Interaction of a supersonic particle with a three-dimensional complex plasma

E. Zaehringer[1,3], M. Schwabe[1], S. Zhdanov[1], D. P. Mohr[1], C. A. Knapek[1], P. Huber[1], I. L. Semenov[2], and H. M. Thomas[1]
[1] Deutsches Zentrum für Luft- und Raumfahrt (DLR), D-82234 Weßling, Germany
[2] Leibniz-Institut für Plasmaforschung und Technologie e.V, Greifswald, Germany
[3] erich.zaehringer@dlr.de

The Ekoplasma setup is developed as next generation plasma chamber for future investigation of complex plasmas on the International Space Station. In this contribution the setup is used during the 29th DLR parabolic flight campaign to study the influence of a supersonic projectile on a three-dimensional complex plasma. Micron sized particles formed a large undisturbed system in the "Zyflex" chamber during microgravity conditions. A Mach cone with a double Mach cone structure was excited by a supersonic probe particle with Mach number $M \approx 1.5-2$ in the large weakly damped particle cloud. The sound speed is measured with different methods and particle charge estimations are compared to the calculations from standard theories. High image resolution enabled the study of the Mach cone on the single particle level and gives insight to the dynamics. We discovered a heating of the microparticles behind the supersonic projectile but not in the flanks of the Mach cone. The heating is connected to different waves of the double Mach cone structure.

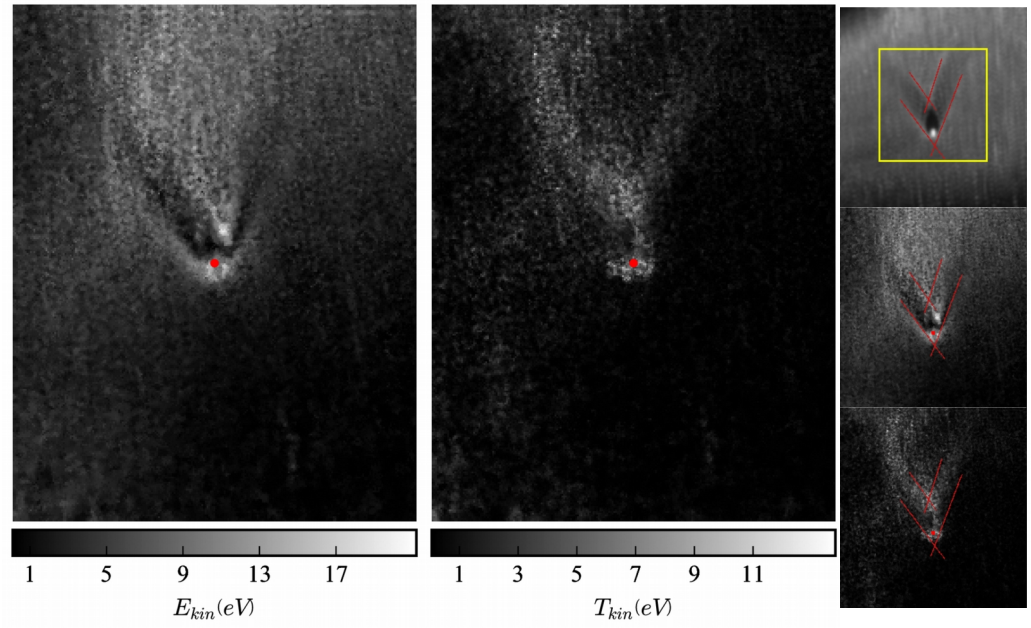

Figure 1 – Effect of the supersonic particle on the kinetic energy (left) and kinetic temperature distributions (middle) in the microparticle cloud. (right) The double Mach cone structure is indicated by red lines and the position of the probe particle by a red dot for blurred overlay (top), energy (middle) and temperature (bottom). Note that the heating occurs mainly behind the supersonic particle and not in the waveshock fronts of the first Mach cone.

This work and some of the authors are funded by DLR/BMWi (FKZ 50WM1441).