Investigating the Structures of Paramagnetic Aggregates (InSPACE-1)
ISS On-Orbit Operations

Objective: To (1) visually study the gelation transition in magneto-rheological fluids (MR) under steady and pulsed magnetic fields, and (2) determine the three-dimensional low-energy (equilibrium) structure of an MR emulsion in a pulsed magnetic field.

Significance: MR fluids are a class of smart materials capable of changing visco-elastic properties. Microgravity data will provide an assessment of the viscous-elastic properties for use in new brake systems, seat suspensions, robotics and vibration damping systems.

Approach: InSPACE consists of Helmholtz coil assemblies (electromagnets that produce a uniform magnetic field), each with a small borosilicate vial filled with MR fluid. Operated in the MSG, the crew installs a coil onto an optics assembly, adjusts electrical current and frequency causing the MR fluid to aggregate and form microstructures within the fluid.

Statistics on InSPACE Operations
- InSPACE hardware and samples were launched to the ISS on 6/5/2002, and 11/23/2002 respectively.
- Primary operations occurred on ISS in Increment 7. The nominal revised test matrix was performed the week of 7/2/2003 with 26 runs / 41 test points completed.
- Additional 5 science test runs were performed by Jeffrey Williams in Increment 13 the week of 6/5/06 including a Saturday Science run.
- Operations focused on a transition in structural configuration over a range of frequencies. Prevailing structures aligned in a columnar fashion along the magnetic field lines with elaborately shaped interfacial cross-sections.

Significant Findings to Date
- New sheet-like structures with spiny interfaces in the cross-section were observed.