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A quadratically enriched logarithmic zeta function

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André Weil proposed a beautiful connection between algebraic topology and the number of solutions to equations over finite fields in a celebrated paper from 1948: the zeta function of a variety over a finite field is simultaneously a generating function for the number of solutions to its defining equations and a product of characteristic polynomials of endomorphisms of cohomology groups. The ranks of these cohomology groups are the Betti numbers of the associated complex manifold. We enrich the logarithmic derivative of the zeta function to a power series with coefficients in the Grothendieck–Witt group of stable isomorphism classes of unimodular modular forms, using traces of powers of Frobenius in A1-homotopy theory. We show the quadratically enriched logarithmic zeta function to be connected to the Betti numbers of the associated real manifold under certain hypotheses. This is joint work with Margaret Bilu, Wei Ho, Padma Srinivasan, and Isabel Vogt and joint work in progress with Tom Bachmann.

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