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Universal sets of quantum gates based on geometric phases YU SHI, Fudan University, QIAN NIU, University of Texas at Austin — We rigorously study adiabatic and nonadiabatic geometric phases of two Heisenberg-coupled identical spins in a rotating magnetic field. The geometric phase of the total system is still some solid angle, and is independent of Heisenberg coupling constant. The adiabatic geometric phase is also independent of the magnetic field rotating speed. Using this result, for both adiabatic and nonadiabatic cases, we explicitly and exactly construct novel robust dynamic-geometric-hybrid two-qubit square root of swap and controlled-NOT gates, as well as purely geometric single qubit gates, including $\pi/8$ and Hadamard gates, thus presenting a complete scheme of robust universal quantum computing. This scheme can be implemented in NMR, quantum dots and cold atoms.

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