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Vortex-antivortex molecules in superconducting films with magnetic dot arrays M.V. MILOSEVIC, J.S. NEAL, S.J. BENDING, Department of Physics, University of Bath, BA2 7AY, UK, A. POTENZA, C.H. MARROWS, School of Physics and Astronomy, University of Leeds, LS2 9JT, UK — Following earlier works [Milosevic and Peeters, PRB (2003), PRL (2004)], we studied the vortex-antivortex stabilization in a superconducting film under a square array of magnetic dots of variable size. The theoretical side of the investigation was done within the Ginzburg-Landau theory, and main findings comprise: (i) multi-shell vortex-antivortex structures, (ii) the profound interaction between neighboring vortex-antivortex molecules through exchange of "valence" antivortices, and (iii) dual interaction of stabilized vortex-antivortex pairs and magnetic dots with excess flux-lines of the applied homogeneous magnetic field. On experimental side, the results are corroborated by scanning Hall probe measurements, performed on a 80nm thick Pb film, on top of a square array (period 5μm) of magnetic dots of four sizes - R=0.522, 0.738, 0.808, and 0.902μm, etched out of a [2nm Pt] [0.6nm Co/1.0nm Pt]$_{10}$ multilayer film with perpendicular magnetization. A 20nm thick Ge layer was evaporated on top of the dots to avoid the proximity effect. In measurements performed at T=5K, direct SHPM images showed the structure of antivortices between the magnetic dots, whereas the successive difference images revealed the positioning of additional vortices in applied homogeneous magnetic field.

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