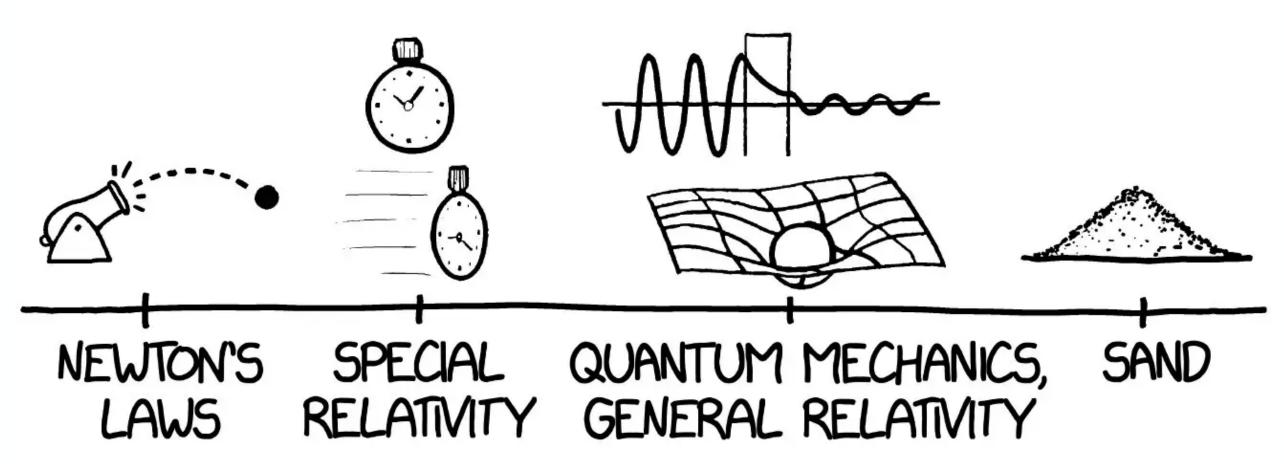
Light Scattering from Granular Media on Ground and in Space

Jan Philipp Gabriel, Christopher Mayo, Marlo Kunzner and Matthias Sperl

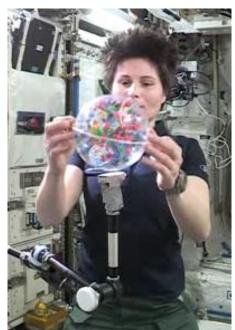
ESA Exploration Science Workshop 2024 – Warsaw, Poland



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Granular Matter in Space





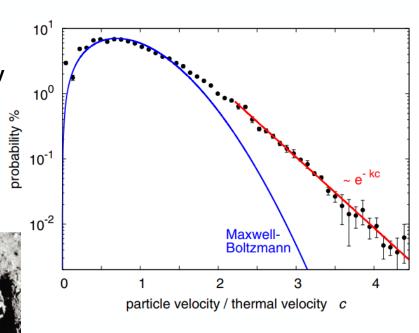


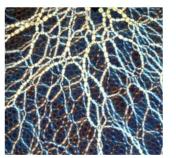
- Granular Gases, μg to counter sedimentation → sounding rocket; orbital platform; MEGraMa
- Granular Fluids, μg to counter inhomogeneity and anisotropy → light scattering: drop tower; parabolic flight; ISS, SoMaDy
- Granular packings, μg to counter pressure gradients → sound: ISS, GraSCha; VipGran: AIGE; rheology
- Applications of granular matter in space, e.g. Moon → Concrete Solidification (MASON), Sintering (RegoLight.eu)

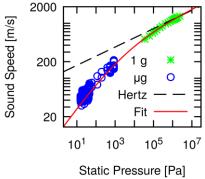












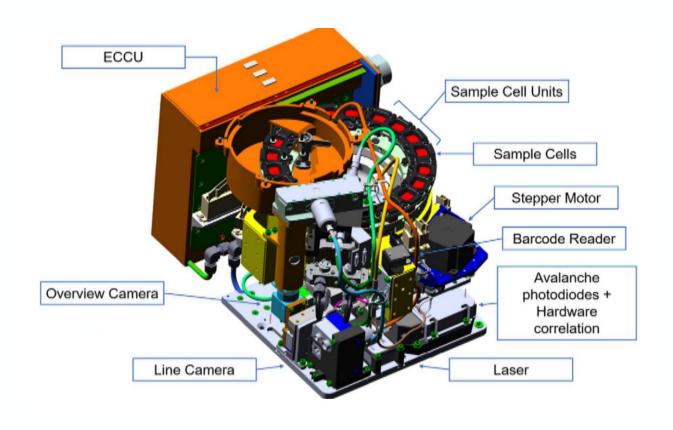


Soft Matter Dynamics Module (SMD)



Foams - Emulsions - Grains





Born, et al., Rev. Sci. Instrum. (2021).

Samples



 Dense dissipative system with a soft pulsed agitation

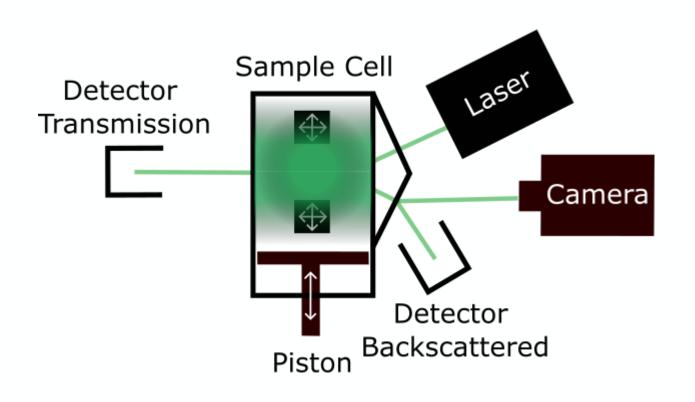
Non-Ergodic

140µm polystyrene spheres

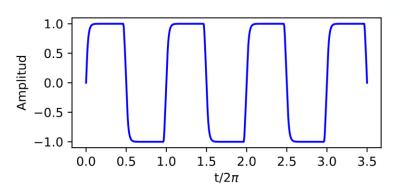


Four Piezo Agitation

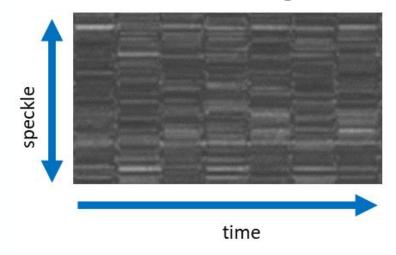




Agitation Profile

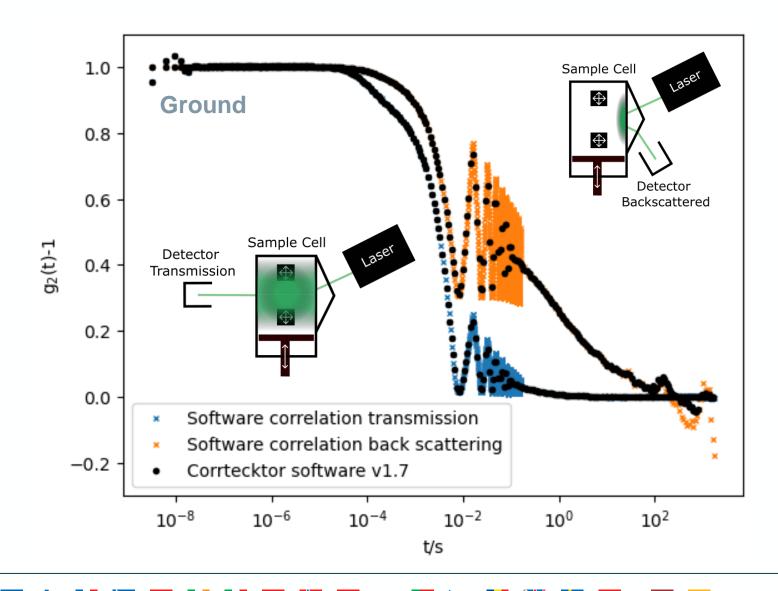


Line Camara Image



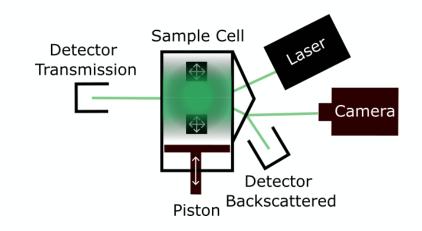
Transmission and Backscattering

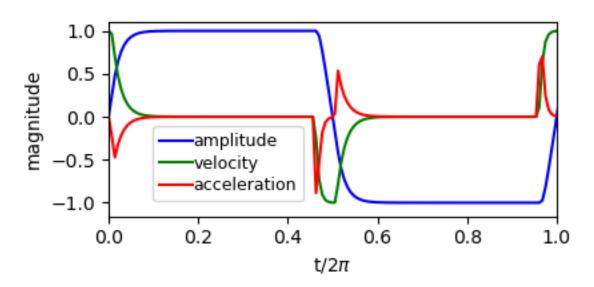


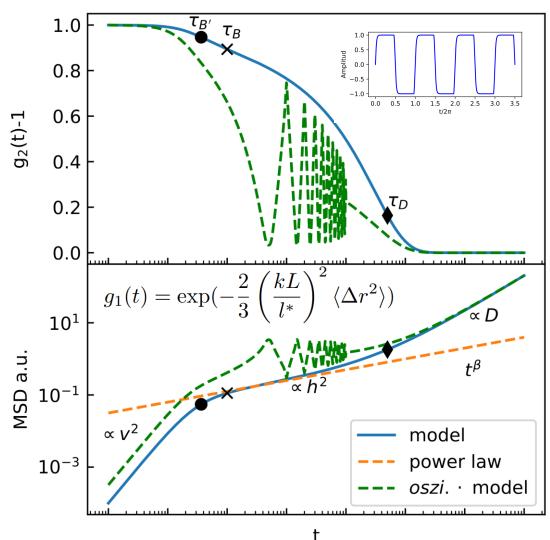


Modelling Piezo Agitation



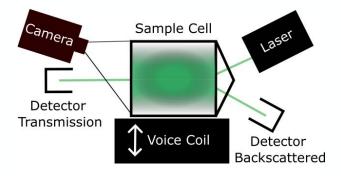


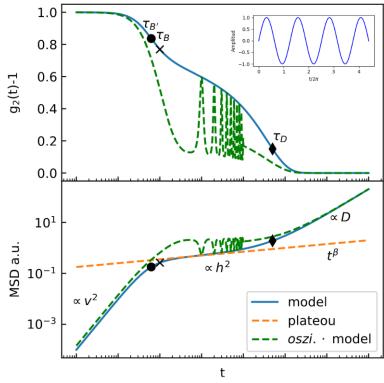


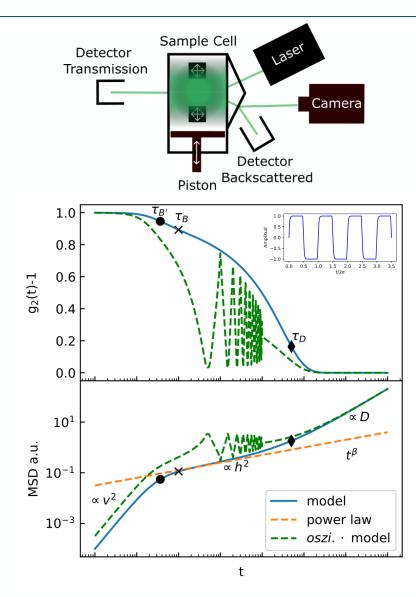


Voice Coil vs. Pulsed Agitation



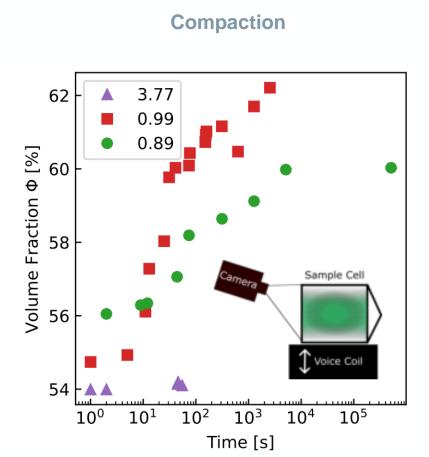




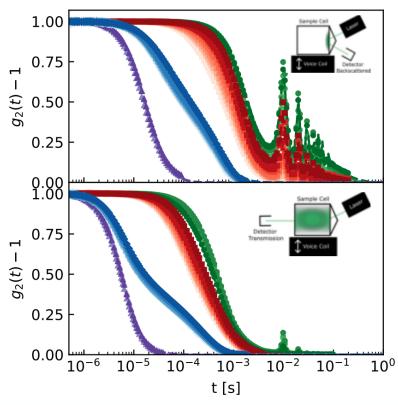


Voice Coil Densifies on Ground

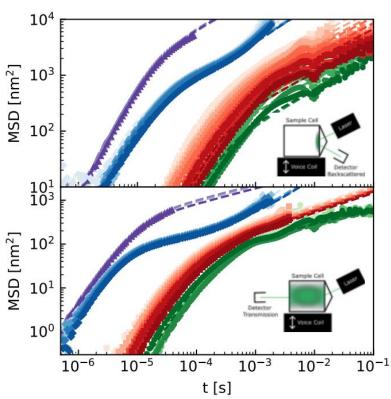






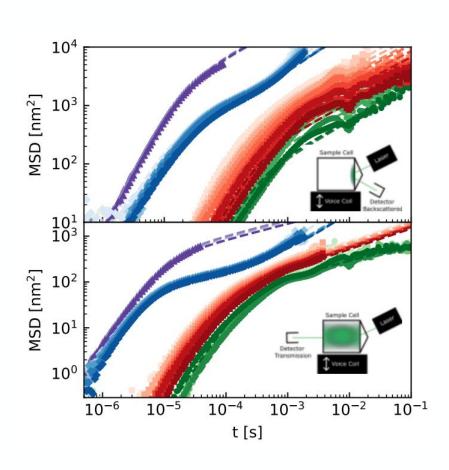


Mean squared displacement

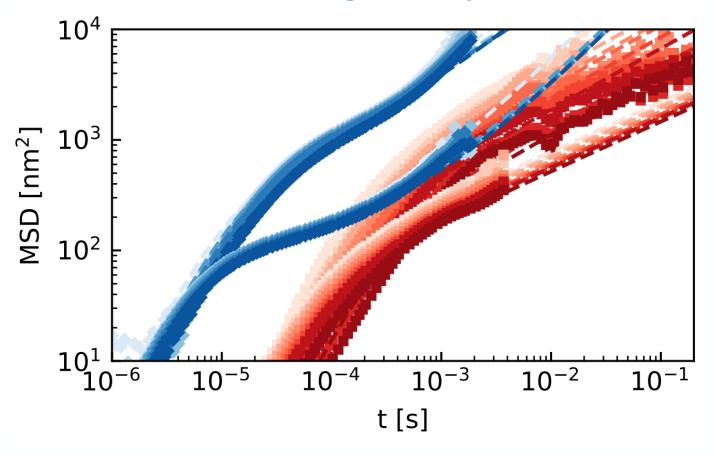


Backscattering vs. Transmission



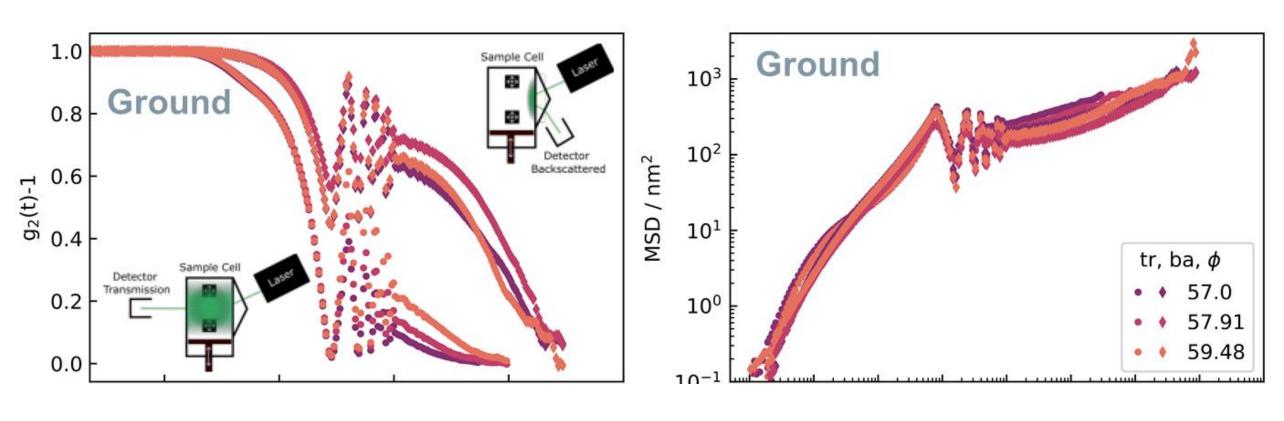


Heterogeneous Dynamics



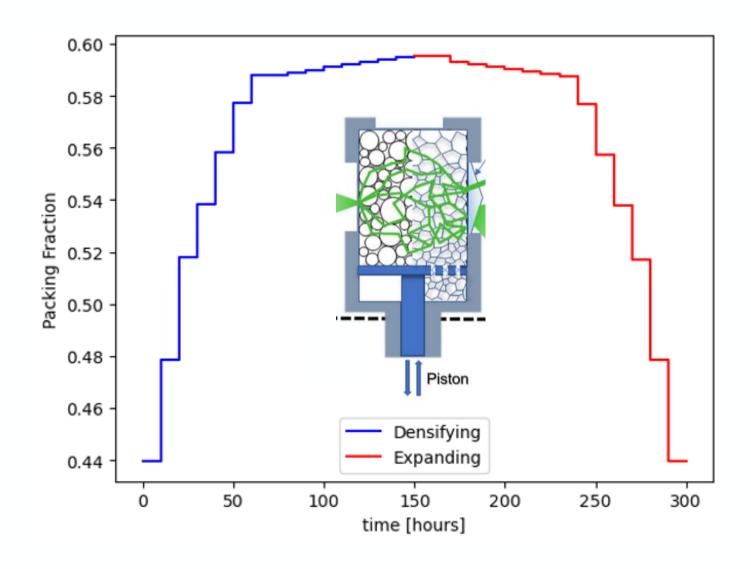
Piezo Agitation on Ground





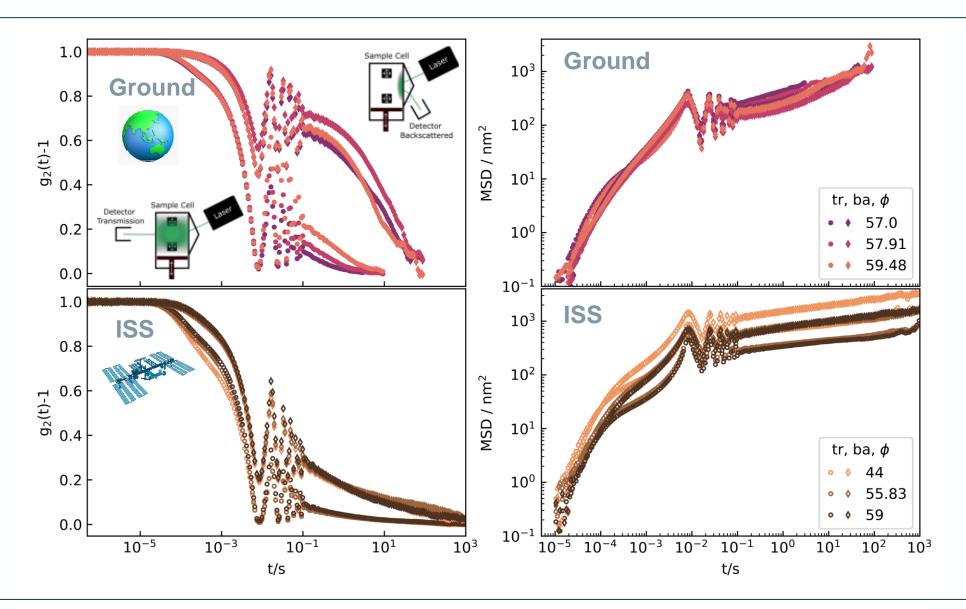
Experiment Protocol





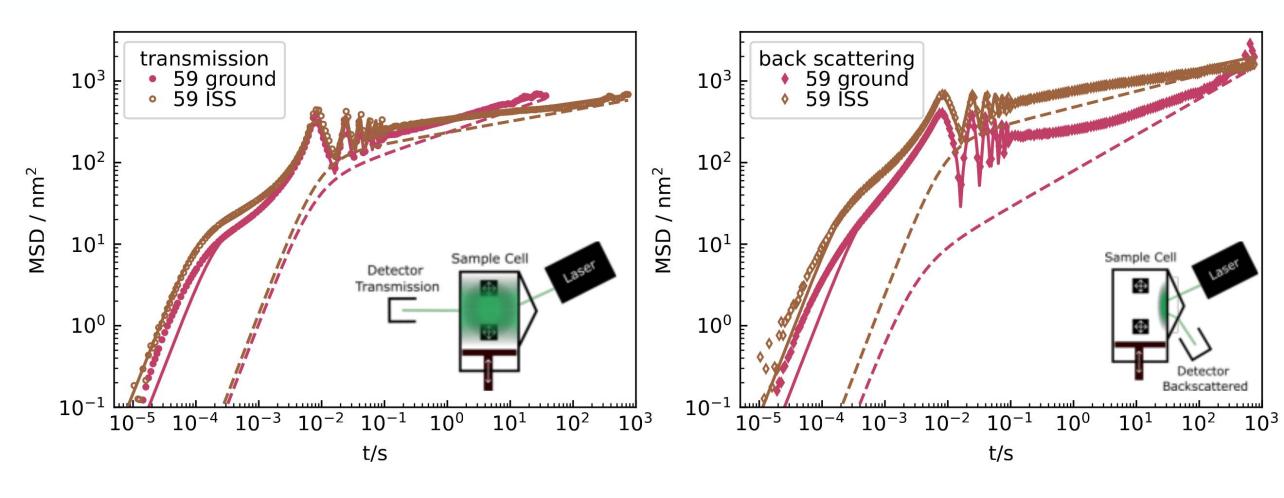
Piezo Agitation On Ground vs. ISS





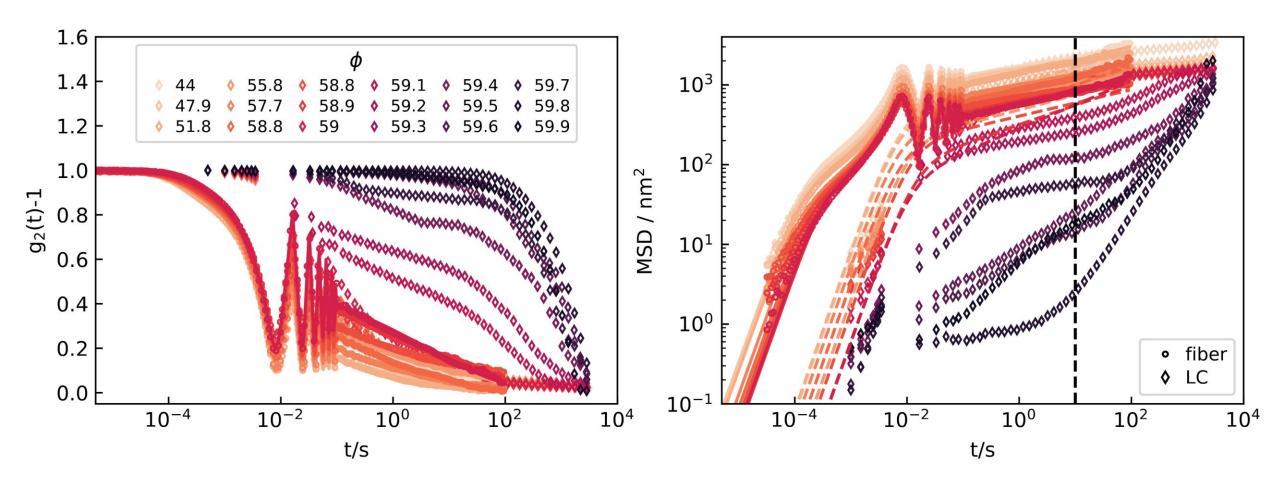
Particle Mobility On Ground vs. ISS





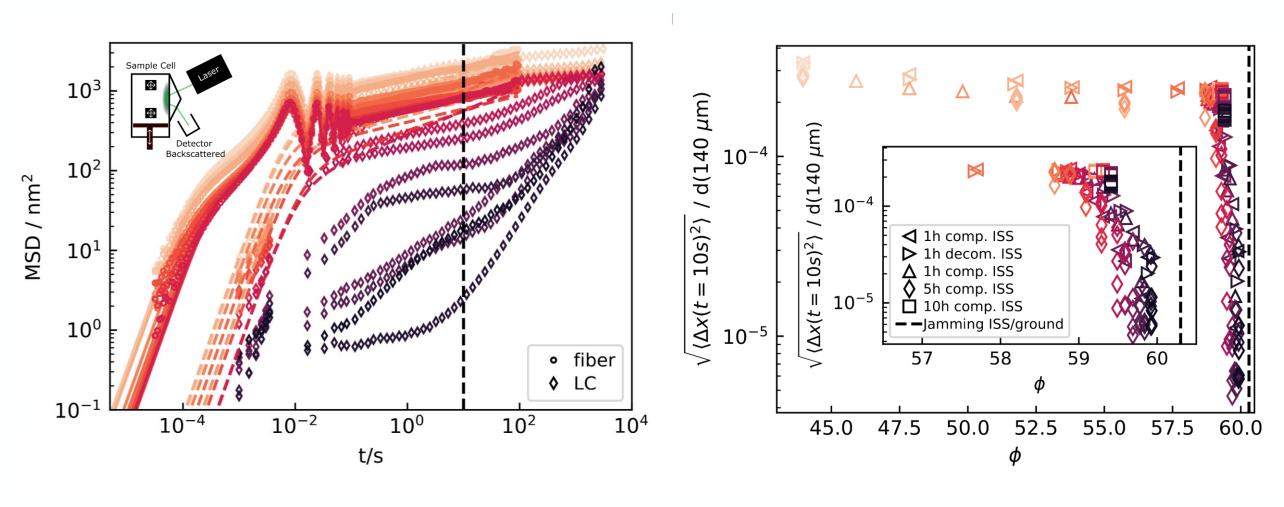
Line Camera and Ergodicity





Glass and Jamming On ISS





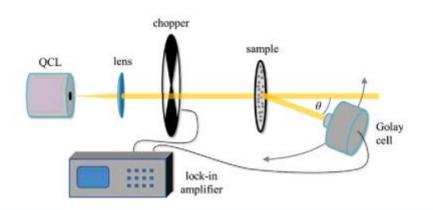
Future Low Gravity Research on Granular Matter







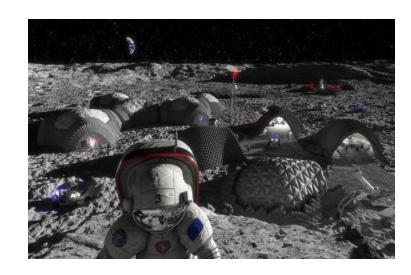
THz Light Scattering



Rheology



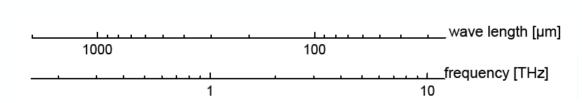
Moon

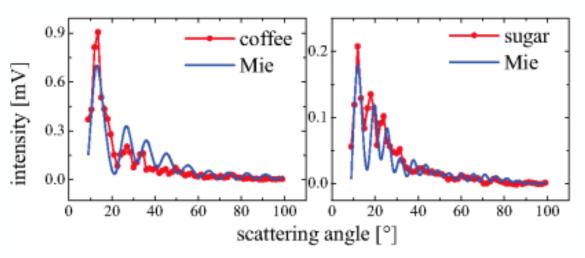


Future Low Gravity Research on Granular Matter



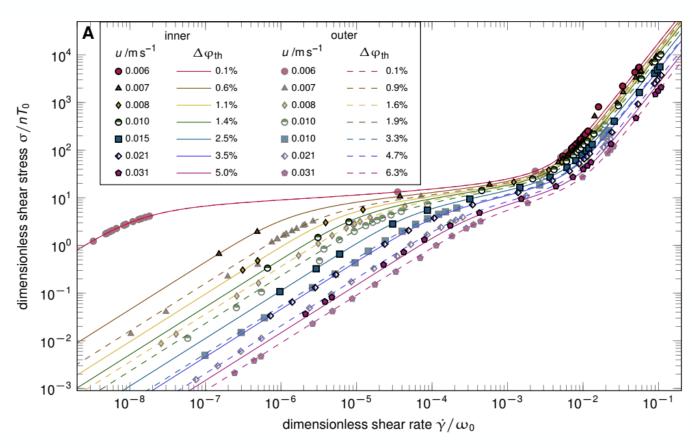
THz Light Scattering





Born, et al., EPL 106, 48006 (2014); Patent DE102012219674A1 (2012/2014).

Rheology



D'Angelo, et al., https://arxiv.org/abs/2309.00413