Effects of anisotropy and disorder-mediated nucleation of vortices on the superheating field of superconductors DANilo LIARTE, Cornell University, SAM POSEN, Fermi National Accelerator Laboratory, MARK TRANSTRUM, Brigham Young University, GIANLUIGI CATELANI, Peter Grunenberg Institut, MATTHIAS LIEPE, JAMES SETHNA, Cornell University — We provide a theory for the effects of disorder and materials anisotropy on the maximum parallel surface field $H_{sh}$ that a superconductor can sustain, important for accelerating cavities in current particle accelerators. (Current niobium cavities routinely operate above $H_{c1}$, in a metastable regime susceptible to vortex penetration). Dirt is discussed in an ‘instanton’ calculation of disorder-mediated vortex nucleation. The increased susceptibility to dirt due to the smaller coherence lengths in new materials (Nb$_3$Sn, NbN, MgB$_2$) is swamped by much stronger effects of the distance from the pure $H_{sh}$: Nb$_3$Sn should be as reliable at 0.92 Tesla as Nb at typical operating fields of 0.18 Tesla, according to a crude estimate. The effects of anisotropy in layered materials is calculated within Ginzburg-Landau theory, applicable near the critical temperature. For high-$\kappa$ materials like MgB$_2$, the anisotropy is negligible near $T_c$; we speculate about possible large anisotropies at lower temperatures. We briefly review current experimental development of Nb$_3$Sn cavities.

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