Speaker: Marco Roncaglia

Affiliation: INRIM, National Institute of Metrology, Turin, Italy

Title:
Simulating One-Dimensional Anyons with Ultracold Atoms

Abstract:

In our three dimensional world only two kind of particles can exist: bosons and fermions. However in low-dimensional systems it is possible to conceive objects, called anyons, which carry fractional exchange statistics, interpolating between bosons and fermions. Traditionally, anyons are associated to the fractional quantum Hall effect, where collective excitations of 2D electrons show a statistical exchange phase, determined by intensity of the magnetic field. Here we discuss experimental ways to simulate anyons in 1D lattices with fully tunable exchange statistics. In our setup, anyons are obtained starting from bosons with occupation-dependent hopping amplitudes, which can be realized by assisted Raman tunneling. The statistical angle can thus be continuously controlled by modifying the relative phase of external driving fields. This opens the fascinating possibility of smoothly transmuting a bosonic statistics via anyons into a fermionic one, giving rise to surprising effects like superfluid-insulating phase transitions induced by the particle statistics as a free parameter.