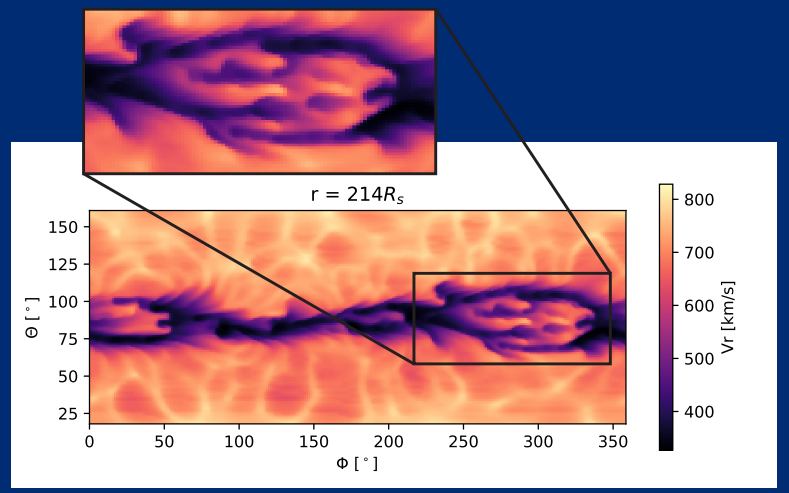
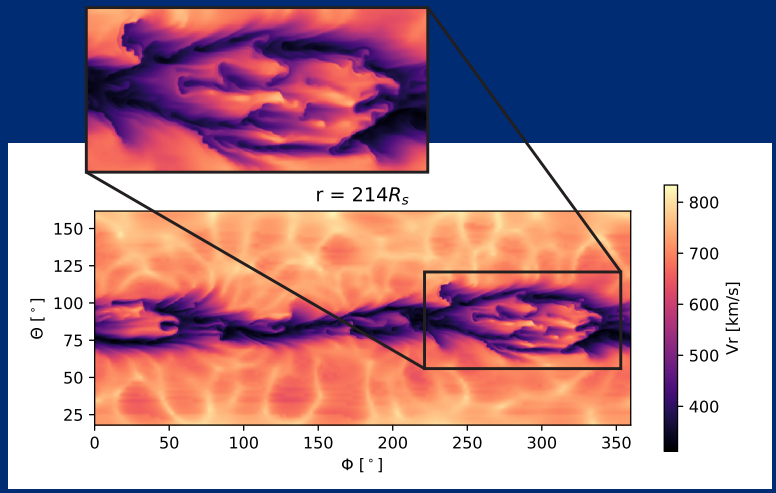
High-resolution Simulations of the Inner Heliosphere in Search of the Kelvin–Helmholtz Waves

- Kelvin-Helmholtz (KH) instability can be generated at velocity shears in plasmas. Whether such shears in the solar wind can be a source of in situ generation of turbulence and heating is an open question.
- Previous global models of the solar wind were unable to resolve mesoscale velocity shears and thus could not be used to address in situ generation of KH waves.
- We used the Grid Agnostic MHD for Extended Research Applications (GAMERA) model whose high resolving power, in combination with a highly refined spatial grid, allowed us for the first time to extend the simulation from global scales roughly into the first decade of the inertial range (down to ~ 1.5 × 10^5 km).



low-resolution



high-resolution (this work): shows the mesoscale structures that does not exist in the lower resolution simulation.

- Using this very high resolution simulation, we studied two types of solar wind velocity shears: radial and azimuthal. We found that radial shears, which dominate the global structure of the inner heliosphere, are stabilized by compressibility. However, smaller-scale azimuthal shears generated inside stream interaction regions can be potentially KH-unstable.

An exceedingly high resolution global simulation of the solar wind resolved for the first time mesoscale structure in the inner heliosphere. It showed that velocity shears could be Kelvin-Helmholtz unstable leading to solar wind turbulence and heating.

P. Mostafavi et al. (2022) Astrophysical Journal, DOI: 10.3847/1538-4357/ac3fb4