New ideas in Synchrotron-based Perturbed Angular Correlation

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The relatively unconventional nuclear resonance scattering technique of Synchrotron Radiation Perturbed Angular Correlation Spectroscopy (SRPAC) has great potential and was indeed used to study the properties of Mössbauer active nuclei, *e.g.*, iron-57 [1], tin-119 [2], nickel-61 [3]. SRPAC may be also used with less-known Mössbauer active nuclei [4] both in the solid or liquid phase. This technique probes isolated nuclei and is independent of recoil-free fraction.

The synchrotron radiation is used to incoherently excite the nuclei, *i.e.*, the excited transitions originate from a single ground state and terminate in a metastable state that decays towards the ground state by different paths determined by the hyperfine interactions between the nuclei and their electronic environment.

Although SRPAC and Nuclear Forward Scattering (NFS) are carried out using a very similar instrumentation, they are two essentially different experimental techniques. In short, NFS is an elastic coherent method that probes collective effects over a nuclear ensemble and thus is extremely sensitive to sample thickness, whereas SRPAC is an incoherent method and thus is in principle insensitive to sample thickness. Notably, NFS takes place by definition only in the forward direction, whereas SRPAC scattering occurs in the full solid angle.

An interesting feature in SRPAC is the so-called magic angle. The synchrotron radiation is a highly linearly polarized beam. In these conditions there is an angle, *i.e.*, 35.3 deg relative to the horizontal plane, at which the potential hyperfine interactions do not contribute to the measured spectra. Thus, the spectra measured at the magic angle may be used to quantify non-trivial multiple scattering phenomena or potential radiation trapping effects.

In this talk SRPAC will be briefly introduced and the concept of magic angle will be discussed in the context of revealing the hidden hyperfine interactions in epsilon-Fe.

References:

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