

**Trace formulas for general Hermitian matrices: a
scattering approach on their associated graphs**

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Two trace formulas for the spectra of arbitrary Hermitian matrices are presented. In either case the one associates a unitary scattering matrix to the given Hermitian matrix H such that the unitary matrix depends on the spectral parameter. In the first type the unitary matrix is obtained by exponentiation. The new feature in this case is that the spectral parameter appears in the final form as an argument of Eulerian polynomials—thus connecting the periodic orbits to combinatorial objects in a novel way. To obtain the second type, one expresses the input in terms of a unitary scattering matrix in a larger Hilbert space. One of the surprising features here is that the locations and radii of the spectral discs of Gershgorin's theorem appear naturally as the pole parameters of the scattering matrix. Both formulas are discussed and possible applications are outlined.