Periodic ellipsoidal billiards and extremal polynomials

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Abstract: A comprehensive study of periodic trajectories of the billiards within ellipsoids in the d-dimensional Euclidean space is presented. The novelty of the approach is based on a relationship established between the periodic billiard trajectories and the extremal polynomials of the Chebyshev type on the systems of d intervals on the real line. The case study of trajectories of small periods $T, d \leq T \leq 2d$ is given. In particular, it is proven that all d-periodic trajectories are contained in a coordinate-hyperplane and that for a given ellipsoid, there is a unique set of caustics which generates $d+1$-periodic trajectories. A complete catalog of billiard trajectories with small periods is provided for $d = 2$ and 3. This is a joint work with Milena Radnovic.