

Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Ising superconductivity and Majorana fermions in superconducting transition metal dichalcogenides"

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Abstract: Ising superconductors with in-plane upper critical fields several times higher than the Pauli limits have been discovered recently in transition metal dichalcogenides such as MoS₂ and NbSe₂ thin films [1-3]. These Ising superconductors have very strong Ising spin-orbit couplings (SOC), in the order of 10 to 100meV, which pin electron spins to the out-of-plane directions. This is in contrast to Rashba SOC which pins electron spins to in-plane directions. Here, we explain how Ising SOC can enhance the in-plane upper critical field of Ising superconductors [1-4]. We also show that Ising superconductors can be used to create Majorana fermions by placing a metal wire on top of the Ising superconductor [5], similar to the case of Rashba wire on top of s-wave superconductors. We further show that an applied in-plane magnetic field can drive a monolayer NbSe₂ [2,5] and into a nodal topological phase with Majorana flat bands when the applied in-plane field is higher than the Pauli limit but smaller than the upper critical field.

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2. X. Xi, Z. Wang, W. Zhao, J-H Park, K. T. Law, H. Berger, L. Forró, J. Shan, K. F. Mak, *Nature Physics* 12, 139-143 (2016).
3. Y Saito et al. *Nature Physics* 12, 144-149 (2016).
4. Benjamin T. Zhou, Noah F.Q. Yuan, Hong-Liang Jiang and K. T. Law, *Phys. Rev. B* 93, 180501 R (2016).
5. Wen-Yu He, Benjamin T. Zhou, James J. He, Noah F.Q. Yuan, Ting Zhang and K. T. Law, arXiv:1604.02867.

3:00pm
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