NUCLEAR FORWARD SCATTERING ON NICKEL AND GERMANIUM MÖSSBAUER ISOTOPES

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Nuclear forward scattering of synchrotron radiation became an important technique to study magnetic and electronic properties of solids. Observation of the nuclear forward scattering relies on the finite lifetime of an excited nuclear state and a pulse structure of synchrotron radiation. Nuclear resonant scattering, delayed in time, is separated from the prompt pulse of incident radiation by a fast detector. The huge intensity of the prompt pulse leads, however, to an overload of the detector which has to be avoided by decreasing the energy bandwidth of synchrotron radiation by appropriate monochromators. For low-energy nuclear resonances this is routinely achieved using special monochromator with high order reflections of perfect silicon crystals, which provide a narrow band pass (~meV) and high angular acceptance matching the angular divergence of synchrotron radiation. However, for nuclear resonances beyond 30 keV this approach is no longer applicable, because the angular widths of high-order reflections become very small.

Here we show how nuclear forward scattering at high-energies can be performed with x-ray optics based on silicon crystals in combination with fast multi element detectors. This was done using low-order reflections with a moderate energy resolution but sufficiently high angular acceptance. The method was applied to study 67.41 keV Mössbauer transition in ^{61}Ni, and 68.75 keV Mössbauer transition in ^{73}Ge. The method can be applied to a series of other Mössbauer isotopes with the energy of transition between 60 and 90 keV.

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