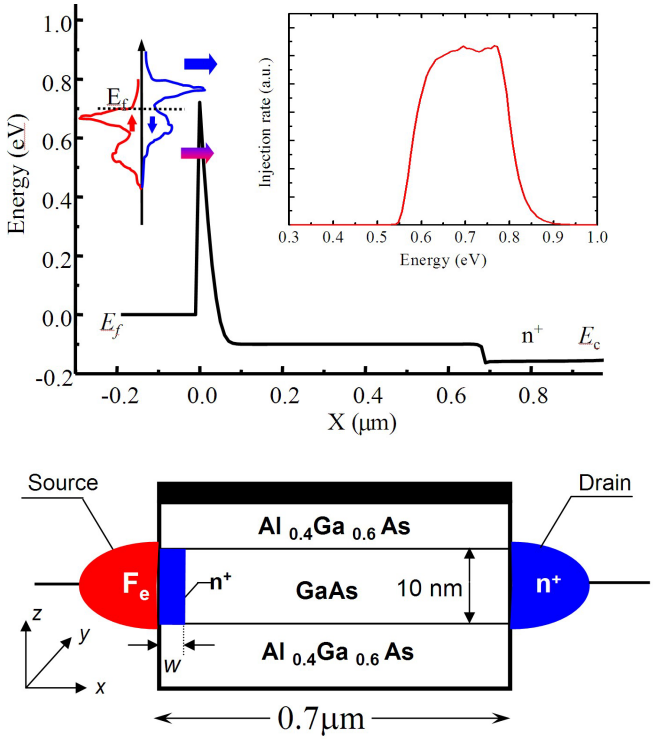
ITR/SY: Center for Modeling of Quantum Dynamics, Relaxation and Decoherence in Solid-State Physics for Information-Technology Applications

Vladimir Privman, Clarkson University, DMR-0121146

The main **objective** of our program has been the exploration of *coherent quantum mechanical processes* in novel solid-state semiconductor information processing devices, with components of atomic dimensions: **quantum computers**, **spintronic devices**, and **nanometer-scale computer logic gates**.

The **achievements** to date include new modeling tools for evaluating initial decoherence and transport associated with quantum measurement, spin polarization control, and quantum computer design, in semiconductor device structures.

Our **program** has involved an interdisciplinary team, from Physics and Electrical Engineering to Computer Science and Mathematics, with extensive collaborations with leading experimental groups and with Los Alamos National Laboratory.



Monte Carlo simulation of spin injection and spin-polarized transport, accounting for thermionic emission and tunneling.

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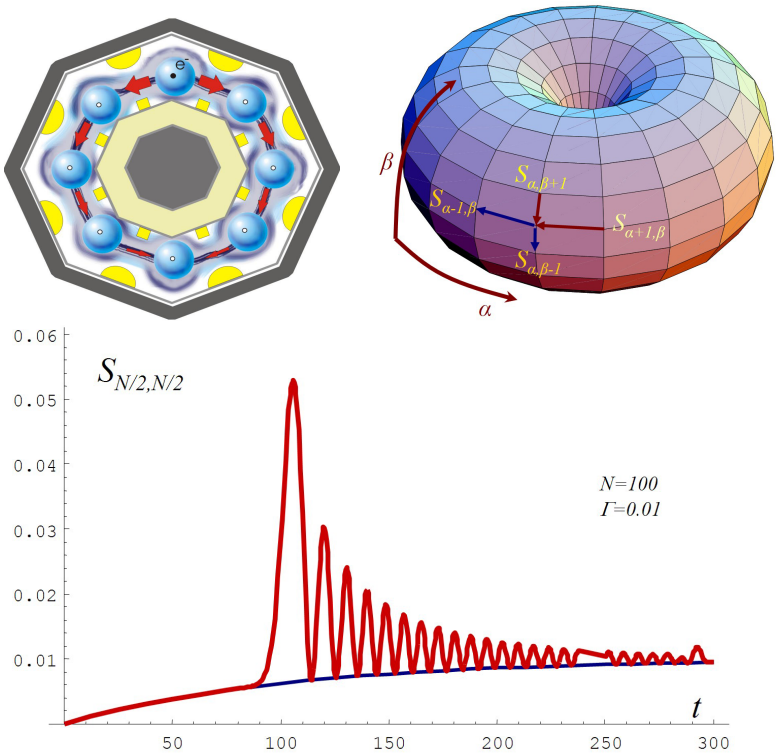
The **educational impact** includes training 12 undergraduate students, 10 graduate students, 4 postdoctoral researchers, and the development of 3 new courses to introduce quantum nanotechnology concepts to undergraduate and graduate students.

Our **outreach program** has included sponsoring conference events, an international *Quantum Device Technology* workshop series, and numerous lectures and presentations.

Our results to date are **published** in over 60 research articles and several reviews.

Applications for **national security** (information security and national leadership in advanced technology) have resulted in funding of our program by the National Security Agency.



Analytical evaluation of the algorithmic speed-up offered by quantum walks, realizable as electrons tunneling between nano-sized quantum dots.