

University of Rochester
Department of Electrical and Computer Engineering

Superconducting Spintronic Electronics: Solving Energy Problem in High-End Computing

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Computer Studies Building (CSB) 209

Abstract: The explosive growth of the Internet transformed data centers into large industrial scale computer facilities with extraordinarily high energy demands. From Google and Facebook to banking, cloud computing and supercomputing, an average data center already use as much electricity as a medium-size town. Besides just high energy costs, there is a compelling technical reason to improve energy efficiency of computing technologies. The development of the next generations of high-end computers will not be possible unless a significant improvement in energy efficiency is achieved over the technology available today. The heart of the problem is in a relatively low energy-efficiency of current computer circuit technologies consuming too much energy for computing, storing and moving data between processors and memories. I will review several key innovations happened just within last few years which dramatically increased a potential of superconductivity addressing known critical problems which prevented the use of superconductivity in high-end computing in the past. Superconducting single flux quantum (SFQ) digital circuits by virtue of their inherent low power dissipation, high speed, lossless interconnect present an excellent opportunity to dramatically increase energy efficiency of high- and magnetic order parameters co-exist to deliver new opportunities

Bio: Dr. Oleg Mukhanov, Chief Technology Officer and Sr. (1987) from Moscow State University and the M.S. in electrical engineering from the University of Michigan (with honors). Dr. Mukhanov has more than 30 years of experience in the field of superconducting electronics. He joined Hypres – an IBM spinoff focused on superconducting electronics. He joined Hypres to initiate the development of the RSFQ technology, which he co-invented in 1985. Prior to Hypres he worked at the RSFQ technology basis. Over the years at Hypres, Dr. Mukhanov worked on performance superconductor digital, mixed signal, and analog processing and storage, radio frequency signal reception, signal processing, and a variety of applications including wireless communications, signal processing, and computing. He is a co-inventor of RSFQ logic and was the developer of the co-invented Digital-RF architecture and led the development of the also co-invented and led the development of new generation of superconducting ferromagnetic random access memories for embedded systems and co-

