# Advanced Colloids Experiment (ACE-T)

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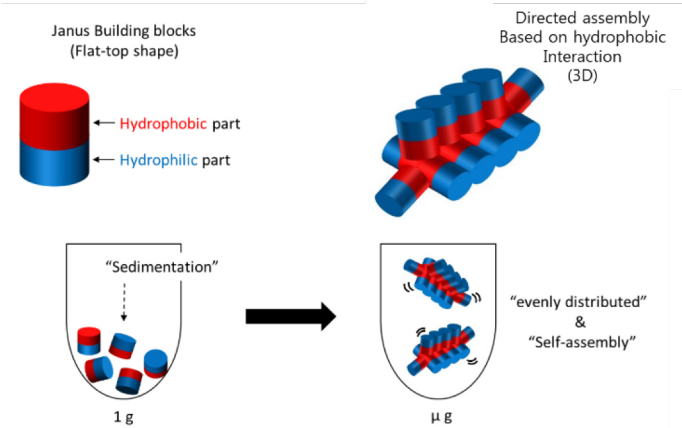


*ACE T-1 (Chang-Soo Lee, CNU, S. Korea) Janus particles should self-assemble into 3D structures on ISS (SpX-9) in the absence of sedimentation.*

## *Objective:*

- To remove gravitational jamming and sedimentation so that it is possible to observe how order arises out of disorder and to learn to control this process. Small colloidal particles can be used to model atomic systems and to engineer new systems. Colloids are big enough (in comparison to atoms) to be seen and big enough and consequently slow enough that their evolution can be recorded with a camera. With a confocal microscope and specialty cells, we can observe this process in 3-d and learn to control it.

## *Relevance/Impact:*

- Understanding phase separation without the effects of gravity reveals how to extend product shelf-life. This is a multi-billion $ concern for P&G. (Lynch, P&G Principal Scientist, works directly with NASA through a CASIS Space Act Agreement) See: http://www.nasa.gov/mission_pages/station/research/news/ACE/#.VO8zqFqFHeM. High ranking in NASA Decadal Survey, p.250-251.
- Studying phase separation near a critical point with an emphasis on spinodal decomposition – observing change in rate of phase separation. (Weitz)
- The technology exists to create lock-and-key self-replicating non-biological structures from nanoscale building blocks in microgravity using colloidal self-assembly – colloidal engineering. (Chaikin)
- With temperature sensitive polymers and microgels, the processes of repeatable melting and crystallization can be observed in 3-d at the level of the individual particles with these model "atomic" systems. (Yodh)
- Study Complex Fluids via 2013 (NASA) NRA selections, EPSCoR Announcements, 2 ISS ESA international partners, and S. Korea (NASA HQ 2009 MOA).

## *Development Approach:*

- Incremental development approach: ACE-M (basic Microscopy of discrete samples), ACE-T provides sample cells that control Temperature and in-situ mixing. Full 3-D imaging available with confocal microscopy which takes a series of high magnification slices of (fluorescently tagged) samples and assembles them to produce a clear high-resolution 3-D image.

## *ISS Resource Requirements*

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|---|---|
| **Accommodation** (carrier) | Light Microscopy Module |
| **Upmass (kg)** (w/o packing factor) | 3.5 kg/ACE-T base<br>1.0 kg per ACE-M, T module |
| **Volume ($m^3$)** (w/o packing factor) | .001 $m^3$ ACE T Base<br>.00001 sample module |
| **Power (kw)** (peak) | .012kw ACE-T, 1.1 kw FIR/LMM |
| **Crew Time (hrs)** (installation/operations) | 2.5 - 3.5 per installation |
| **Launch/Increment** | SpaceX-3-15 / Increment 35-56 |