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**Tristan Freiberg\*** (tfreiberg@uwaterloo.ca), **Pär Kurlberg** and **Lior Rosenzweig**. *Poisson spacings between sums of two squares and spectral correlations for the square billiard.*

We investigate the level spacing distribution for the quantum spectrum of the square billiard. Extending work of Connors–Keating and Smilansky, we formulate an analogue of the Hardy–Littlewood prime  $k$ -tuple conjecture for sums of two squares, and show that it implies that the spectral gaps, after removing degeneracies, are Poisson distributed. We also give numerical evidence for the conjecture and its implications. (Received September 12, 2016)