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New topological excitations in quantum Hall systems[1] YULI LYANDA-GELLER, TSUGING LIN, GEORGE SIMION, JOHN D. WATSON, MICHAEL J. MANFRA, GABOR CSATHY, LEONID ROKHINSON, Department of Physics, Purdue University, West Lafayette, IN 47907 USA — We discover new topological excitations of two dimensional electrons in the quantum Hall regime. The strain dependence of resistivity observed experimentally is shown to change sign upon crossing filling-factor-specified boundaries of reentrant integer quantum Hall effect (RIQHE) states. This observation violates the known symmetry of electron bubbles thought to be responsible for the RIQHE. We demonstrate theoretically that electron bubbles become elongated in the vicinity of charge defects and form textures of finite size. Calculations confirm that textures lower the energy of excitations. In the two-electron bubble crystal these textures form two-dimensional hedgehogs around defects having one extra electron, and vortices around defects lacking one electron. Strain affects vortices and hedgehogs differently, explaining striking strain-dependent resistivity. The sharp transition from insulating RIQHE state to conducting state is caused by melting of Abrikosov crystal comprised of the defects. The proposed physical mechanism of conductivity due to topological defects is shown to lead to an unusually large magnitude of the strain effect on resistivity in the range of RIQHE filling factors, in agreement with experiment.

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