Contribution ID: **35** Type: **Instruments**

A dedicated polarization analysis setup for ANTARES

Wednesday, 26 April 2023 16:00 (30 minutes)

The outstanding transmission characteristics of the neutron combined with its magnetic moment render it a unique probe for the determination of magnetic properties of bulk ferromagnetic materials. While neutron scattering techniques probe magnetism from an atomic length scale up to a few 100 nm, neutron imaging has been shown to provide complementary information from macroscopic length scales down to a few 100 µm. Imaging with polarized neutrons can be employed to directly visualize large individual magnetic domains as e.g. found in grain oriented electric steel typically used for transformers. Moreover, the spatial variation of magnetic properties of samples arising e.g. from stress introduced during manufacturing or chemical inhomogeneity can be probed.
Currently, the spatial resolution with polarized neutrons at ANTARES is limited to ~0.5 mm mainly by the large distance between the sample and the detector that is required for the placement of the polarization analyzer, which has a length of ~500 mm. Moreover, since the polarizer and analyzer available at ANTARES are not optimized for the spectrum of the instrument, the polarization reaches only ~70% at a wavelength of 4.3 Å, where the flux is only 10% of the peak flux. We propose to design and acquire dedicated polarizers and analyzers for ANTARES in order to strongly improve the spatial resolution, flux and polarization at the same time. The same setup could in the future also be used for polarized imaging experiments at the proposed new imaging instrument FLASH-NT.

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Session Classification: Analytics, Positrons and Imaging (API)