

Superconducting Computing: Present Status and Perspectives

N. Yoshikawa

Yokohama National University, Japan

Abstract— Recent rapid growth in high-performance processor applications, such as AI and cryptocurrency, ultimately enhances the demand of more energy-efficient computing technologies, which would not be achievable by the CMOS technology nearing the end of Moore's law. Superconducting computing based on Boolean logic is thought to be the most promising candidate for post-CMOS computing in terms of performance and energy efficiency. A distinguished feature in superconducting computing is the availability of two unique logic styles: one is high-speed single- flux-quantum logic and the other is energy-efficient adiabatic logic. After reviewing the present research status in superconducting computing, this talk will present a perspective on energy-efficient superconducting computing based on the adiabatic quantum flux parametron (QFP), introducing new circuit technologies, including EDA tools, a direct-coupled QFP, a reversible QFP, three-dimensional integration and hybridization with CMOS memories. A roadmap toward the realization of superconducting computing will be discussed.

Keywords (Index Terms) — Superconducting electronics, superconducting computing, adiabatic quantum flux parametron.

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