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Hyperfine interactions in condensed matter research

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The hyperfine interactions between the magnetic dipole and electric quadrupole moments of probe nuclei embedded in condensed matter have been utilized for many years to infer information either on the properties of the probe nuclei or of the matrix in which they are located [1]. These hyperfine interactions have led to development of interrogation techniques which allow the study of effects at the atomic level. Mössbauer Spectroscopy methodology has undergone significant development over the recent past, together with different approaches to populate the Mössbauer probe nuclei, as more complex systems have been investigated.

Following a brief review of the principles of application of nuclear moments in materials research, examples will be given of applications in 12B ⊠-NMR and 19F-Time dependent perturbed angular distribution (TDPAD) measurements, and of Mossbauer spectroscopy (MS) utilizing conversion electron Mössbauer spectroscopy (CEMS), MS following Coulomb excitation and emission MS following implantation of radioactive pre-cursors. The strengths (and shortcomings) of the different approaches will be discussed.

This contribution will set the scene for a more detailed presentation on eMS measurements undertaken at ISOLDE/CERN.

[1] G. Schatz and A. Weidinger, Nuclear Condensed Matter Physics (Wiley, 1995)

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