First Observation of Scattering of Sub-GeV Electrons in Ultrathin Si Crystal at Planar Alignment and its Relevance to Crystal-Assisted 1D Rainbow Scattering

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Rainbow Scattering (RS) is a very specific type of scattering, which has been well known for a long time in the three-dimensional (3D) scattering of waves and particles (both classical and quantum), see e.g. [1]. In the theory of crystal rainbows (2D RS) with fast ions [2], the key aspect is the specific dependence of the deflection angle on the impact parameter with a crystal axis. The challenge and motivation appears to answer a question - whether the 1D (one-dimensional) RS by a crystal plane in an ultrathin crystal exist? To observe 1D-RS, the first precise measurements of 255 MeV electron scattering by an ultrathin 0.58 μm Si crystal at angles of incidence less than the Lindhard critical angle between a beam and (111) plane were performed at the SAGA-LS facility. The main results are as follows [3]:

1) 1D-RS of relativistic 255 MeV electrons was observed for the first time.
2) The simulations of electron trajectories revealed the multiple-value connection (as in 3D-RS) between deflection angle and impact parameters (points of incidence into a crystal), which affects the angular distributions of scattered electrons. This connection is dependent on the crystal thickness L, which is the second important parameter that characterizes 1D-RS.
3) The comparison of the experimental and theoretical results showed a fair agreement.

In this work we continue investigation of 1D-RS of relativistic electrons for different crystal and electron energy.

References

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