Hyperelliptic curves, the scanning map, and moments of quadratic L-functions

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I will explain a calculation of the stable cohomology of the moduli space of hyperelliptic curves, with coefficients in an arbitrary symplectic local system. The result is closely related to, and provides a geometric interpretation of, a series of conjectures on asymptotics of moments of families of quadratic L-functions. (Joint with J. Bergström, A. Diaconu and C. Westerland).