Versatile cryogenic sample exchange with the Phenix Front Loader: applications from physics and chemistry of materials to studying planetary ices.

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The Phenix Front Loader (Phenix FL) is a next-generation cryogenic stage developed by Oxford Cryosystems Ltd, offering rapid, stable, and precise low-temperature X-ray powder diffraction capabilities. Its design enables *in situ* sample exchange between < 78 K – 300 K without breaking vacuum or warming the stage, using a sample holder, helium gas flow, and a cryo-stable shaft architecture. The system has been deployed in a wide range of crystallographic studies, revealing its versatility in supporting time-efficient and high-fidelity structural investigations [1].

Originally developed for planetary science, the Phenix FL proved especially valuable for studying exotic ices formed under high pressure, like those found deep within planets or moons in the Solar System. By supporting sample insertion at cryogenic temperatures and continuous cooling without cryogenic liquids, the system ensured structural preservation of quenched ice phases, enabling precise lattice parameter determination and minimized contamination. Sample turnaround times under 10 minutes significantly improves experimental throughput [2].

In structural chemistry, Phenix FL enables solvent-free solid-state characterization of sensitive or very reactive samples like centrohexaindane [3], a highly hindered molecule, by facilitating high-resolution diffraction from 315 K to 40 K. The stability of the instrument under temperature ramping allows detection of subtle thermal contraction effects and preservation of phase integrity, critical for confirming complex unit cell metrics.

Across these diverse applications, the Phenix FL consistently delivers high thermal stability and reproducible sample positioning. Its modularity and compatibility with standard laboratory diffractometers have made it a useful tool for rapid, reproducible cryogenic measurements in crystallography and materials science.

Furthermore, Phenix FL offers an alternative to a standard Phenix for powder and solid samples where speed of sample exchange becomes an additional benefit. Cryogenic exchange offers an advantage for hydrogen-bonded systems, catalysts, reactive metals or crystalline ices. The cryostat enables phase-pure, low-temperature measurements between 40 K and 315 K, critical for observing ferroelectric ordering or phase transitions. The system's atmospheric isolation preserves sensitive materials in discrete phases and significantly reduces risk of ice formation during sample handling [1-4].

References:

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