EGU21-77
https://doi.org/10.5194/egusphere-egu21-77
EGU General Assembly 2021

Measurement of the effective mean-free-path of the solar wind protons

Jesse Coburn[1], Christopher Chen[2], and Jonathan Squire[3]
[1]Physics and Astronomy, Queen Mary University of London, London, United Kingdom of Great Britain and Northern Ireland (jessecob13@gmail.com)
[2]Physics and Astronomy, Queen Mary University of London, London, United Kingdom of Great Britain and Northern Ireland (christopher.chen@qmul.ac.uk)
[3]Physics Department, University of Otago, Dunedin, New Zealand (jonathan.squire@otago.ac.nz)

The solar corona is heated and accelerated sufficiently to escape the gravitational bound of the sun into the interplanetary medium as a super-Alfvénic turbulent plasma called the solar wind. The Spitzer-Härm particle mean-free-path and relaxation time (i.e. to an isotropic Maxwellian distribution function) for typical solar wind proton parameters are large compared to the system size and therefore a non-collisional treatment of the plasma can be argued to be appropriate. Despite the long mean-free-path, large scales of the solar wind are fluid-like: density-pressure polarizations follow a polytropic equation of state. These observations suggest effective collisional processes (e.g. quasi-linear relaxation, plasma wave echo) are active, altering the equation of state from a non-collisional (or kinetic) to a polytropic equation of state (e.g. fluid magnetohydrodynamics [MHD]). We employ 13 years of high cadence onboard 0th-2nd moments of the proton velocity distribution function recorded by the Wind spacecraft to study the equation of state via compressive fluctuations. Upon comparison with a collisional kinetic-MHD dispersion relation solver, our analysis indicates an effective mean-free-path (collision frequency) that is [▯10^2] smaller (larger) than the typical Spitzer-Härm estimate. This effect is scale dependent justifying a fluid approach to large scales which breaks down at smaller scales where a more complex equation of state is necessary.