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Topological order in finite-temperature Gaussian fermionic systems[1] LUKAS WAWER, Department of Physics, University of Kaiserslautern, DOMINIK LINZNER, Department of Physics, University of Kaiserslautern, University of Darmstadt, MICHAEL FLEISCHHAUER, Department of Physics, University of Kaiserslautern — Since their discovery, topological states of matter have been praised for their fascinating and potentially useful properties as protected edge states or anyonic excitations. However, these features seem to vanish at finite temperature. Exploiting the equivalence of Zak (or Berry) phase and polarization we can classify topological order in finite-temperature systems by means of the many body polarization [1]. We show that topological order defined in this way survives at any finite temperature T in Gaussian fermionic systems. We first consider a 1D model for symmetry protected topological order (Su-Schrieffer-Heeger model) and find that there is a quantized winding of the polarization for closed paths in parameter space for all $T < \infty$. At $T = \infty$ a topological phase transition occurs and for $T < 0$ the polarization winding reverses its sign. We then study a 2D model (Hofstadter-Hubbard model) with intrinsic topology and show a similar behavior. [1] D. Linzner, L. Wawer, F. Grusdt, and M. Fleischhauer, Phys. Rev. B **94**, 201105(R) (2016)

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