Vortex dynamics in type-II superconductors with columnar defects (LT26)

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In experiments, columnar defects are introduced to high-Tc superconductors by heavy-ion irradiation to increase the critical current. A Bose glass (BG) phase and moving BG phase have been predicted theoretically. Recently, possible Bragg-Bose glass (BBG) phase in vortex states of high-Tc superconductors with sparse and weak columnar defects has been proposed. However, the nature of this phase driven by external current is not clear. We have performed large-scale computer simulations in the current-driven 3D frustrated anisotropic XY model with sparse and weak columnar defects by means of resistively-shunted junction dynamics. At low temperature, a moving ordered phase with hexagonal Bragg peaks has been found. At the moment, we can not rule out the possibility of moving BG property with the diverging tilt modulus. With increases of temperature, a moving smectic appears via a first-order phase transition. It is also found that this moving Bragg glass like phase can be destroyed by increasing the density of columnar defects. We also perform 3D numerical simulation on moving vortices in the presence of columnar defects at zero temperature by using Langevin dynamics. The depining and creep motion of the vortices are studied, and the moving phase diagram is proposed.