SPECTRAL GAP FOR CONVEX GRAPHENE QUANTUM DOTS

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We will discuss the massless Dirac operator D_Ω on a bounded and sufficiently smooth domain $\Omega \subset \mathbb{R}^2$ with so-called *infinite mass boundary conditions*. This Dirac operator arises in an effective mathematical theory for graphene quantum dots. The operator D_Ω is self-adjoint in $L^2(\Omega, \mathbb{C}^2)$ and non-semi-bounded. Its spectrum $\sigma(\mathsf{D}_\Omega)$ is discrete and symmetric with respect to the origin. The size of the spectral gap for D_Ω

$$\boxed{\mathcal{L}_\Omega := \mathrm{dist}\,(\sigma(\mathsf{D}_\Omega), 0) > 0}$$

is known to be important in applications. Our main result concerns the geometric control on $\mathcal{L}_\Omega$ for convex C^3-domains. Namely, we obtain an upper-bound on $\mathcal{L}_\Omega$ in terms of $\mathcal{L}_\mathbb{D}$ for the unit disk $\mathbb{D}$ with an explicit geometrically-induced pre-factor. This result can also be formulated as a reverse Faber-Krahn-type inequality for D_Ω under a suitable geometric constraint.

This talk is based on a joint work with Thomas Ourmières-Bonafos.