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Expanding high-pressure neutron instrumentation capabilities

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The demand for high-pressure equipment has doubled over the last decade at the Institut Laue-Langevin. To cope with this demand and ensure successful experiments, we have enhanced pressure generators and expanded our suite of pressure devices.

First, we have significantly improved the 1 GPa liquid pressure generators with:

- a comprehensive revamp of the automation program improving the reliability,
- a modern user interface easing control and maintenance,
- additional sensors and controls enhancing safety,
- programmable pressure ramps controlled with greater precision,
- remote control and data archiving capabilities.

These enhancements will also be extended to 1 GPa helium gas pressure generators.

We have also developed a non-magnetic Ø6 mm sample bore double-wall pressure cell accommodating pressures up to 1 GPa with liquid or gas pressure transmitting media. Compared to other cells, it reaches higher pressures and features improved neutron transmission and signal-to-noise ratio. Our processes also now adhere to European Certification standards for answering new safety regulations. Today, we prepare a 2 GPa clamp incorporating in-situ temperature and pressure measurements via Ruby fluorescence [1, 2].

As for cells tailored for NSE and SANS experiments, they have demonstrated exceptional qualities, including ultra-low neutron background and high neutron transmission. While the 50 MPa and 300 MPa versions have proven high reliability, the 500 MPa variant has encountered issues and we actively seek advices and know-how to develop a optimal design.

References:

- [1] P. Naumov, R. Gupta, M. Bartkowiak et al., Optical Setup for a Piston-Cylinder Pressure Cell: A Two-Volume Approach. *Phys. Rev. Applied* **17** (2022) 024065
- [2] R. Khasanov, M. Elender and S. Klotz. The use of LEDs as a light source for fluorescence pressure measurements, *High Pressure Research* **43** (2023) 192

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