

## The simulation of the dynamics of an intense proton beam in the collider NICA

In the physics of accelerators and colliders there is one important parameter as “impedance”. Impedance determines the level of the influence of the field induced by the beam in the longitudinal and transverse directions on the beam motion. Knowledge of the impedance allows a better understanding of the instability threshold of the machine and helps to estimate the highest possible luminosity of the collider.

Thus, the main objective at the moment is the calculation of the impedance of each device in the collider for further calculation of their contribution to the general impedance.

In the first part of the report the physics of the beam motion in an accelerator chamber is considered.

The second part describes the method of calculating the impedance - the method of electro-magnetic simulation through the CST Studio Suit software package, which was used for calculation of the impedances of accelerators at CERN. The results of these calculations were confirmed experimentally.

The third part gives an example of the calculation of the impedance for the part of vacuum chamber of the quadrupole magnet, which is a part of the arch of the collider NICA. A graph of the longitudinal impedance, graphs of the transverse impedance in the plane XOZ and YOZ are presented. It is shown that the impedance is characterized by a number of high-frequency resonances peaks, whose parameters are determined by the geometry of the chamber and induced by a bunched circulating beam.

As the result of the calculations the general impedance of the structure of the collider will be obtained. Thus, having knowledge about the dynamics and the instability of the beam in the accelerator / collider, it will be possible to set tasks for optimization of design solutions in order to minimize impedances and obtain the highest luminosity of the collider.

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**Track Classification:** Particle Accelerators and Nuclear Reactors