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Preliminary Report:

In this experiment we explored analogies to quantum optical effects in the limit of (collective) strong coupling.

By inserting a 36 nm-thick layer of resonant ^{57}Fe between two distributed Bragg-Reflectors (DBRs) consisting of 12 Pt/C double layers of 3 nm thickness each, we have created a defect-mode planar photonic crystal waveguide for X-rays. The multilayer carries a single defect mode at approximately the center of the Bragg-peak. The DBRs allow multiple reflection and modify the matter-light coupling of the cavity system, as seen in the split resonances of the Mößbauer spectrum taken near the center of the defect mode, see Fig. 1. To our knowledge, this is the first time a defect-mode photonic crystal waveguide has been used in the x-ray regime.

The splitting of the outmost resonance lines in the spectrum in Fig. 1 indicates the pronounced polaritonic character of the enhanced light-matter interaction in this structure. In order to clearly reveal this splitting we employed a high-purity polarimeter to extract only the orthogonal component $\sigma \rightarrow \pi$ of the energy spectrum refelcted by the layer structure. The spectrum was obtained by employing a 1 micron thick foil of ^{57}Fe-enriched stainless steel as an analyzer mounted on a Doppler drive between the polarimeter and detector.

Evaluation of the data is currently in progress.

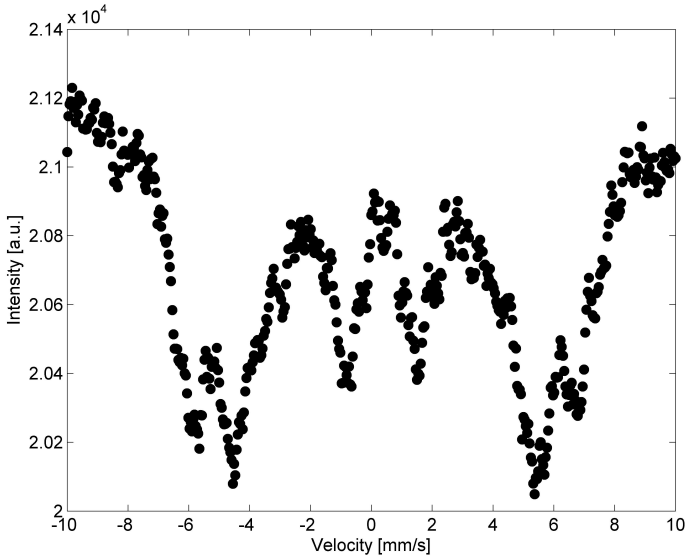

Fig. 1: Reflected energy spectrum from the DBR layer system containing a 36 nm thick layer of ^{57}Fe.

Possible advantages of this type of waveguide as opposed to conventional total-reflection waveguides include the fact that it carries only a single mode. Furthermore, the coupling of the light into the waveguide can take place in principle at much higher angles. Finally, the mode shape depends mostly on the width of the defect, and less on its index of refraction, allowing the use of several materials and thicknesses within the total defect.