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Application of the Josephson Junction for the ANNs Energy Efficient Memory

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For progress in the field of high–performance computing and artificial intelligence, it is necessary to improve the energy efficiency and density of integration of existing circuits, which can be realized only with the use of a new element base - superconducting neurons and synapses. The proposed study is relevant due to the possibility of developing new energy-efficient computers with non-von Neumann architecture based on elements of superconducting spintronics. For this reason, the use of superconducting materials seems to be the most promising direction that meets these tasks. Traditionally, in superconducting logic and memory, information is associated with a quantum of magnetic flux, which, firstly, limits the degree of integration (a cell must contain one quantum of flux), and secondly, determines the localization of information, which complicates the physical implementation of information processing algorithms. These limitations lead to a low functional density of existing superconducting circuits and make it difficult to develop circuits based on non-classical principles of information processing, such as deep neural networks, which are key components in the creation of artificial intelligence. Recently, fundamental physics research in superconductor-ferromagnet thin-film tunnel structures based on magnetic Josephson Junctions created a new opportunity to solve this long-standing problem.