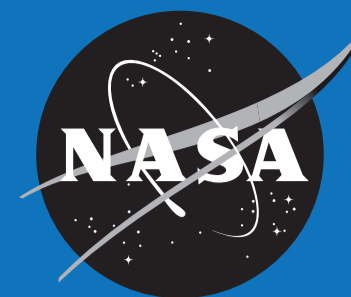




Visualization of Thin Liquid Crystal Bubbles in Microgravity

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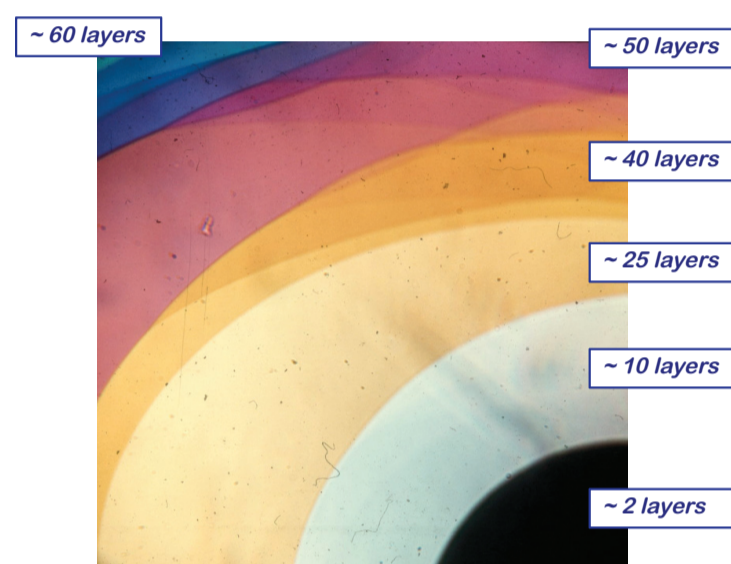
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Introduction

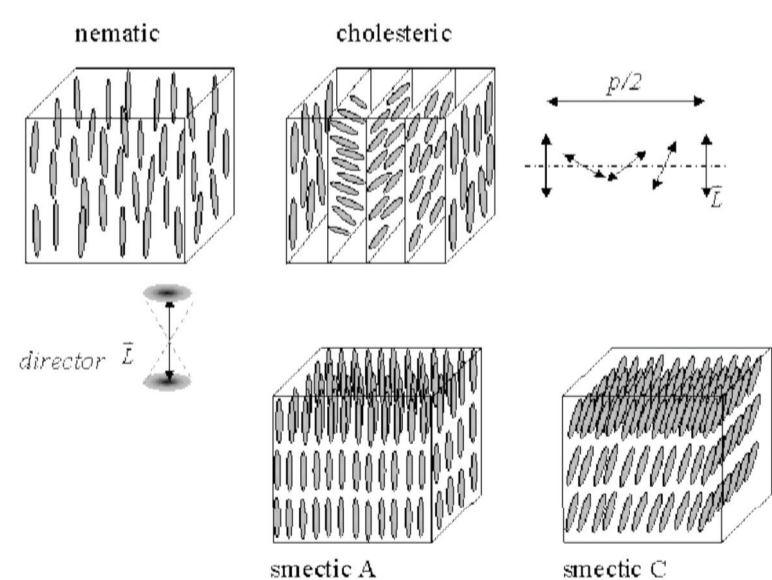
Observation and Analysis of Smectic Islands in Space (OASIS) experiment exploits the unique characteristics of freely suspended liquid crystals in a microgravity environment to advance the understanding of fluid state physics.

Ultra-Thin Freely Suspended Liquid Crystal Films

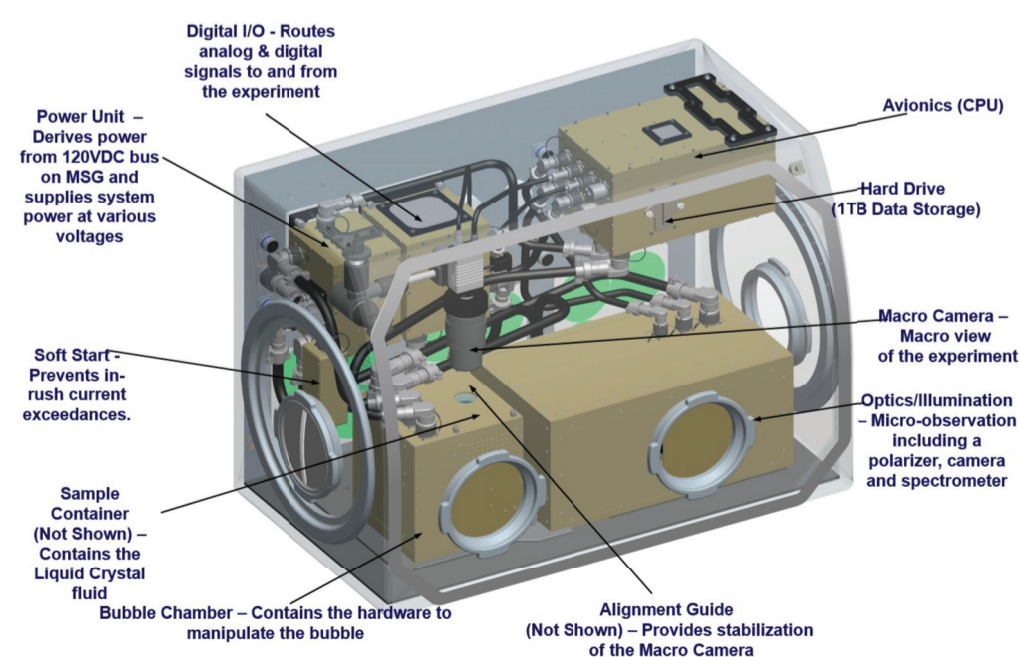
- Quantized thickness (3 nm for a single molecular layer)



- Thinnest known stable condensed phase structures and have the largest surface-to-volume ratio of any condensed phase preparation, making them ideal for studies of fluctuation and interface phenomena
- Stable fluid structures
- Largest surface-to-volume ratio
- Low vapor pressure



OASIS Hardware



Science Objective in Microgravity

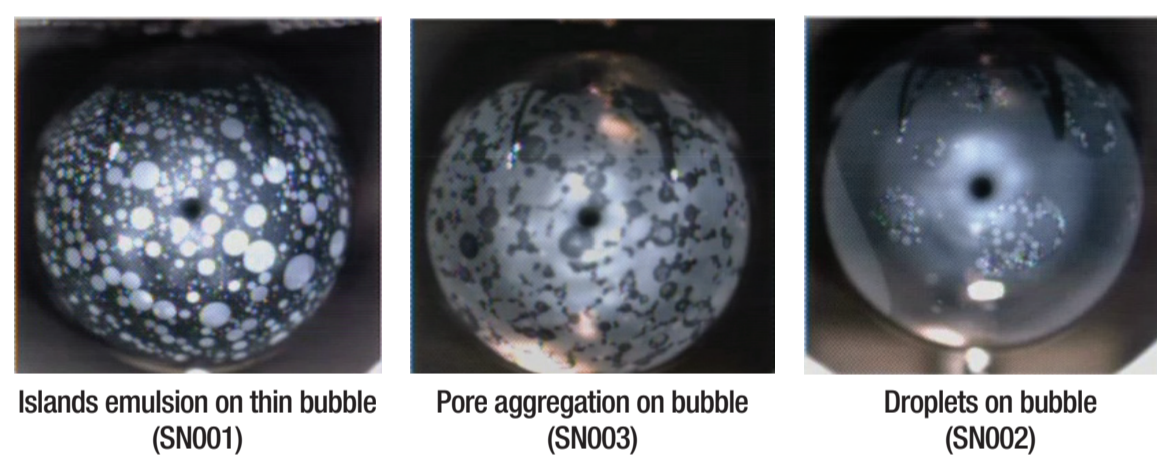
- 2D Hydrodynamics Hydrodynamics of Islands and Droplets
- 1D Interfaces in 2D Space Coarsening & Ostwald Ripening
- Island Interactions
- Thermocapillary Effects Marangoni Effect
- Surface and Line Tension Dependence on Film Thickness
- Textural Interactions Interactions of Islands/Droplets and Defects
- Ultraweak Interactions Interactions of Islands Effects of Perturbing Bubbles

Visualization of Thin Liquid Crystal Bubbles

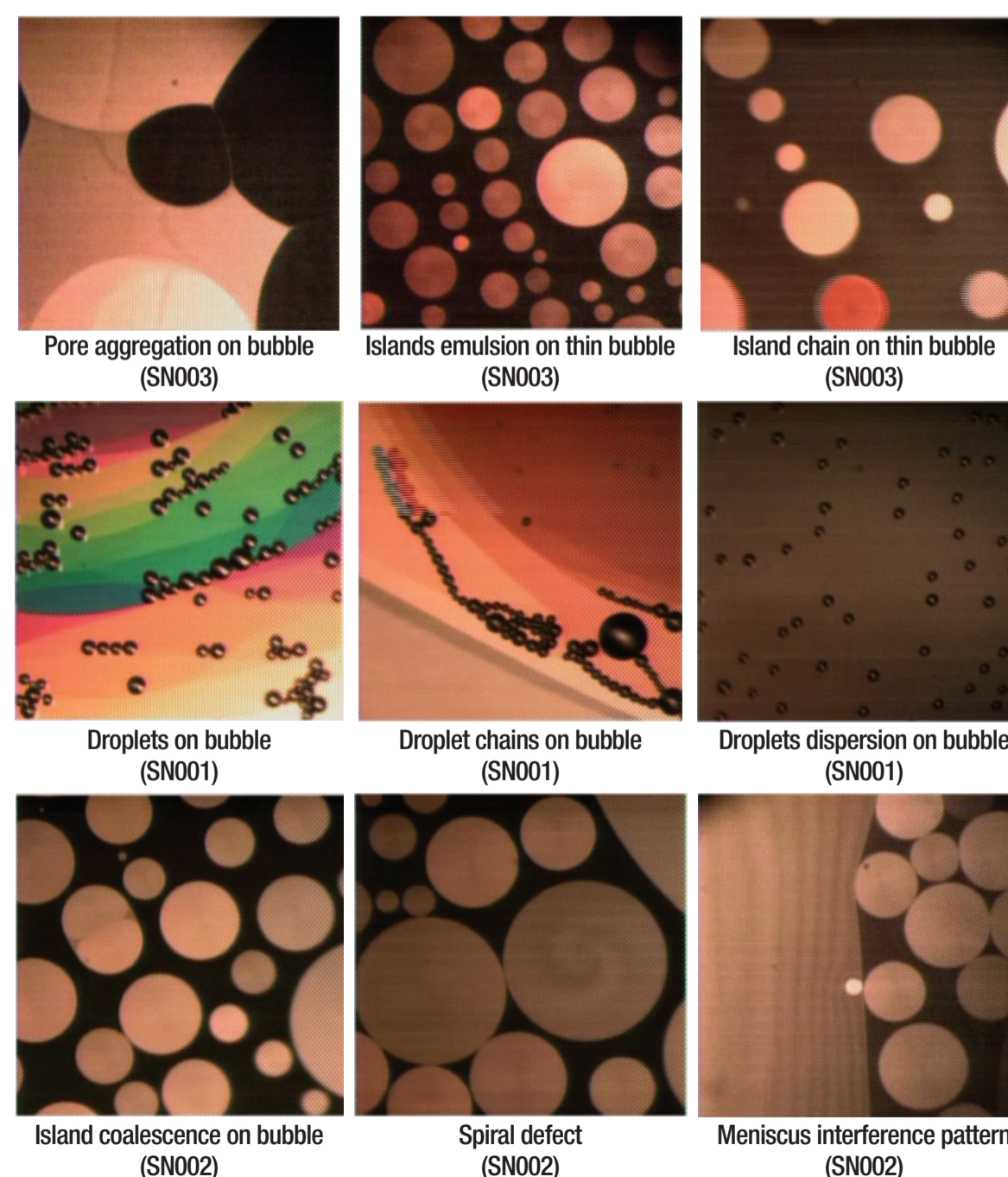
The OASIS experiment is performed on 4 different liquid crystal sample materials

- SN001 – Polar Smectic A (8CB + MX 12160 Mixture)
- SN002 – Racemic Smectic C (12846)
- SN003 – Chiral Smectic C (MX12805)
- SN004 – Non-Polar Smectic A (MX12160)

Macro View Images



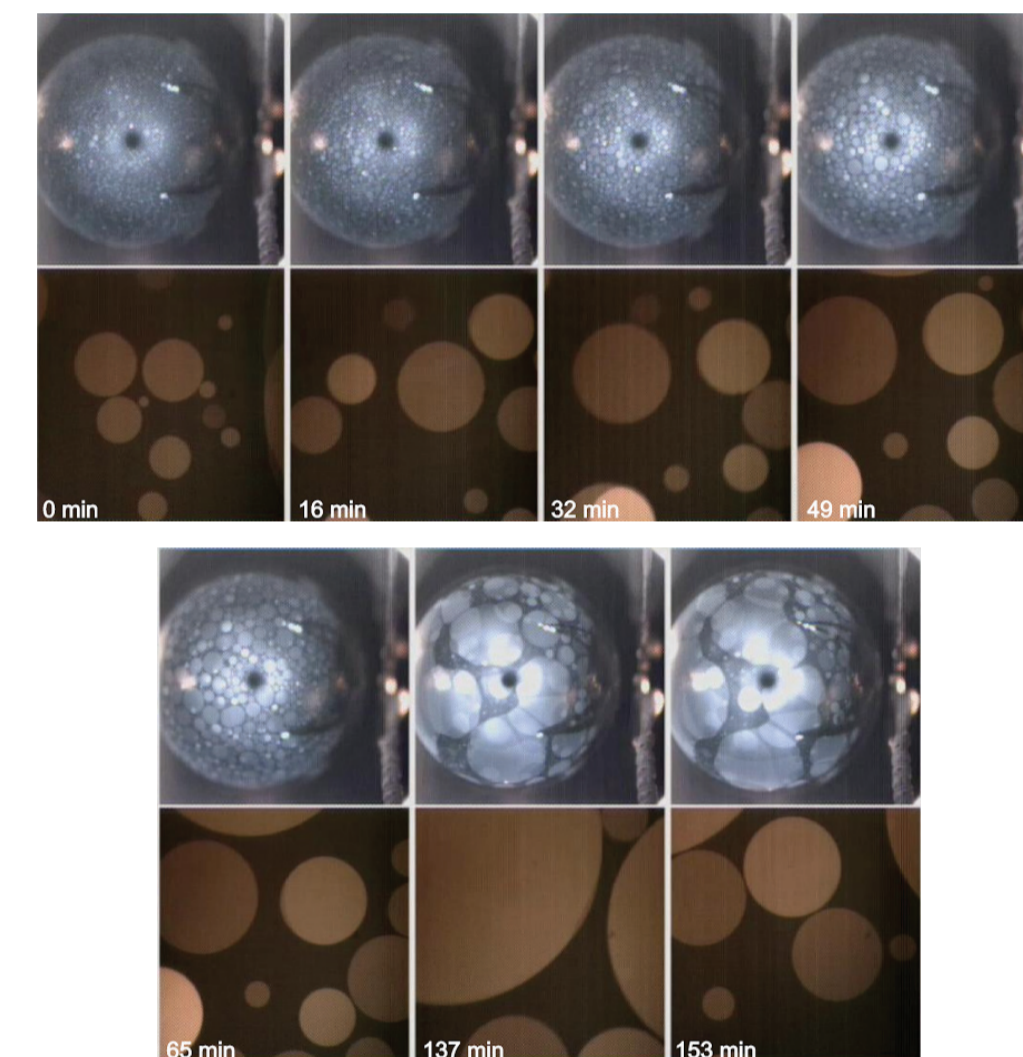
Micro View Images



Experimental Results

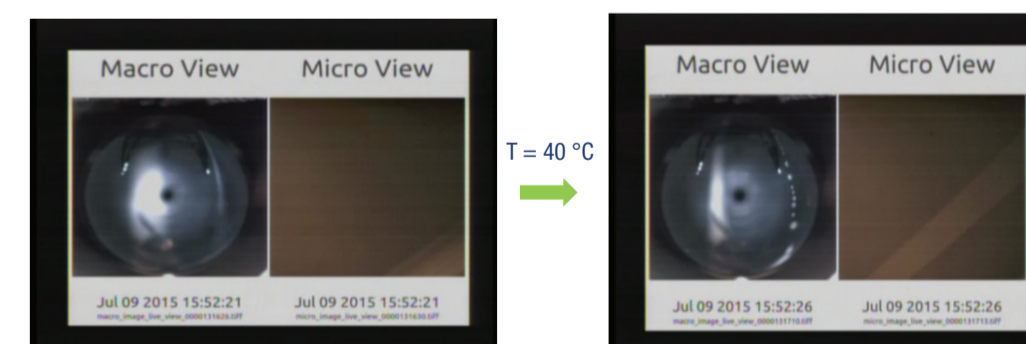
Island Emulsion Coarsening

Three-dimensional (3D) coarsening dynamics in emulsions, foams, and other non-equilibrium systems is an important and relatively well-studied problem. Bubbles of smectic liquid crystal, investigated in the OASIS experiments on the International Space Station (ISS), offer a well-characterized, homogeneous platform for the study of both equilibrium and non-equilibrium behavior of collective systems of 1D interfaces in 2D.



Plateau-Rayleigh Instability

Observation of two-dimensional equivalent of the Plateau-Rayleigh instability phenomena on a thin bubble of smectic liquid crystal on this OASIS space experiment. By applying a very low air jet causes the thicker region of the bubble into a narrow continuous stream on the bubble surface. A localized heating on the flow causes a type of varicose perturbation, breaks the flow and creates streams of small disc-like islands.



Thermomigration

By applying a temperature gradient across the north and south polar regions of the bubble, we observed temperature Marangoni type of Thermomigration/thermocapillary convection of islands on the bubble were observed. The images below shows the time sequence of the convection flow of islands moving away from the heated south pole of the bubble.

