

## Extremely Energy-efficient Superconductive Logic Circuits Based on Adiabatic Flux Quantum Devices

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**Abstract**— Adiabatic quantum flux parametron (AQFP) is an extremely energy-efficient superconductive logic device due to the adiabatic switching in the logic operation. Its switching energy is close to the quantum limit and can be reduced proportionally to the operation frequency. The minimum switching energy can be reduced even lower than the thermal limit  $k_B T \ln 2$  known as the Landauer limit. This talk will present the latest research status in superconductive integrated circuit technologies based on the AQFP logic, which includes microprocessors for high-performance computing, detection and control circuits for quantum computers, stochastic processors for neuromorphic computing, and readout circuits for superconductive image sensors. The research activities toward the reversible computing paradigms using AQFP logic will also be presented.

**Keywords (Index Terms)** — Digital, superconducting, electronics, adiabatic, low-power, quantum flux parametron, QFP.

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