K.A.M. Tori Isospectral Deformations and Spectral Rigidity

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We are interested in the spectral rigidity of the Laplace-Beltrami operator in the case when the corresponding classical Hamiltonian system is either completely integrable or close to a non-degenerate completely integrable system. By the Kolmogorov-Arnold-Moser (K.A.M.) theorem there exists a large family of invariant tori of the classical system. We show that the values of the corresponding Mathers beta function given by the average action on the K.A.M. tori is an isospectral invariant. As an application we obtain infinitesimal rigidity of Liouville billiard tables in dimensions two and three. Spectral rigidity is obtained as well in the presence of elliptic bouncing ball geodesics. The proof is based on a construction of smooth families of quasi-modes associated with the K.A.M. tori.