# Chez Pierre

Presents ...

**Monday, November 4, 2019**
**12:00pm Noon**
**MIT Room 4-331**

# Chez Pierre Seminar

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"Stiefel-Whitney classes and topological phases in band theory."

I am going to talk about novel topological properties of spinless fermions systems with space time inversion $I_{ST}$ symmetry which is the combination of time-reversal symmetry with additional inversion or two-fold rotation symmetry. In three dimensions, the band topology of $I_{ST}$ symmetric systems can support nodal lines with Z2 monopole charges [1]. Here we show that the Z2 monopole charge is equivalent to the second Stiefel Whitney invariant. Also using the mathematical properties of the Stiefel-Whitney classes, we show the intriguing linking structure of monopole nodal lines and discuss the condition that the second Stiefel-Whitney number becomes a well-defined 2D topological invariant. In the case of 2D two band systems with $I_{ST}$ symmetry, we show that the nontrivial band topology can be characterized by the Euler class. We prove that a two-band system with nontrivial Euler invariant has band crossing points with nonzero total vorticity, which naturally explains the violation of the well-known Nielsen-Ninomiya theorem in twisted bilayer graphene at magic angle[2]. We propose that both the topological property of monopole nodal lines and the fragile topology of 2D insulators with nontrivial Euler class originate from the underlying mathematical structure of the $I_{ST}$ symmetric real wave functions, that is, the Stiefel-Whitney classes [1,3].

*REFERENCES:*

*[1] J. Ahn, D. W. Kim, Y.K.Kim and **B. –J. Yang**, "Band topology and linking structure of nodal line semimetals with Z2 monopole charges", Phys. Rev. Lett. 121, 106403 (2018)..*

*[2] J. Ahn, S. J. Park and **B. –J. Yang**, "Failure of Nielsen-Ninomiya theorem and fragile topology in systems with space-time inversion symmetry: application to twisted bilayer graphene at magic angle", Phys. Rev. X, 9, 021013 (2019)*

*[3] Junyeong Ahn, Sungjoon Park, Dongwook Kim, Youngkuk Kim, **Bohm-Jung Yang**, "Stiefel-Whitney class and topological phases in band theory", arXiv:1904.00336.*