§29. Large Amplitude Langmuir and Ion-Acoustic Waves in a Relativistic Two-Fluid Plasma

Nejoh, Y. (Hachinohe Inst. Tech.)
Sanuki, H.

The purpose of this study is to show the 3−D pseudopotential for a relativistic two−fluid plasma, to exhibit the possibility of the existence of novel solutions of nonlinear Langmuir and ion−acoustic waves.

We consider an unmagnetized, collisionless relativistic two−fluid plasma consisting of the hot and isothermal electrons and ions. We assume the electron and ion flow velocities are relativistic and do not take into account kinetic effects.

a) *Relativistic Langmuir waves*

We derive the pseudopotential of the Langmuir waves and show the 3−D bird's eye view. By the consideration of the relativistic effect, we illustrate the existence region of large amplitude relativistic Langmuir waves in Fig.1. Large amplitude Langmuir waves can propagate in region *A*.

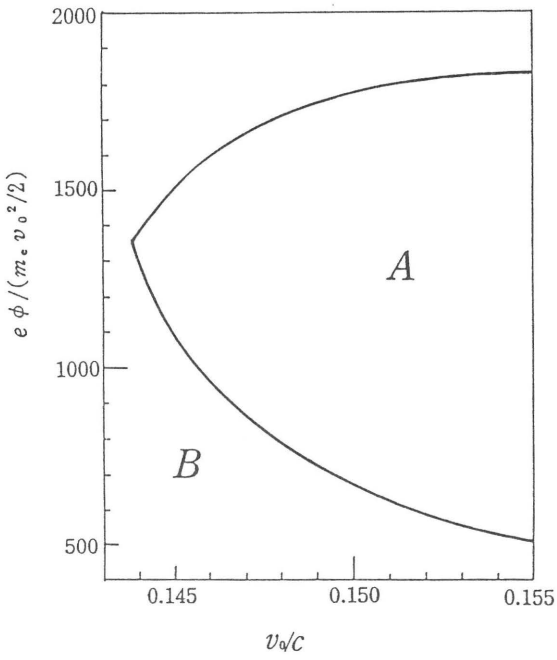

Fig.1. The existence region of large amplitude relativistic Langmuir waves

b) *Relativistic ion−acoustic waves*

In order to obtain pseudopotential for ion−acoustic waves, we show a bird's eye view of the pseudopotential in the range of $0.1 < \Phi < 0.8$ and $1.2 < M < 1.58$. Figure 2 shows the allowable region of nonlinear ion−acoustic waves depending on the potential Φ and the Mach number M. Ion−acoustic waves exist in region *A*.

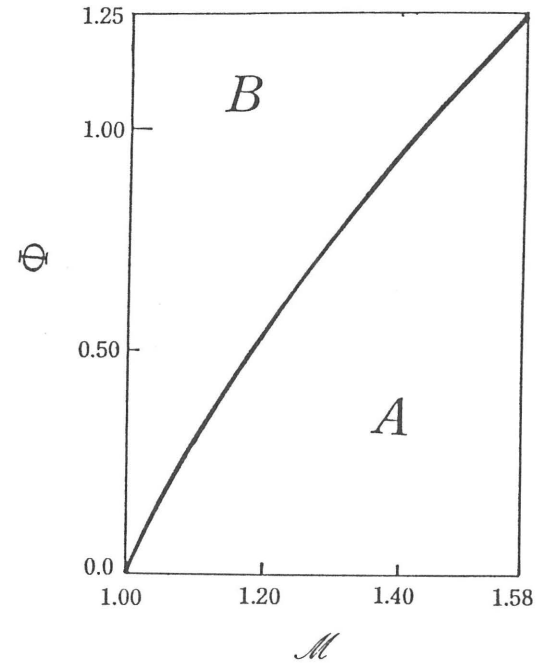

Fig.2. The existence region of large amplitude ion−acoustic waves.

Conclusion

The existence conditions for large amplitude relativistic Langmuir waves strongly depend on the relativistic factor v_0/c and the mass ratio m_i/m_e, where v_0 and c are the electron flow velocity and the light velocity. The existence region of large amplitude ion−acoustic waves sensitively depend on the Mach number rather than the relativistic effect. Therefore, this investigation predicts [1] new findings on large amplitude relativistic Langmuir and ion−acoustic waves in plasmas.

References

1. Nejoh,Y., and Sanuki,H. Phys. Plasmas 1 (1994) (in press).