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Detecting topological superconductivity using doubled Shapiro steps[1] JAY SAU, University of Maryland College Park, F SETIAWAN, Condensed Matter Theory Center,University of Maryland College Park — The fractional Josephson effect has been observed in many instances as a signature of a topological superconducting state containing zero-energy Majorana modes. However, it has been suggested that such a fractional Josephson effect might occur in non-topological systems. Here, we apply a scattering matrix-based noise formalism to calculate the fractional ac Josephson effect in one such non-topological scenario that may occur generically in semiconductor-based Josephson junctions. We find that the presence of a weakly coupled resonant impurity bound state in a semiconductor in the vicinity of a highly transparent channel produces a nearly topological fractional Josephson effect similar to Majorana modes. The Josephson effect signature for Majorana modes become distinct from this non-topological scenario only at low frequency. We argue that a variant of the fractional Josephson effect, namely the doubled Shapiro step, which can be performed at lower frequency and will generically appear in topological superconductors, can provide a more reliable signature of the topological superconducting state.

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Jay Sau
University of Maryland College Park

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