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Towards Ultra-Low Power Computing: SFQ Brownian Logic Circuits

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***Abstract*–Innovative computers that utilize emerging technologies such as single-flux quantum and silicon photonics have emerged as important alternatives for the post-Moore era. Unlike conventional digital computers, these calculate using an analogy of phenomena that occur in devices, so it has the potential to reduce calculation costs to the utmost limit. However, noise suppression is one of the most critical issues in every device and ultimately determines the efficiency of computer operation. To overcome the problem of noise limit and realize an ultimate low-power computer, we must break away from the idea of "suppressing noise" and consider a completely different approach. This paper introduces an SFQ-circuit architecture that utilizes noise as a mechanism for circuit operation, which we refer to as SFQ Brownian Logic Circuits (SBLCs). A circuit freed from the design constraint of noise suppression has the potential to become a highly efficient computer. We discuss grand challenges and opportunities in such SFQ computing platforms, accompanied by introductions to our recent research activities.**

***Keywords (Index Terms)*–Josephson Device, Digital, Noise, Reversible Logic**

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