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Induced superconductivity in the quantum spin Hall edge

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The quantum spin Hall insulator is an example of a two-dimensional topological insulator, a phase of matter in which protected gapless surface states surround a gapped bulk. Inducing superconducting pairing within the helical edge states of the quantum spin Hall effect has been proposed as an avenue towards topological superconductivity. In this talk we present measurements of superconductivity induced in two-dimensional HgTe/HgCdTe quantum wells, a material which becomes a quantum spin Hall insulator when the well width exceeds $d_C = 6.3$ nm. In wells that are 7.5 nm wide, we find that supercurrents are confined to the one-dimensional sample edges as the bulk density is depleted. However, when the well width is decreased to 4.5 nm the edge supercurrents cannot be distinguished from those in the bulk. Our Josephson interferometry measurements provide evidence for supercurrents carried by the helical edges of the quantum spin Hall effect, one of the crucial ingredients for one-dimensional topological superconductivity. These results also directly yield information about the microscopic structure of the edge modes. In particular we find that the widths of the edge channels range from 180 nm to 408 nm.