SOLITARY WAVE PROPAGATION IN SOLAR FLUX TUBES

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The aim of the present work is to investigate the excitation, time dependent dynamic evolution and interaction of nonlinear propagating (i.e. solitary) waves on vertical cylindrical magnetic flux tubes in compressible solar atmospheric plasma. The axisymmetric flux tube has a field strength of 1000 G at its footpoint what is typical for photospheric regions. Nonlinear waves, that develop into solitons, are excited by a footpoint driver. The propagation of the nonlinear signal is investigated by solving numerically a set of fully nonlinear 2.0D MHD equations in cylindrical coordinates. For the initial conditions axisymmetric solutions of the linear dispersion relation for wave modes (in the present case we focus on the sausage mode only) in a magnetic flux tube are applied. The dispersion relation is solved numerically for a range of plasma parameters. We found two solitary solutions by solving the full nonlinear MHD equations. First, we investigate the nonlinear wave propagation with external sound speed in the current geometry. Next, we investigate a solitary wave propagating close to the tube speed found also in the numerical solution. In contrast to previous analytical of numerical studies, here no approximations were made to find the solitary solutions. A natural application of our studies may be spicule formation in the chromosphere, as suggested by Roberts (1982), where it was demonstrated theoretically, that a solar photospheric magnetic flux tube may support the propagation of solitons governed by the Benjamin-Ono (slow mode) equations in slab geometry.