Towards Tpological Superconductivity and Majorana Modes in a 2D Topological Insulator and their Potential for Quantum Computation

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Topological insulators coupled to conventional superconductors are predicted to host topological superconductivity and to support localized Majorana zero-modes. Majorana modes are predicted to obey non-Abelian exchange statistics, which makes them interesting building blocks for topologically-protected quantum computing. In this talk, I will focus on our recent experiments which show gate-tunable induced superconductivity in a two-dimensional topological insulator (InAs/GaSb quantum wells). We observe superconductivity in all three transport regimes of our devices: bulk electron transport, edge mode transport and bulk hole transport. Using superconducting quantum interference, we show that the supercurrent flows through the edge modes when the Fermi level is tuned into the hybridization gap. I will discuss possible experiments aimed at detecting Majorana modes in 2D-TI-superconductor devices, and their potential for quantum computation.

BIO: Professor Pribiag received his Ph.D. in 2010 at Cornell University, where he studied magnetization dynamics in nanoscale systems driven by spin-transfer torques. His work demonstrated that a direct current induces steady-state oscillations of a magnetic vortex in a spin valve. These vortex oscillations are more coherent than uniform modes and do not require an applied magnetic field. For his postdoctoral work at the Kavli Institute of Nanoscience Delft, he focused on quantum transport in low-dimensional materials with strong spin-orbit coupling, including single-spin dynamics in quantum dots and superconducting transport in 2D topological insulator devices. He joined the School of Physics and Astronomy at the University of Minnesota in fall 2014. His current work focuses on the physics of nanoscale devices based on novel low-dimensional materials, such as quantum spin Hall insulators (2D topological insulators), complex oxide interfaces, and semiconductor nanowires.

Awards: NSF CAREER Award (2016-2021). VENI Award, Netherlands Organisation for Scientific Research (2011-2014)