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Peak Effect at Disorder-driven Dimensional Crossover in the Mixed Phase of Layered Superconductors JOSE P. RODRIGUEZ, California State University at Los Angeles — Collective pinning of the vortex lattice in layered superconductors with material defect centers is studied through a duality analysis of the corresponding XY model with uniform frustration[1]. We find first that long-range vortex-glass order across layers emerges from the decoupled vortex-liquid phase as the temperature is lowered. The resulting low-temperature phase shows weak superconductivity across layers. It crosses over to a defective vortex lattice with strong inter-layer coupling when the relative disorder scale between adjacent vortex lattices in isolated layers matches the Josephson penetration depth[2]. In particular, the Larkin length L_c^c extracted from the phase correlations between different layers at low temperature saturates down to the inter-layer spacing at the dimensional crossover into the weak superconductor. Collective pinning theory then implies that a peak in the critical current flowing along layers exists there. We then notably predict that the (second) peak field is diminished by an increase in point disorder before it saturates. Comparison to the peak effect shown by organic superconductors and by high-temperature superconductors is made where possible.

[1] J.P. Rodriguez, Phys. Rev. B **69**, 100503(R) (2004).
[2] J.P. Rodriguez, Physica C **404**, 311 (2004).

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