

PERSPECTIVES OF SUPERCONDUCTING NANO-ELECTRONICS

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In the present work we have developed logic gates, that are fundamental structures of digital circuits based of superconducting nano-structures. There are seven basic logic gates (AND, OR, XOR, NOT, NAND, NOR, and XNOR). All other types of Boolean logic gates can be created from a suitable network of just NAND or NOR gate(s). At the present technology logic gates are mostly made of Complementary Metal Oxide Semiconductor transistors and diodes. Often millions or billions of logic gates are packaged in a single integrated circuit. We show that these semiconducting technology can be replaced by superconducting one. Our study is focused on fluxon logic gates which are based on fluxon dynamics. We show that it is possible to produce logic gates based on fluxon dynamics using two dimensional Josephson Transmission Lines and Josephson junctions of various shapes. The logic is based on the flux cloning and fluxon collision phenomena developed recently. We designed OR, AND, XOR and the universal logic gate NAND, estimated they operational times and described simple computing processes with the use of the described fluxon logics.