Anisotropic pickup ion distribution in the Heliosheath

Charge exchange between neutral atoms and solar wind ions creates pickup ions (PUIs), which are more energetic than typical solar wind ions and drive important physical processes in the heliosphere. Some of the PUIs are created locally within the heliosheath.

Science Question:

- How does the velocity distribution of locally created PUIs evolve in the heliosheath?

Methods:

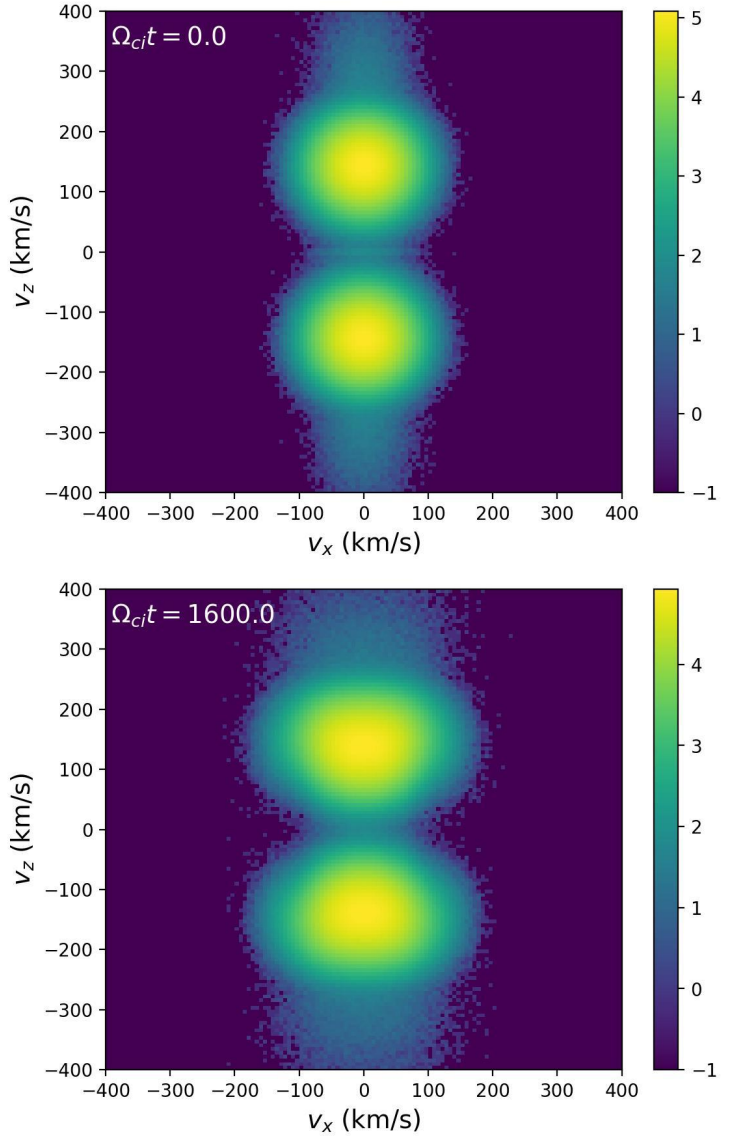
- Using hybrid kinetic simulations, which treat the ions as particles and the electrons as a fluid, we studied the evolution of a seed population of PUI's.

Results:

- The top image on the right shows the initial "ring" distribution of PUIs and the bottom shows the distribution later in time. The distribution evolves due to pitch angle scattering and flattens in the direction parallel to the magnetic field. However, pickup ions in the heliosheath can maintain a highly anisotropic pitch angle distribution.

Impacts:

- The anisotropy increases the number of particles moving perpendicular to the background magnetic field. This has implications for modeling energetic neutral atoms (ENAs) measured by Interstellar Boundary Explorer (IBEX).



Du et al. ApJL, [2025]; https://doi.org/10.3847/2041-8213/adbc9a