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THE SOFT MATTER DYNAMICS EXPERIMENT FOR THE ISS

Abstract

Soft Matter Dynamics is an experiment platform developped under ESA contract to enable a variety of soft matter experiments with extended micro gravity time. It is launched to the ISS with SpaceX-15 and part of ESA's astronaut Alexander Gerst Horizons mission.

The Soft Matter Dynamics experiment platform provides optical microscope, single and multi speckle diffusing wave spectroscopy, supporting also time resolved correlations, to investigate primarily dynamics inside and on the surface of opaque but translucent materials. The experiment platform can be extended with on-orbit replaceable science cartridges. These are smart inserts that can include not only new materials but also custom agitation mechanisms, sensors and thermalisation, thereby expanding the science goals of the mission. The initial research are non-equilibrium dynamics in dense granular media and coarsening of wet foams. Potential future experiments include for instance coarsening of emulsions and rheology of foams and emulsions.

Details on the instrument performance and first observations will be presented. The long time stable micro gravity conditions, high data bandwidth, large power and heat dissipation provided to experiments on the ISS allow to perform extended experiment sessions, large parameter variation studies and on orbit data processing. This enables two important advances in laboratory research of soft matter: derivation of macroscopic properties from fundamental causes via parameter separation and true observational science. Especially the latter is a huge opportunity of extended microgravity experiment time, giving scientists the chance to find unexpected behaviour, adapt and refine the experiment, and thereby gain new (unintended) insights.

Soft matter are materials that on the one hand are used in many industrial processes, are well understood empirically and have interesting future potential, for instance as design materials. On the other hand soft matter is a primary research candidate for investigations on non-equilibrium thermodynamics, phenomena at the critical point or rheology, like jamming and glass transitions. Fundamental research under gravity conditions is generally limited by the macroscopic softness of these materials, i.e., most of the internal processes are hidden by gravity induced dynamics and stresses.