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**Simulating chemical energies to high precision with fully-scalable quantum algorithms on superconducting qubits** PETER O'MALLEY, UC Santa Barbara, RYAN BABBUSH, Google Inc., Venice, CA, IAN KIVLICHAN, JHONATHAN ROMERO, Harvard University, JARROD MCCLEAN, Lawrence Berkeley National Lab, ANDREW TRANTER, Tufts University, RAMI BARENDS, JULIAN KELLY, YU CHEN, Google Inc., Santa Barbara, CA, ZIJUN CHEN, UC Santa Barbara, EVAN JEFFREY, AUSTIN FOWLER, Google Inc., Santa Barbara, CA, ANTHONY MEGRANT, UC Santa Barbara, JOSH MUTUS, Google Inc., Santa Barbara, CA, CHARLES NEILL, CHRISTOPHER QUINTANA, UC Santa Barbara, PEDRAM ROUSHAN, DANIEL SANK, Google Inc., Santa Barbara, CA, AMIT VAINSENCHER, JAMES WENNER, UC Santa Barbara, THEODORE WHITE, Google Inc., Santa Barbara, CA, PETER LOVE, Tufts University, ALAN ASPURU-GUZIK, Harvard University, HARTMUT NEVEN, Google Inc., Venice, CA, JOHN MARTINIS, UC Santa Barbara and Google Inc. — Quantum simulations of molecules have the potential to calculate industrially-important chemical parameters beyond the reach of classical methods with relatively modest quantum resources. Recent years have seen dramatic progress both superconducting qubits and quantum chemistry algorithms. Here, we present experimental demonstrations of two fully-scalable algorithms for finding the dissociation energy of hydrogen: the variational quantum eigensolver and iterative phase estimation. This represents the first calculation of a dissociation energy to chemical accuracy with a non-precompiled algorithm. These results show the promise of chemistry as the "killer app" for quantum computers, even before the advent of full error-correction.

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