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TIPSI hybrid spectrometer at the planned European Spallations Neutron Source ESS: Probing different length scales simultaneously

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On going material performance improvement leads to incorporate advance ceramics/polymer/metals/ into diverse heterogeneous system (metallic matrix, carbon, nanofiber etc···). The behavior and performances of these systems usually depends on the interplay between atomic, nano/meso and macros/microscopic structure.
Traditionally the structural information on these length is determined separately by wide angle diffraction techniques (atomic/nanoscopic in reciprocal space Q=[0.3, 10] Å-1), by small angle diffraction (nano/meso Q[0.002, 0.1]Å-1) experiments and direct space technique like imaging/SeSANS one for submicronics to millimeter sizes.
The goal of the proposed hybrid instrument at ESS, TIPSI, is to study these materials in operandi and in situ at multiple length scales with high time resolution to obtain a multi-length scale coherent picture. The idea is to use simultaneous or quasi simultaneous neutron powder diffraction (NPD), small angle neutron scattering (SANS/SeSANS) and neutron imaging (NI) to cover a broad range of length scales.

Technique Diffraction Small angle scattering Imaging
Length scale ˜0.01-5 nm ˜1-1000 nm ˜0.01-100 mm

The challenge in combining the different methods is simultaneous optimization. The different techniques have significantly different requirements regarding optimal working conditions. The challenges will be met by using two neutron sources –both a cold and a thermal source. The instrument is envisioned to have a length of 180 m; this is a sweet spot for placing a resolution chopper at 6 m distance from the moderator and allows sufficient space for directing two beams onto the same sample spot by curved guides. Chopper pulse selectors will alternately send pulses from the cold and the thermal source to avoid confusing the detector. However it is possible that frame overlap can be handled and in this case every pulse can be used.

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