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Electron Velocity Distribution Function in Magnetic Clouds in the Solar Wind

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We present a study of the kinetic properties of the electron velocity distribution functions within magnetic clouds, since they are the dominant thermal component. The study is based on high time resolution data from the GSFC WIND/SWE electron spectrometer and the Berkeley/3DP electron plasma instrument. Recent studies on magnetic clouds has shown observational evidence of anti-correlation between the total electron density and electron temperature, which suggest a polytrope law $P_e = \alpha N_e^{\gamma}$ for electrons with the constant $\gamma \approx 0.5 < 1$. This anti-correlation and small polytropic γ-values is interpreted in the context of the presence of highly non-Maxwellian electron distributions (i.e. non-thermal) within magnetic clouds. These works suggested that the non-thermal electrons can contribute as much as 50% of the total electron pressure within magnetic clouds. We have revisited some of the magnetic cloud events previously studied and attempted to quantify the nature of the non-thermal electrons by modeling the electron velocity distribution function using a kappa distribution function to characterize the kinetic non-thermal effects. If non-thermal tail effects are the source for the anti-correlation between the moment electron temperature and density and if the kappa distribution is a reasonable representative model of non-thermal effects, then the electron velocity distribution within magnetic clouds should show indication for small κ-values when $\gamma < 1$.