Phase-Charge Duality of One-Dimensional Josephson-Junction Arrays in a Tunable Environment

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One-dimensional small Josephson-junction arrays with an underneath GaAs two-dimensional-electron gas acting as an electromagnetic environment were studied. The magnetic-field and environment-impedance turned superconductor-insulator phase transition was evidenced and discussed in the context of phase-charge duality. A theoretical quantum phase diagram was calculated and showed a quantitative agreement with the diagram obtained experimentally. Further, in the quasi-reentrance regime the turning temperature was found to decrease with increasing strengths of environment and Josephson coupling.