Abstracts

Peter Bouwknegt (Australian National University, Canberra)
On the K-theory classification of topological states of matter
Abstract: Topological insulators and superconductors are many-fermion systems possessing an unusual band structure that leads to a bulk band gap as well as topologically protected gapless extended surface modes (known as the 'bulk-boundary correspondence'). It was recently realised by Kitaev, that deformation classes of gapped Hamiltonians are naturally classified by K-theory. This classification parallels the classification of the 2 complex and 8 real symmetry classes of Hamiltonians (the '10-fold way') of Altland and Zirnbauer, and naturally leads to a periodic table of topological insulators. In this talk I will give a brief overview of these developments. I will also describe how the bulk-boundary correspondence fits in with the K-theory picture.

James Fullwood (University of Hong Kong, Hong Kong)
On topological invariants of elliptic fibrations
Abstract: A regime of string theory referred to by physicists as 'F-theory' exploits the geometry of elliptically fibered Calabi-Yau fourfolds to model the purported extra dimensions of space-time. As such, topological invariants of the total space of these fibrations often have physical meaning, as the topology of the extra dimensions constrain the manner in which strings can propagate within the fourfold. Moreover, a duality between F-theory and type-IIB predicts certain relationships between invariants of the total space of the elliptic fibration and invariants of the base. Keeping in line with the prophetic nature of string theory, these relationships seem to hold in a much more general context, i.e., they hold for elliptic fibrations over a base of arbitrary dimension without any Calabi-Yau hypothesis on the total space of the fibration.

Man Ho Ho (Hong Kong Baptist University, Hong Kong)
A condensed proof of the Grothendieck-Riemann-Roch theorem in differential K-theory
Abstract: The Atiyah-Singer family index theorem can be stated as the equality of analytic and topological index maps in K-theory. In recent years, extensions of K-theory, called differential K-theory, have been developed, with motivation from mathematical physics. There are several models of differential K-theory, due to Bunke-Schick, Freed-Lott, Hopkins-Singer and Simon-Sullivan. The family index theorem and the Grothendieck-Riemann-Roch theorem has been generalized to differential K-theory by Freed-Lott and Bunke-Schick respectively. In this talk we present a condensed proof of the Grothendieck-Riemann-Roch theorem in differential K-theory. We introduce the necessary ingredients needed to understand the Grothendieck-Riemann-Roch theorem in differential K-theory, including Cheeger-Simons differential characters, Freed-Lott differential K-theory and the construction of the differential analytic index. If time permits we will go over Freed-Lott's proof of the index theorem in differential K-theory.

Xiaochun Rong (Capital Normal University, Beijing and Rutgers University, New Brunswick)
Continuity of extremal transitions and flops for Calabi-Yau manifolds
Abstract: We will discuss metric behavior of Ricci-flat Kähler metrics on Calabi-Yau manifolds under algebraic geometric surgeries: extremal transitions or flops. We will prove a version of Candelas and de la Ossa's conjecture: Ricci-flat Calabi-Yau manifolds related via extremal transitions and flops can be connected by a path consisting of continuous families of Ricci-flat Calabi-Yau manifolds and a compact metric space in the Gromov-Hausdorff topology. This is joint work with Yuguang Zhang.

Mathai Varghese (University of Adelaide, Adelaide)
New deformations of geometric elliptic complexes
Abstract: I will discuss new deformations of well known geometric elliptic complexes. As a consequence, I will define new secondary invariants for these deformed complexes that are metric independent, and explore some consequences and applications. This is joint work with Siye Wu, and another joint work with Moulay Benameur.

Xinwen Zhu (Northwestern University, Evanston and HKUST, Hong Kong)
Hitchin fibrations and Langlands duality
Abstract: TBA