Condensed Matter Physics Seminar Series

Very high energy physics of fractional quantum Hall states

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Fractional quantum Hall (FQH) states and other types of strongly-correlated topological phases continue to fascinate physicists with their properties such as quasiparticles with exotic braiding statistics, emergent gauge fields, protected gapless edge excitations, etc. Many of these properties have been well-understood due to a combination of techniques, ranging from effective field theory to numerical simulations, tailored to the low-energy physics. In contrast, the highly-excited spectrum and out-of-equilibrium dynamics of FQH states largely remain an uncharted territory. In this talk, I will discuss two types of experimental probes that have recently opened the window to the high-energy realm of FQH states. On the one hand, advances in scanning tunneling microscopy (STM), including sample and tip preparation, have started to reveal the intrinsic correlation physics of FQH states [1]. I will explain how the signal from such experiments allows to explore the anatomy of FQH states, including the identification of non-Abelian anyons [2,3]. On the other hand, when FQH states are driven out of equilibrium by geometric fluctuations, their resulting dynamics reveals signatures that lie outside the well-known theories such as composite fermion theory [4]. I will show that such dynamics can be naturally explained in terms of parton quasiparticles. Thus, out-of-equilibrium dynamics reveals that partons are indeed the “real” FQH quasiparticles which, similar to quarks, only become observable only at sufficiently high energies.

Zlatko Papic is a Lecturer in the Theoretical Physics Group at the University of Leeds. He obtained his PhD at Université Paris Sud in 2010. He was a postdoctoral researcher at Princeton University (2010-2013), and a joint postdoctoral fellow between Perimeter Institute and Institute for Quantum Computing in Waterloo (2013-2015). His research spans condensed matter theory and quantum information.

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4-330 PAB