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IUPAP C-10 Award Talk: From Topological Insulators to Quantum Anomalous Hall Effect

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The quantum anomalous Hall (QAH) effect can be considered as the quantum Hall (QH) effect without external magnetic field, which can be realized by time reversal symmetry breaking in a topologically non-trivial system [1, 2]. A QAH system carries spin-polarized dissipationless chiral edge transport channels without the need for external energy input, hence may have huge impact on future electronic and spintronic device applications for ultralow-power consumption. The many decades quest for the experimental realization of QAH phenomenon became a possibility in 2006 with the discovery of topological insulators (TIs). In 2013, the QAH effect was observed in thin films of Cr-doped TI for the first time [3]. Two years later in a near ideal system, V-doped TI, contrary to the negative prediction from first principle calculations, a high-precision QAH quantization with more robust magnetization and a perfectly dissipationless chiral current flow was demonstrated [4]. In this talk, I will introduce the route to the experimental observation of the QAH effect in above-mentioned two systems [3, 4], and discuss the zero magnetic field dissipationless edge current flow as well as the origin of the dissipative channels in the QAH state [5]. Finally I will talk about our recent progress on the QAH insulator-Anderson insulator quantum phase transition and its scaling behaviors [6]. References [1] F. D. M. Haldane, Phys. Rev. Lett. 61, 2015-2018 (1988). [2] R. Yu et al, Science 329, 61-64 (2010). [3] Cui-Zu Chang et al, Science 340, 167(2013). [4] Cui-Zu Chang et al, Nature Materials 14, 473(2015). [5] Cui-Zu Chang et al, Physics Review Letters 115, 057206 (2015). [6] Cui-Zu Chang et al, Physics Review Letters 117, 126802 (2016)..