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Zeta functions of Heisenberg cycles and dynamics

Along the orbit of a smooth ergodic flow on a compact manifold$M$, placing a Dirac-Schrodinger operator $x + \frac{d}{dx}$ determines a spectral triple over $C(M) \rtimes \mathbf{R}_d$, the crossed product of $C(M)$ by the group of real numbers with the discrete topology, acting on M by the flow. Such Heisenberg cycles generate analytic zeta functions $\zeta(f) = \mathrm{trace}(fH^{-s})$, with $H = -\frac{d^2}{dx^2} + x^2$ the harmonic oscillator, and as we show, the meromorphic and pole structure of these zeta functions seems to detect fine information about ergodic averages in dynamics. We demonstrate this for the periodic flow on the circle, and the Krönecker flow on $\mathbf{T}^2$, and briefly summarize various applications to K-theory.