Nuclear Ensembles with Switchable Transition Frequency Gradient: From Nuclear Memories to Spectral Intensity Enhancement

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Some appealing advantages of the hard X-ray photons with energies of 10-100 keV resonantly interacting with atomic nuclei, compared to optical photons resonantly interacting with bound electrons in atoms, stimulate the development of quantum X-ray optics. For example, 14.4-keV radiation can be focused into several nanometers spot and resonantly absorbed by just 70 nm-thick ^{57}Fe foil at room temperature. However, controlling of the single photon – nuclear ensemble interaction is challenging due to the absence of the relatively bright spectrally narrow hard X-ray radiation sources as well as high quality cavities. At the same time, some alternative techniques, such as acoustic and magnetic control, developed in the second part of the 20 century (see, for example, [1–3] and references there in), have been successfully used recently for an implementation of several quantum optical effects (see, for example, [4, 5], and references there in).

In this talk we discuss one more possibility, namely, introducing of the switchable transition frequency gradient in a nuclear ensemble along the photon propagation direction. We show that such a technique may be used for realization of the quantum nuclear memory [6], as well as spectral intensity enhancement [7].

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