NICA Extracted Ion Beam Diagnostics Using Optical Cherenkov Radiation

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In this report, we explore the potential of using optical Cherenkov radiation (ChR) as a diagnostic tool for the NICA ion beam. A 1 mm-thick CVD diamond sample is employed as a ChR radiator, exhibiting a wavelength-dependent refractive index. The Cherenkov light spectrum produced by such a radiator features a narrow spectral line when observed at a fixed angle.

We have simulated the ChR spectral distribution and photon yield, taking into account the proposed experimental station in the SPD test zone of the NICA accelerator complex. The vacuum chamber enables measurement of the ChR spectrum at a right angle to the ion beam direction using a Hamamatsu spectrometer (model TBD), via a waveguide with a 4.5 mm aperture lens located 270 mm from the radiator.

The available xenon ion energy range is 1-4.5 GeV per nucleon. The simulation results demonstrate the feasibility of monitoring the energy and physical dimension of ion beams using a single diamond plate. Test measurements are planned during the Nuclotron run in 2025-2026.