

**University of Rochester**  
**Department of Electrical and Computer Engineering**

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

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**Wednesday, October 12th**  
**12:00PM – 1:00PM**  
**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-end computing. The long-standing memory problem is being addressed by a new class of cryogenic spintronics devices capable of co-integration with SFQ circuits and new superconducting spintronics elements, in which competing superconducting and magnetic order parameters co-exist to deliver new opportunities for electronics.

**Bio:** Dr. Oleg Mukhanov, Chief Technology Officer and Sr. Executive VP at Hypres. He received the Ph.D. in physics (1987) from Moscow State University and the M.S. in electrical engineering (1983) from Moscow Engineering Physics Institute (with honors). Dr. Mukhanov has more than 30 years of experience in superconducting electronics. From 1991 to present, he has been with Hypres – an IBM spinoff focused on the development of high-performance superconducting electronics. He joined Hypres to initiate the development of Rapid Single Flux Quantum (RSFQ) superconductor circuit technology, which he co-invented in 1985. Prior to Hypres he was a staff scientist in Moscow State University developing the RSFQ technology basis. Over the years at Hypres, Dr. Mukhanov has initiated and led many projects on high-performance superconductor digital, mixed signal, and analog circuits. These include circuits and devices for data processing and storage, radio frequency signal reception, signal and time digital processing, cryogenic interfaces for a variety of applications including wireless communications, radar, electronic warfare, instrumentation, and high-end computing. He is a co-inventor of RSFQ logic and was the designer of a number of the world's fastest digital circuits. He co-invented Digital-RF architecture and led the development of the world's first cryocooled Digital-RF receiver system. He also co-invented and led the development of new generation of energy-efficient single flux quantum technology and superconducting ferromagnetic random access memories for energy efficient computing systems. Dr. Mukhanov authored and co-authored over 160 scientific papers, book chapters and over 20 patents. He is a member of advisory committees of international conferences and institutions on superconducting electronics, was chair and member of organizing and program committees of many national and international superconductor electronics conferences. In 2005-2007, Dr. Mukhanov was a president of the US Committee on Superconducting Electronics. He is an editor of IEEE Transactions of Applied Superconductivity and received an IEEE outstanding service recognition as an editor of special issues of this journal. Dr. Mukhanov is a Fellow of IEEE and member of American Physical Society. He is the recipient of The IEEE Award for Continuing and Significant Contributions in the Field of Small Scale Applied Superconductivity (2015).

Pizza and soda provided.