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**Universal Conductivity in a Two-dimensional Superfluid-to-Insulator Quantum Critical System** KUN CHEN, University of Massachusetts, Amherst, LONGXIANG LIU, University of Science and Technology of China, YOU-JIN DENG, University of Massachusetts, Amherst & University of Science and Technology of China, LODE POLLET, Ludwig-Maximilians-Universität München, NIKOLAY PROKOF'EV, University of Massachusetts, Amherst — We compute the universal conductivity of the (2+1)-dimensional XY universality class, which is realized for a superfluid-to-Mott insulator quantum phase transition at constant density. Based on large-scale Monte Carlo simulations of the classical (2+1)-dimensional $J$-current model and the two-dimensional Bose-Hubbard model, we can precisely determine the conductivity on the quantum critical plateau, $\sigma(\infty) = 0.359(4)\sigma_Q$ with $\sigma_Q$ the conductivity quantum.The universal conductivity curve is the textbook example of where the AdS/CFT correspondence from string theory can be tested and made to use. For the first time, the shape of the $\sigma(i\omega_n) - \sigma(\infty)$ function in the Matsubara representation is accurate enough for a conclusive comparison and establishes the particle-like nature of charge transport.We find that the holographic gauge/gravity duality theory for transport properties can be made compatible with the data if temperature of the horizon of the black brane is different from the temperature of the conformal field theory. The requirements for measuring the universal conductivity in a cold gas experiment are also determined by our calculation.

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