Phase-Steepened Alfvén Waves, Proton Perpendicular Energization and the Creation of Magnetic Holes and Magnetic Decreases: The Ponderomotive Force

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Abstract. Solar wind protons detected within Magnetic Holes (MHs) and Magnetic Decreases (MDs) are found to be preferentially heated perpendicular to $\vec{B}_0$. The MHs/MDs are associated with the phase-steepened edges of nonlinear Alfvén waves. The proton anisotropies can lead to the proton cyclotron and mirror mode plasma instabilities. We examine the Ponderomotive Force (PF), a phenomenon due to wave pressure gradients, and show that for this plasma regime and for phase-steepened Alfvén waves, the PF proton acceleration/energization will primarily be orthogonal to $\vec{B}_0$. It is suggested that accelerated ions create the MHs/MDs by a diamagnetic effect