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## **Development of experimental and theoretical investigations in NRC “Kurchatov Institute” of fast particle irradiation effects on radiation resistance of new collimator and superconductor materials for magnet oriented on the Future Circular Collider (FCC).**

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The effect of irradiation of fast particles on the radiation resistance and behavior of collimators and superconductor materials for magnets is very important and serious task for Future Circular Collider (FCC). The energies of fast protons in FCC will be up to 100 TeV and it is much higher comparing with LHC proton beam, where energy is up to 7 TeV. Other very important point for fast particle beams in FCC is the effects of heavy ions (including Pb ions) with energies up to 2.75 TeV/nucleon on the behavior of collimator materials for FCC. Such scientific theoretical investigations were started in NRC KI.

In this report will be explain the developed methodology and will be show the obtained experimental results in NRC KI for investigations of the physical mechanisms of radiation resistance of collimator materials and superconductor materials for magnet, that can be applied also for FCC.

Experimental studies of new collimator materials include the irradiation of these materials on NRC KI cyclotron by different types of ions (fast protons and heavy ions), measurements and analysis of the following physical and mechanical properties of new collimator materials before and after irradiation by fast particles: electrical resistance, thermal expansion coefficient, specific heat, thermal diffusion coefficient, microstructure analysis using transmission electron microscopy (TEM) and X-ray diffraction on the NRC KI Synchrotron Source.

The theoretical investigations include the calculations of primary radiation damage formation in collimator materials for FCC using FLUKA simulations for different proton energies taking into account elastic and inelastic processes of fast particles and secondary particle formation (neutrons, pions, protons, etc.). Very serious new part of theoretical investigations in NRC KI is the development of theoretical models for shock wave formation in different collimator materials under fast proton (up to 100 TeV) and heavy ion irradiation (up to 2.75 TeV/nucleon), taking into account of nuclear reactions. Some results will be show here.

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