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**Molecular Dynamics simulations of the vortex matter two-stage melting transition in $Bi_2Sr_2CaCu_2O_8$ in the presence of straight and of tilted columnar defects**[1] JIN-TAO LIU, YADIN Y. GOLDSCHMIDT, University of Pittsburgh — In this paper we use London Langevin molecular dynamics simulations to investigate the vortex matter melting transition in the highly anisotropic high-temperature superconductor material $Bi_2Sr_2CaCu_2O_8$ in the presence of low concentration of columnar defects (CDs). We reproduce with further details our previous results obtained by using Multilevel Monte Carlo simulations that showed that the melting of the nanocrystalyne vortex matter occurs in two stages: a first stage melting into nanoliquid vortex matter and a second stage delocalization transition into a homogeneous liquid. Furthermore, we report on new dynamical measurements in the presence of a current that identifies clearly the second stage delocalization transition. In addition to CDs aligned along the c-axis we also simulate the case of tilted CDs which are aligned at an angle with respect to the applied magnetic field. Results for a $45^0$ tilt of the CDs show that the location of the melting transition is not affected by the tilt when the ratio of flux lines to CDs remains constant.

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