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Coupling Centrifugation with Neutron Scattering for In Situ Structural Control

We present a novel in situ sample environment for neutron scattering, inspired by soft matter techniques but to our knowledge never before implemented at large-scale facilities. Based on controlled centrifugation, this setup enables the application of accelerations from 1000 to 5000 g, generating stable density gradients that induce phase transformations and nanophase separation directly within the beamline. These structural changes can be monitored in real time, with the system returning to its initial state once rotation ceases — opening new pathways to study irreversible, gravity-driven phenomena. The prototype consists of a vertical centrifuge holding eight Hellma cells in a rotating disk. Validated on the D22 SANS instrument at ILL, the setup has demonstrated its potential for the purification and densification of dilute colloidal dispersions of ludox type. This new tool paves the way for advanced investigations of soft matter systems and colloidal interactions and may serve as a versatile platform for the analysis of multi-populations samples, fluid extraction and selective separation under controlled acceleration.

Primary authors: ALBA-SIMIONESCO, Christiane (LLB); PREVOST, Sylvain (ILL)

Co-authors: LEGENDRE, Frédéric (LLB); LAVIE, pascal (LLB); TESSIER, Olivier (LLB); HOFFMANN, ingo; PLAZANET, Marie (Liphy); MALAYIL, Firoz (ILL); ZEMB, Thomas (ICSM)

Presenter: ALBA-SIMIONESCO, Christiane (LLB)

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