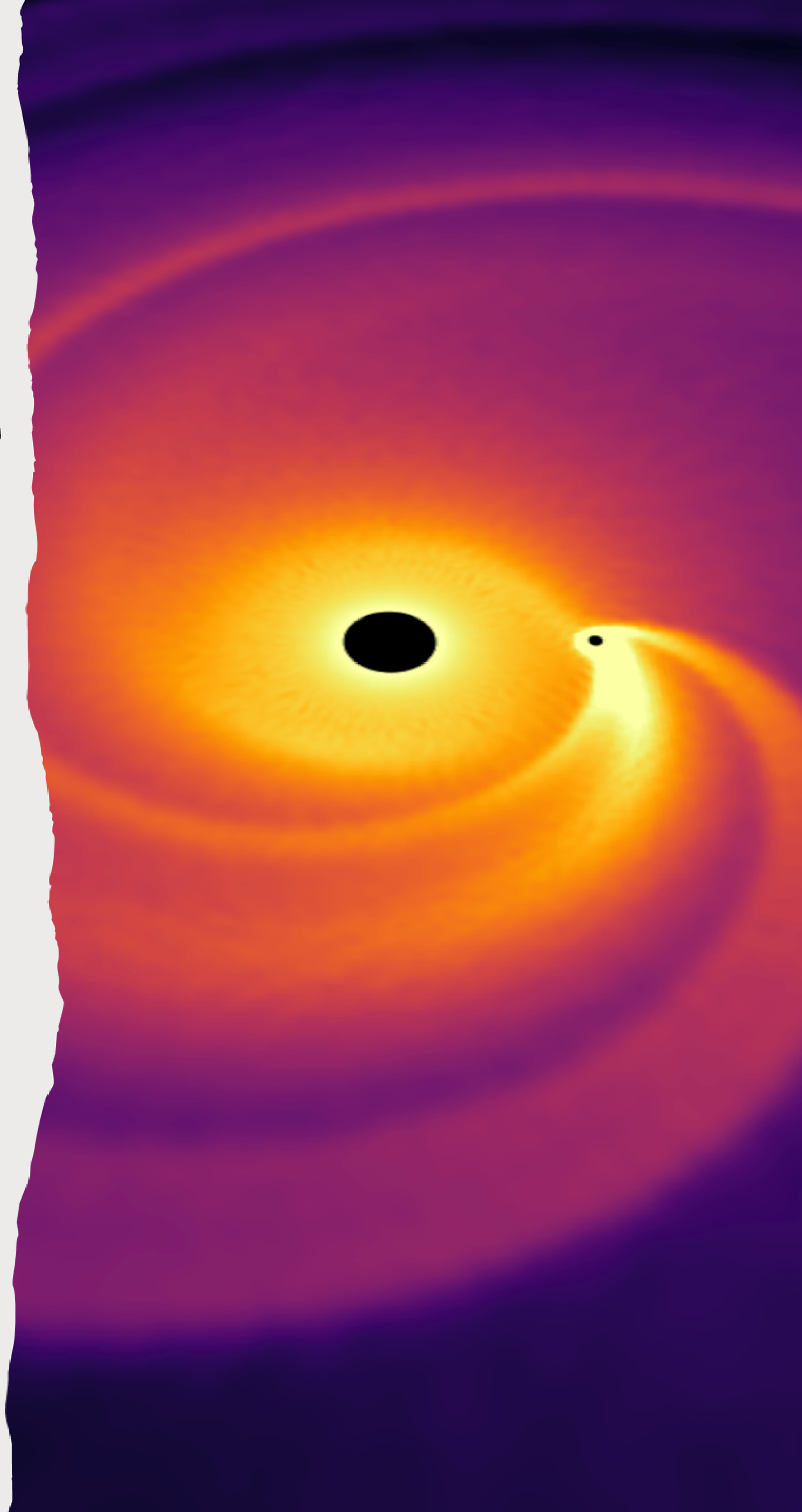
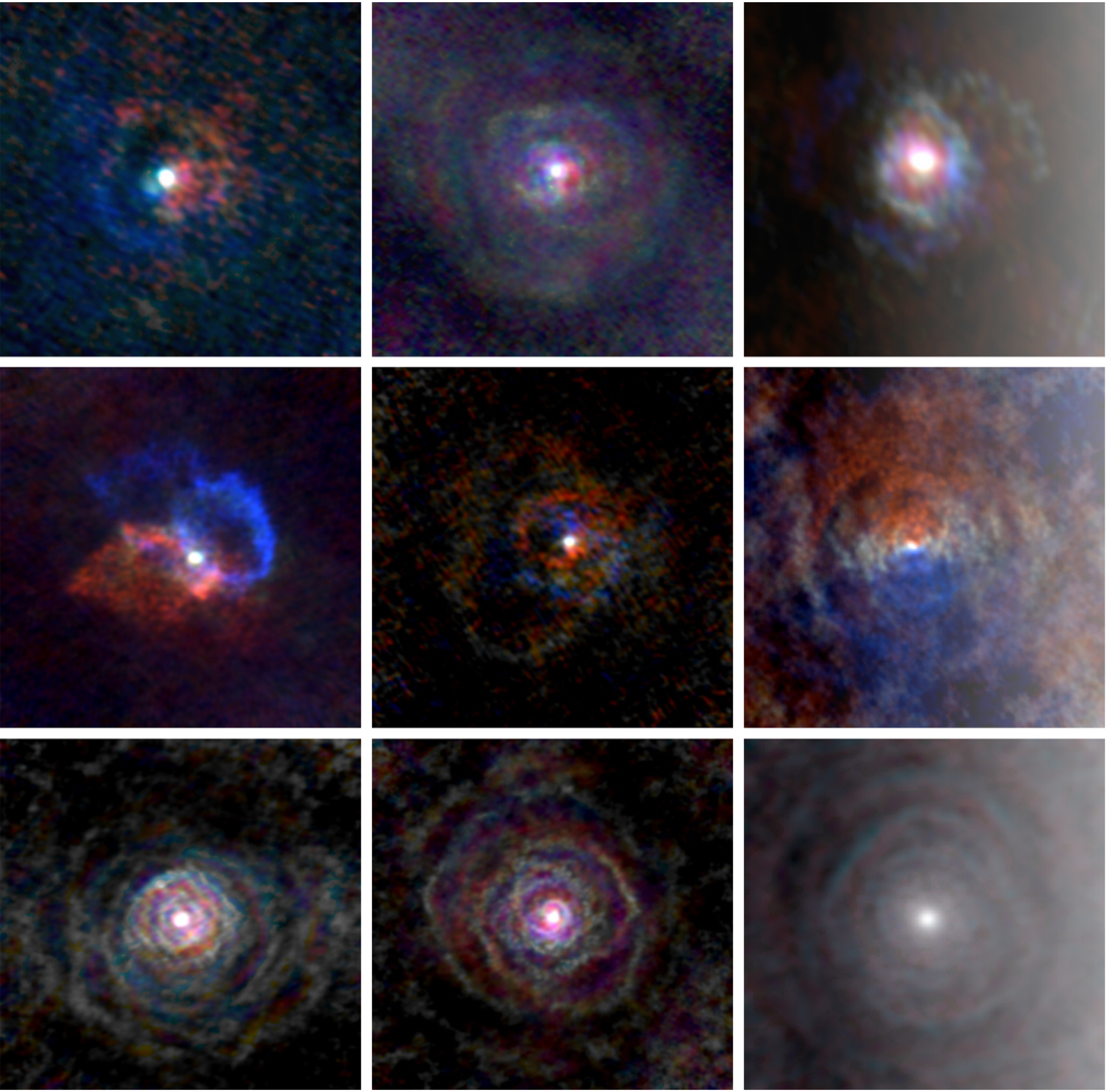
Impact of different radiative transfer prescriptions on the morphological structures of AGB outflows

- **Mats Esseldeurs**
- 1st year PhD student
- Supervisor: Leen Decin
- mats.esseldeurs@kuleuven.be





Goal

- Unravel impact of companion on wind structures and dynamics
- Get better understanding of observations through simulations

Hydrodynamic setup

- 3D Smoothed Particle Hydrodynamics (SPH)
- Phantom by Price et al. (2018)

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Astronomy & Astrophysics

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BIPOLAR PRE–PLANETARY NEBULAE: HYDRODYNAMICS OF DUSTY WINDS IN BINARY SYSTEMS. II. MORPHOLOGY OF THE CIRCUMSTELLAR ENVELOPES

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Wind accretion in binary stars – I. Intricacies of the flow structure

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Slowly, slowly in the wind

3D hydrodynamical simulations of wind mass transfer and angular-momentum loss in AGB binary systems

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3D models of the circumstellar environments of evolved stars: Formation of multiple spiral structures

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Formation of the Asymmetric Accretion Disk from Stellar Wind Accretion in an S-type Symbiotic Star

Young-Min Lee[1,2], Hyosun Kim[3], and Hee-Won Lee[1]
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CrossMark

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- External accelerations
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Parameter	Value	Unit
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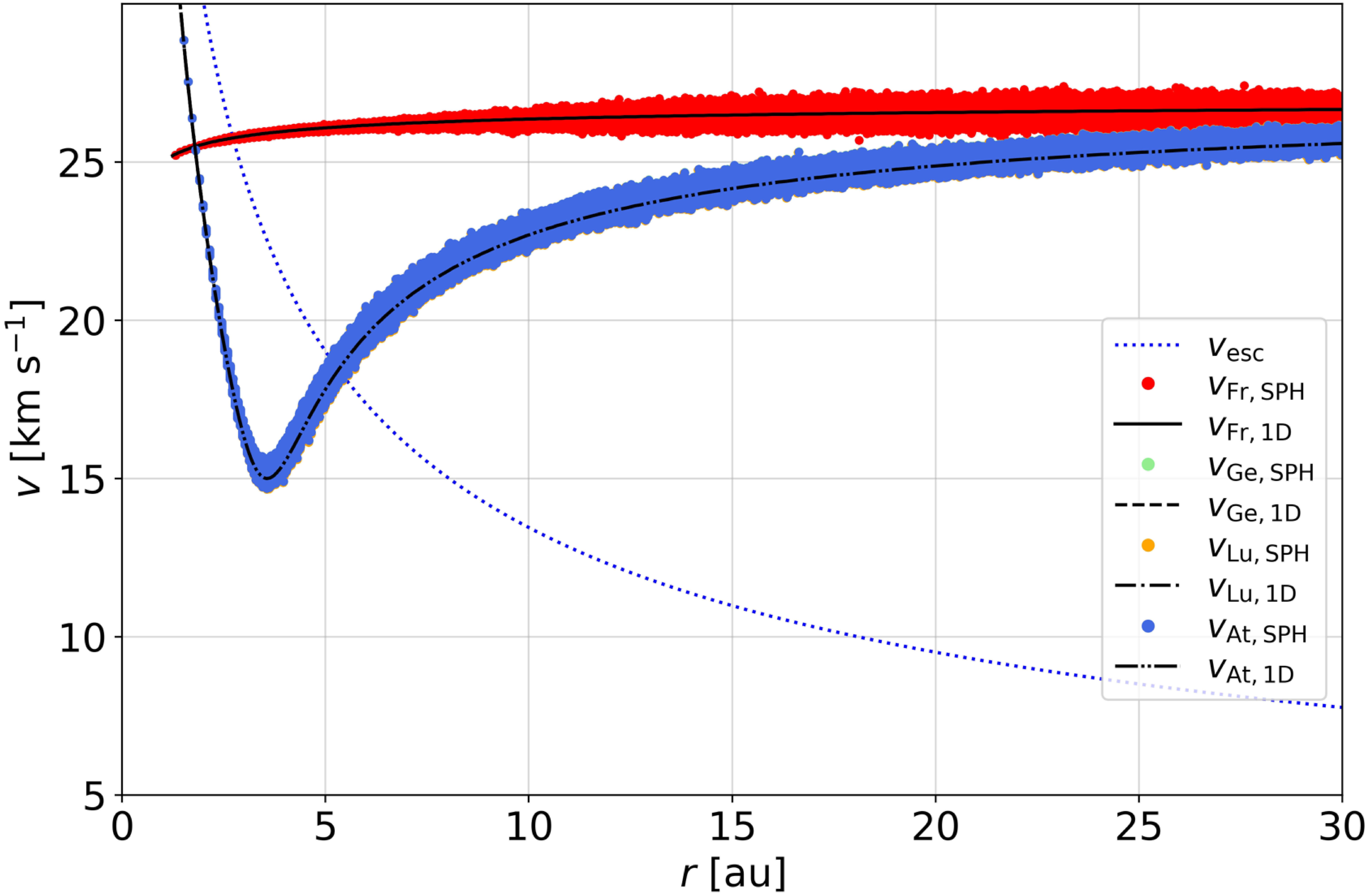

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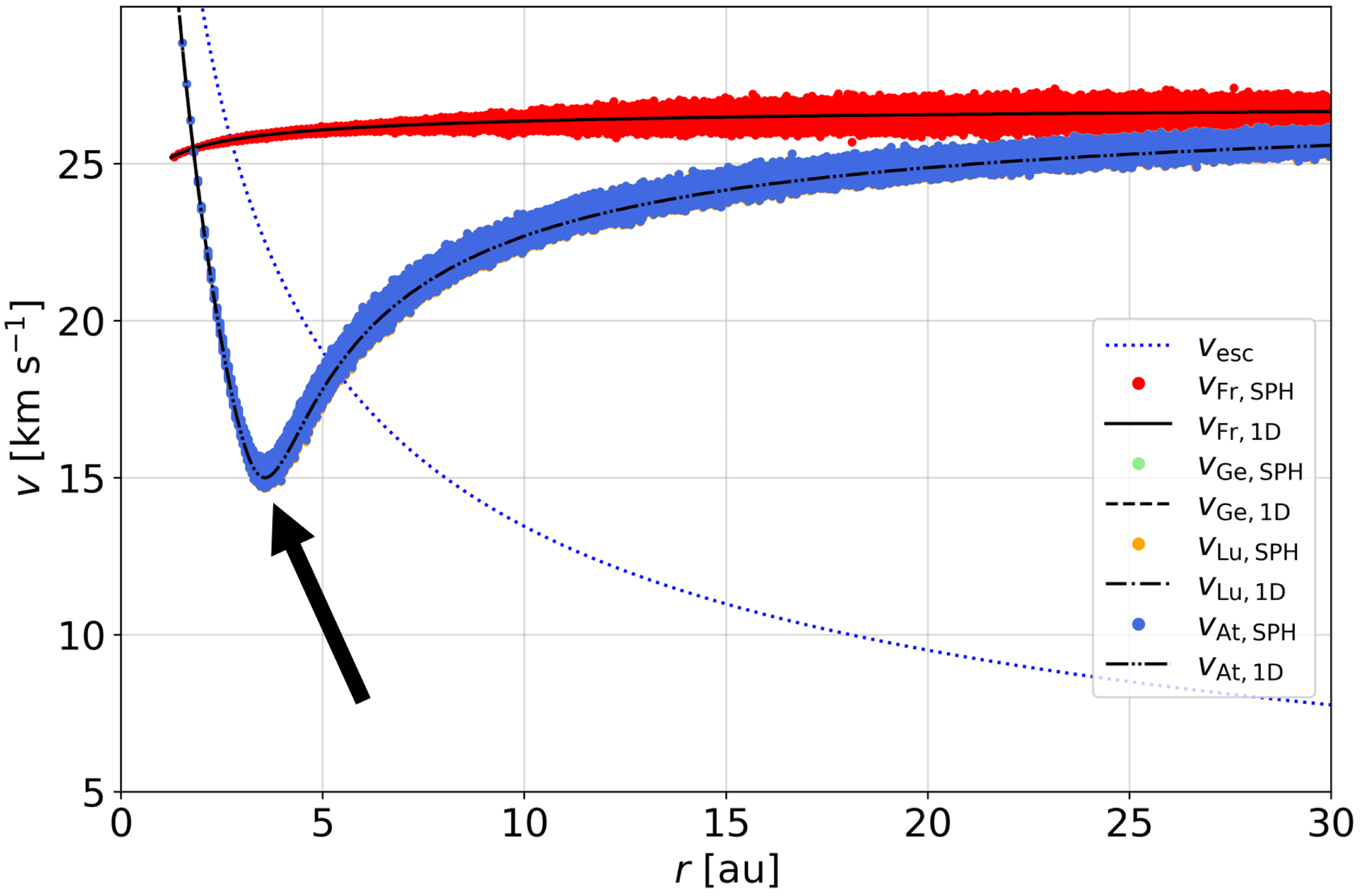

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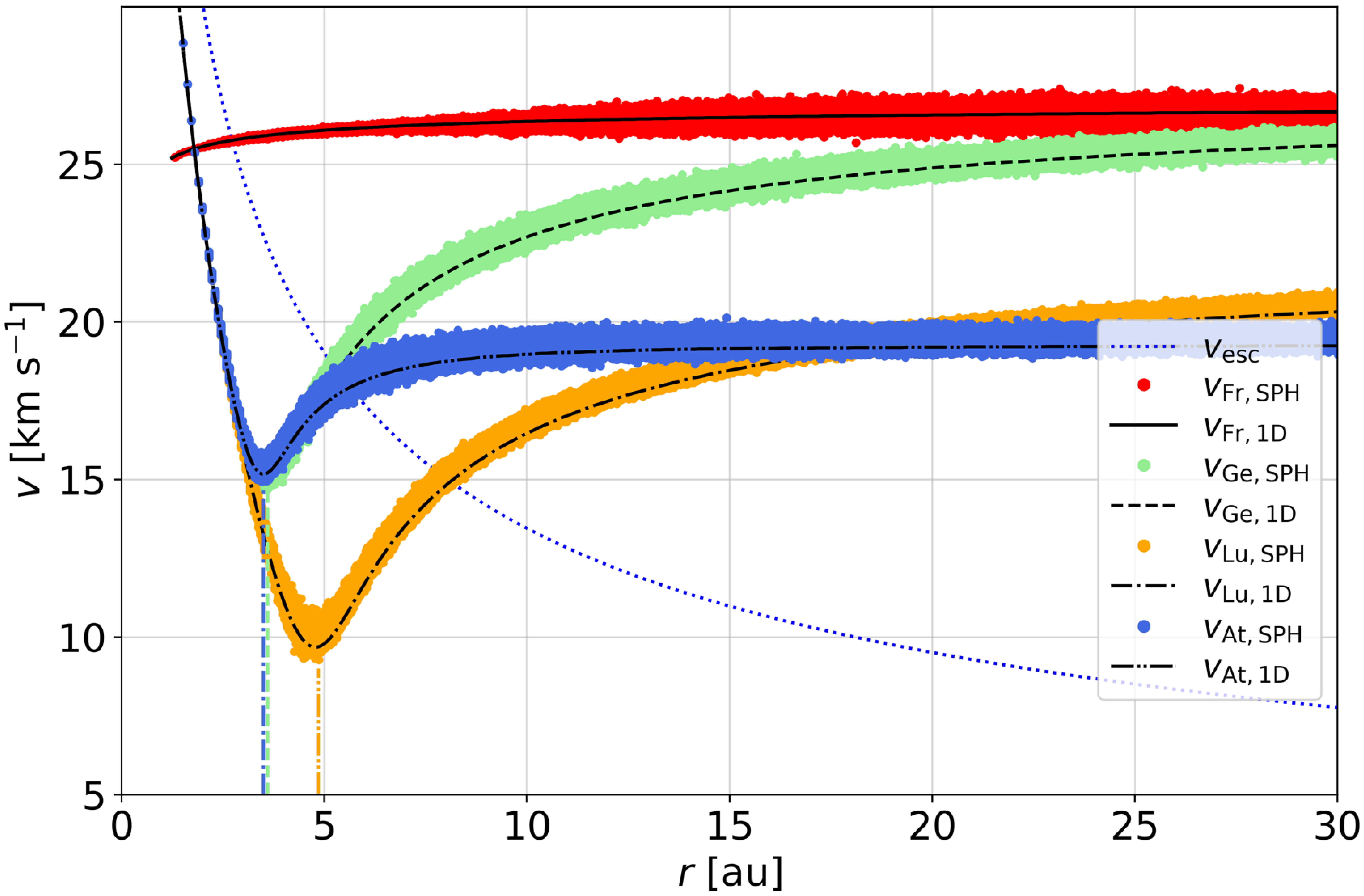

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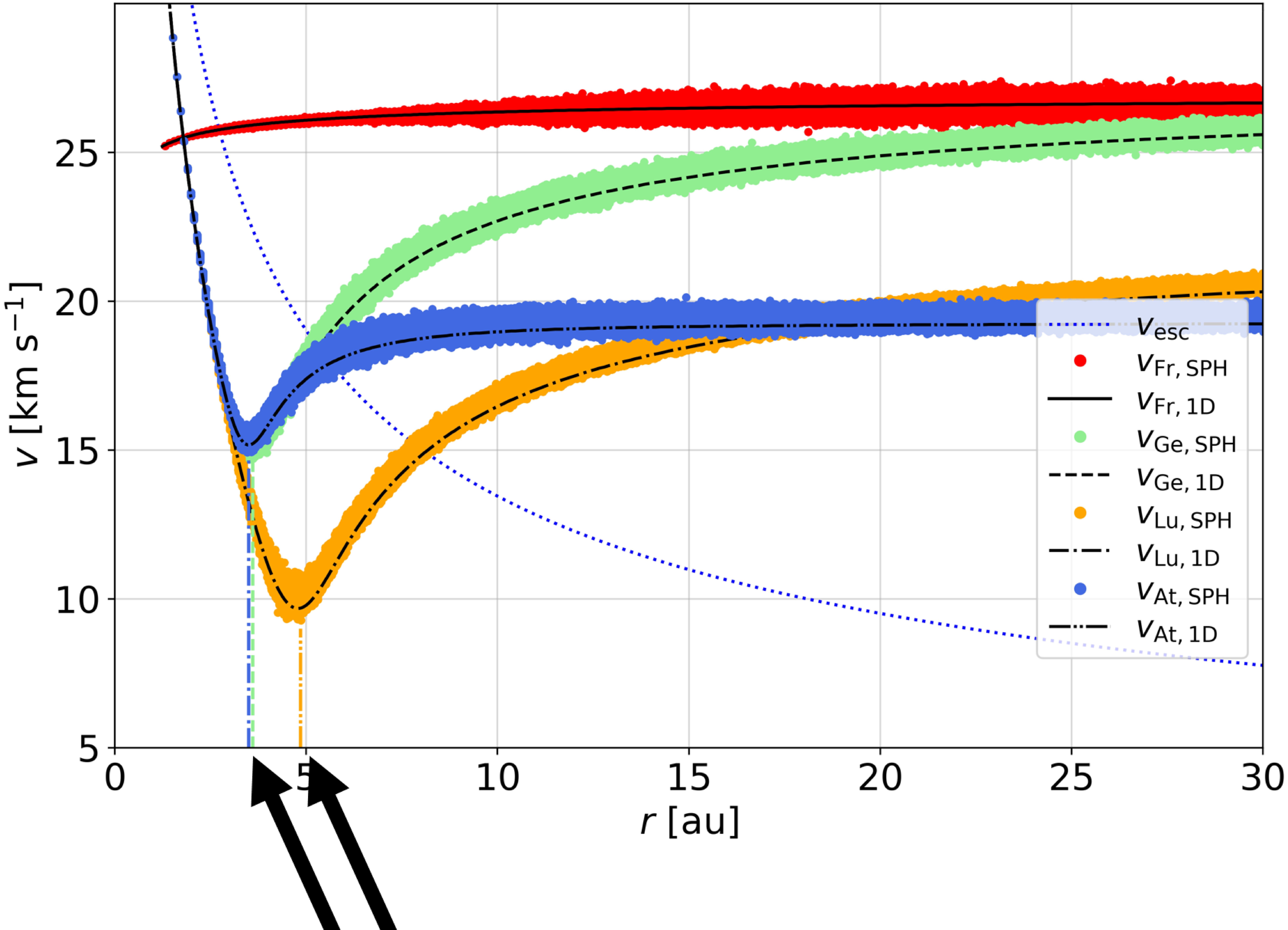

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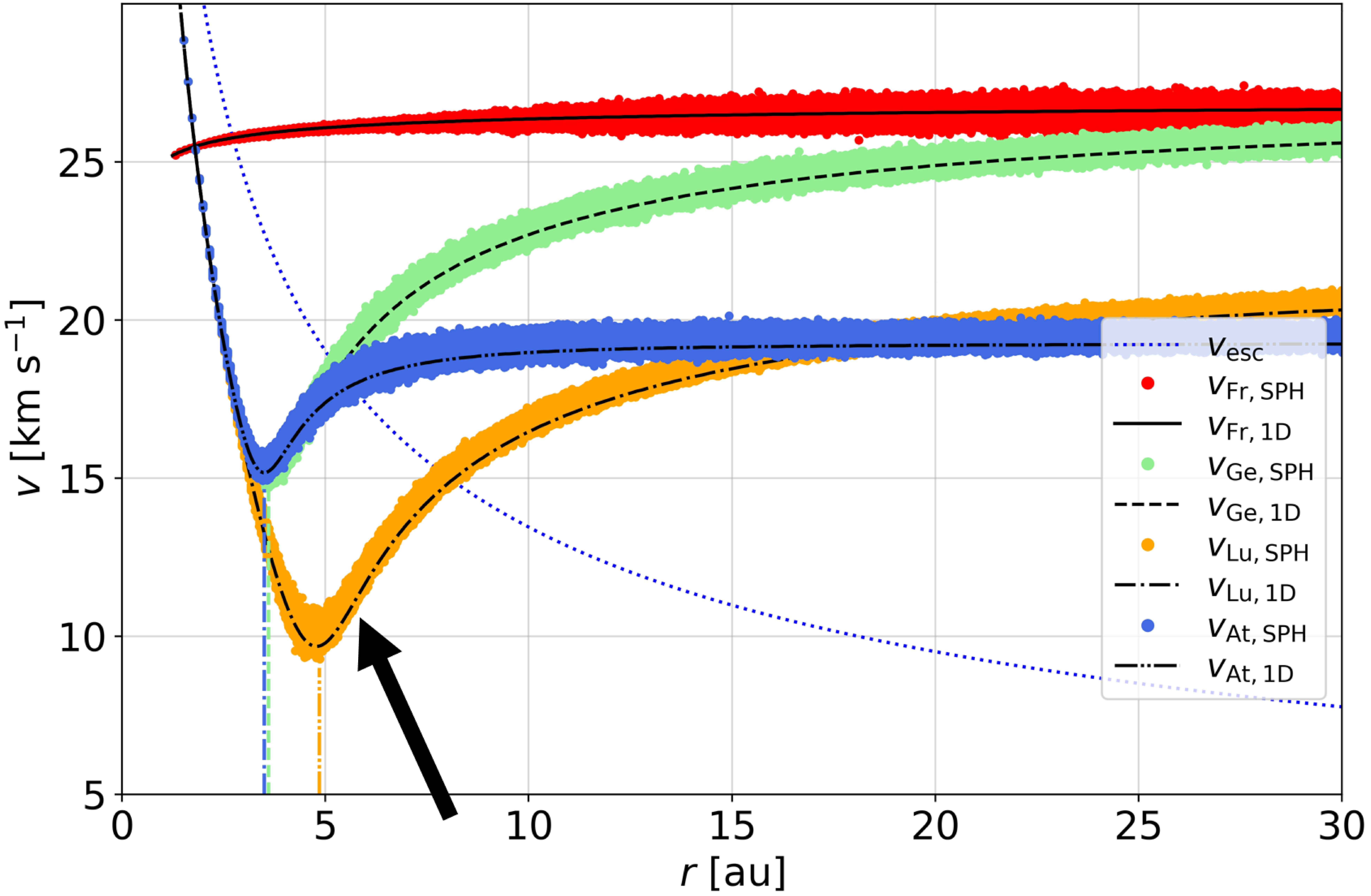

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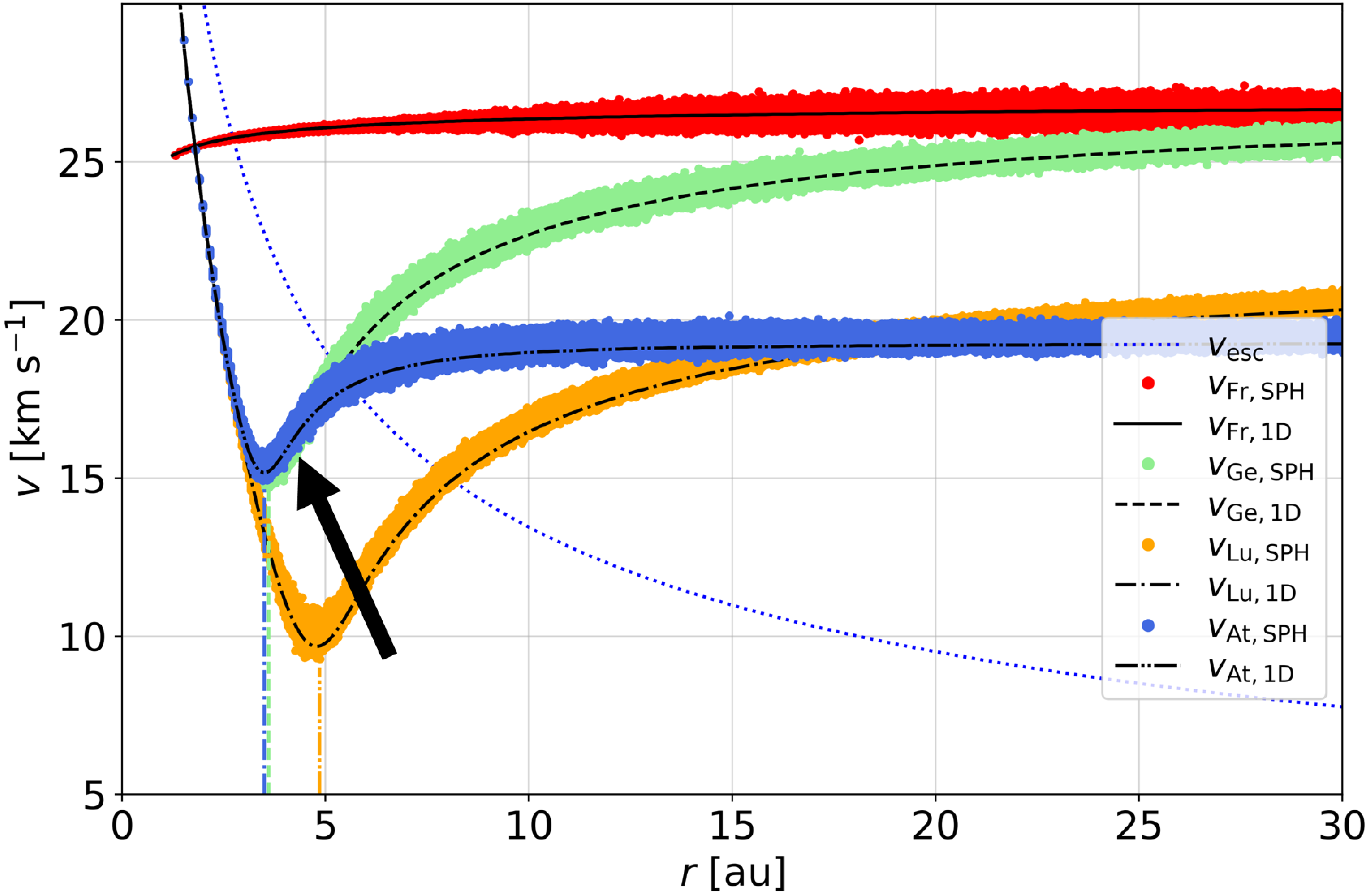

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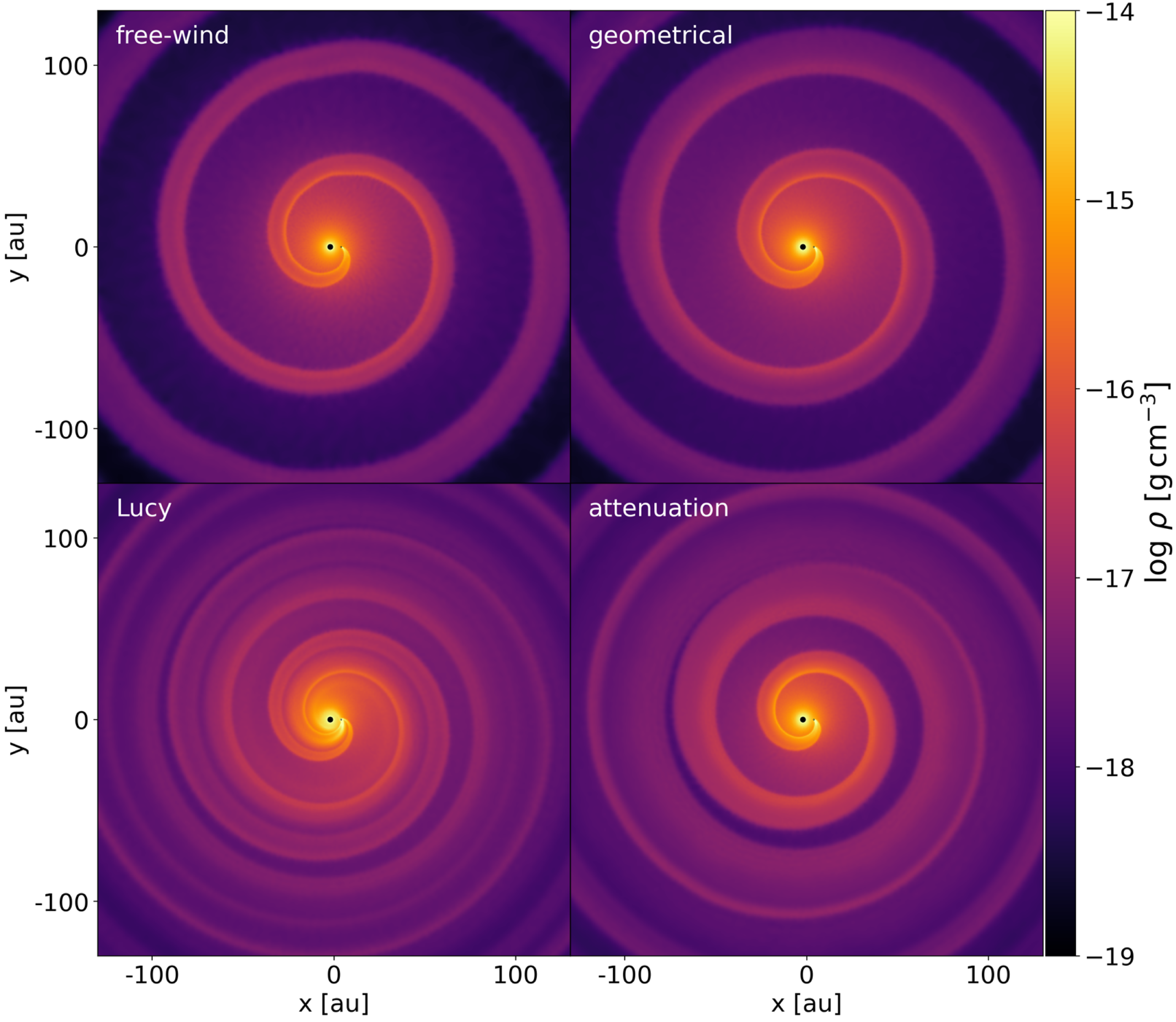

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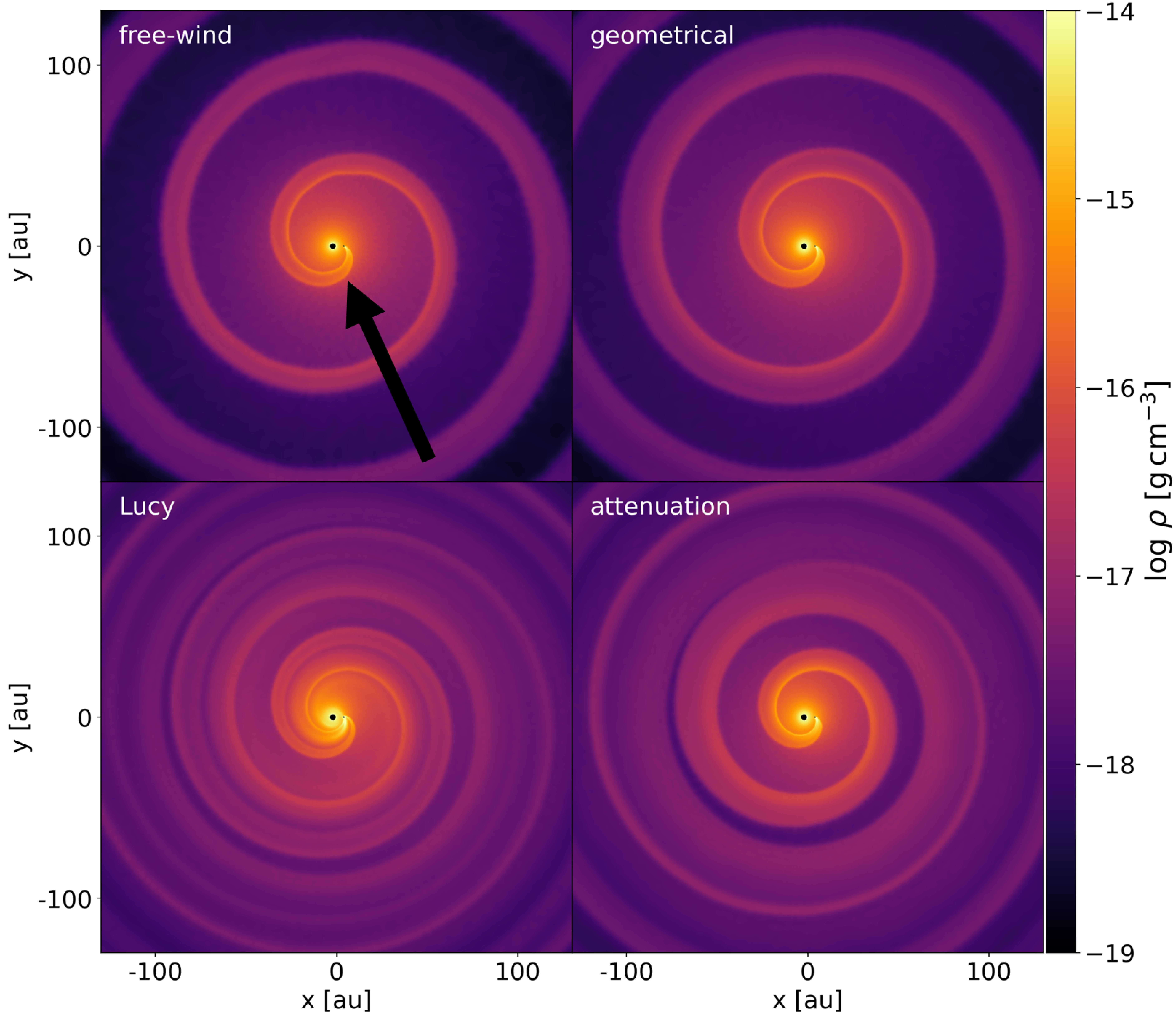

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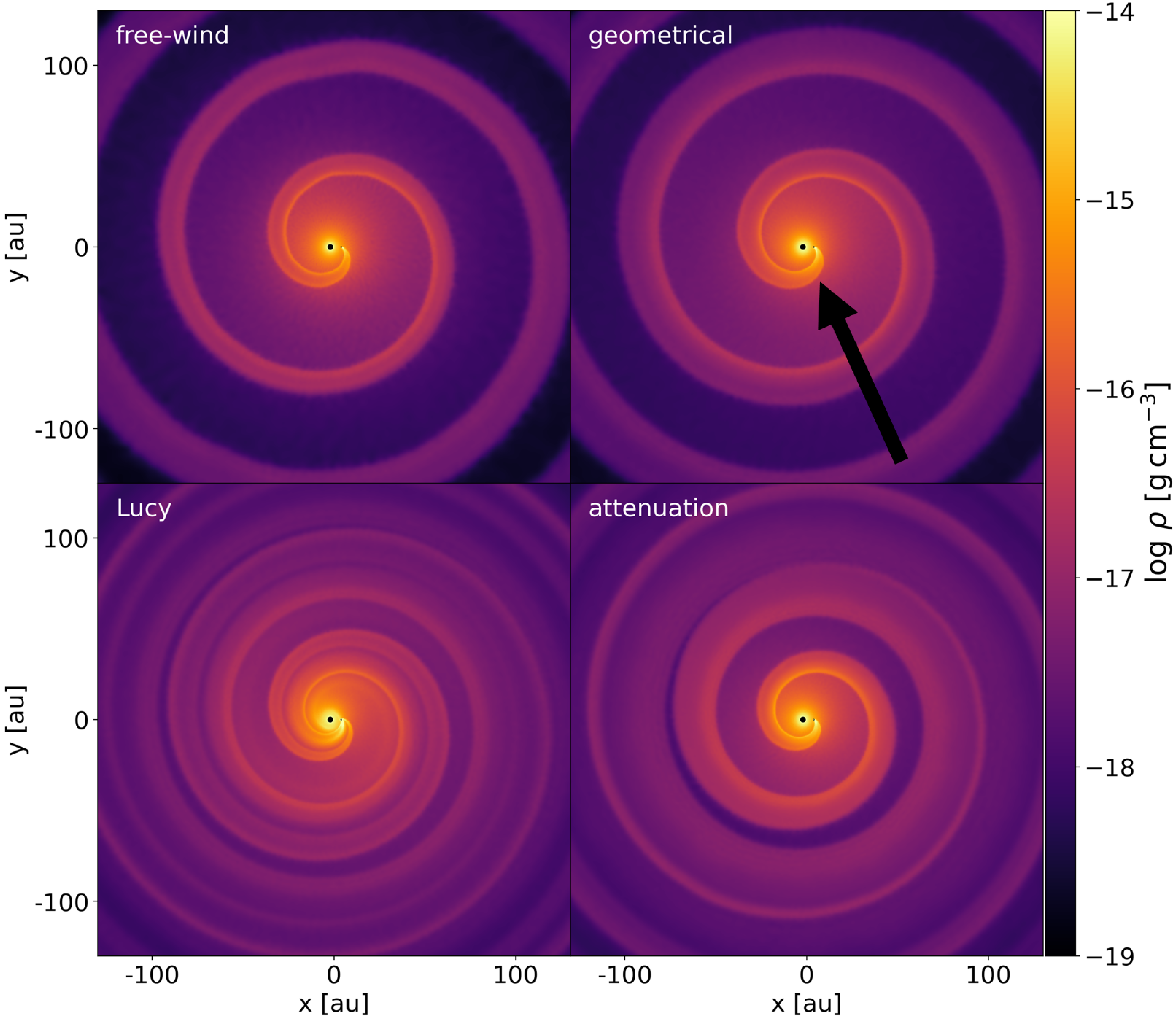

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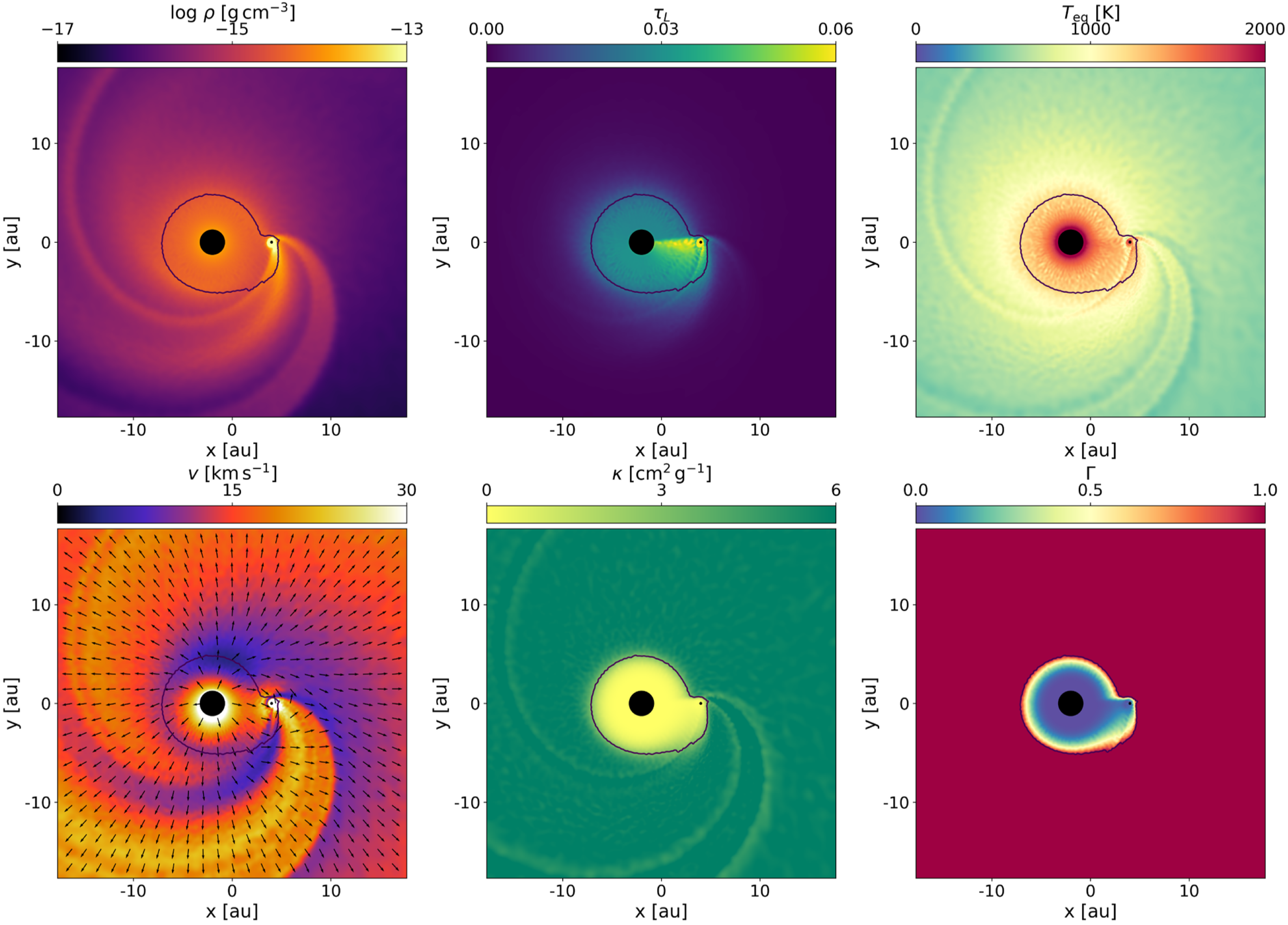

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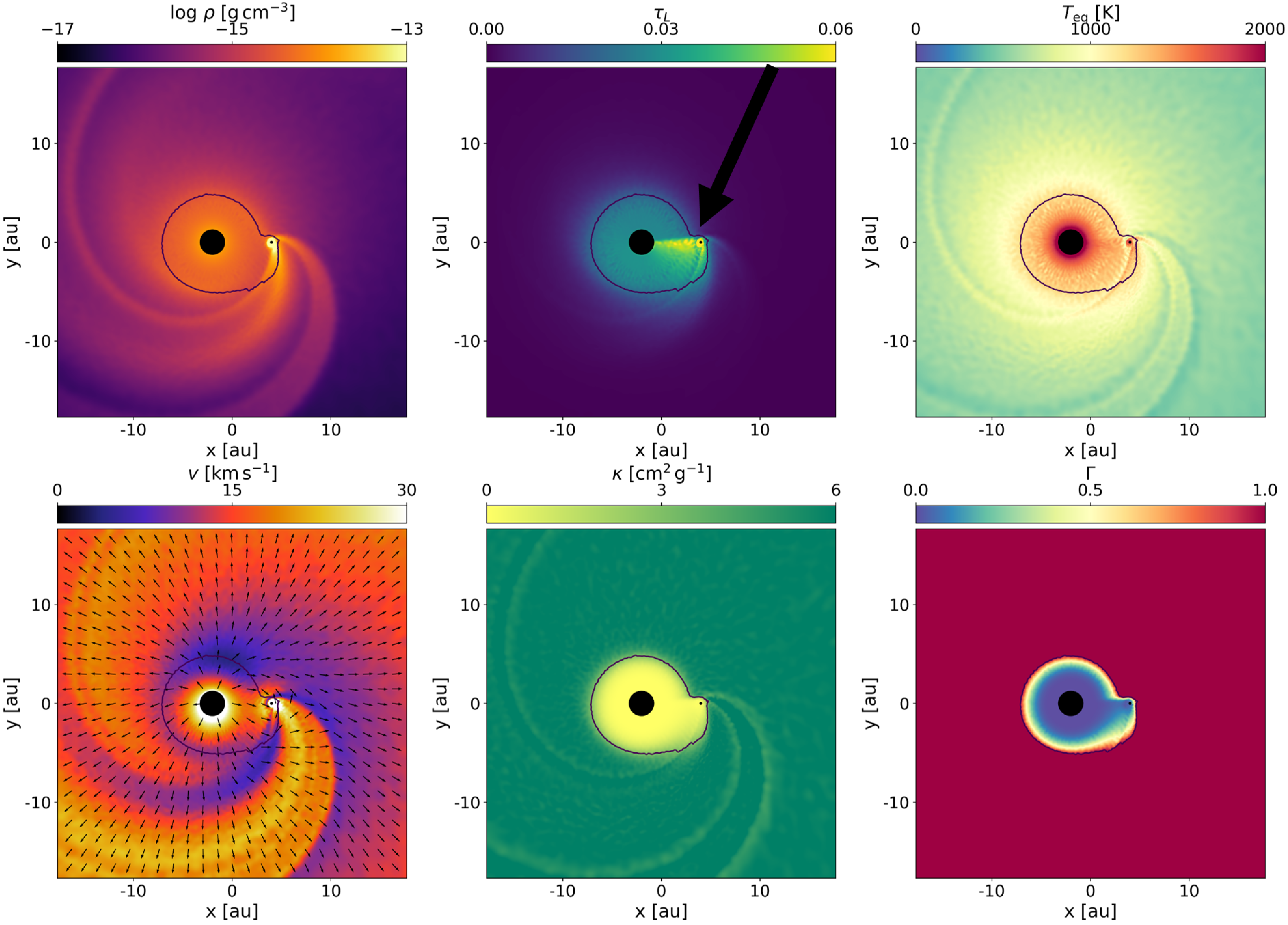

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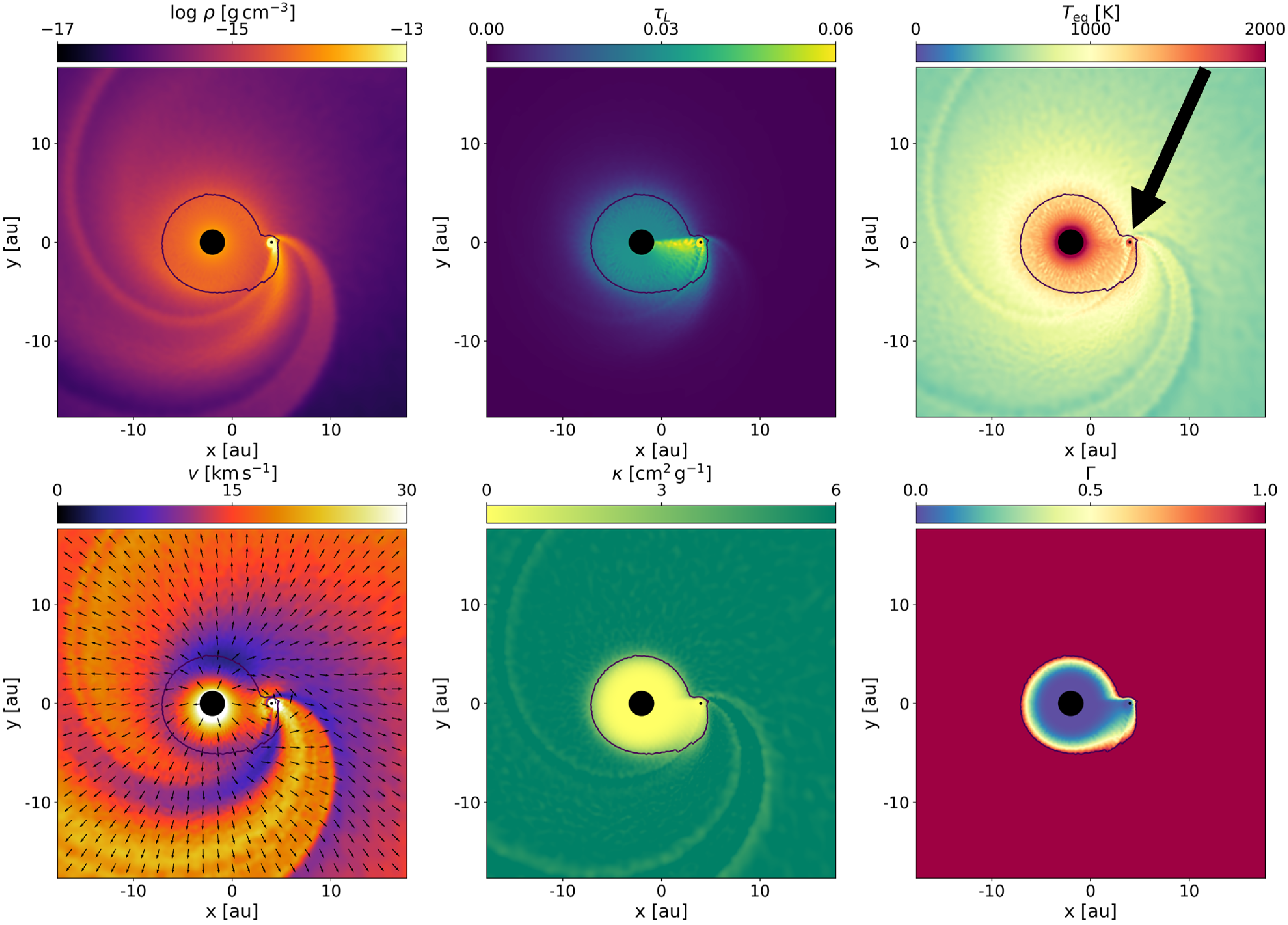

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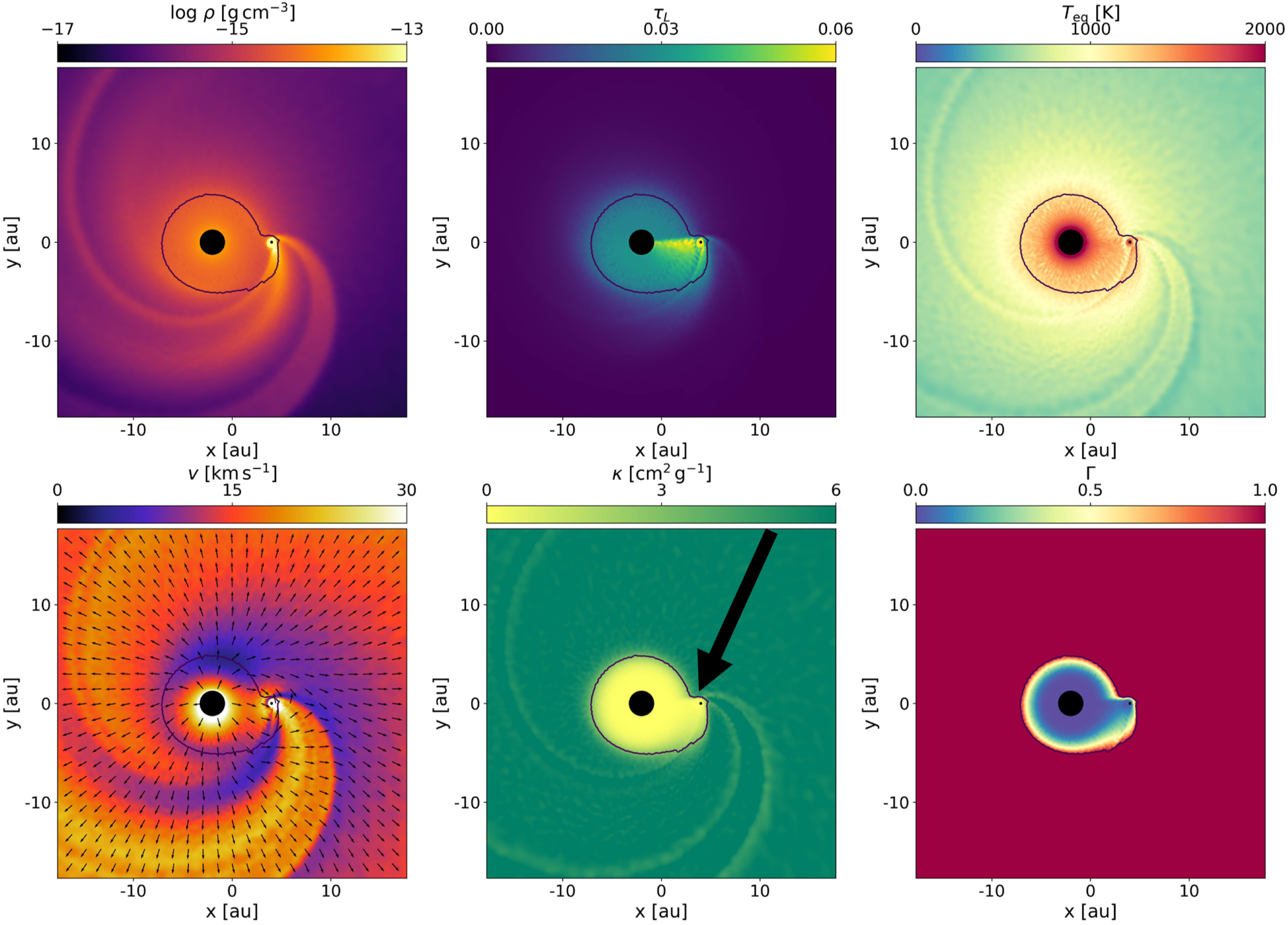

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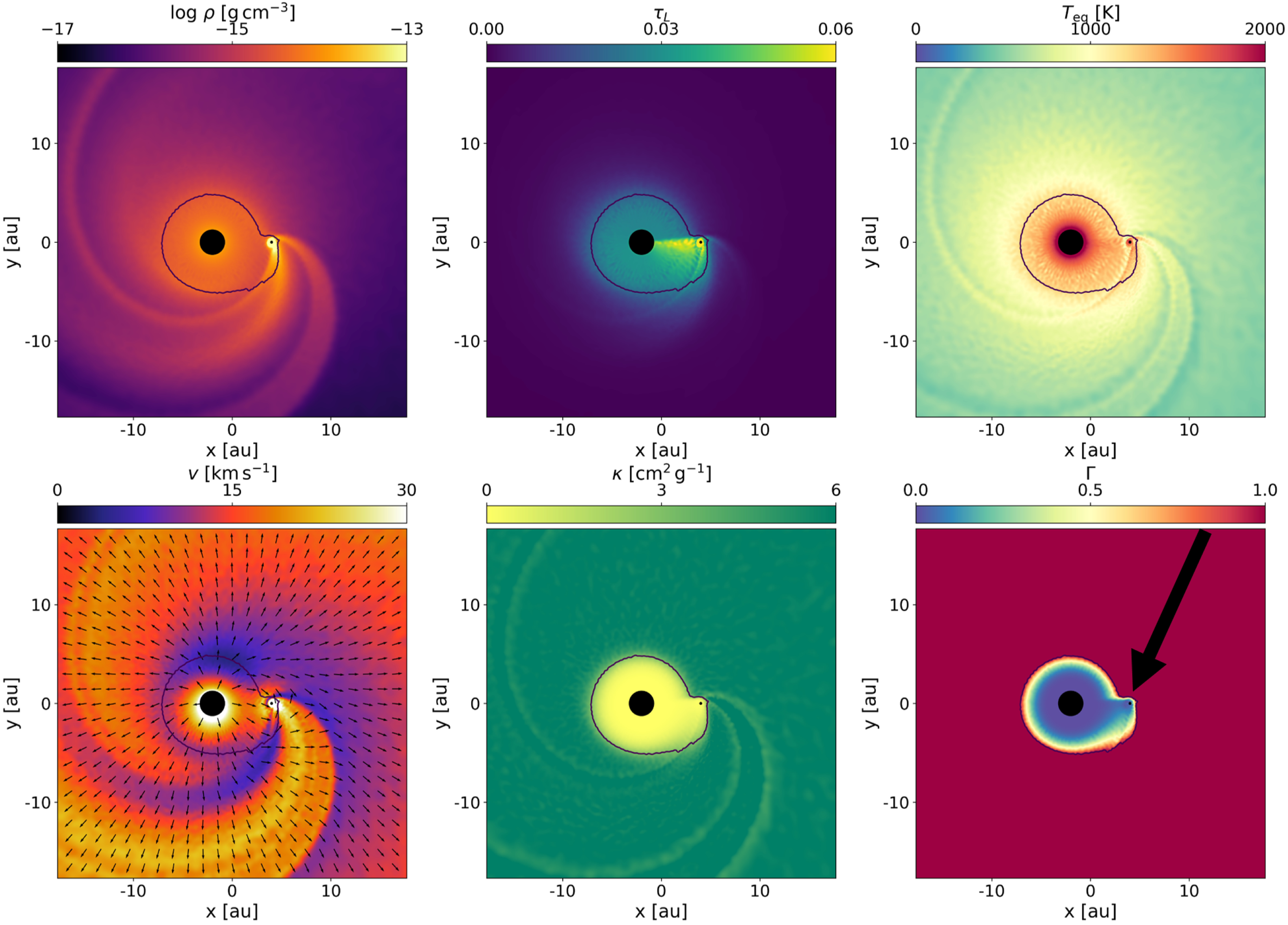

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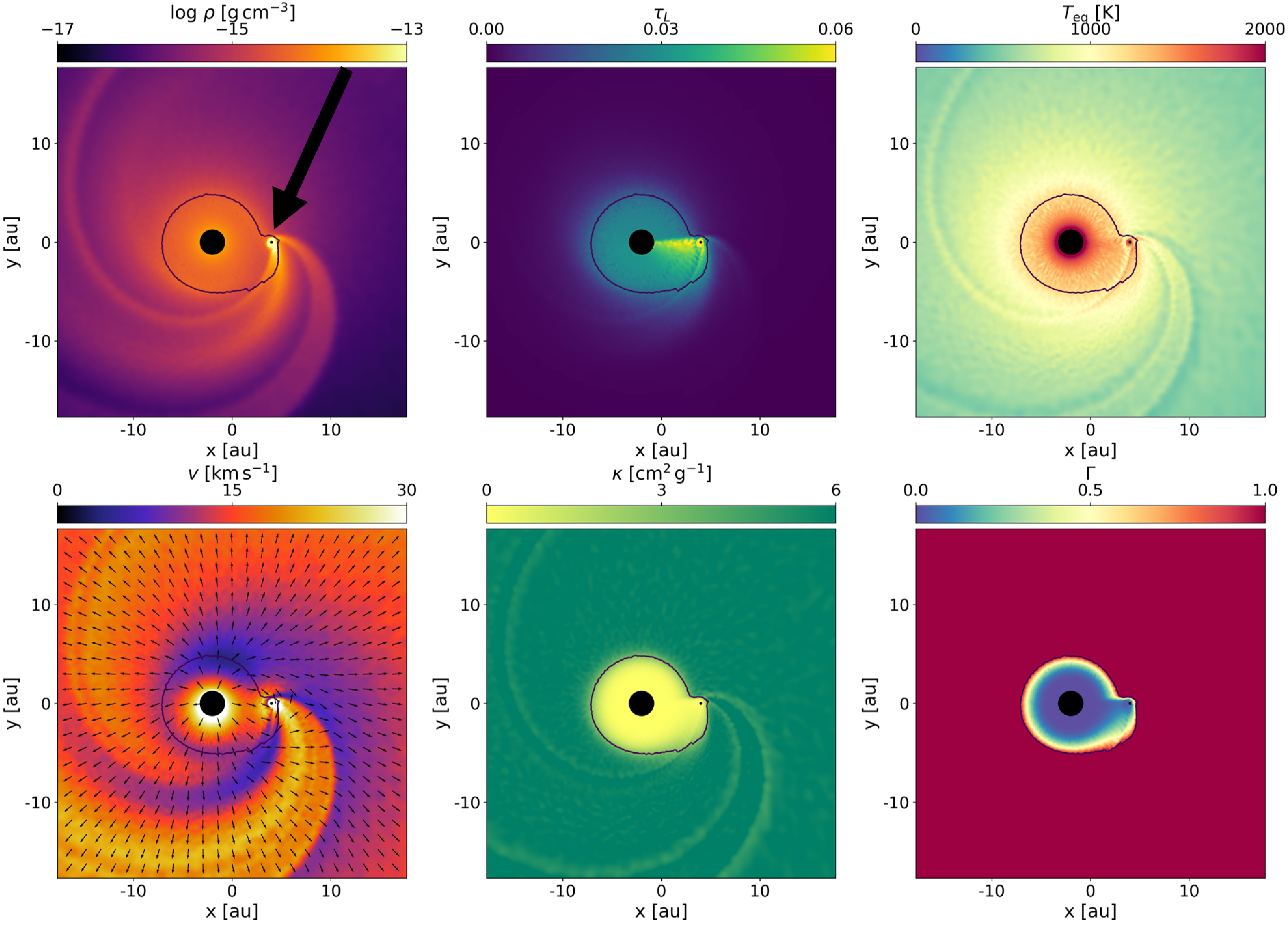
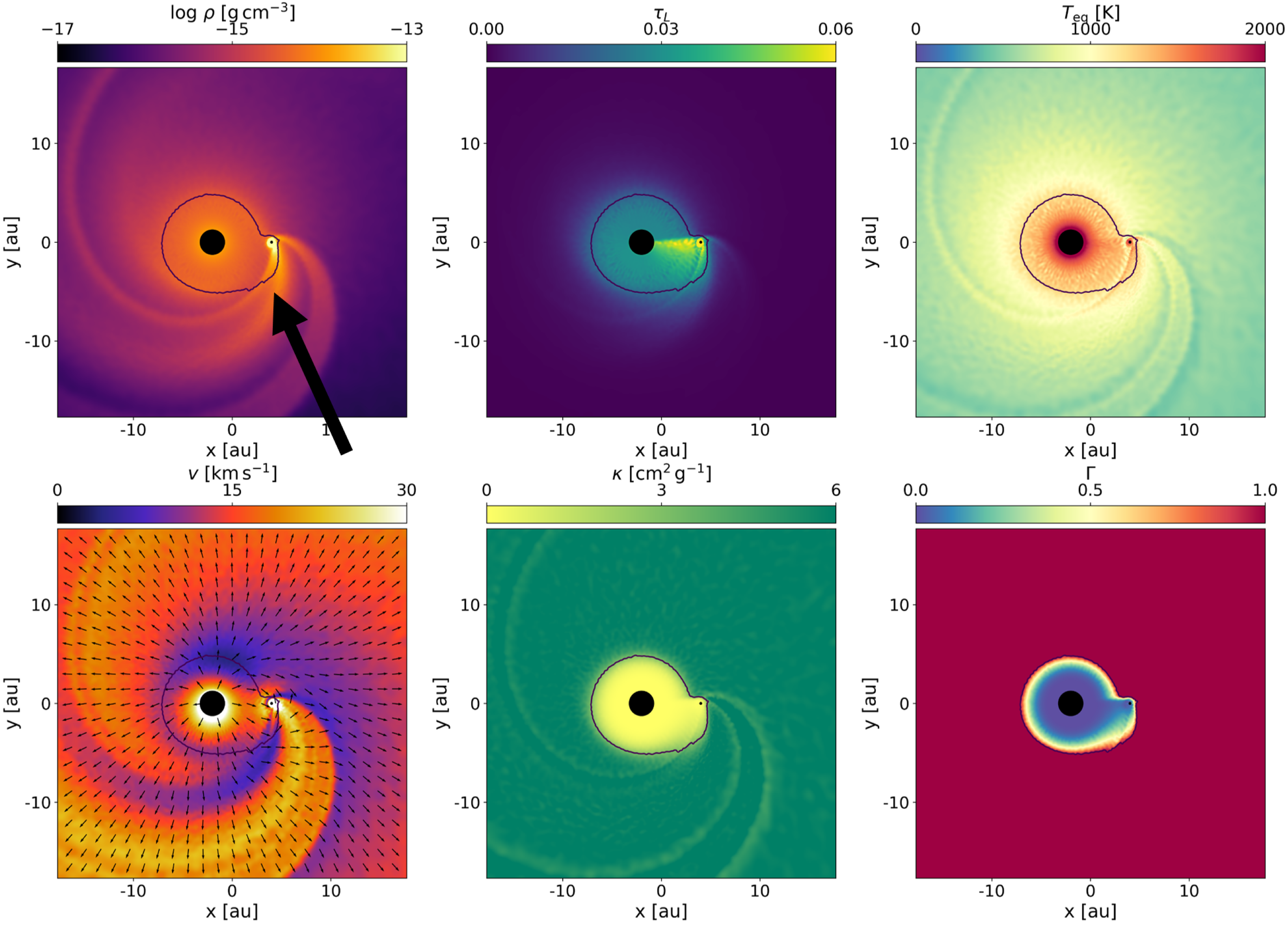


Lucy Approximation



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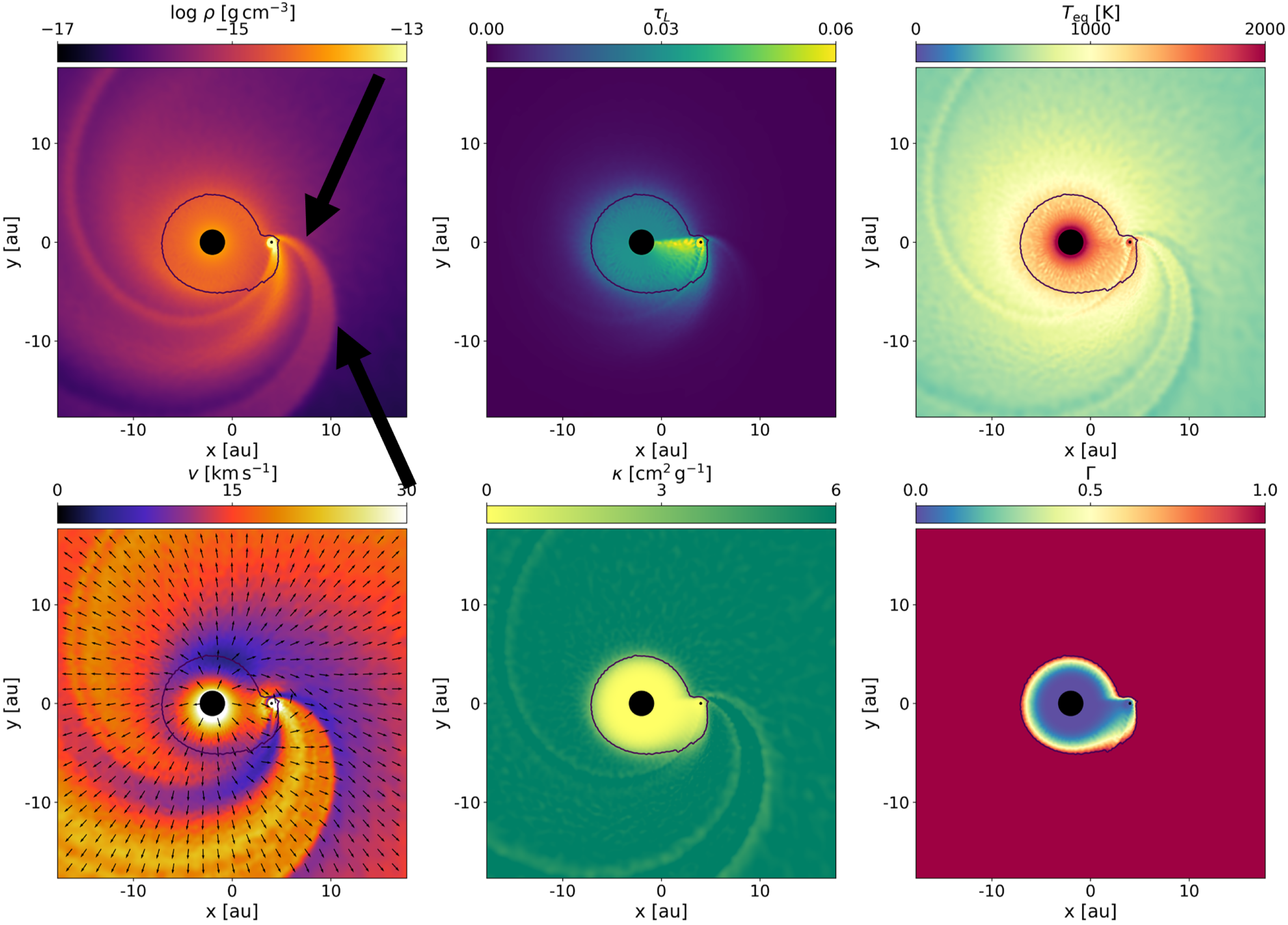
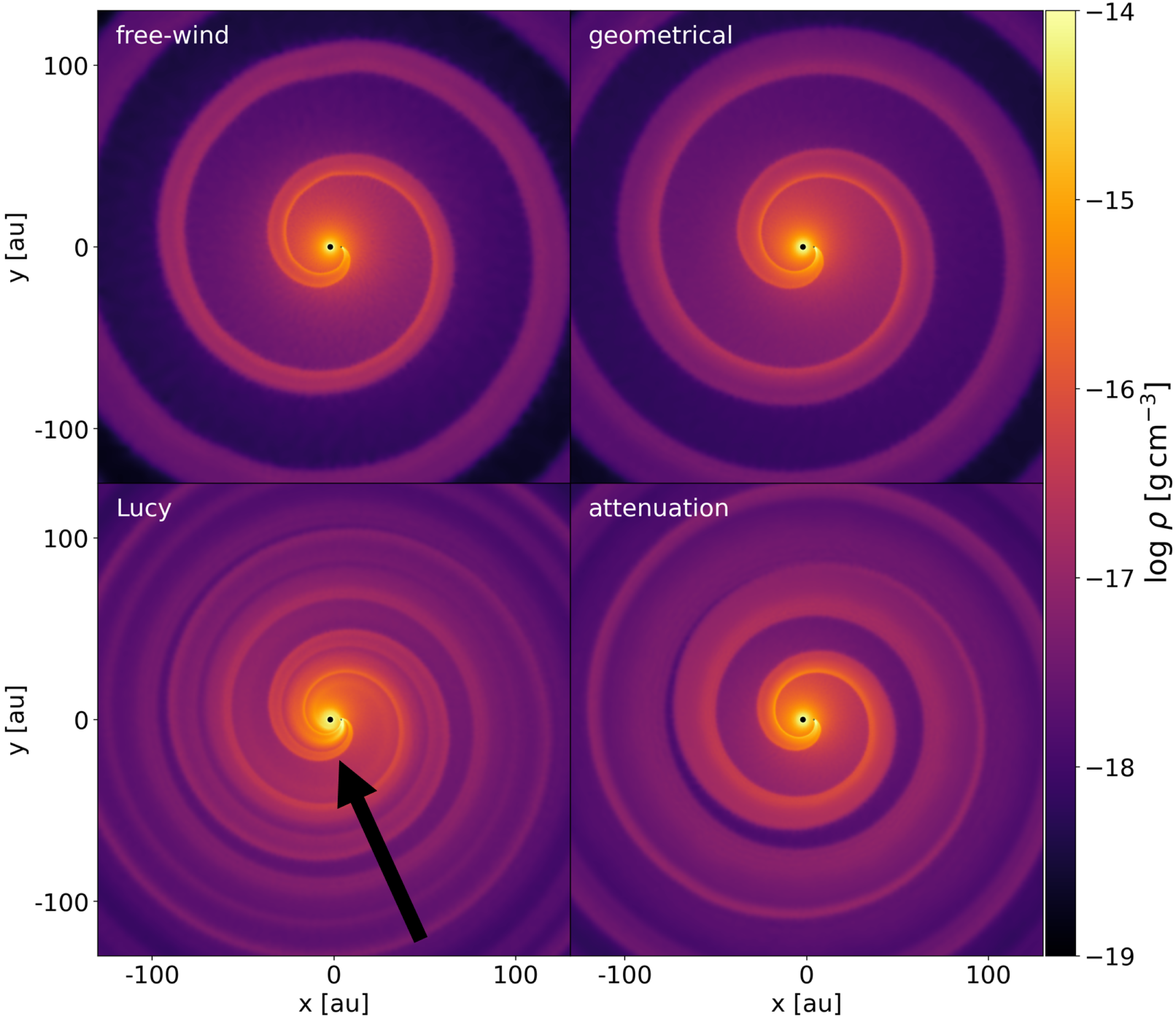
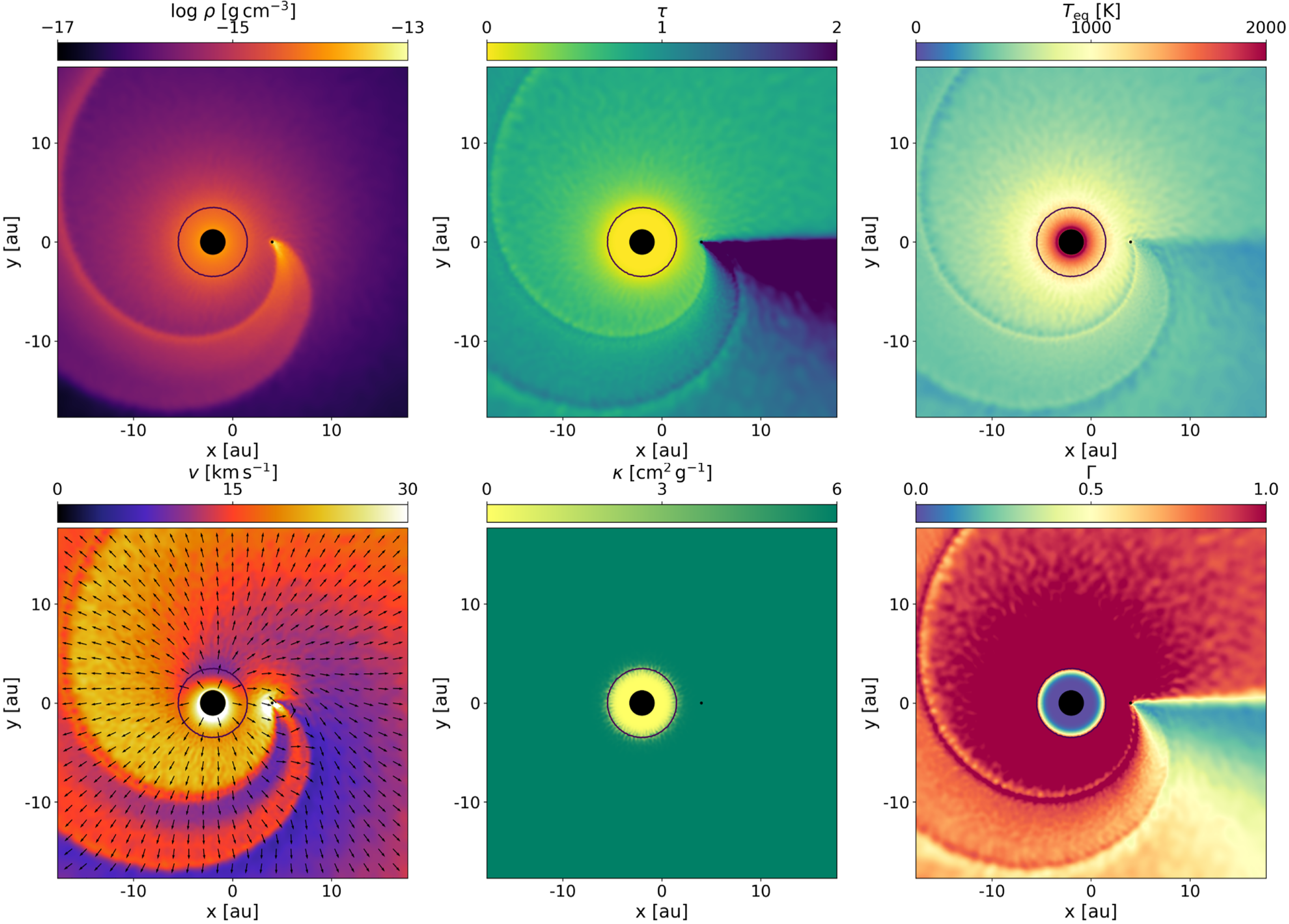


Morphological structures

Parameter	Value	Unit
$\dot{M}_{\rm AGB}$	10^{-8} or 3×10^{-6}	$\rm M_\odot\,yr^{-1}$
$M_{\rm AGB}$	1.02	$\rm M_\odot$
$L_{\rm AGB}$	4384	$\rm L_\odot$
$T_{\rm eff,AGB}$	2874	K
$R_{\rm AGB}$	1.24	au
$R_{\rm inj}$	1.24	au
$v_{\rm inj}$	33 or 25.2	$\rm km\,s^{-1}$
γ	1.2	
μ	2.381	



Attenuation Approximation



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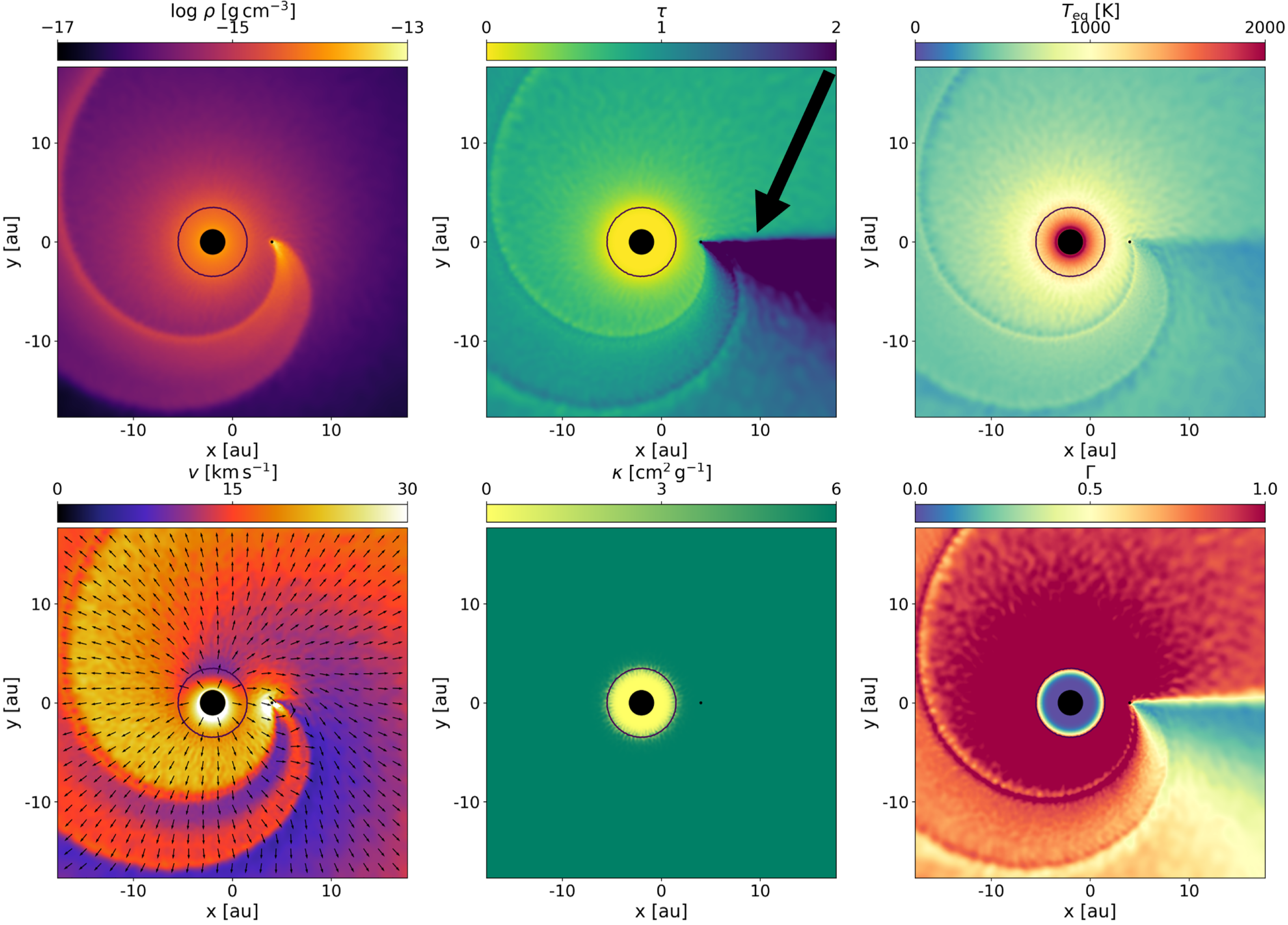

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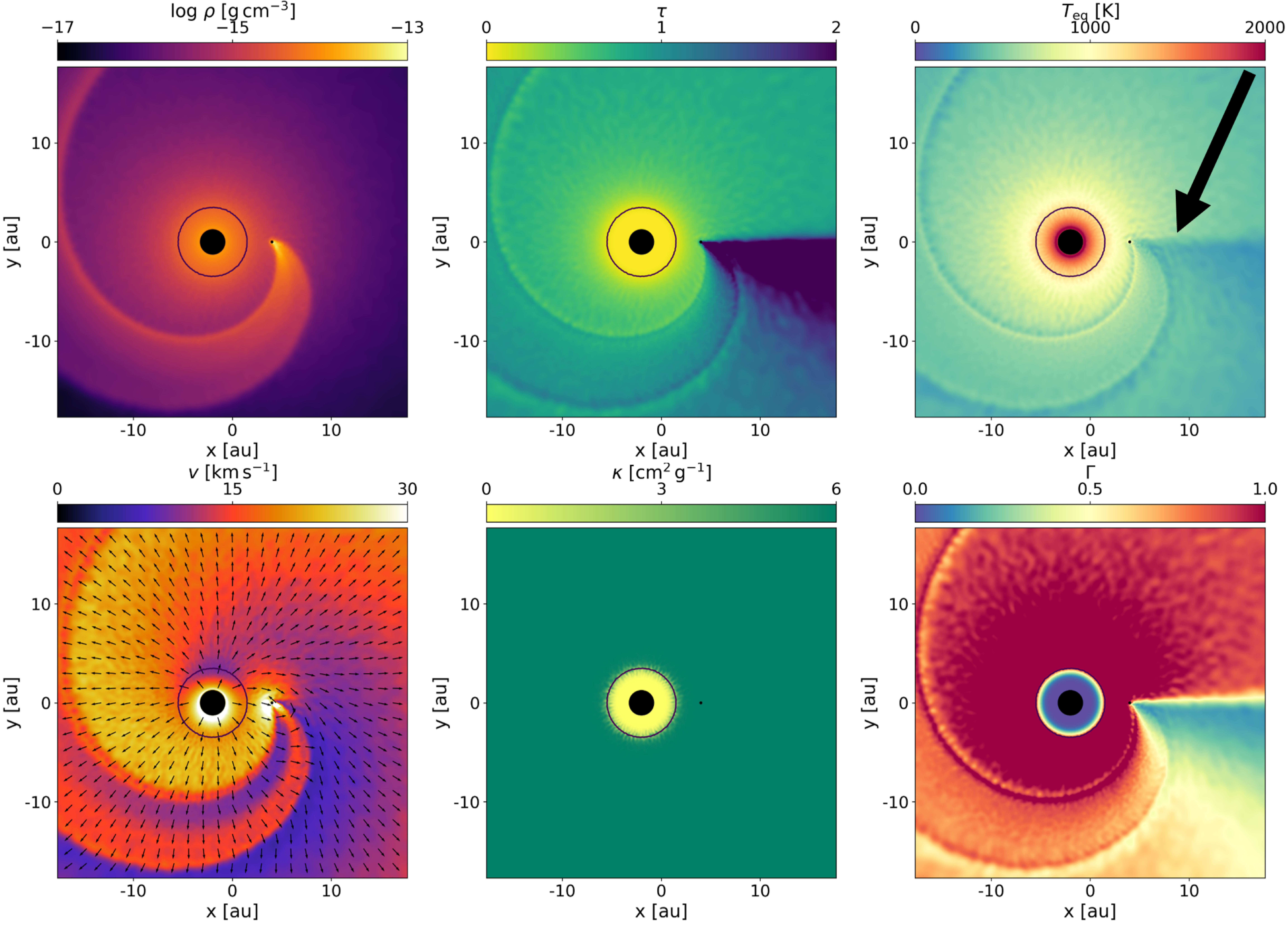

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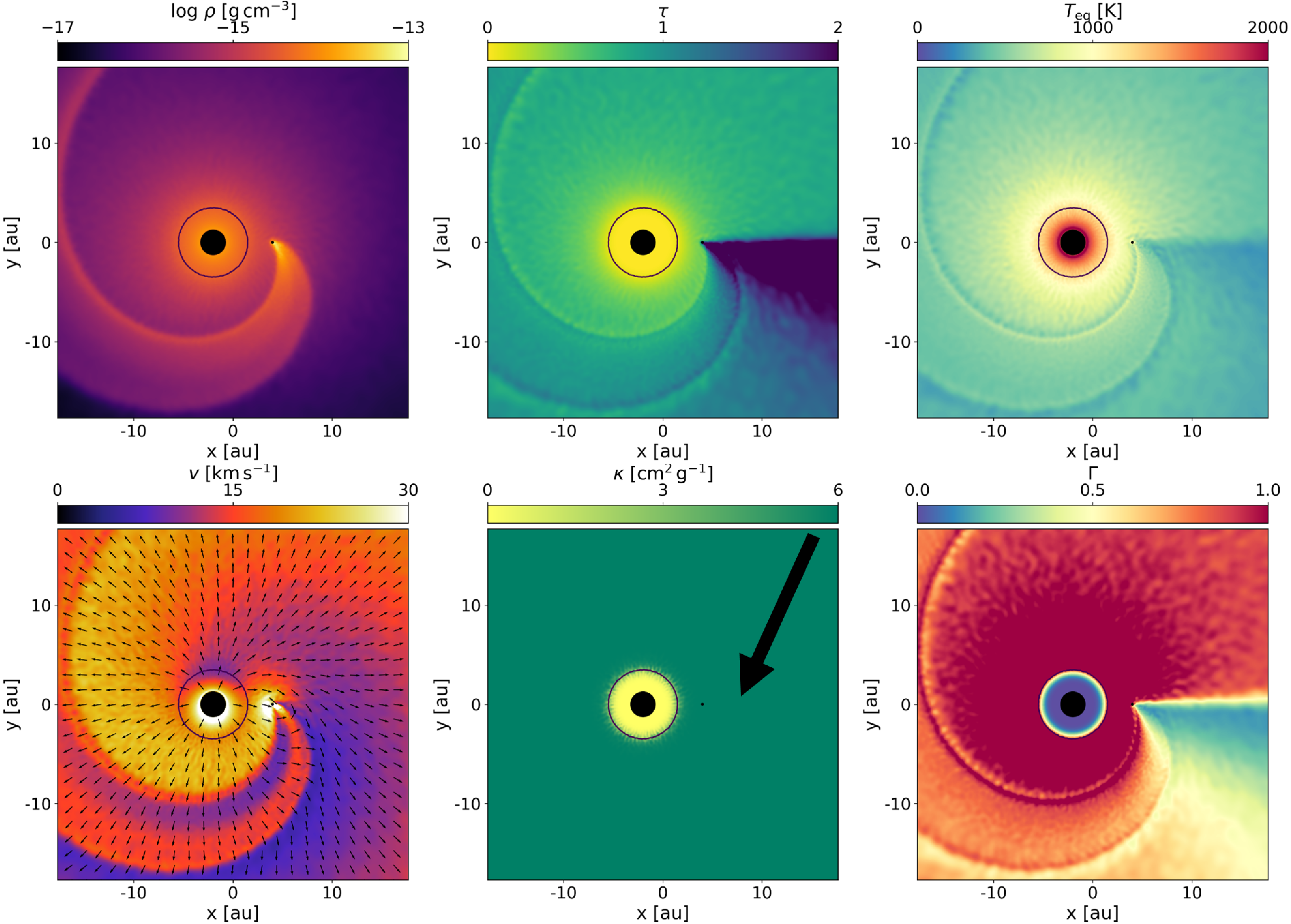

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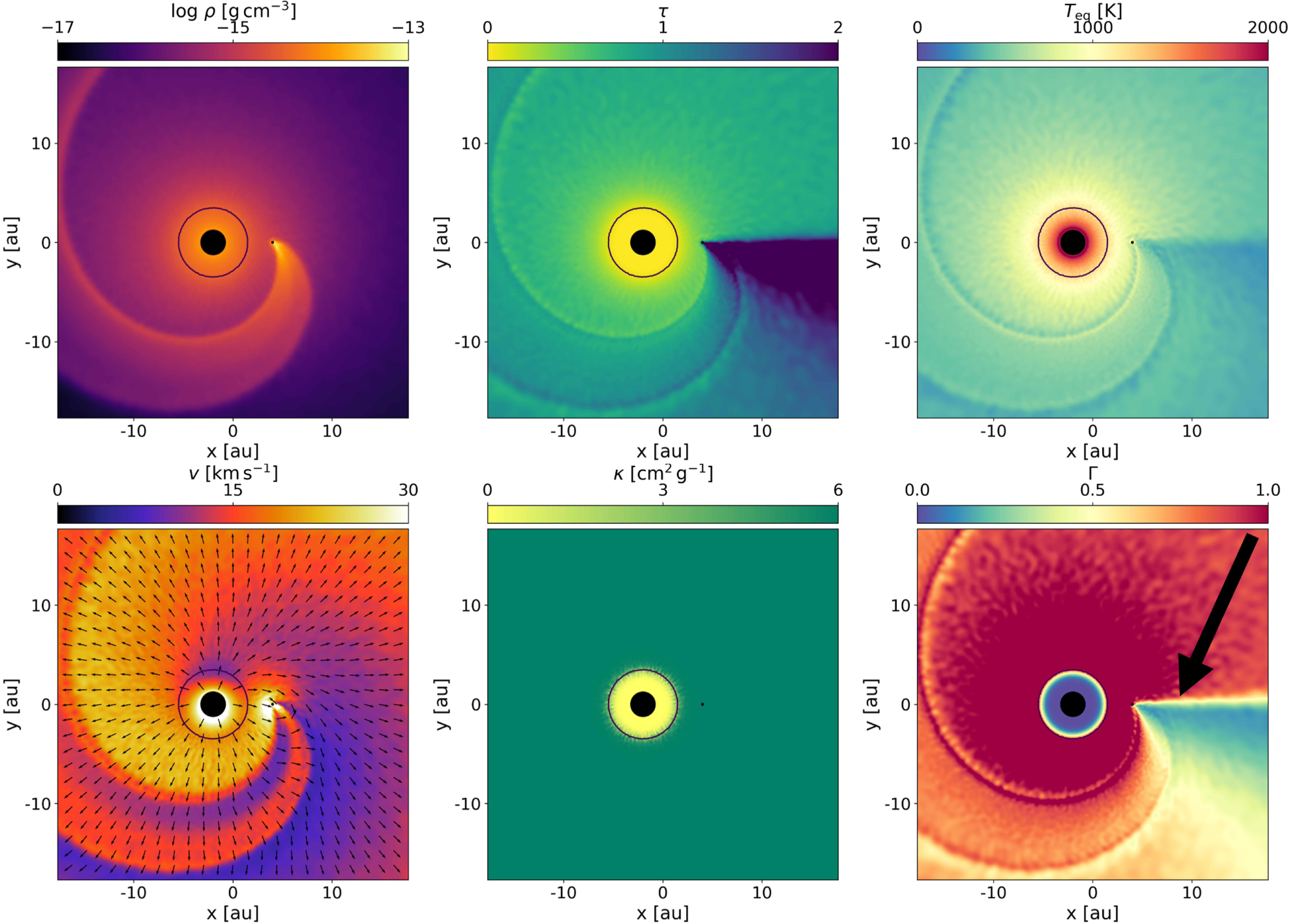

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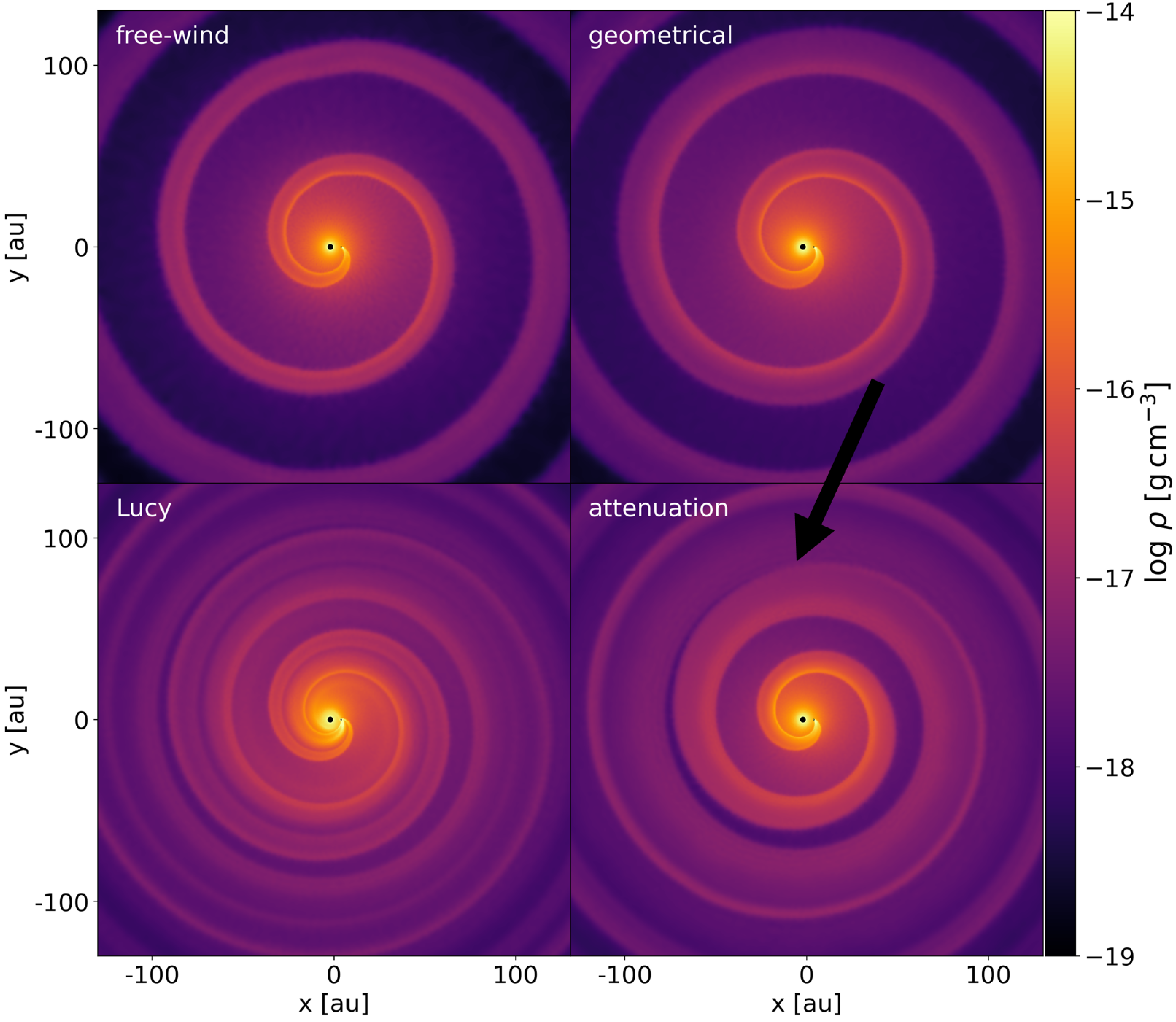
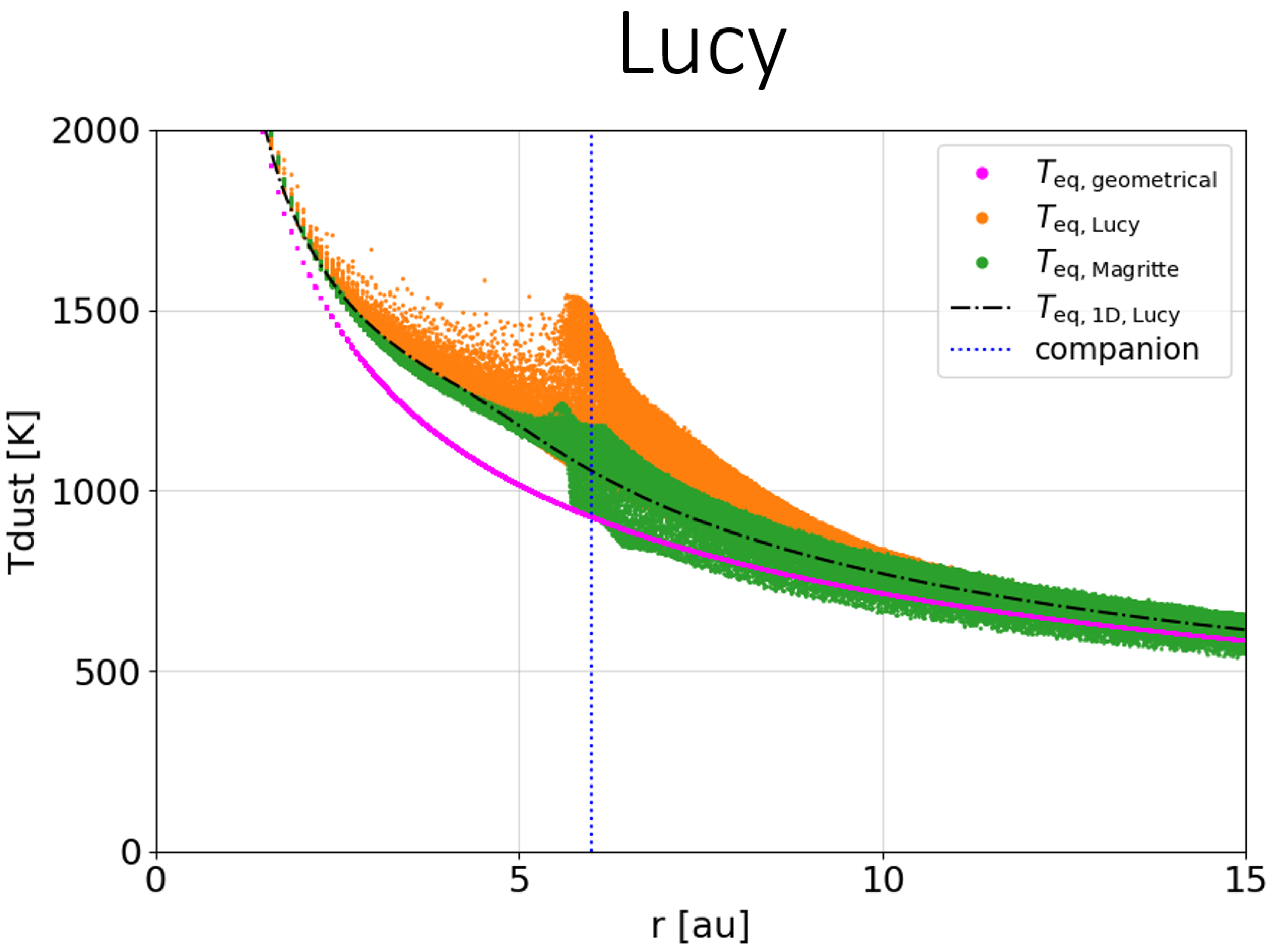
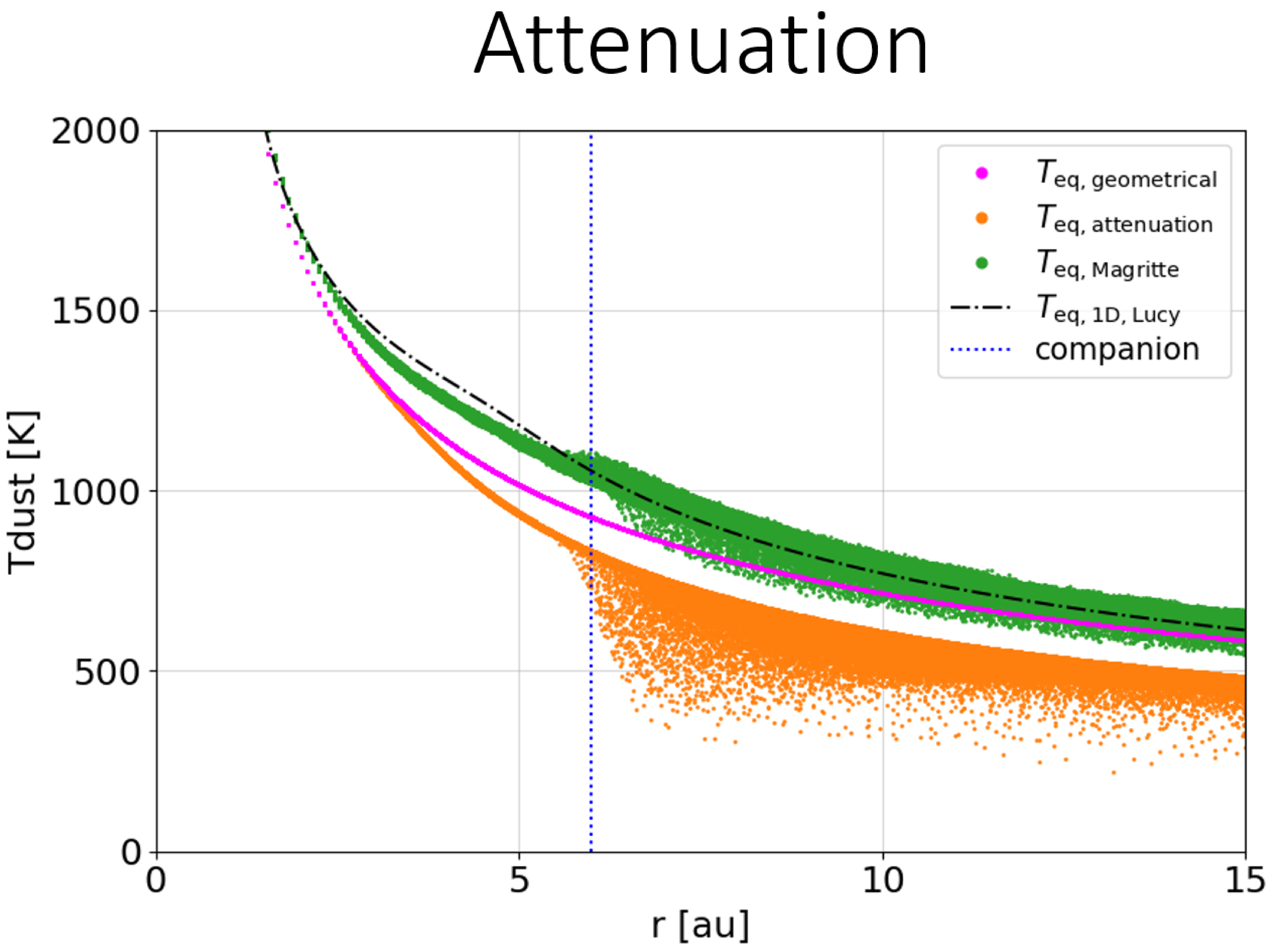


Most adequate approximation





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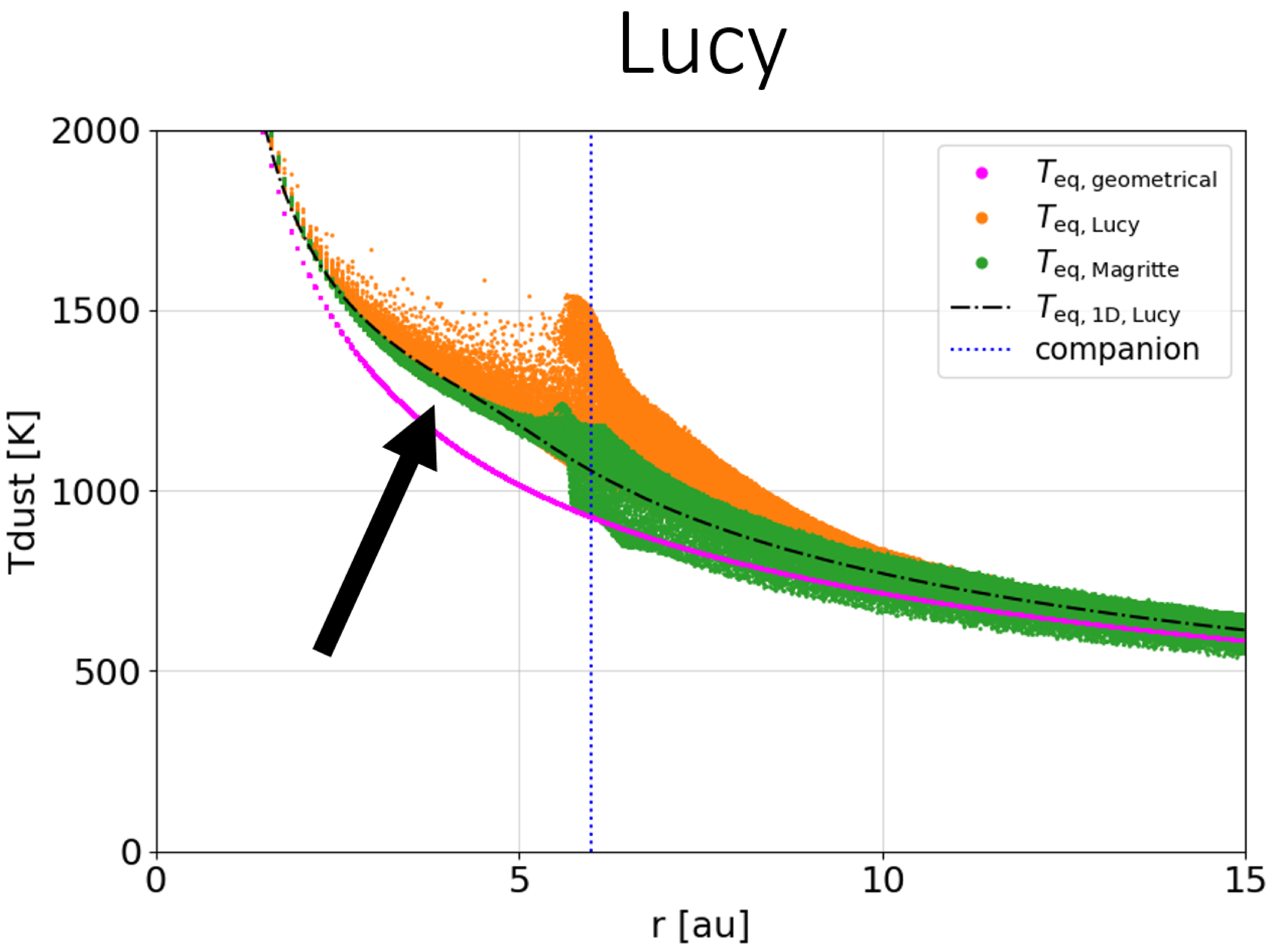

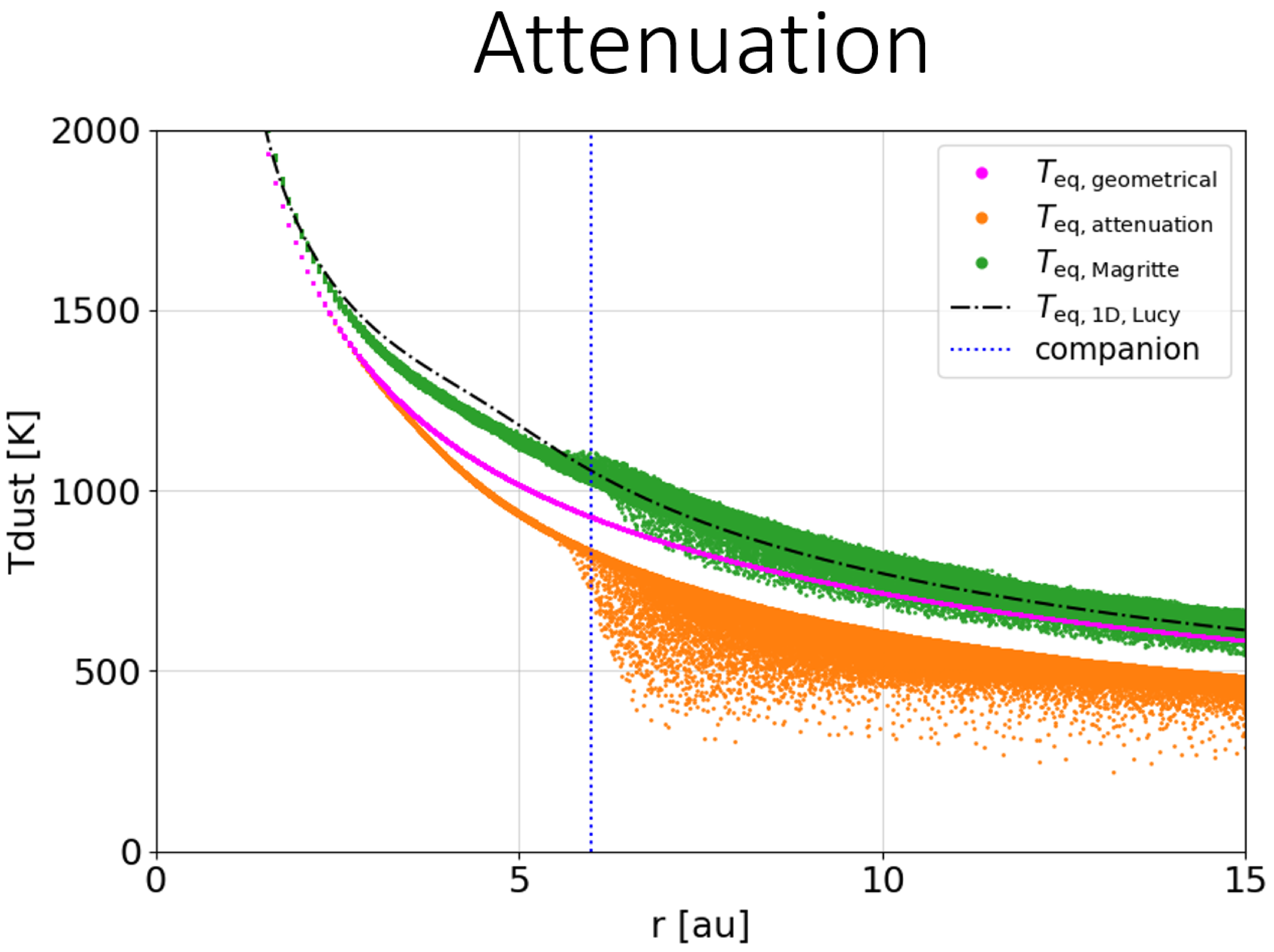

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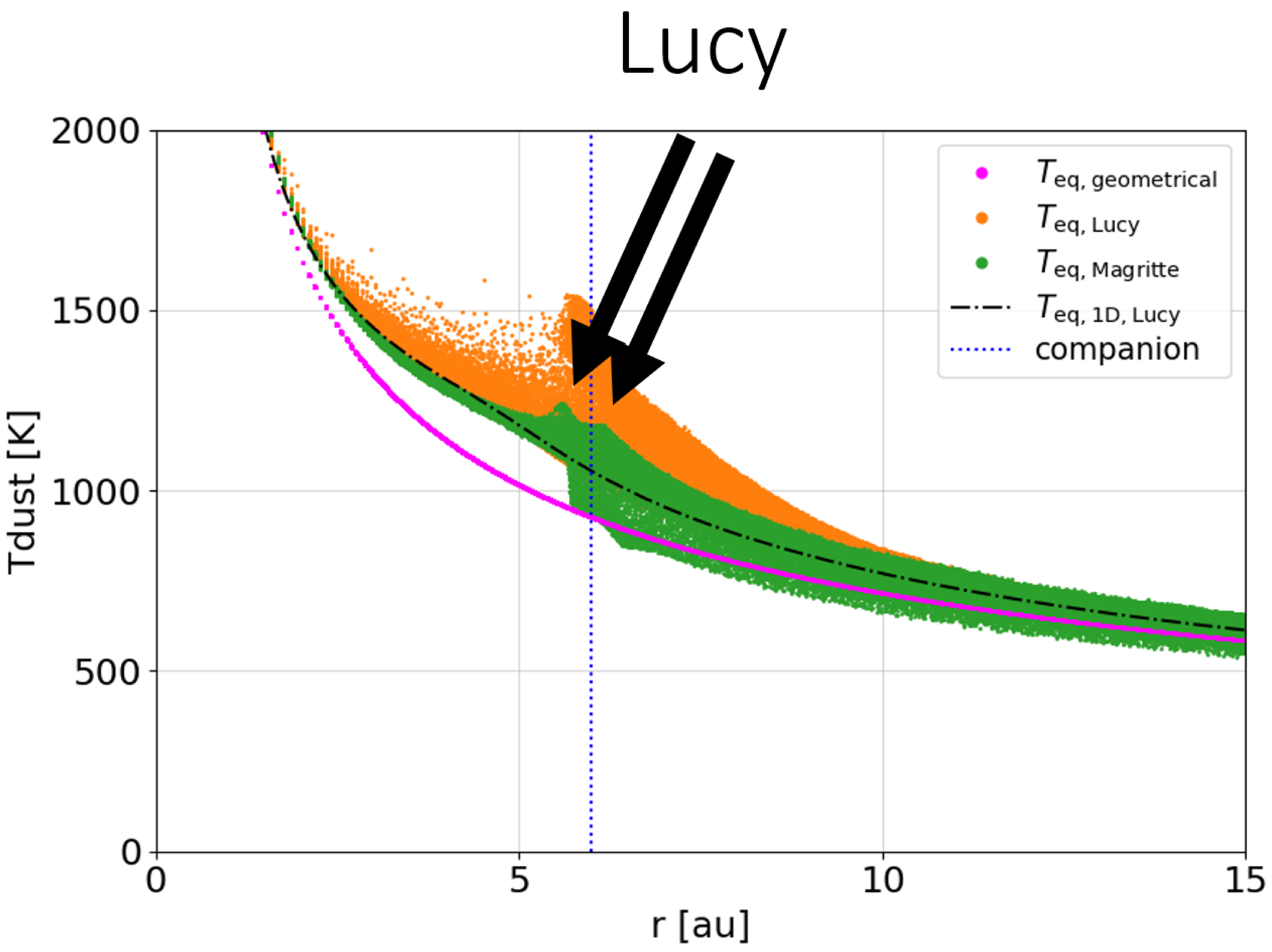

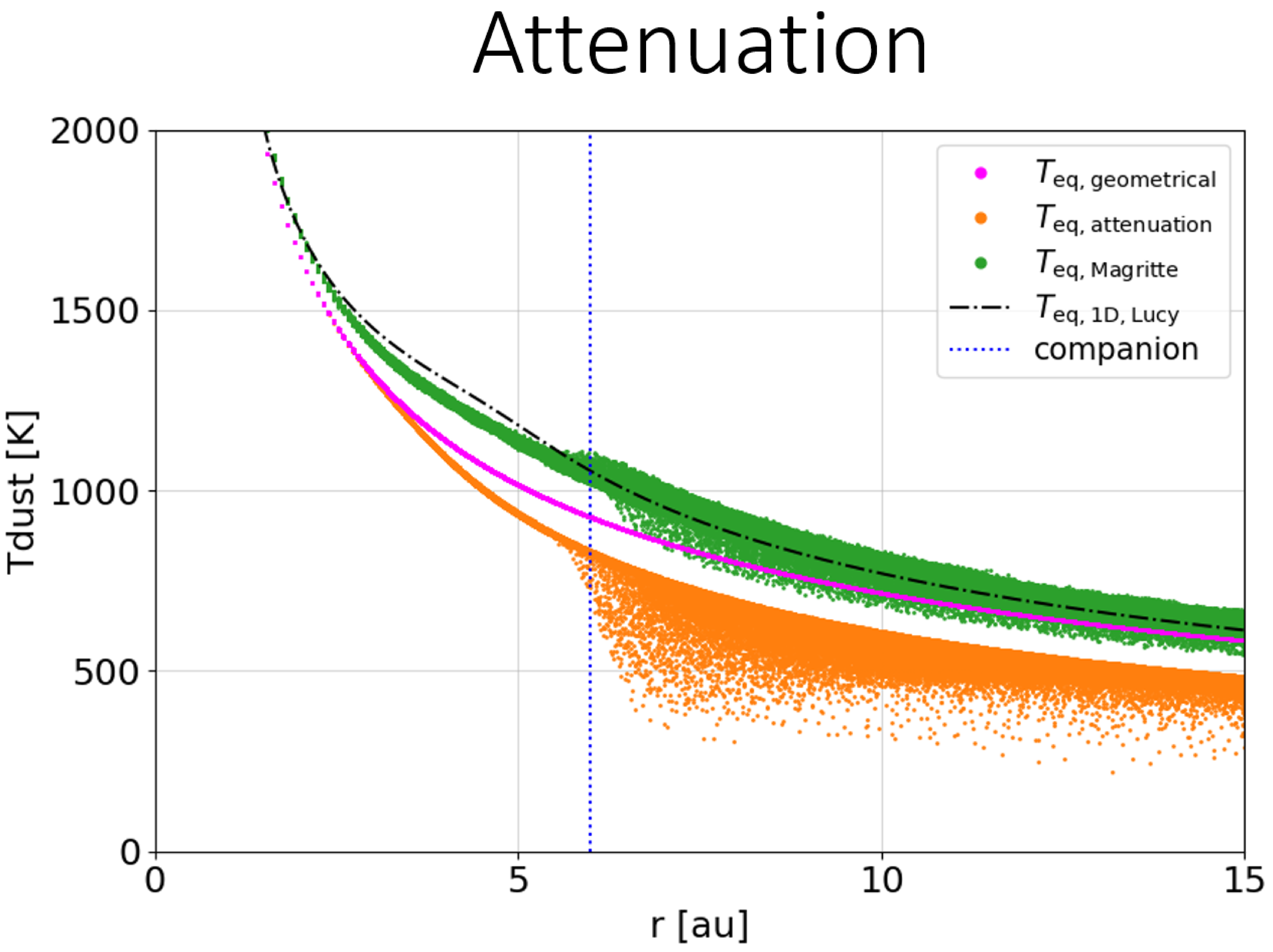

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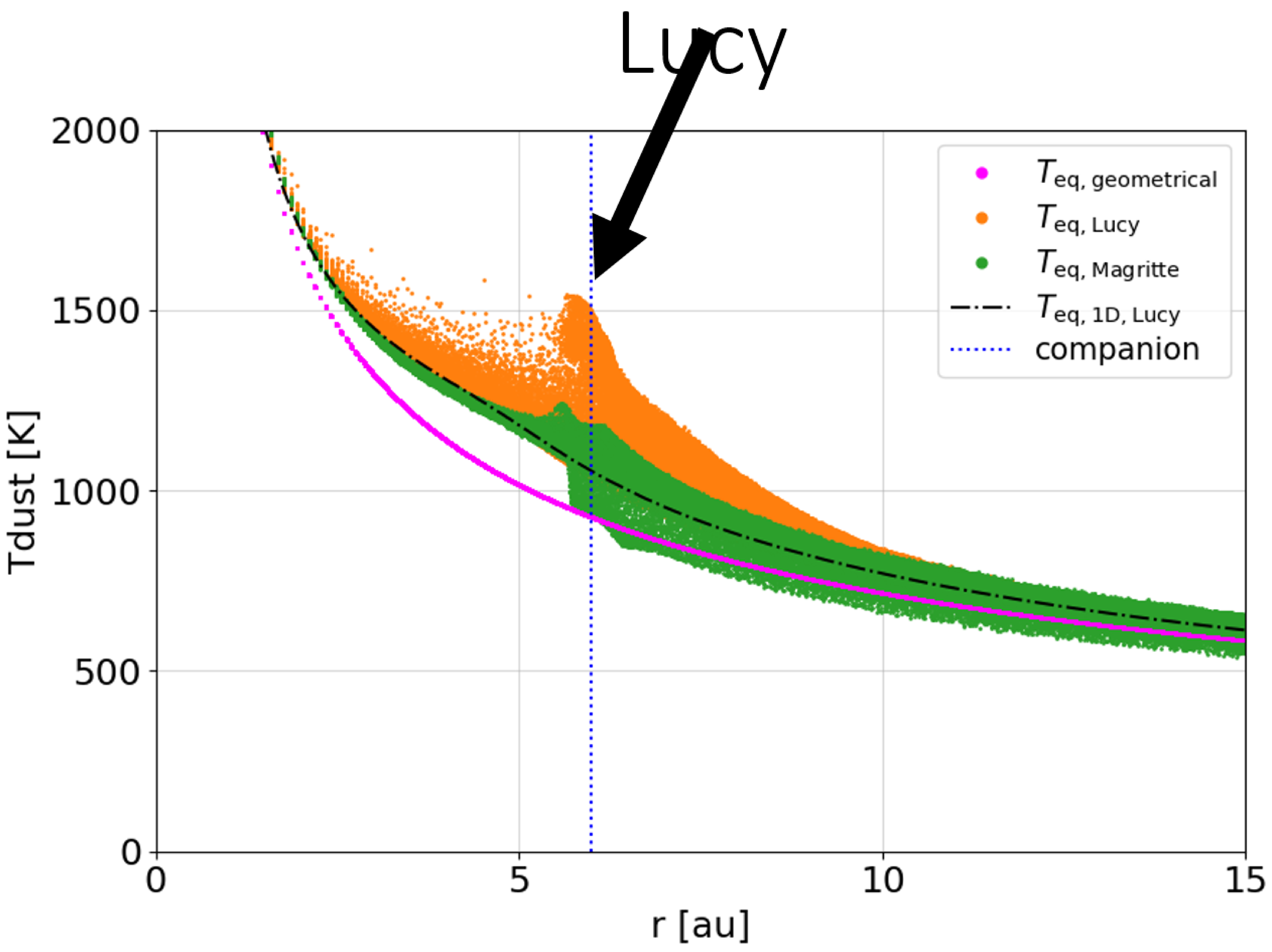

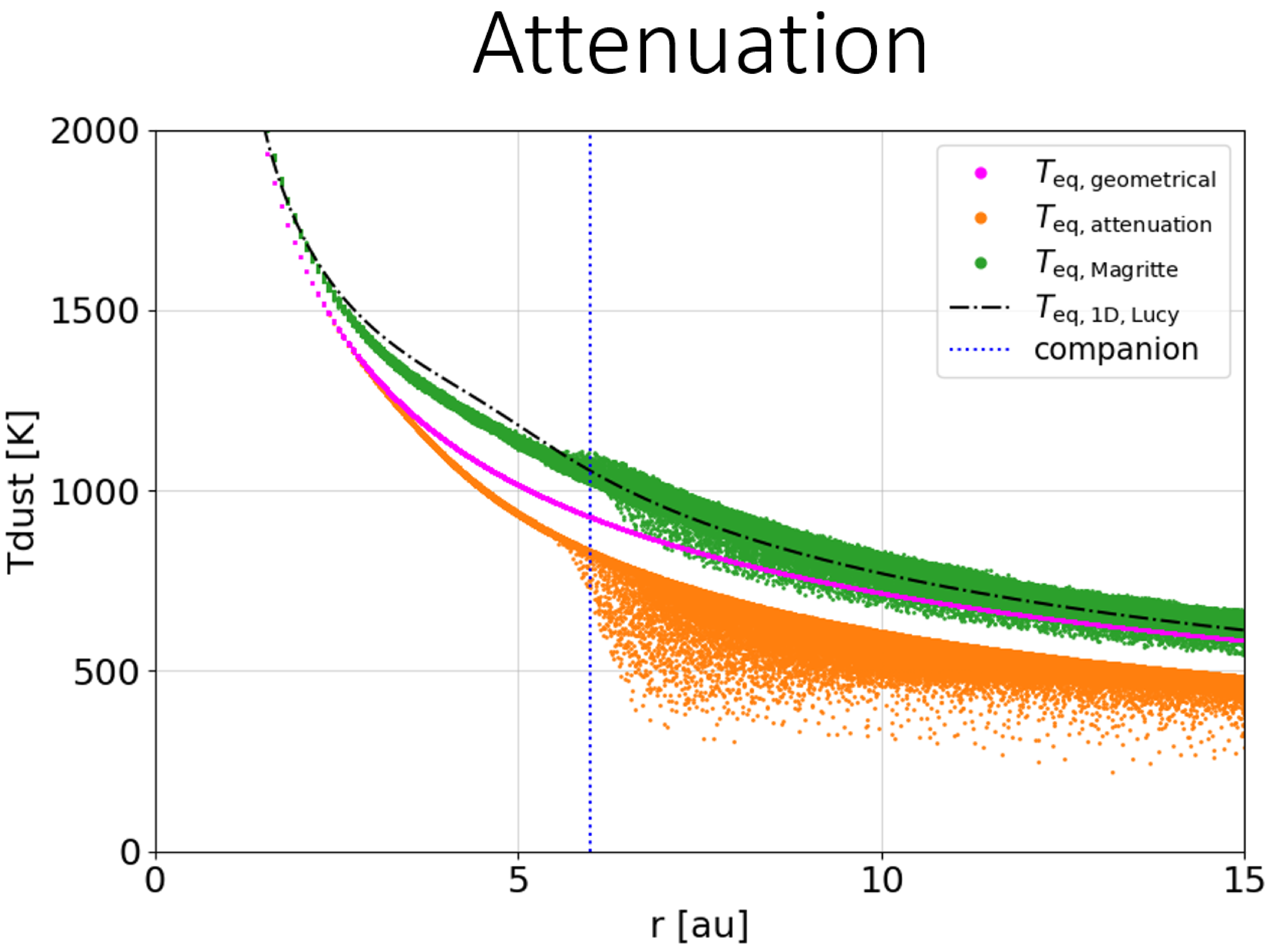

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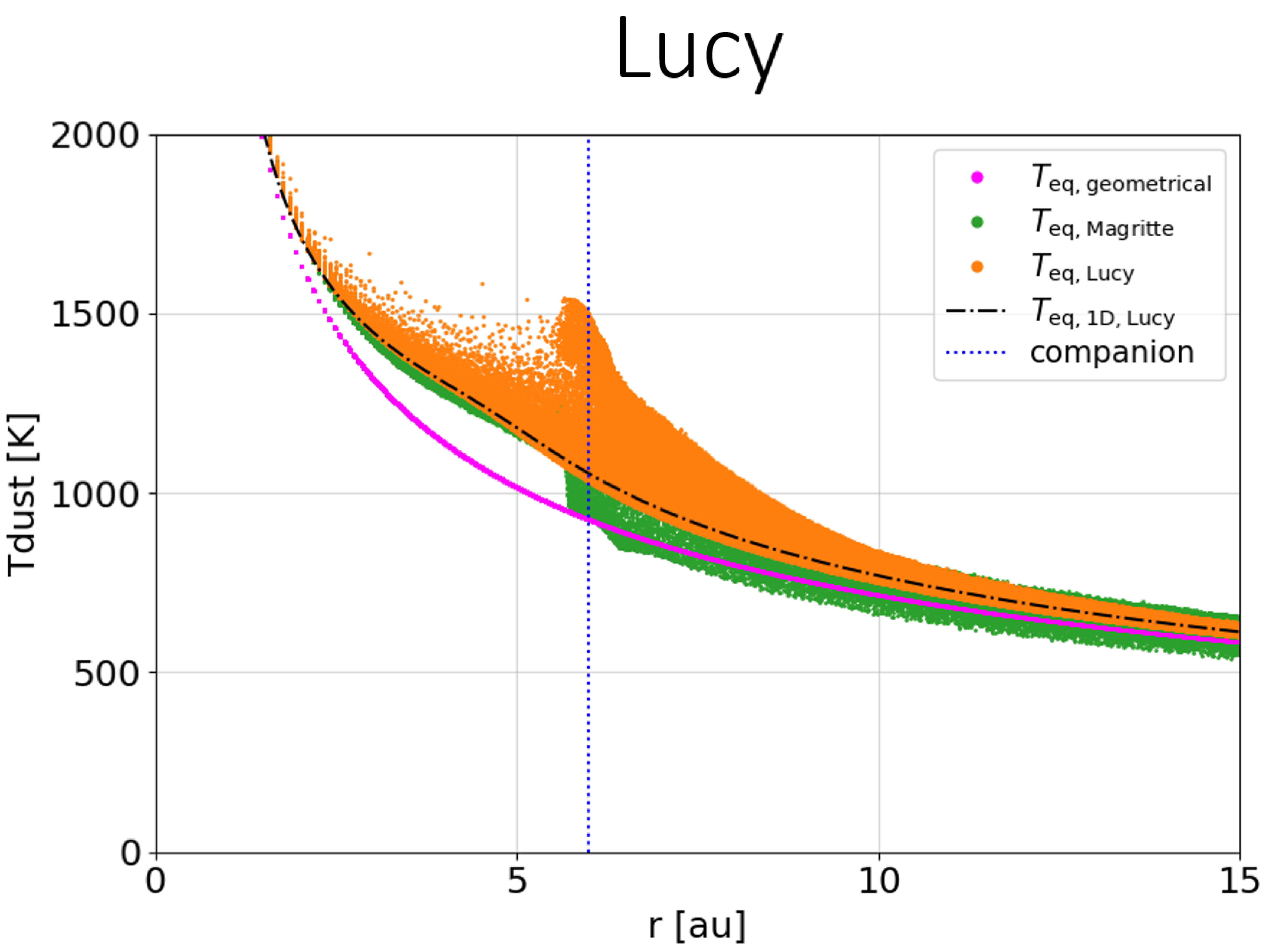

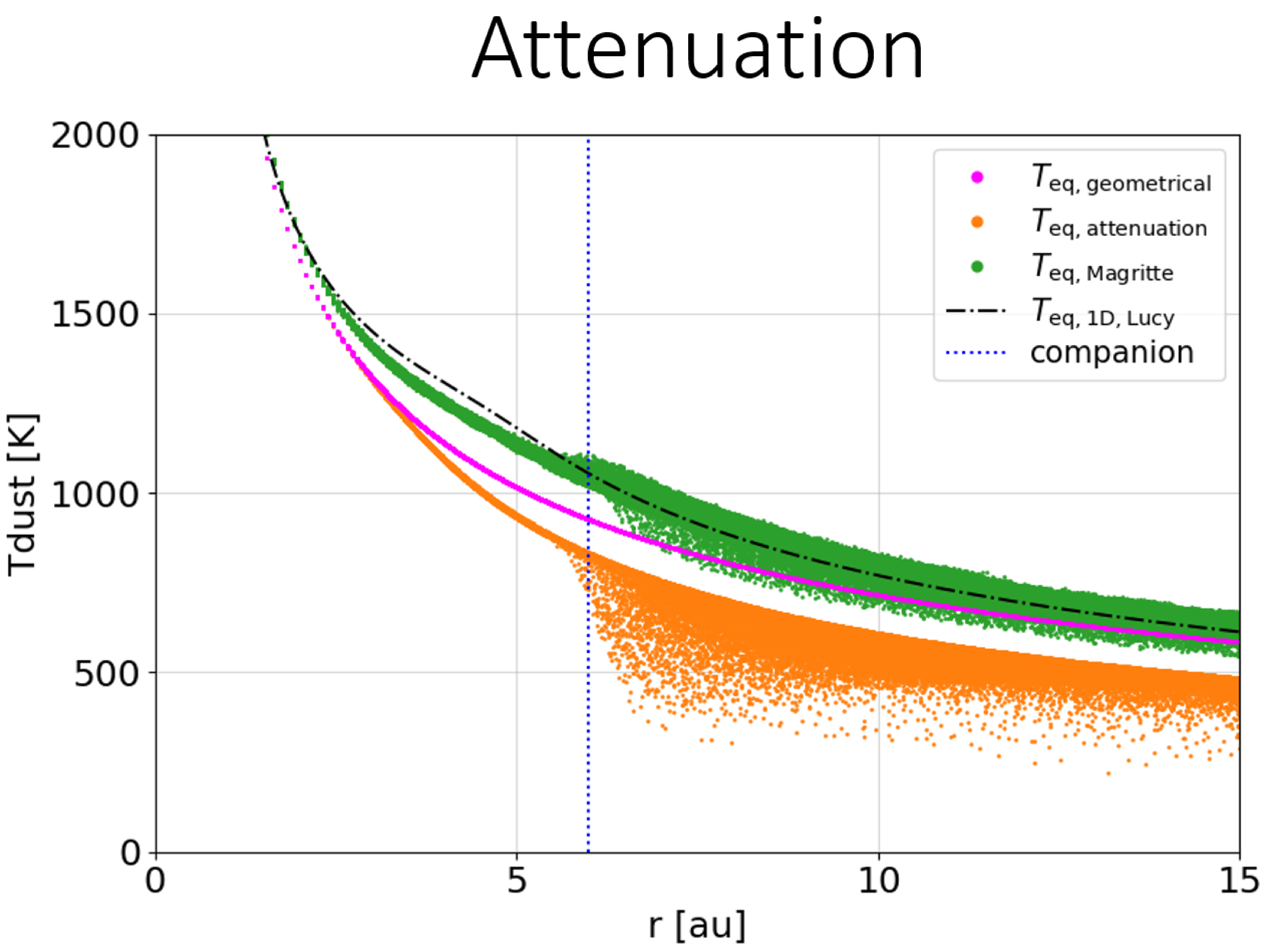

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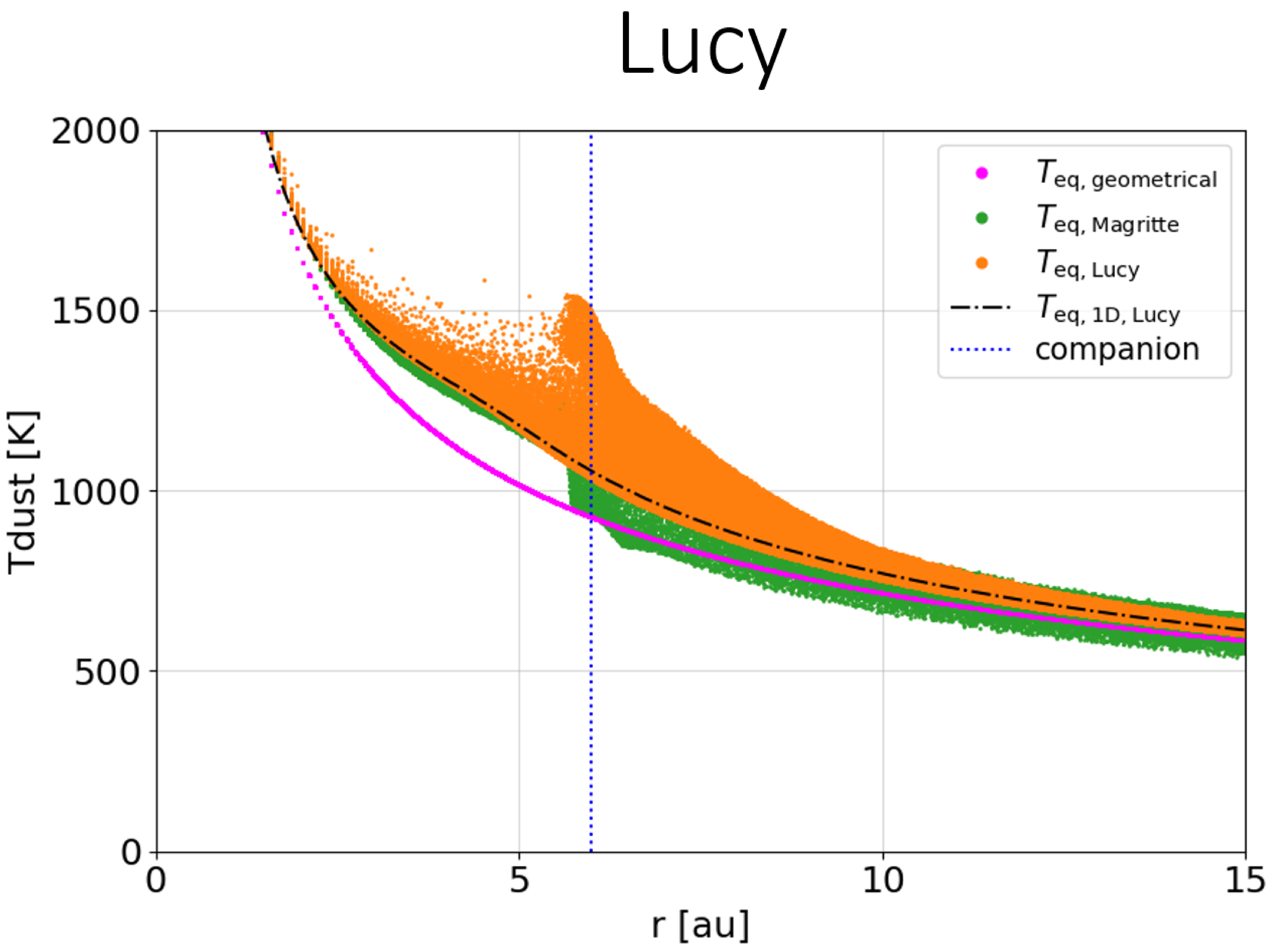

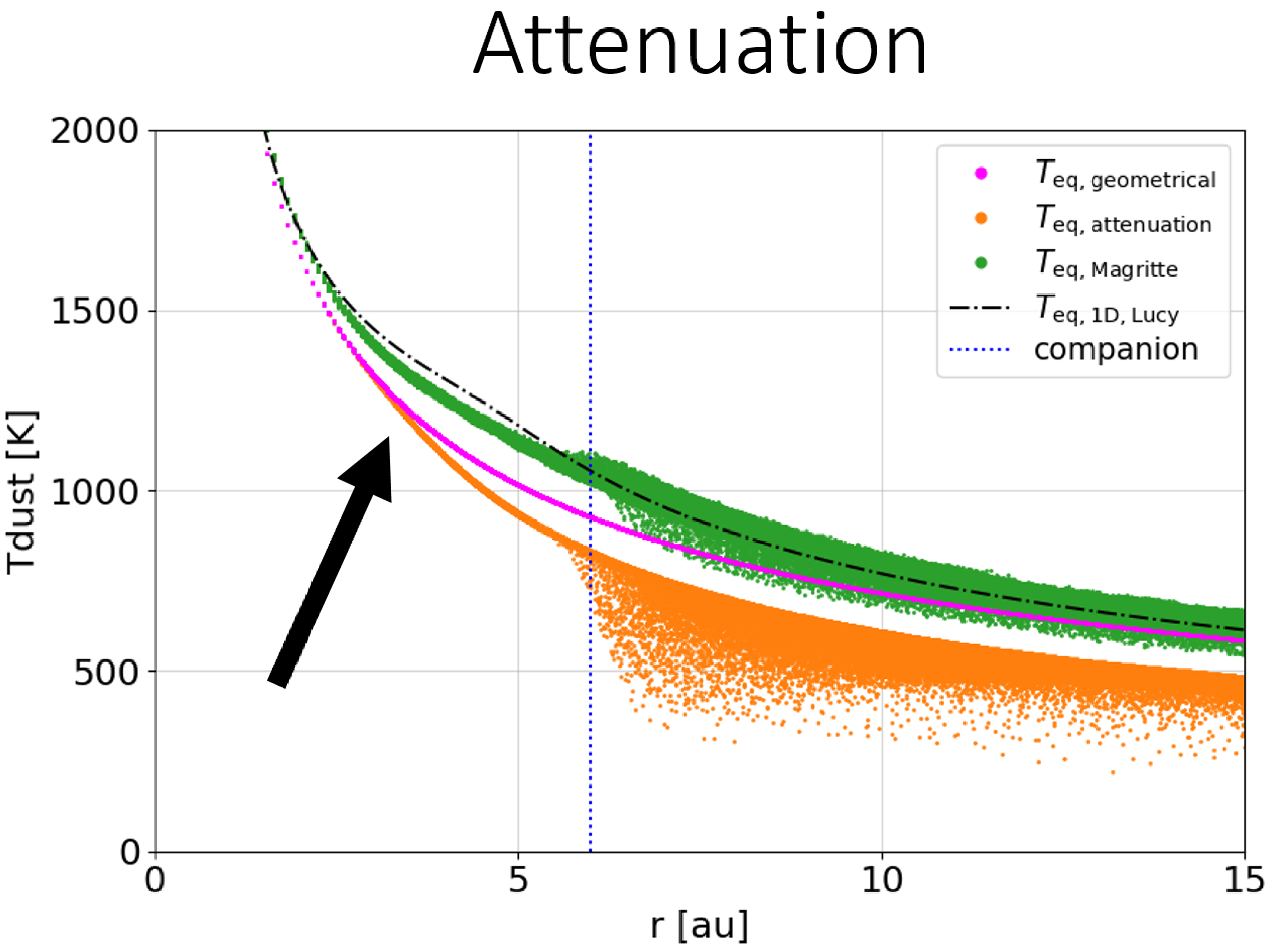

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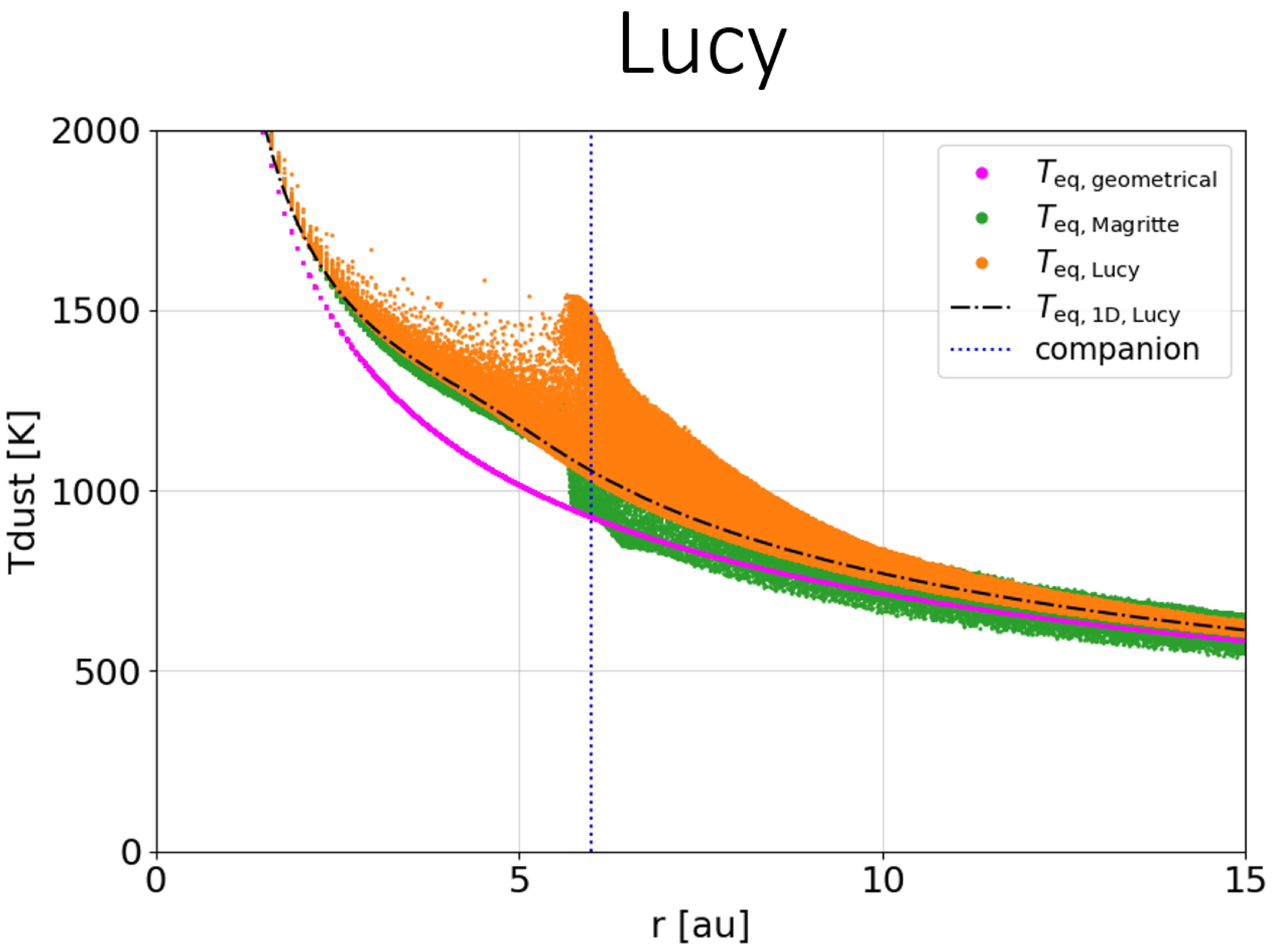
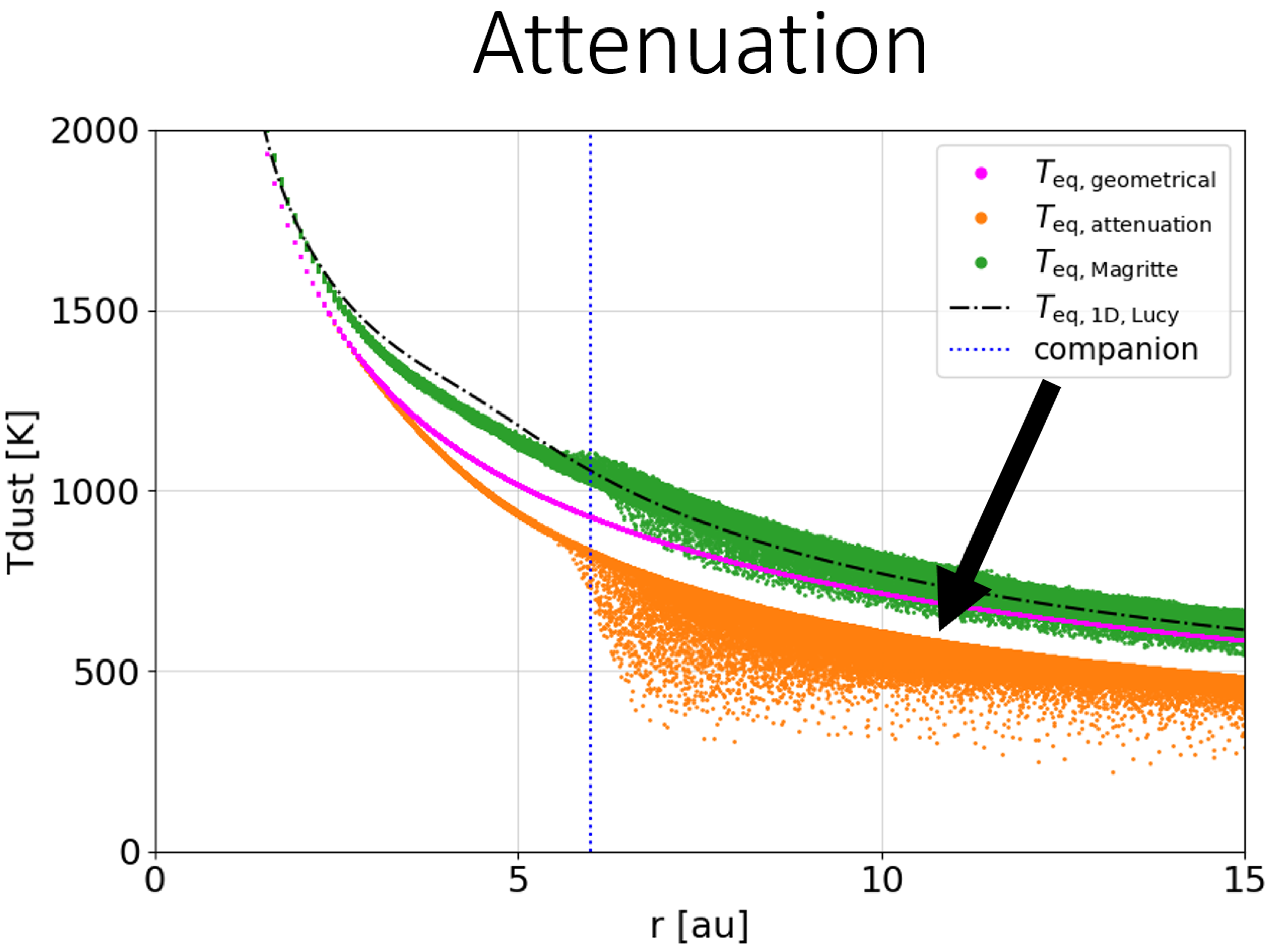
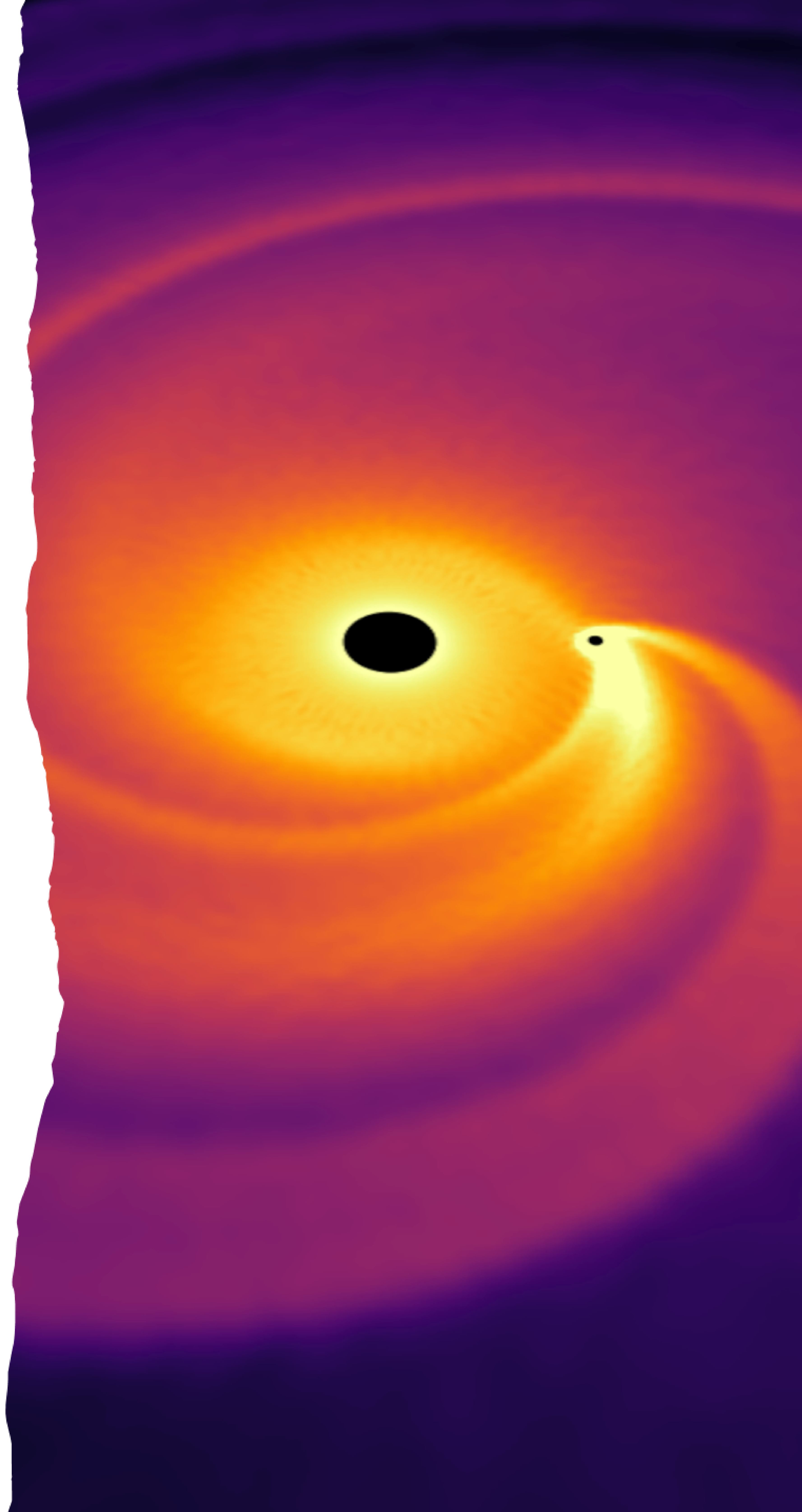




Conclusions

- Accounting for dust formation and radiative transfer is crucial in simulating AGB outflows
- The Lucy approximation provides the most accurate results, although it does not account for all effects



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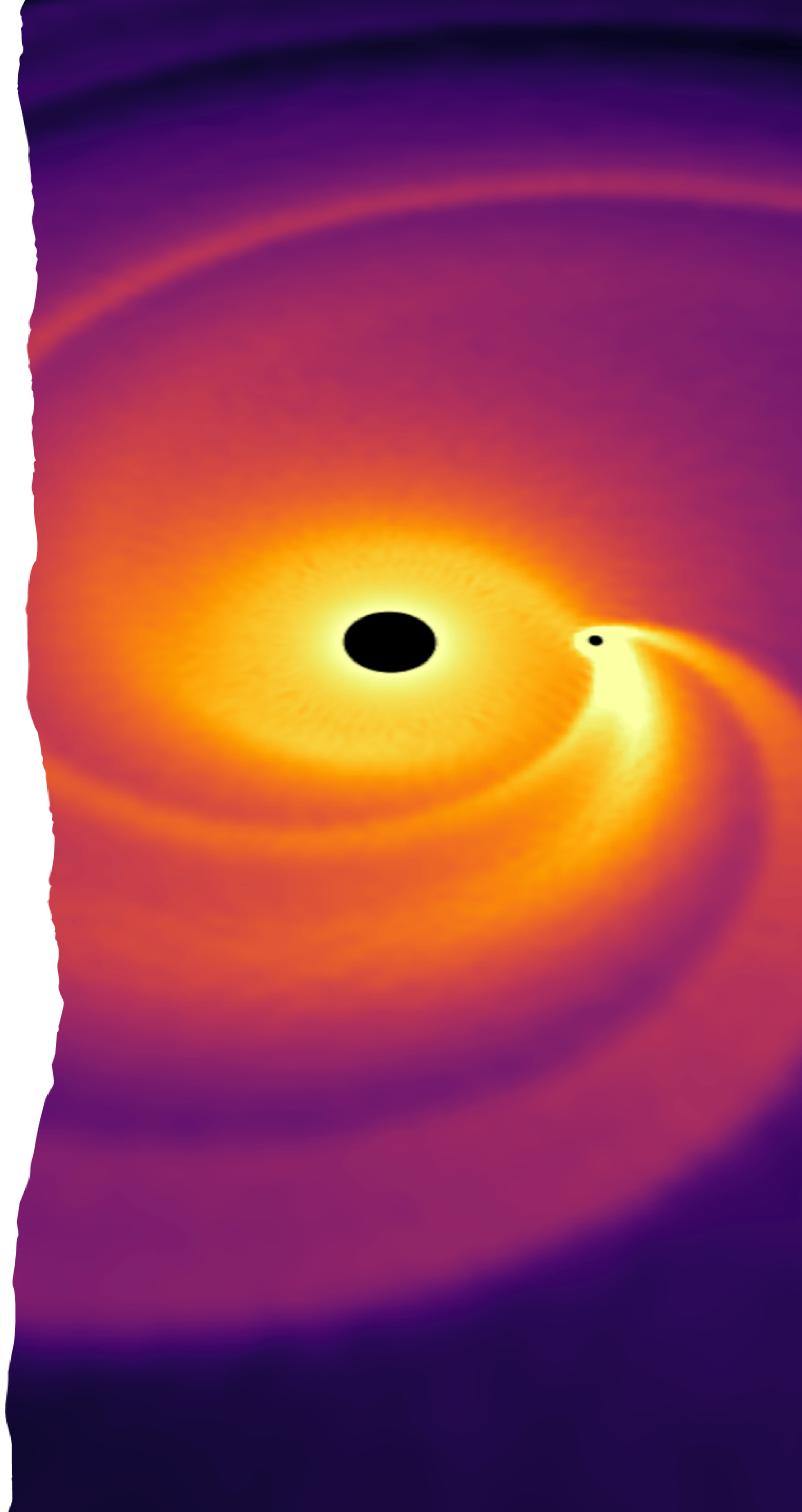

Outlook

- Cooling
  - H-cooling (Jolien Malfait)
  - More cooling (Lionel Siess)
- Pulsations
  - Follow Aydi & Mohamed (2022)
- Chemistry
  - Chemistry emulator (Silke Maes)

- Comparing models and observations