Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Phase diagram and quantum criticality of disordered Majorana-Weyl fermions JUSTIN WILSON, California Institute of Technology, JED PIXLEY, PALLAB GOSWAMI, University of Maryland at College Park — A three-dimensional $p_x + ip_y$ superconductor hosts gapless Bogoliubov-de Gennes (BdG) quasiparticles which provide an intriguing example of a thermal Hall semimetal (ThSM) phase of Majorana-Weyl fermions. We study the effect of quenched disorder on such a topological phase with both numerical and analytical methods. Using the kernel polynomial method, we compute the average and typical density of states for the BdG quasiparticles; based on this, we construct the disordered phase diagram. We show for infinitesimal disorder, the ThSM is converted into a diffusive thermal Hall metal (ThDM) due to rare statistical fluctuations. Consequently, the phase diagram of the disordered model only consists of ThDM and thermal insulating phases. Nonetheless, there is a cross-over at finite energies from a ThSM regime to a ThDM regime, and we establish the scaling properties of the avoided quantum critical point which marks this cross-over. Additionally, we show the existence of two types of thermal insulators: (i) a trivial thermal band insulator (ThBI), and (ii) a thermal Anderson insulator (AI). We also discuss the experimental relevance of our results for three-dimensional, time reversal symmetry breaking, triplet superconducting states.

Justin Wilson
Caltech

Date submitted: 10 Nov 2016 Electronic form version 1.4