An isoperimetric inequality for the first Steklov-Dirichlet Laplacian eigenvalue of convex sets with a spherical hole

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In this paper we prove the existence of a maximum for the first Steklov-Dirichlet Laplacian eigenvalue in the class of convex sets with a fixed spherical hole under volume constraint. More precisely, if \( \Omega = \Omega_0 \setminus B_{R_1} \), where \( B_{R_1} \) is the ball centered at the origin with radius \( R_1 > 0 \) and \( \Omega \subset \mathbb{R}^n \), \( n \geq 2 \), is an open bounded and convex set such that \( B_{R_1} \subset \Omega_0 \), then the first Steklov-Dirichlet Laplacian eigenvalue \( \sigma_1(\Omega) \) has a maximum when \( R_1 \) and the measure of \( \Omega \) are fixed. Moreover, if \( \Omega_0 \) is contained in a suitable ball, we prove that the spherical shell is the maximum.

This is a joint work with Nunzia Gavitone, Gloria Paoli and Gianpaolo Piscitelli.