DEPARTMENT OF PHYSICS UNIVERSITY OF MARYLAND **CNAM** Condensed Matter Colloquium

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Quantum Spin Hall Effect and Topological Insulators

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Recently, a new class of topological states has been proposed and experimentally realized. These topological insulators have an insulating gap in the bulk, but have topologically protected edge or surface states due to the time reversal symmetry. In two dimensions the edge states give rise to the quantum spin Hall (QSH) effect, in the absence of any external magnetic field. I shall review the theoretical prediction [1] of the QSH state in HgTe/CdTe semiconductor quantum wells, and its recent experimental observation [2]. The edge states of the QSH state supports fractionally charged excitations [3]. The QSH effect can be generalized to three dimensions as the topological magneto-electric effect (TME) of the topological insulators [4]. Bi_2Te_3, Bi_2Se_3 and Sb_2Te_3 are theoretically predicted to be topological insulators with a single Dirac cone on the surface [5]. I shall present a realistic experimental proposals to observe the magnetic monopoles on the surface of topological insulators [6].

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[5] Haijun Zhang, Chao-Xing Liu, Xiao-Liang Qi, Xi Dai, Zhong Fang, and Shou-Cheng Zhang, Nature Physics 5, 438 (2009).
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Host: Ian Appelbaum