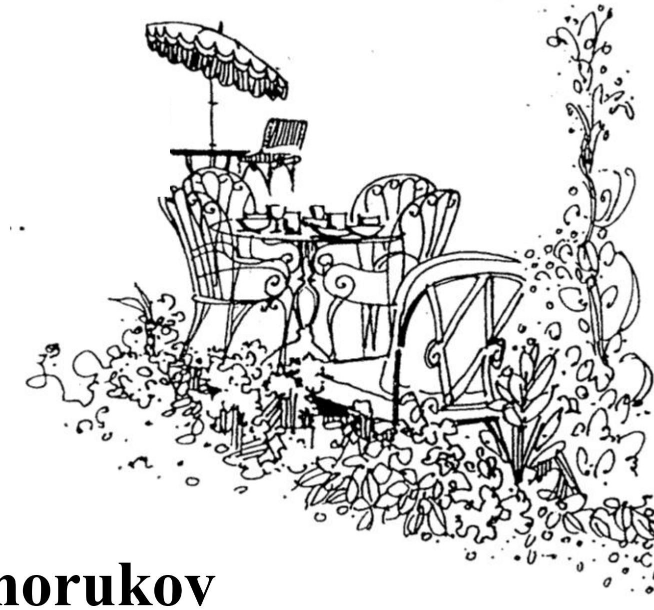
Chez Pierre



Presents ...

Monday, April 25, 2011
12:00pm
MIT Room 4-331

Eugene Sukhorukov
University of Geneva

"Theory of fractional quantum Hall interferometers"

Interference of fractionally charged quasi-particles is expected to lead to Aharonov-Bohm oscillations with periods larger than the flux quantum.
However, according to the Byers-Yang theorem, observables of an electronic system are invariant under adiabatic insertion of a quantum of singular flux.
We resolve this seeming paradox by considering a microscopic model of an electronic interferometer made from a quantum Hall liquid at filling factor 1/m in the shape of a Corbino disk. Quantum Hall edge states are utilized in place of optical beams, quantum point contacts play the role of beam splitters connecting different edge channels, and Ohmic contacts may be considered a source and drain of a quasi-particle current. Depending on the position of Ohmic contacts one distinguishes interferometers of Fabry-Perot (FP) and Mach-Zehnder (MZ) type. An approximate ground state of such interferometers is described by a Laughlin type wave function, and low-energy excitations are incompressible deformations of this state. We construct a low-energy effective theory by projecting the state space of the liquid onto the space of incompressible deformations and show that the theory of the quantum Hall edge so obtained is a generalization of a chiral conformal field theory. A quasi-particle tunneling operator in our theory is found to be a single-valued function of tunneling point coordinates, and its phase depends on the topology, determined by the positions of Ohmic contacts. We describe strong coupling of the edge states to Ohmic contacts and the resulting quasi-particle current through the interferometer with the help of a master equation. We find that the coherent contribution to the average quasi-particle current through MZ interferometers vanishes after the summation over quasi-particle degrees of freedom. Remaining contribution originates from electron tunneling and oscillates with the electronic period, in agreement with the Byers-Yang theorem. When a magnetic flux through FP interferometers is varied with a modulation gate, current oscillations have the quasi-particle periodicity, thus allowing for the spectroscopy of quantum Hall edge states. Importantly, in contrast to previous models our theory does not rely on any ad-hoc constructions, such as Klein factors.