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Phase diagrams of vortex matter with multiple length scale pair interaction in layered superconductors QINGYOU MENG, Department of Physics, University of Massachusetts, Amherst, CHRISTOPHER VARNEY, Department of Physics, University of West Florida, HANS FANGOHR, Engineering and the Environment, University of Southampton, EGOR BABAEV, Department of Physics, University of Massachusetts, Amherst, and Department of Theoretical Physics, The Royal Institute of Technology — Recently, Romero-Isart *et al.* [Phys. Rev. Lett. 111, 145304 (2013)] proposed a new way of trapping ultracold atoms using the magnetic field generated by a vortex lattice, where the lattice is generated by pinning the vortices. Here, we show that the same effect can be achieved with layered superconductors without pinning the vortices. We utilize Langevin dynamics to determine the ground state phase diagrams for pair potentials that describe the vortex physics of layered superconducting systems. We also present two zero temperature phase diagrams of vortex matter with three and four short length scale pair interaction. In the first phase diagram, there are 10 phases such as hexagonal, dimer, stripe, void, like kagomé, square, dimer hexagonal, honeycomb, glass and cluster phases. And in the second one, there are 8 phases such as hexagonal, dimer, stripe, honeycomb, kagomé, glass, void and cluster phases.

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