Neutrons, Muons and Coherent-THz in Chemistry

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State-of-art neutron and coherent-THz techniques now allow material and molecular chemists to access ~9 decades of energetic (1μeV-100eV) resolution (**Fig.1**), without being hindered by selection rules, sensitivity or energy resolution. From H_2O reorientation dynamics (Coherent-THz spectroscopy, **Fig.2**), through librations and 'fingerprint' vibrations, to atomic-cohesion & bond breaking (*via* atomic-recoils) with Neutron Compton scattering (NCS).

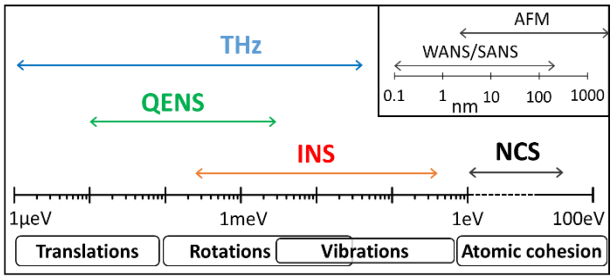

Fig.1 Neutron and THz methods with their energetic/structural extents (compared vs. AMF). Relevant dynamics shown at approximate energies.

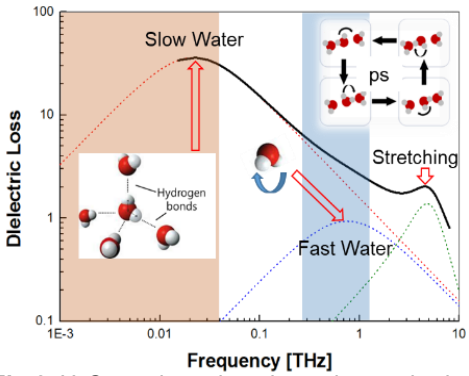

Fig.2 H_2O reorientation dynamics probed by THz spectroscopy.

This is complemented by even wider range of structural (10pm-1dm) and temporal resolutions (10^{-18}-10^{2}s); ato-second (10^{-18}s) time-scales; rapid-enough to track electronic rearrangements & dynamic atomic cohesion.

The main talk provides an overview of the successful application of neutron and coherent-THz methods to a setting biocement, the antibiotic pencillin and a family of homogeneous catalysts used for cross-coupling reactions.

The talk also briefly introduces the avoided-level crossing muon-spin resonance technique (ALC-μSR), successful employed to track radical reactions in selected natural anti-oxidants.