Strong pinning regimes explored with large-scale Ginzburg-Landau simulations\textsuperscript{1} ROLAND WILLA, ALEXEI E. KOSHELEV, Argonne National Laboratory — Improving the current-carrying capability of superconductors requires a deep understanding of vortex pinning. Within the theory of (3D) strong pinning [1] an ideal vortex lattice is weakly deformed by a low density \( n_p \) of strong defects. In this limit the critical current \( j_c \) is expected to grow linearly with \( n_p \) and to decrease with the field \( B \) according to \( B^{-\alpha} \) with \( \alpha \approx 0.5 \). In the small-field limit the (1D) strong pinning theory of isolated vortices predicts \( j_c \propto n_p^{0.5} \), independent of \( B \). We explore strong pinning by low defect densities using time-dependent Ginzburg-Landau simulations [2]. Our numerical results suggest the existence of a wide regime, where the lattice order is destroyed and yet interactions between vortices are important. In particular, for large defects we found an extended range of power-law decay of \( j_c(B) \) with \( \alpha \approx 0.3 \), smaller than predicted. This regime requires the development of new analytical models. Exploring the behavior of \( j_c \) for various defect densities and sizes, we will establish pinning regimes and applicability limits of the conventional theory. [1] G. Blatter et al., Phys. Rev. Lett. 92, 067009 (2004) [2] I. A. Sadovskyy et al., J. Comput. Phys. 294, 639 (2015)

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