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Far-from-equilibrium universality classes: From heavy-ion collisions to superfluid scalar systems

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Quantum many-body systems far from equilibrium can approach a nonthermal fixed point during their real-time evolution. One example is scalar field theory, which occurs in models of cosmological inflation, and similar examples are found for ultracold Bose gases and for non-Abelian plasmas relevant for heavy-ion collisions. We present two novel far-from-equilibrium universality classes that provide links between these field theories.
One of them involves nonrelativistic, relativistic and expanding scalar systems. It occurs in the deep infrared regime of very high occupancies and leads to the formation of a Bose-Einstein condensate. The other novel universality class encompasses scalar field theories and non-Abelian plasmas in a longitudinally expanding background and corresponds to an early dynamical stage of heavy-ion collisions in the high-energy limit.
The observed universality connects different physics disciplines from heavy-ion collisions to ultracold atoms, making a remarkable link between the world's hottest and coldest matter.

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