

# AstroBEAR AMR MHD Simulations of Planetary Wind Launching

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## Abstract

Using AstroBEAR, a 3D MHD fluid dynamics simulation code, we have developed a new platform on which to study the dynamics of planetary winds, including a variety of microphysics such as ionization heating, radiation pressure, and charge exchange. In this poster we present simulations using key new features such as the ability to self-consistently track the time-dependent deposition of stellar ionizing radiation into the planet's atmosphere and the inclusion of both radiation pressure and local ionization dynamics that allow us to track where in the flow neutrals can be accelerated. We present results from initial parameter space explorations of the wind launching versus planetary characteristics, as well as preliminary results from our study of the effects of radiation pressure.

## Computational Method

$$\frac{\partial \rho \mathbf{v}}{\partial t} + \nabla \cdot (\rho \mathbf{v} \otimes \mathbf{v}) = -\nabla p - \rho \nabla \phi + \mathbf{f}_R + \mathcal{F}_{rad}$$

$$\frac{\partial E}{\partial t} + \nabla \cdot ((E + p)\mathbf{v}) = \mathcal{G} - \mathcal{L}$$

$$\frac{\partial}{\partial t} + \nabla \cdot (\mathbf{v}) = \mathcal{R} - \mathcal{I}$$

$$\frac{\partial}{\partial t} + \nabla \cdot (\mathbf{v}) = \mathcal{I} - \mathcal{R}$$

Figure 1:

## Wind Properties

	Run1	Run2	Run3	Run4
Planet Mass	$M_p$	$0.07M$	$0.263M$	$0.263M$
Stellar Ionizing Flux	$F_0$	$2 \times 10^{13}$	$2 \times 10^{13}$	$2 \times 10^{14}$
Neutral Tail				
Ionization Shadow				
Wind Width				

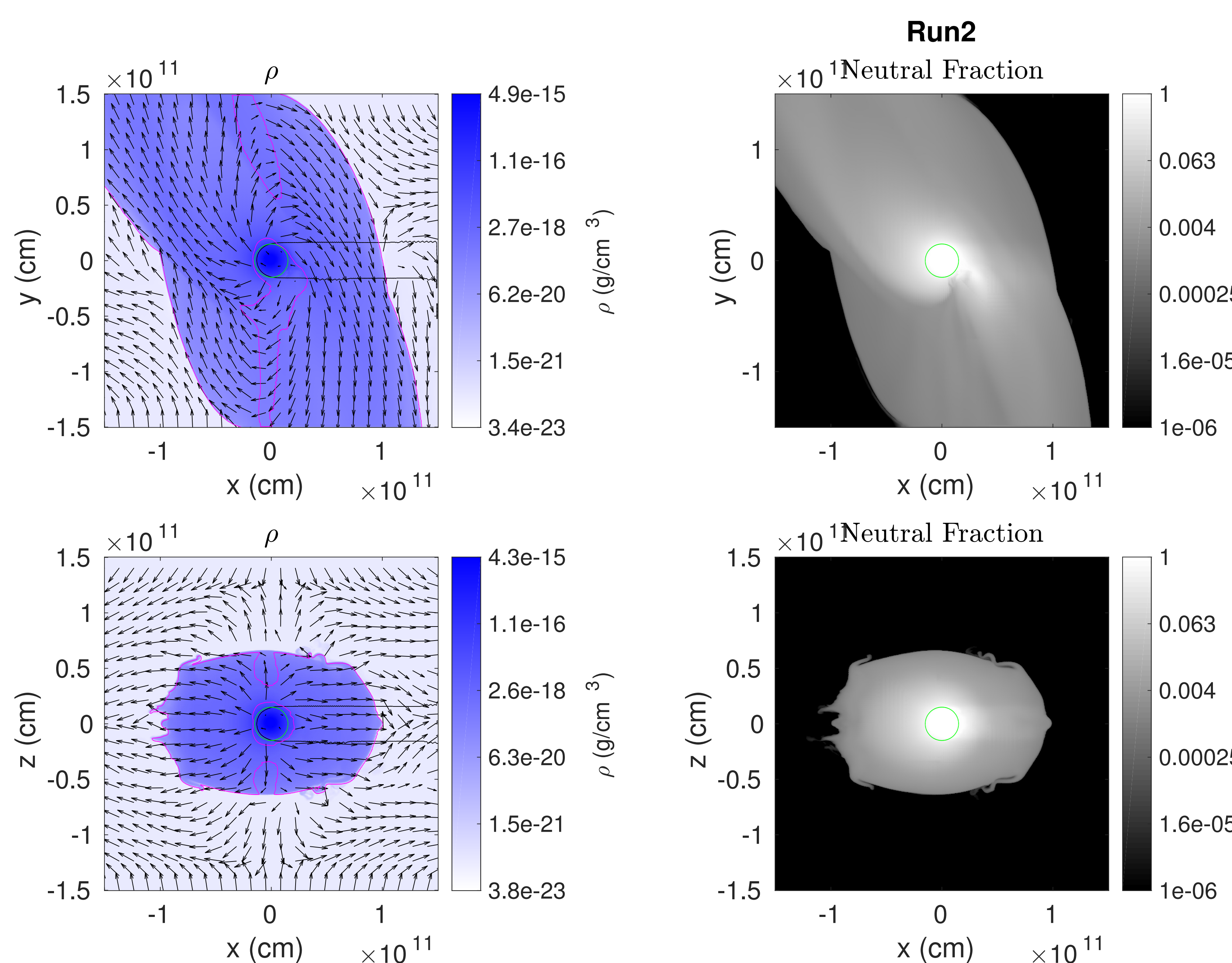
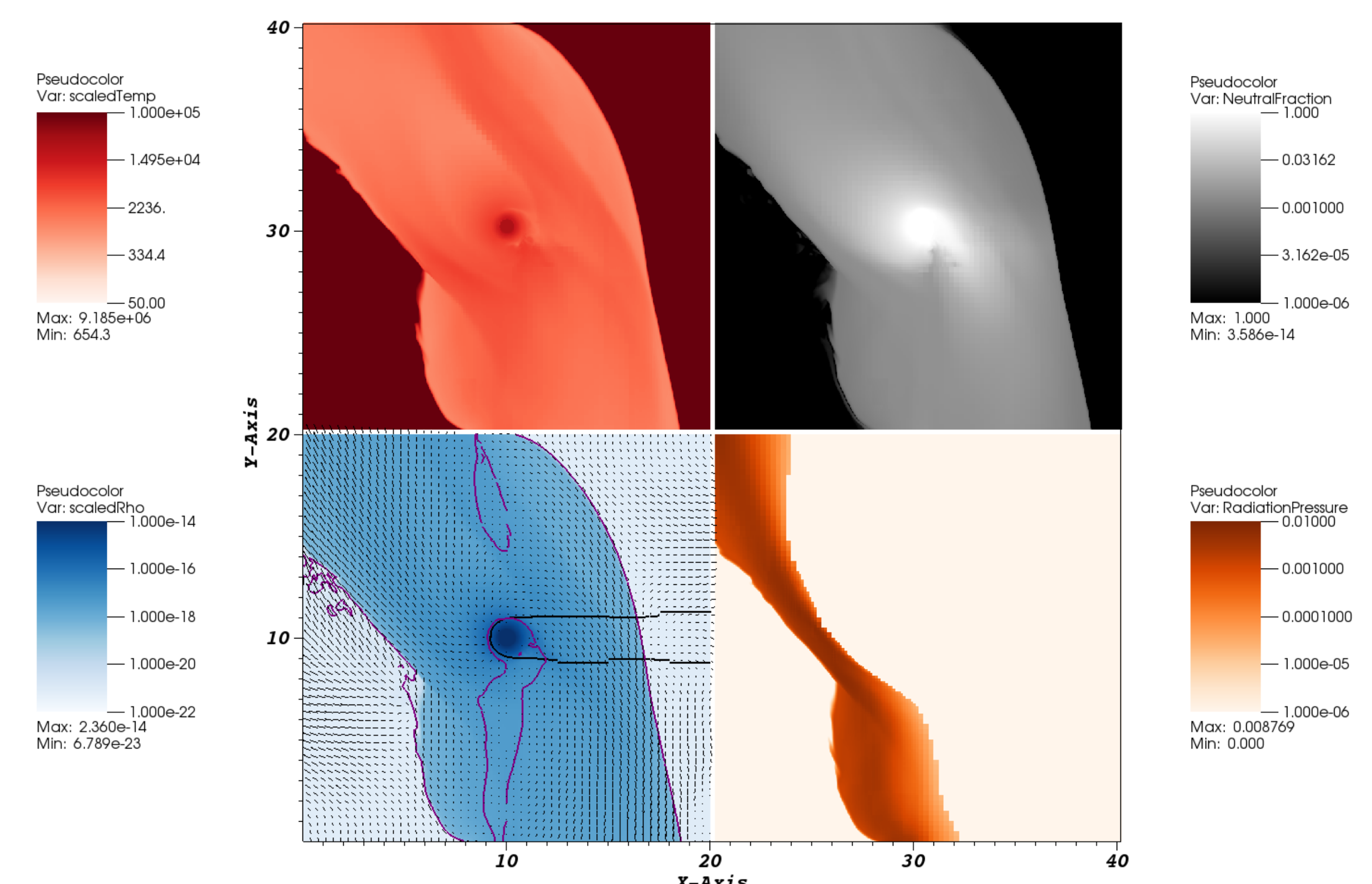


Figure 2:

## Conclusion

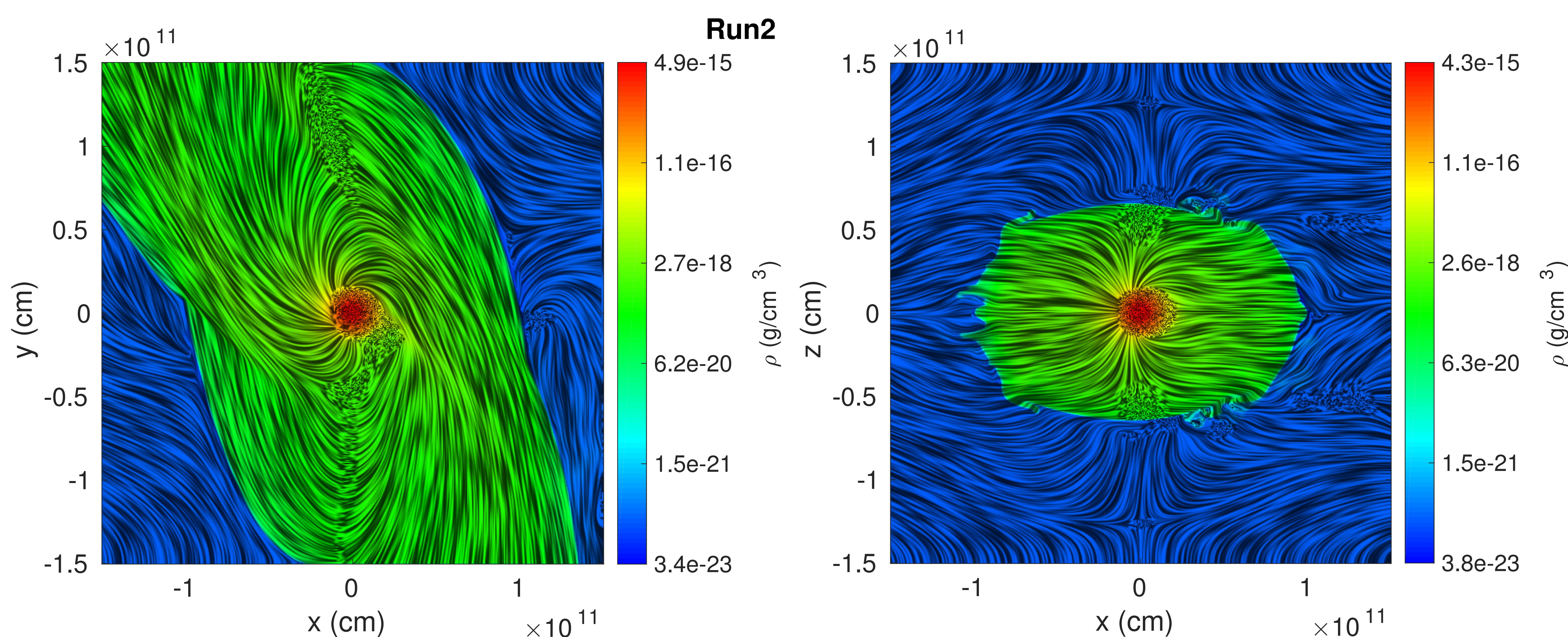
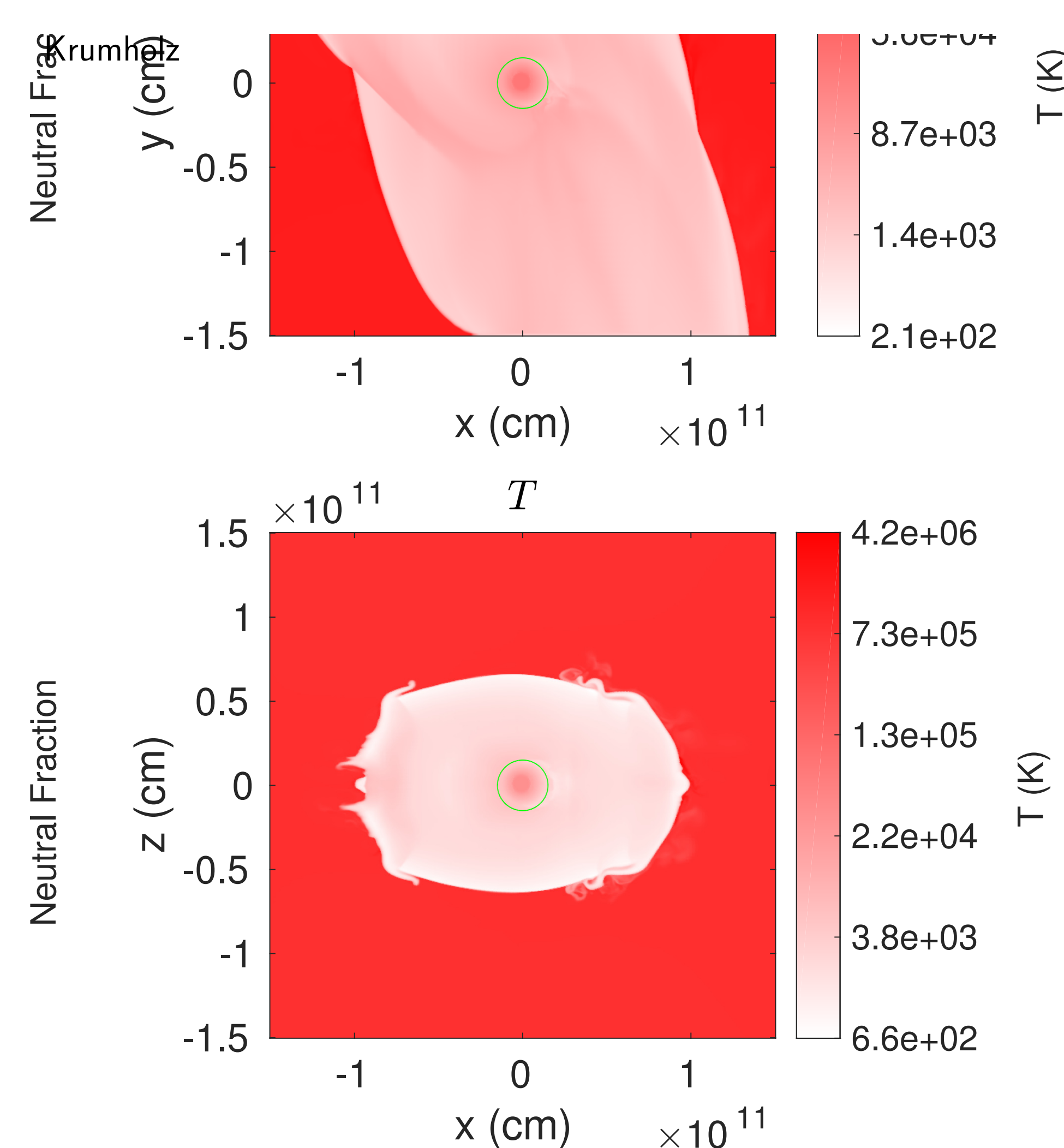


Figure 3: