

# PRIME NUMBERS, QUANTUM CHAOS, AND PSEUDO-LAPLACIANS

AMY T. DECELLES

ABSTRACT. Prime numbers are the most elementary numbers after the whole numbers, yet primes are subtle. Mathematicians have been seeking to understand the patterns in primes for centuries. The celebrated Riemann Hypothesis is the archetype of an unanswered question involving primes. Riemann's brilliant observation was the precise connection between primes and zeroes of a complex-valued function now known as the Riemann zeta function. Hilbert proposed a strategy for proving the Riemann Hypothesis: finding a positive symmetric operator whose eigenvalues are parametrized by zeros of zeta. Striking correlations have been observed between the eigenvalues of random matrices and the zeros of zeta, raising hopes that there might be a connection with quantum chaos, but there is no known causal relationship between these phenomena. Recent work of Garrett and Bombieri, picking up on work of Colin de Verdiere, Hejhal, and others in the 1980s, suggests that pseudo-Laplacians should be considered as candidates for operators whose eigenvalues correspond to zeros of the zeta function.

UNIVERSITY OF ST. THOMAS, DEPARTMENT OF MATHEMATICS, 201 O'SHAUNESSY SCIENCE HALL, 2115 SUMMIT AVENUE, ST. PAUL, MINNESOTA 55105

*E-mail address:* [adecelles@stthomas.edu](mailto:adecelles@stthomas.edu)

*URL:* <http://personal.stthomas.edu/dece4515>