### Rheological Properties of Quasi-2D Fluids in Microgravity

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**Liquid Crystals**

- Liquid crystals (LCs) are anisotropic liquids,
- They possess the fluidity of a true liquid, as well as varying degrees of long range orientational and positional order that are normally associated with crystalline solids

- Structure and model of a liquid crystal molecule

**Some thermotropic LC-phases**

- solid
- Smectic phase (Sm)
- Nematic phase (N)
- liquid

**Science Background**

The smectic layer structure facilitates the preparation of freely suspended films with thicknesses of few molecular layers and lateral extensions up to several cm, aspect ratios can exceed 10⁶. Such films may serve as models for 2D liquids.

- Ambient temperature 50 °C
- Thermogradient up to 10 K/mm
- LC film thickness is approximately 500 nm

**TEXUS Suborbital Flight**

The OASIS-Tex project was scheduled as a parameter test for OASIS and it provided experimental data on the Marangoni instability in smectic films.

TEXUS-52 (left) with the OASIS-Tex experiment started successfully in Esrange (Sweden) on April 27, 2015, and reached a height of 250 km providing 6.5 minutes of microgravity (µg). The experiment (right) with was built in cooperation with German Space Agency (DLR) and Astrium.

**The OASIS-Tex Experiment**

- Freely suspended smectic film with thermocontacts

Schematic side view (left) and top view (middle) of the OASIS Marangoni setup. Two thermocontacts are placed on a free-standing smectic film. Convection is seen by the Schlieren texture of the smectic c director field. The camera shows an 7mm x 5mm section of the film plane (right).

- LC: 5-n-Octyl-2-(4-n-octyloxyphenyl)pyrimidine

**OASIS-Tex Early Results**

- Up to 8 K/mm almost no motion is visible
- At 10 K/mm (hot contact at smectic nematic phase transition temperature) onset of a slow convective motion (approx 100µm/s)

**The OASIS Experiment (ISS)**

- Development of small sample modules that are imaged within the OASIS experiment chamber. The setup makes use of the Microgravity Science Glove Box aboard the ISS.

**The OASIS Experiment on ISS**

- Exploitation of the unique characteristics of freely suspended liquid crystal films in a microgravity environment, to advance the understanding of fluid state physics.
- Microgravity suppresses island sedimentation, this allows long time observations of droplets or smectic islands on LC-bubbles.

**Snapshots of the OASIS-Tex Marangoni experiment. The formation of target patterns is an indicator for convective motion. Particle image velocimetry yields velocities around 100 µm/s.**

**The film thickness was determined from reflectivity of the 3 different RGB-LEDs in the early stage of the experiment. During the experiment the marked 500 nm thick homogeneous part spreads over the whole film.**

**Coarsening of a smectic island emulsion under microgravity (ISS).**