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Dust charge fluctuations effect on the lower hybrid instability in a tokamak

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In the present study, the effect of dust particles on the excitation of lower hybrid instability prompted by the injected transverse neutral beam in a tokamak with magnetic shear is studied. The origin of dust in the tokamak lies in the disruptions and its presence can considerably change the properties of tokamak plasma. Many researchers have tried incorporating the effect of fluctuating charges on the wave propagations and have found several interesting result. Dust particles in a tokamak having high Z impurities like tungsten can become radioactive when come into contact with tritium. Therefore, this type of dust present in the tokamak can spread serious health problems. Similarly, dust having large surface area can act as a catalyst or due to its chemical activity; it increases the risk of explosion. The lower hybrid mode is evanescent in the inner and outer region while propagating waves in the intermediate region. The neutral beam, on getting fully ionized in the plasma, resonantly couples with the lower hybrid wave in the intermediate region, driving the mode unstable. During the major disruption in a tokamak, it is possible to see that the ions are accelerated across the magnetic field. Such an acceleration can takes place if during disruption some ion-cyclotron instability[1-3] is excited. Moreover, the effect of dust grains, their nature, density and size on the instability growth is theoretically observed and presented in the study which shows that the growth rate of lower hybrid instability scales as one third power of beam density and increases significantly with the sheared magnetic field due to modification in the parallel wave number and the mode structure. The growth rate is found to be increased with the dust grain density while decreased with increasing the size of dust grains as illustrated by Figure 1. The theory present in this study can be very useful in describing the complexity generated due to interaction of tokamak plasma with dust grains that are responsible for the decreased efficiency and performance of the device.

References

[1] R.E. Waltz, W. Pfeiffer and R. R. Dominguez, Plasma Phys. **20**, 43(1980).

[2] Chunshi Cui and J. Goree, Fluctuat,IEEE Transactions on Plasma Science **22**, 143 (1994).

[3] Stefano Atzeni, Angelo Schiavi and Mauro Temporal, Plasma Phys. Control. Fusion **46 B**, 111 (2004).

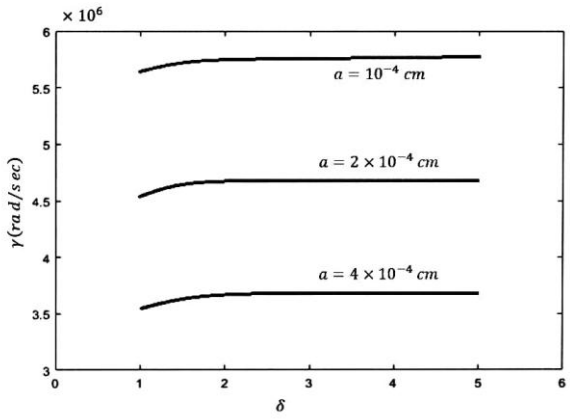

Fig. 1: Variation of growth rate as a function of dust grains size a.