FLUID MODEL SIMULATIONS OF 2D ALFVÉN WAVE SOLITON STRUCTURES IN A 3D ELECTROMAGNETIC PLASMA*

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The Alfvén wave is a fundamental propagation mode in plasmas. Such waves are hydromagnetic in nature, occurring as fluid perturbations in plasmas under a magnetic field which drive them along the field lines. Related coherent nonlinear structures such as solitons can also occur in such plasmas and can be similarly driven by the magnetic field.

We illustrate the formation and time-evolution of these nonlinear structures by employing a model based on the complete mass, momentum and energy conservation equations for a two-fluid, three-dimensional plasma under electromagnetic fields. A recently developed code[1] based on a high-resolution finite difference scheme[2] is then used to study the formation and evolution of solitary wave structures restricted to propagation in the 2D plane.

The model equations are first written in conservation form with source terms, and together with appropriate initial and boundary conditions, they are numerically integrated in time as outlined in the previous work[1]. For chosen magnetic field directions and initial Gaussian density perturbations, we illustrate how solitary waves evolve and travel at speeds close to the Alfvén velocity in directions aligned to the field.

To obtain these results we have improved on the absorbing boundary conditions used before[1] and can thus illustrate in particular, that large-scale long-duration fluid simulations can be carried out conveniently as "black-box" integrations for the study of nonlinear wave propagation in complex plasma models.

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2. J. Balbas, E. Tadmor and C.C. Wu, "Non-Oscillatory Central Schemes for One- and Two-Dimensional Equations I.", *J. Comput. Phys.* (2004), vol. 201, pp. 261-285.

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