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Stochastic Heating of Protons in Low-β Fast Solar Wind Streams Near $r = 0.3$ AU

Sofiane Bourouaine and Benjamin D. G. Chandran
Space Science Center and Department of Physics, University of New Hampshire, Durham, NH 03824, USA
(s.bourouaine@unh.edu)

We use Helios-2 measurements to investigate whether stochastic heating by low-frequency AW/KAW turbulence is capable of explaining the perpendicular heating of proton near 0.29 AU. We analyze magnetic-field measurements in low-β fast-solar-wind streams to determine the rms amplitude of the fluctuating magnetic field, δB_ρ, near the proton gyroradius scale ρ. We then evaluate the stochastic heating rate $Q_{\perp\mathrm{stoch}}$ (which is given by a previously published analytical formula) using the measured value of δB_ρ . After the estimation of the 'empirical' perpendicular heating rate of proton $Q_{\perp\mathrm{emp}}$ near $r = 0.29$ AU, we find that $Q_{\perp\mathrm{stoch}} \sim Q_{\perp\mathrm{emp}}$, but only if the two dimensionless constants appearing in the formula for $Q_{\perp\mathrm{stoch}}$ lie within a certain range. This range is consistent with the results of numerical simulations of the stochastic heating of test particles in reduced magnetohydrodynamic turbulence, consistent with the hypothesis that stochastic heating accounts for much of the perpendicular proton heating occurring in low-β fast-wind streams at $r \sim 0.3$ AU.