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Numerical study of the penetration of a fast-moving particle at the interface of a three-dimensional binary complex plasma

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A complex plasma is a weakly ionized gas containing small solid particles. Using video microscopy, localized structures and dynamics can be directly recorded in the experiments. A binary complex plasma contains two differently sized microparticles. It was discovered that phase separation can still occur due to the imbalance of forces under microgravity conditions despite the criteria of spinodal decomposition not being fulfilled. An interface between separated phases emerges and various interfacial phenomena are investigated [1,2].

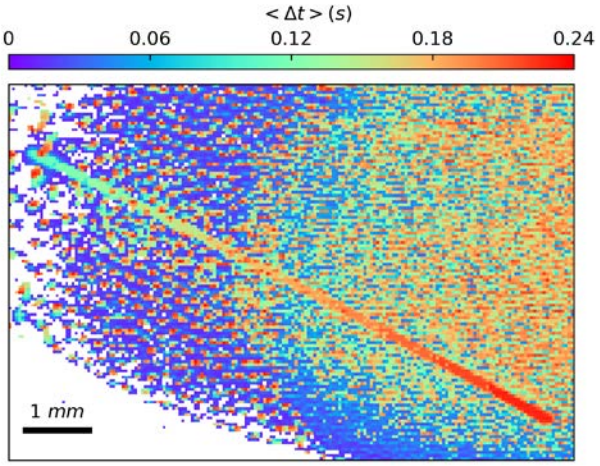

Figure 1 Trajectory of a supersonic particle observed in PK-3 Plus laboratory on board the ISS.

In this talk, we present a study on the penetration of a supersonic particle at the interface of a binary complex plasma [3]. This study was inspired by the experiments performed in the PK-3 Plus Laboratory on board the International Space Station (ISS), as shown in figure 1. We performed a series of Langevin dynamics simulations to investigate the dynamics of the penetration procedure.

As results, Mach cone structure behind the fast-moving particle was observed, where a kink of the lateral wake front was observed at the interface. By comparing the evolution of axial and radial velocity, we show that the interface solitary wave is non-linear. The dependence of the background particle dynamics in the vicinity of the interface on the penetration direction reveals that the disparity of the mobility may be the cause of various interface effects.

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