

# Investigation of the jamming point using 3D stress birefringent techniques

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**Location:** Cologne, Germany

## 1 Stress birefringence

Stress birefringence is a technique that allows to create a visual representation of stress. As you know a material under stress may have a different stress at different positions. It is interesting to see where the stress is and why. Stress birefringence techniques use the fact that light shifts phase under stress to visualize the stress. This creates some very interesting (pretty!) images like the one in Figure 1.

Not too long ago the DLR designed a method to produce spheres that are stress-birefringent. This is a world novelty: other research groups use disks only. They are therefore limited to two dimensional systems. The DLR can do experiments with full three dimensional packings and stress birefringence. The images may be recorded using a '3D' camera that consists of many 'eyes' (like the eye of a fly) to create a reconstruction of the stress in the packing.

## 2 Jamming point

The jamming point is a transition point where a granular packing turns from rigid to free to be reformed. The mechanical properties of the packing radically change near this point and so it is an interesting topic of research. Where previously it was thought to be a very uniquely identifiable point, the jamming point appears more and more to be depended on the history of the granular packing as well; history here meaning for instance previously applied stress, the way a container was filled, etc.

A possible master's project would investigate if the jamming point indeed moves around, and by what and how it is influenced. The work to do this may include simulations (with support from the MSM group), image analysis, and some elementary chemistry (making the particles). The amount of lab/desk work is rather tunable to what you think is interesting and important.

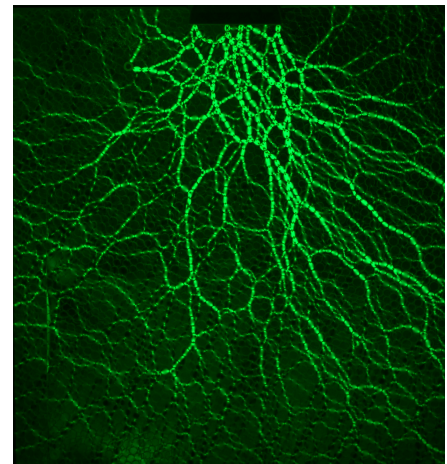


Figure 1: Force chains in a granular packing, visualized using stress birefringent materials.

## 3 DLR

The DLR (German Aerospace Center) is a governmental research institute with several locations. The main location is in Cologne (near the airport) and hosts the Institute of Material Physics in Space. This institute is home to it's own workshop that could build experiments for you, a foosball table and rating system, and the granular (research)group.

The granular group has some theorists but you will mainly be experimentalist: this is what the granular group is good at and you will be able to profit from it. The group has lots of exciting experiments (such as on sounding rockets and in parabolic flights) and many experienced people.

For more info on the project you could ask Matthias Sperl [matthias.sperl@dlr.de](mailto:matthias.sperl@dlr.de) and for more info on living/working in Cologne ask Alex Kamphuis (current master student) [mail@alexkamphuis.nl](mailto:mail@alexkamphuis.nl).