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Re-examining the critical velocity of a clean one-dimensional superconductor PAUL GOLDBART, Universiy of Illinois, TZU-CHIEH WEI, University of British Columbia — We re-examine the issue of the critical velocity of a clean, one-dimensional superconductor at the level of mean-field theory. We find that the zero-temperature value of the critical velocity (i.e., the uniform velocity of the superfluid condensate at which the superconducting state becomes unstable) is a factor of $\sqrt{2}$ smaller than the Landau value. This contrasts with a prior finding, which held that these velocities equal one another. The smaller critical velocity, which our analysis yields, is the result of a pre-emptive Clogston-Chandrasekhar-type discontinuous phase transition, analogous to the Sarma and Maki-Tsuneto threshold exchange field of a superconductor. We also consider the role of temperature, explore critical currents, and examine metastability and its limits in the temperature vs. flow-velocity phase diagram, and we comment on the effects of electron scattering by impurities. [1] T-C. Wei and P.M. Goldbart, Phys. Rev. B 80, 134507 (2009).

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