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SIMULATIONS OF THERMAL LOADS ON OPTICAL ELEMENTS OF THE "FAST PROCESSES" BEAMLINE AT THE SYNCHROTRON RADIATION FACILITY SKIF

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Studies of fast processes, including real-time monitoring of substances and engineering materials under conditions of dynamic and pulsed loading of various types, constitute one of the promising application areas of modern synchrotron radiation (SR) sources. To implement such techniques, a high X-ray power density is required, since exposure times as fast as fractions of nanoseconds are typical for such experiments. Therefore, high-power synchrotron radiation sources (i.e., wigglers or undulators) are needed. The 1-3 "Fast processes" beamline of the Synchrotron Radiation Facility SKIF, which is currently under construction, is among a few dedicated appropriate instruments worldwide. It will utilize hard X-ray radiation from a superconducting wiggler with the total thermal power of 40 kW. According to the beamline optical scheme, a large fraction of the radiation will be absorbed by a massive fixed mask made of copper under active water cooling, and only a fractional power of 12 kW will hit first X-ray filters and vacuum-tight windows located downstream. In order to ensure safe operating conditions for all heat-loaded elements exposed directly to hard X-rays, it is necessary to perform detailed numerical simulation of heat transfer processes therein.

In the present work, results of numerical simulations of heat transfer process within X-ray filters (made of either beryllium, diamond, or pyrolytic graphite) are given. Temperature fields within the filters under realistic operating conditions were reconstructed using the Ansys Fluent environment. Based on the simulations, the optimum parameters of required cooling system were identified.