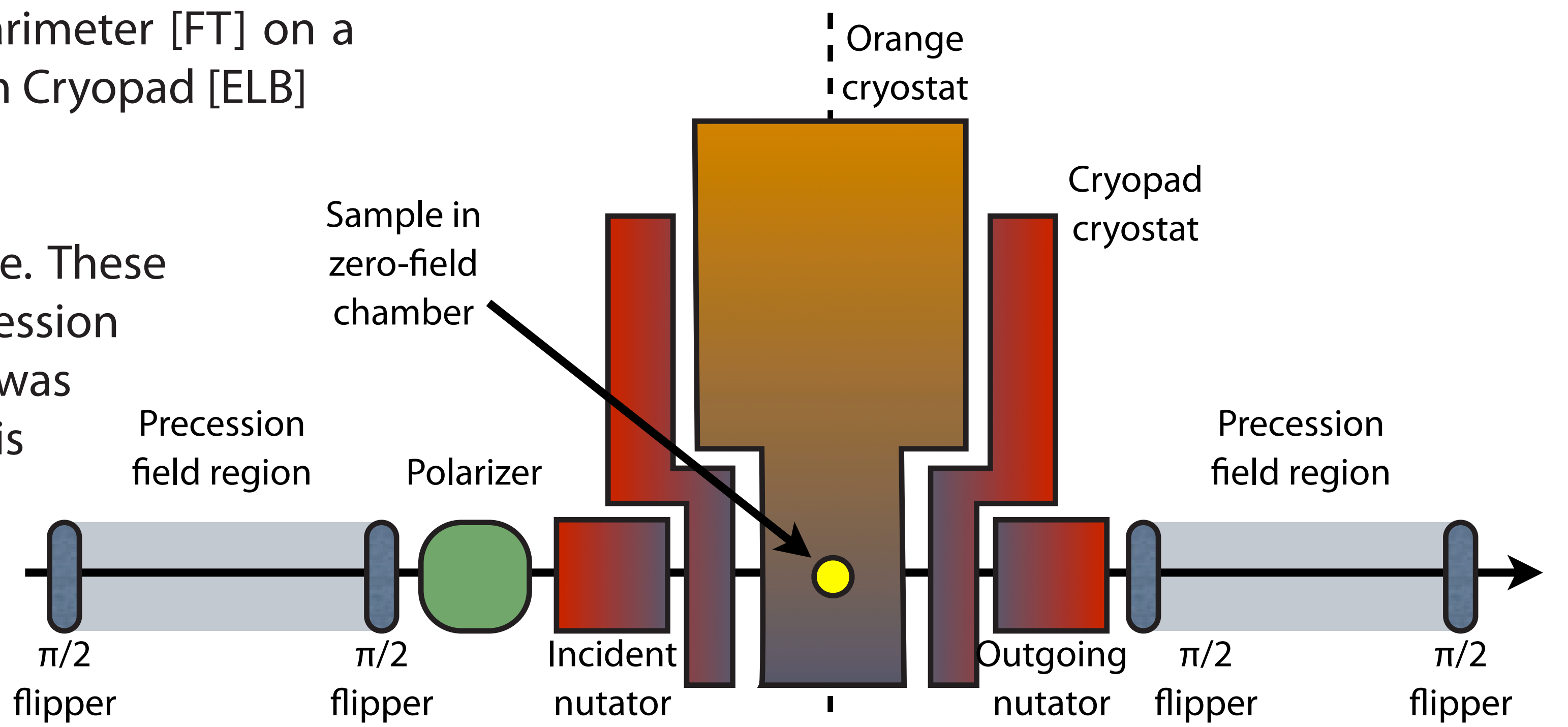


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The multifaceted dynamics of antiferromagnets and helimagnets require more than the conventional neutron spin echo set-up (NSE). Indeed, the neutron beam polarisation is not necessarily flipped upon scattering. When the magnetic interaction vector is complex. In the presence of nuclear-magnetic interferences the rotation of the incident polarisation can be of any angle around or toward a specific direction; it is impossible to distinguish between a simple depolarisation due to e.g. magnetic domains and a rotation of the polarisation vector.

One way of overcoming these difficulties is to implement a zero-field polarimeter [FT] on a NSE spectrometer [FM]. This has now been achieved using the 3<sup>rd</sup> generation Cryopad [ELB] and a modified version of the Intensity Modulated variant of NSE [BF].

To do so, two additional  $\pi/2$  flippers were installed near the sample space. These flippers, combined with the other two  $\pi/2$  flippers, define the Larmor precession regions before and after the sample position. A solid-state polariser was added after the first Larmor precession region to repolarise the beam. This is necessary for handling the polarisation vector in Cryopad. The last step involves the installation of the Cryopad cryostat with its two rotating nutators and the Orange cryostat used to cool the sample.

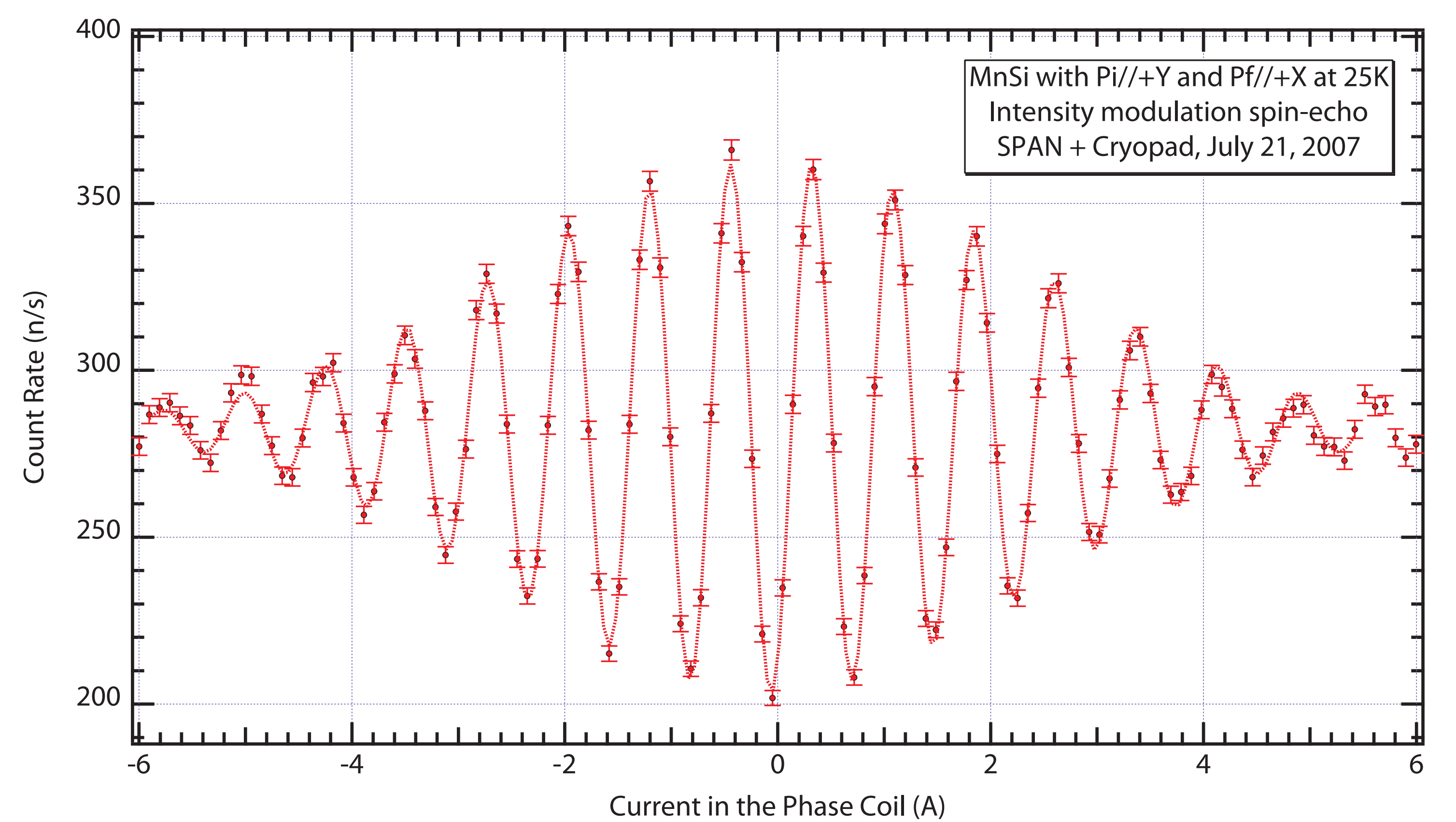


Schematic overview of the set-up

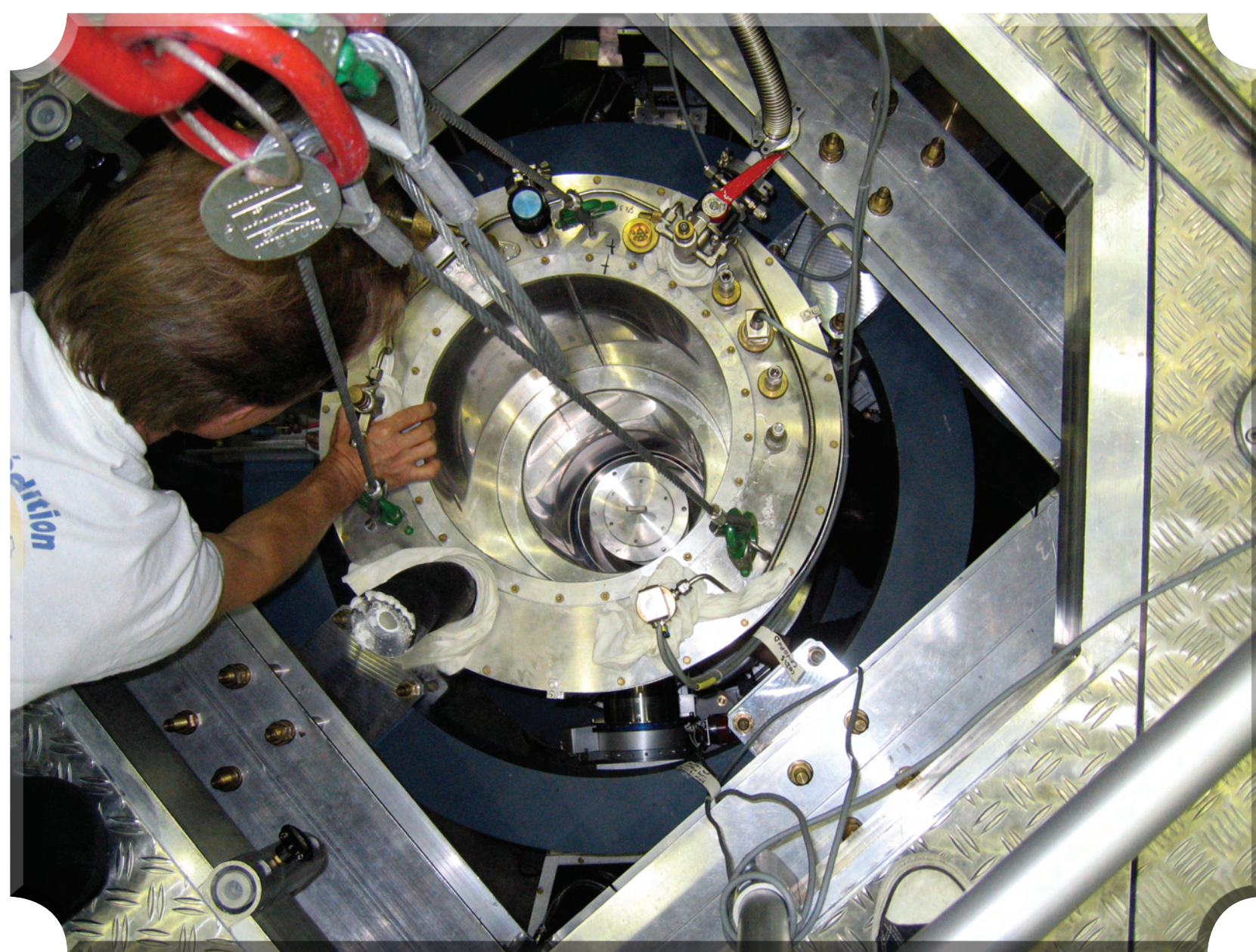
The final set-up consists of two high-field regions split by a zero-field one ( $\approx 2$  mG). The increase in the field (of the spin-echo resolution) obviously has an impact on the zero-field chamber and, therefore, on the precision with which the polarisation vector is handled in Cryopad.

Thanks to the combination of  $\mu$ -metal and Meissner screens, the field screening is likely to be sufficiently efficient. We can work at 50% of the nominal spin-echo resolution on the instruments SPAN at HMI with an uncertainty on the direction of the polarisation vector of the order of 1.7 degrees at 4.5 Å.

After some tuning we can check the set-up with a Grafoil mounted in the zero-field chamber of Cryopad.



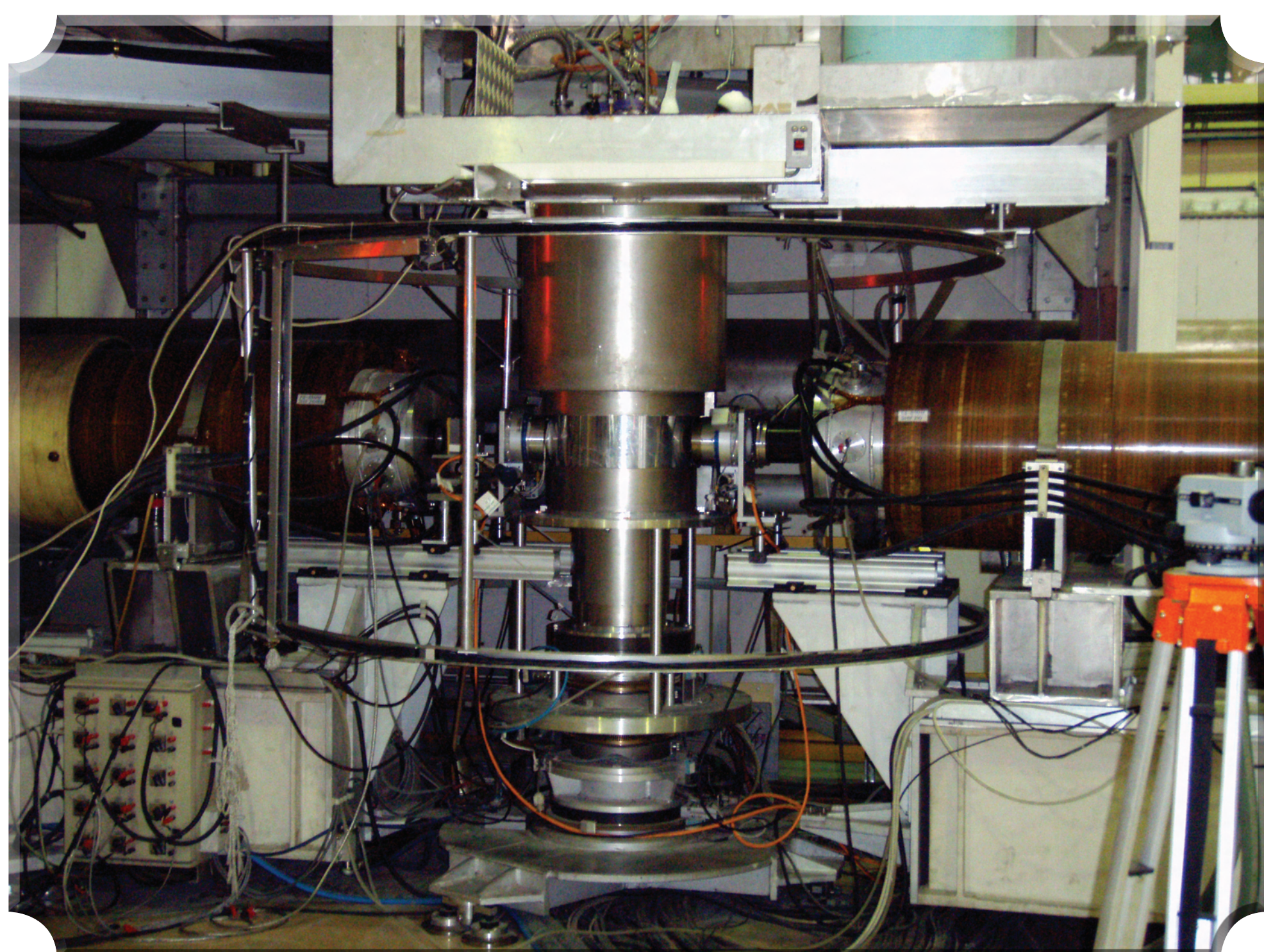
Spin-echo group recorded on the helimagnetic Bragg peak of MnSi with the incident polarisation perpendicular to Q and the scattered polarisation



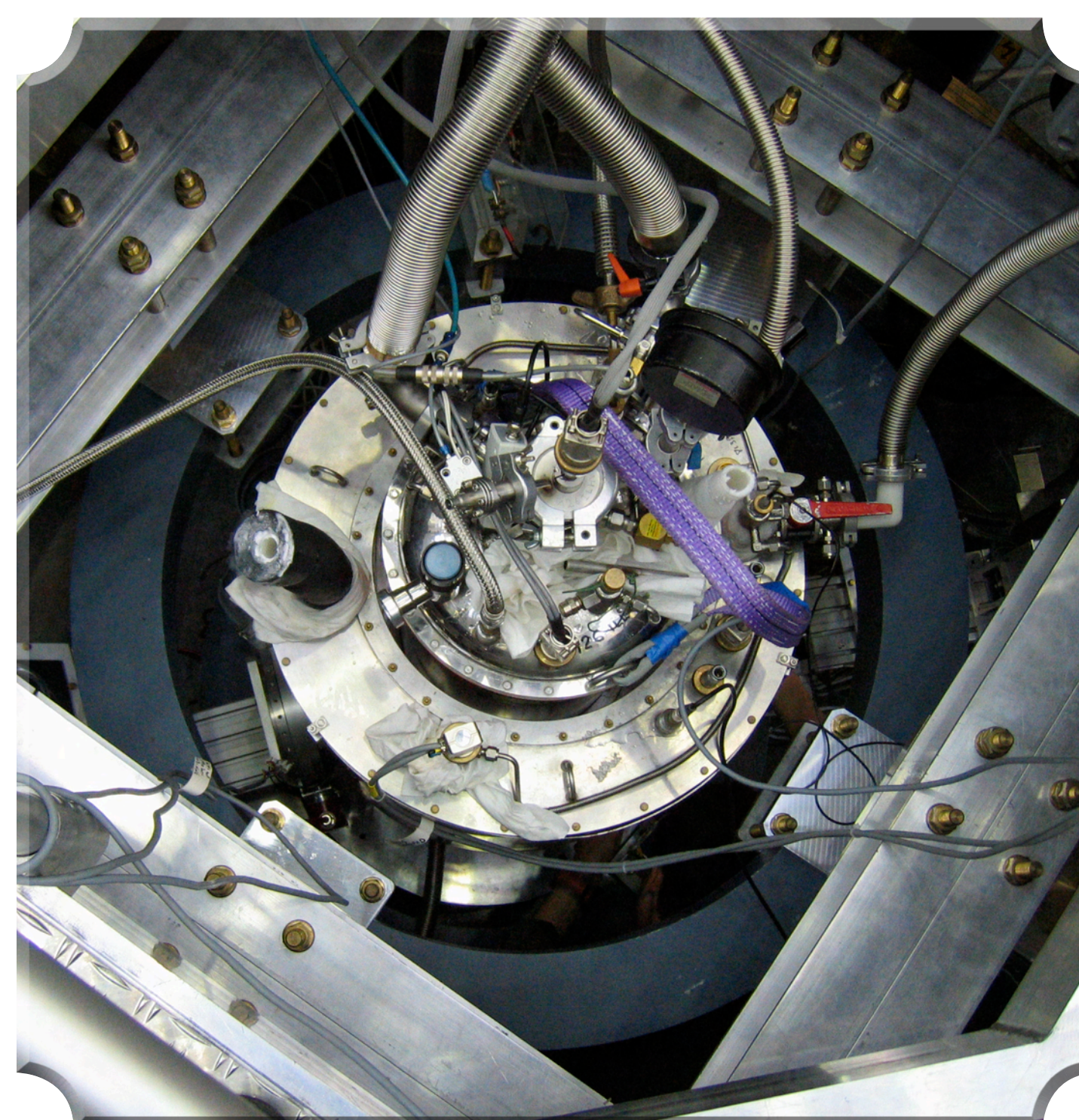
Setting Cryopad on SPAN at HMI

An echo is obtained only for the components of the scattered polarisation parallel to the incident direction (null transverse components). With a magnetic sample for which the incident polarisation is rotated 90° toward the scattering vector (e.g. MnSi) we have checked successfully that we can measure the spin-echo group on transverse components (see plot).

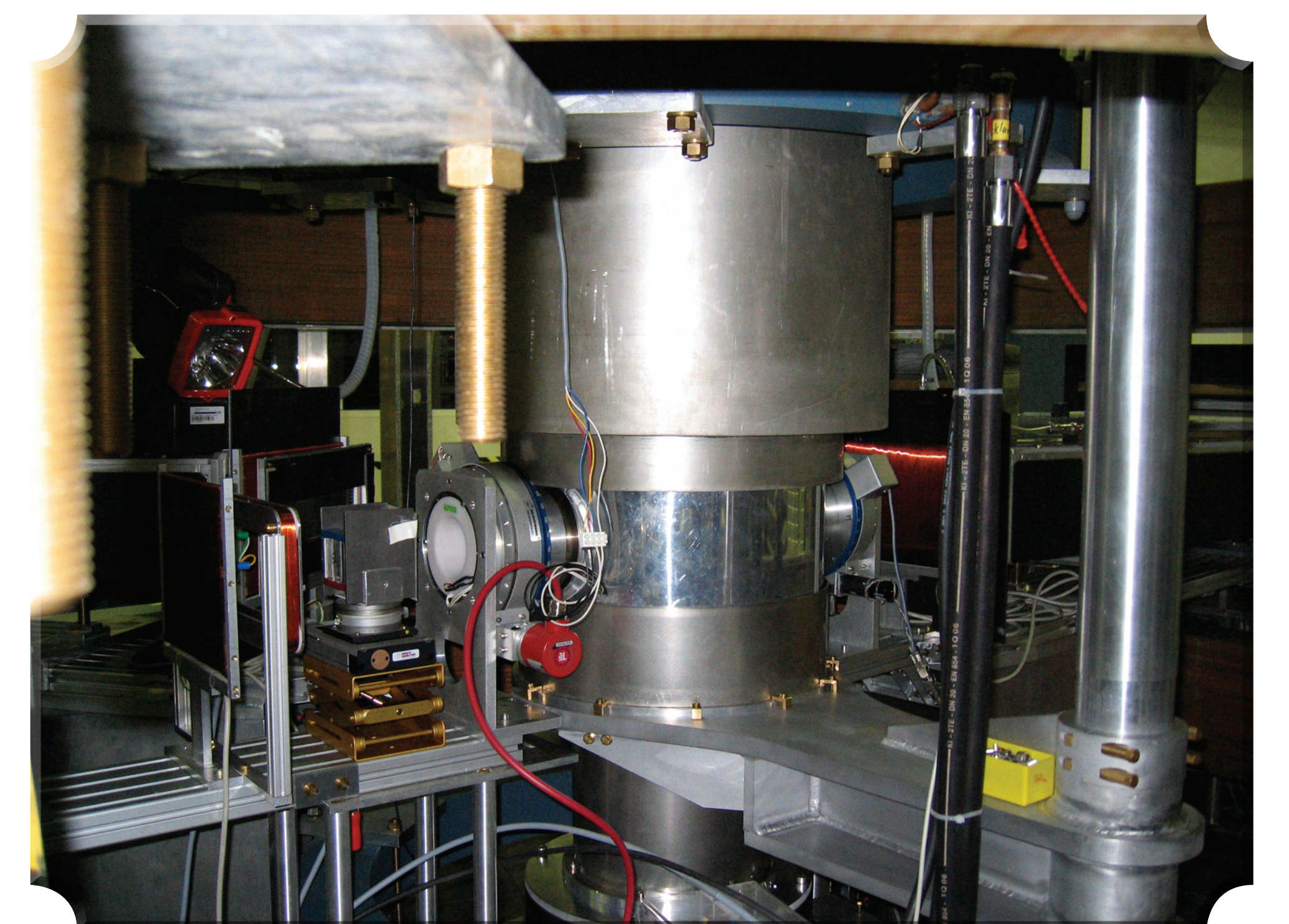
After the successful development of this new technique on SPAN at the HMI, the Cryopad was installed on IN15 at the ILL with the help of P. Falus, B. Farago and C. Gomez, whom we expressly acknowledge here. The measurements on IN15 completed the results on the relaxation of the excitations in MnSi and will be reported elsewhere. The polarimetric spin-echo option is now available on IN15, where the uncertainty on the direction of the polarisation vector is 3.5 degrees at 9 Å.



First scheduled experiment with Cryopad on IN15 at ILL



With the Orange cryostat inside Cryopad on SPAN at HMI



Left to right:  $\pi/2$  flipper, polarizer, nutator, Cryopad, nutator,  $\pi/2$  flipper on SPAN at HMI

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[FM]: F.Mezei, *Z. Phys.* **255** (1972) 146; F. Mezei (ed.), *Neutron Spin Echo*, Lecture Notes in Physics Series, Vol. 128 (Springer, Heidelberg, 1980)

[ELB]: E. Lelièvre-Berna, P.J. Brown, F. Tasset, K. Kakurai, M. Takeda, L.-P. Regnault, *Physica B* **397** (2007) 120–124

[FT]: F. Tasset, *Physica B* **157** (1989) 627; [BF]: B. Farago, F. Mezei, *Physica B* **136** (1986) 627