Stable and unstable spectral inequalities

Dorin Bucur
Université de Savoie

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In the last years, the stability question of several classical spectral inequalities has been raised in the vein of the result by Fusco, Maggi and Pratelli (2008), which gives a sharp quantitative form of the isoperimetric inequality. After an introduction to this topic, I will focus on some recent results obtained with M. Nahon and A. Giacomini on spectral problems involving boundary energies. Precisely, following a question raised by Girouard and Polterovich, I will show that the Weinstock inequality is genuinely unstable, namely that the supremum of the (perimeter normalized) first non-zero eigenvalue of the Steklov problem can be achieved in the geometric neighbourhood of any smooth simply connected domain of the plane. Time remaining, I will introduce a new method to prove quantitative forms of spectral inequalities of Robin type which relies on the analysis of a new class of geometric/energy functionals in the context of free discontinuity/free boundary problems. This talk is a based on joint works with M. Nahon and A. Giacomini.