Current trends in neutron spectroscopy

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The unique blend of particle and wave properties - large rest mass, zero electric charge, magnetic dipole moment, isotope-specific scattering in combination with Å-scale wavelengths - makes of neutrons a very attractive and efficient tool for investigation of structure and dynamics of condensed matter. Thanks to the construction of dedicated national and international high-flux neutron sources this technique, originally reserved to a small number of highly specialized teams, became accessible to a broad scientific community. This trend is ongoing with the construction of next generation spallation sources like the SNS in the USA and ESS in Europe. The progress in neutron source brilliance as well is in neutron optics and detection techniques has promoted the use of inelastic neutron scattering to studies of the dynamics of a wide variety of condensed matter systems. Although the involved scattering cross-sections are 3 – 5 orders of magnitude smaller than those of elastic Bragg scattering, single-crystal sample volumes as tiny as 20 mm^3 and hydrogen mass equivalents of 100 micrograms can be studied successfully these days.

In this lecture we will recall the state of the art of neutron spectroscopic techniques and review several application topics of current interest, ranging from chemical spectroscopy to studies of spin systems with important topological effects.