Asymptotic analysis of high-contrast subwavelength resonator structures

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The ability to focus, trap, and guide the propagation of waves is of fundamental importance in physics. One of the most essential questions is how to localize waves to a prescribed position. Often, especially in low-frequency applications, wave control must be performed on small length scales relative to the wavelength (so-called *subwavelength scales*) in order to be physically feasible. In addition, the desired properties must be robust against imperfections that might appear in the manufacturing of such devices.

The aim of this talk is to address these questions and provide a mathematical understanding of robust wave localization on subwavelength scales. Throughout this talk, we analyze high-contrast subwavelength metamaterials, and prove that these materials may exhibit exotic wave properties on subwavelength scales. We prove the possibility of localizing and guiding waves in such materials, and use the concept of *topological insulators* in order to achieve robust localization. We demonstrate, throughout, the power of layer potential techniques, combined with asymptotic analysis, for solving challenging wave propagation problems at subwavelength scales. Moreover, we illustrate the main mathematical results using efficient numerical techniques.