Experimental report

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Proposal: 1-10-28 **Council:** 4/2015

Title: Entrance solutions for PASTIS-2

Research area: Physics

This proposal is a new proposal

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Experimental team:

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Samples:

Instrument	Requested days	Allocated days	From	To
IN20 He3 Spin Filter	7	3	30/11/2015	04/12/2015

Abstract:

We wish to test different guide-field-flipper solutions in the very short entrance path of PASTIS-2 when mounted on IN20, necessary before PASTIS-2 can be offered for a user experiment.
The aim is adiabatic transport of the polarization independent of the field direction in PASTIS-2, combined with a working flipper in ki (no cross-talk with PASTIS-2), an effective suppression/shift of the zero-field position in the entrance path of the PASTIS-2 coils, and a working 3He-cell with long half-time.
Since this entrance issue involves the inhomogeneous field region around the beam-shutter, it is necessary to test solutions with neutrons, and on IN20. We ask for 1 week of beamtime on IN20 for these tests.

Polarization analysis for thermal neutron multidetector instruments could become one of the most powerful tools in the investigation of modern functional materials. However, at present this technique exists only as prototype. One of the most promising developments is the PASTIS-2 ^{3}He cell and magnet-coil system, since it covers a large horizontal scattering angle without obstructions in the outgoing beam. It serves as a basis for further developments towards larger vertical opening angle in view of polarisation analysis on TOF instruments like the Endurance project PANTHER.

The PASTIS-2 prototype has been designed to be hosted on IN20 in combination with Flatcone. The field homogeneity of the coil system has been pushed far enough to allow sufficiently long measuring times, and this is still the case when PASTIS-2 is mounted on IN20, but the adiabatic transport of the polarization from the vertical guide field in the monochromator protection into the PASTIS-2 coil is still a problem. The zero-field region of PASTIS-2 in the entrance channel needs to be overcome by the entrance coil system, without affecting the homogeneity in the close-by region of the ^{3}He-cell (very sensitive), and without affecting the guide field homogeneity over the whole beam cross section in the region of the flipper in k_i (the homogeneity is completely insufficient at present), for various field directions of the PASTIS-2 coil system. Since the PASTIS-2 coil system is large in comparison with the standard Helmholtz setup, and the distance between monochromator protection and PASTIS-2 is short, and contains the inhomogeneous region of the beam shutter, the task is difficult, and requires tests with neutrons on IN20 to solve the problem.

We had therefore proposed to verify several different ideas to overcome this adiabatic polarisation transport problem at the entrance of PASTIS-2, in order to find a solution that allows flipping in k_i with constant flipping ratio for various field directions of PASTIS-2. This task is too complex to be solved in the one or other occasional isolated test days that we have on IN20. We had therefore asked for 1 week of IN20 beamtime, with Flatcone, PASTIS-2, ^{3}He-cell. 3 days were allocated. We added 4 days of non-allocated time and a few days that were allocated to our proposal 1-20-40.

We tested two solutions,

1. Heusler monochromator and a dedicated entrance coil system with integrated adiabatic RF-flipper,

2. Si-monochromator and a polarising ^{3}He-cell in the entrance of PASTIS-2.

Results:

1. The first variant had the large advantage of dealing with only one time constant. It required an increased distance between monochromator and sample by about 10-15%, and tuning of parts of the entrance coil system as function of the field direction provided by PASTIS-2. Even at finite energy transfer, the aluminium of the fine-tail cryostat is prominent in the polarised spectra due to scattering processes Heusler(222) – elastic Al – inelastic Si(Flatcone). The flipping ratios achieved on Ge-phonons were very satisfactory and considerably larger than those on the aluminium powder lines. The RF-flipper interfered with the IN20-monitor so severely, that the data had to be taken on time basis. For inelastic measurements on magnetic samples this would be a severe disadvantage. The analysis of the background and performance of this solution is not yet completed.

2. The second variant, with Si-monochromator and two ^{3}He-cells was tested at standard monochromator-sample distance, and the monitor could be used as usual. It required the removal of the geometric collimator in the entrance of PASTIS-2. In spite of this, the signal (Ge-phonon)-to-background ratio was better than with Heusler-monochromator and RF-flipper. Moreover, we achieved the same flipping ratio (measured on the same Ge-phonon) as with Heusler monochromator and RF-flipper, and the signal of the two-cell solution appeared only slightly reduced compared to the first variant. A precise comparison would demand the correction for the two-cell-polarisation decay, not accomplished. The initial worry, that the polarisation with two cells could not compete with the Heusler monochromator turned out to be not justified. This test was therefore an important milestone.