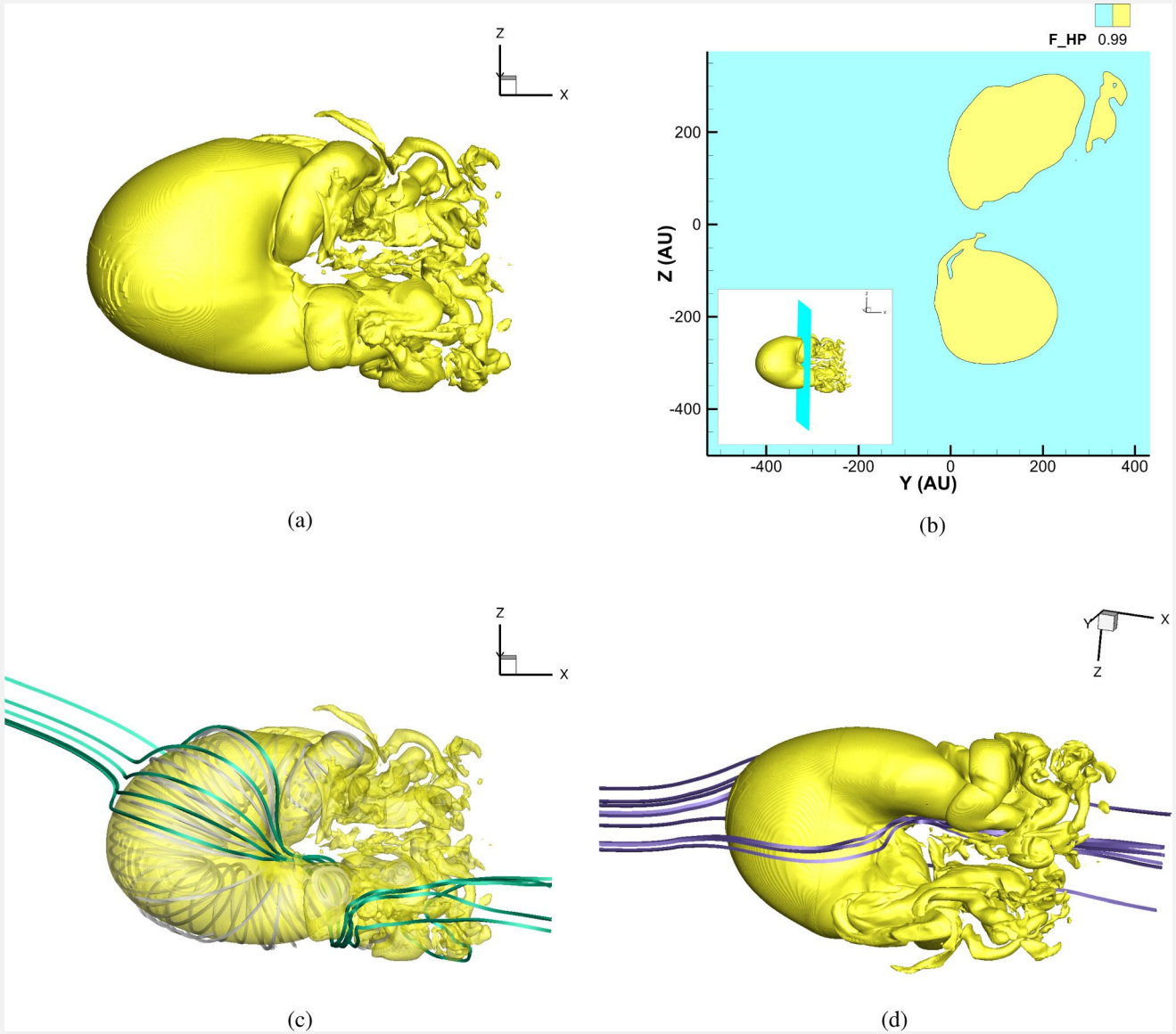
Exploring the Complex Heliotail Boundary by an Extended Level Set Approach

- The heliopause is an important transitional boundary which partly dictates the interplay between the solar wind and interstellar medium. The shape of the heliopause in the heliotail region is a highly debated topic. Computational models disagree on whether the heliotail shape is comet-like (long, continuous heliotail) or croissant-like (short, split heliotail).

- We revisit the croissant heliosphere model, employing a level-set method to define the heliopause in a more physically motivated way. The level-set method relies on the plasma velocity and density of the solar wind and interstellar medium to track the two unique fluids and determine the interface between them.

- We find that the level-set criterion, f_{HP} = 0.99 (shown right), optimally characterizes the heliopause in a way that captures the interstellar velocity field and magnetic field motion through the heliotail lobes and disentangles the “open heliosheath”: a region where solar wind and interstellar plasma are turbulent and mixed.

- This letter also explores other level-set criteria, f_{HP} = 0, 0.5, 0.75, demonstrating that different numerical choices can have a significant impact on the modeled heliotail shape. By highlighting this, we hope to encourage more discussion among modelers to unify how we define the heliopause.



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