

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

*Y. Takabayashi<sup>a</sup>, Yu.L.Pivovarov<sup>b</sup>, T.A.Tukhfatullin<sup>b,1</sup>*

<sup>a</sup> SAGA Light Source, Tosu, Japan

<sup>b</sup> National Research Tomsk Polytechnic University, Tomsk, Russia

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  $\mu\text{m}$  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

- [1] N.Nešković, S. Petrović, M.Ćosić, Rainbows in Channeling of Charged Particles in Crystals and Nanotubes, Lecture Notes in Nanoscale Science and Technology, Springer, 2017.
- [2] M.Ćosić, N. Nešković, S. Petrović, Nuclear Inst. and Methods in Physics Research B **444** (2019) 10.
- [3] Y.Takabayashi, Yu.L.Pivovarov and T.A.Tukhfatullin, Phys. Lett. B **785** (2018) 347.

<sup>1</sup> Corresponding author: [tta@tpu.ru](mailto:tta@tpu.ru)