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Alfven wave resonance in density profile structure and the effect for nonlinear phenomenon

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Wave transport in plasma (e.g. Alfven wave) is a universal phenomenon for astrophysical fluid which is effected by electromagnetic force. Presence of

density structure in plasma causes these wave reflection, and prevents smooth transport for one direction. However, it is known that if the density structure is like square well form, Alfven wave is trapped in the structure and wave reflection does not occur. It seems that this wave trapping is a ordinary case and concerns with physical phenomenon, because density valley usual exist in plasma. For example, it is pointed out that Alfven wave energy is dissipated at low-density area which is located in surface of the sun, and this mechanism is relate to coronal heating.

At linear phase, we can understand analytically the property of Alfven wave transport on square well density profile. Therefore, we can also understand the condition that wave trapping and no reflection occurs. At this phase, the flow is well-regulated and steady state, and compressibility effect (e.g. pressure or density vary) doesn't appear because Alfven wave is essentially transverse wave. However, as the wave injection continues, the amplitude increases and nonlinear effect turns important. At this phase, the flow is complicated due to trapped wave's collision, and square well density profile can not keep the form. As a result, the resonance condition will change voluntarily. This density profile is universal in the plasma gas, so above physical mechanism is important for understanding plasma phenomenon.

In our numerical simulation, we pay attention voluntarily structural change due to linear phase shift to nonlinear phase. Consequently, the linear phase resonance condition directly affects the time evolution in nonlinear phase. We will introduce the result.