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Feynman diagrams versus Feynman quantum emulator KRIS VAN HOUCKE, Ghent University, FÉLIX WERNER, Laboratoire Kastler Brossel, Ecole Normale Supérieure, EVGENY KOZIK, ETH, Zürich, NIKOLAY PROKOF'EV, BORIS SVISTUNOV, University of Massachusetts, Amherst, MARK KU, ARIEL SOMMER, LAWRENCE CHEUK, Massachusetts Institute of Technology, ANDRÉ SCHIROTZEK, Advanced Light Source, Lawrence Berkeley National Laboratory, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — Precise understanding of strongly interacting fermions, from electrons in modern materials to nuclear matter, presents a major goal in modern physics. However, the theoretical description of interacting Fermi systems is usually plagued by the intricate quantum statistics at play. Here we present a cross-validation between a new theoretical approach, Bold Diagrammatic Monte Carlo (BDMC), and precision experiments on ultra-cold atoms. Specifically, we compute and measure with unprecedented accuracy the normal-state equation of state of the unitary gas, a prototypical example of a strongly correlated fermionic system. Excellent agreement demonstrates that a series of Feynman diagrams can be controllably resummed in a non-perturbative regime using BDMC. This opens the door to the solution of some of the most challenging problems across many areas of physics.

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