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4pi periodic Josephson current through a Quantum Spin-Hall edge JAN DAHLHAUS, University of California, Berkeley, CARLO BEENAKKER, DMITRY PIKULIN, TIMO HYART, Instituut Lorentz, Universiteit Leiden, HENNING SCHOMERUS, Department of Physics, Lancaster University — The helical edge state of a quantum spin-Hall insulator can carry a supercurrent in equilibrium between two superconducting electrodes (separation L, coherence length ?). We calculate the maximum (critical) current Ic that can flow without dissipation along a single edge, going beyond the short-junction restriction L?? of earlier work, and find a dependence on the fermion parity of the ground state when L becomes larger than ?. Fermion-parity conservation doubles the critical current in the low-temperature, long-junction limit, while for a short junction Ic is the same with or without parity constraints. This provides a phase-insensitive, dc signature of the 4?-periodic Josephson effect.

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