

## Competition Between the Mirror Instability and the L-Mode Electromagnetic Ion Cyclotron Instability

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Spacecraft observations show that the mirror instability dominates over the L-mode electromagnetic ion cyclotron (EMIC) instability in planetary magnetosheaths, although the theoretical linear growth rate of the L-mode EMIC wave is higher than that of the mirror mode waves. This has been a long-standing puzzle. To analyze the competing processes between the L-mode instability and the mirror instability, we performed both 2D and 3D hybrid simulations, assuming anisotropic energetic ions. In the 2D model, the energy of the L-mode wave is higher at the initial stage because its linear growth rate is larger than that of the mirror mode. However, in the 3D simulation, we find that the mirror mode wave can consume more free energy than the L-mode wave at the initial state of wave growth. The growth of the L-mode EMIC waves declines earlier in the 3D model than that in the 2D model, due to efficient proton scattering by the mirror mode waves. The L-mode EMIC waves are subject to inverse-cascading in the 1D and 2D models, while this is not the case in the 3D model. In the latter model runs, the amplitude of EMIC waves is not strong enough to cause the decay instability. The L-mode EMIC waves in the 3D model are damped by the nonlinear trapping of resonant particles instead. We also find that the nonlinear evolution of the mirror waves in the 3D model is significantly different from that in the 2D model. Although coalescence of the mirror mode structures takes place in both models, in the 2D case, the coalescence proceeds slowly, while in the 3D case coalescence is much more rapid. Because of this rapid change, electric fields are induced, and the energy of the electromagnetic fields is converted to the thermal energy of particles. To know the detail of the competition and the nonlinear processes, we performed simulations with high spacial resolution. We analyzed the inverse-cascading process of L-mode EMIC waves in the 2D model.