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Selected issues of influence irradiation on characteristics of superconducting elements in modern FEL-s facilities

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Currently developed free electron lasers facilities more and more frequently use superconducting elements in theirs advanced constructions. Most frequent examples of these applications are the superconducting electromagnets, current leads to them and especially superconducting cavities. The same concerns the superconducting shields, as well as superconducting correction coils conducting the electron beam along the appropriate way. Beside of numerous advantages of using these new materials, there arise however then new effects, especially connected with the influence of the irradiation appearing in FEL accelerators on the current carrying properties of the unique superconducting materials. The irradiation is caused here by primary electrons beam as well as by secondary beams,composed from neutrons, gamma-rays and photons, which are created then. In the paper are discussed therefore the advantages but also problems arising, while using superconductors in modern accelerators, working in irradiation environment. It is shown in which way the irradiation effects damage the subtle structure of superconducting materials, including 2D HTc superconductors, in which columnar defects are formed. In the paper it will be analysed, in which way these structural defects influence the current carrying properties of the superconducting materials. It will be developed therefore the energetical approach to the process of capturing on the nano-defects of the magnetic pancake vortices, characteristic for HTc superconductors. Various initial positions of the captured vortices will be analysed, movement of them will lead to the potential barrier decrease. The influence of the radiational defects on the current-voltage characteristics will be investigated then and maximal current density values detected, as the function of irradiation intensity and physical parameters as magnetic field and temperature. These researches have therefore pure scientific meaning as well as can be useful for prediction of the proper work of superconducting solenoids and current leads to them in radiational environmen. Analysis can be also extended on the case of micro-cracks and dislocational defects formed during the mechanical winding of superconducting coils and arising then bending strain.

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