IPwin2021: Small electromagnetic inhomogeneities and scattering vs. non-scattering wave-numbers for the Helmholtz equation

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In my set of three lectures I will cover two topics:

**Small electromagnetic inhomogeneities and their asymptotic far-field effects**, (two first lectures).

**Scattering vs. non-scattering wave-numbers for the Helmholtz equation**, (third lecture).

The lectures about small electromagnetic inhomogeneities will cover internal inhomogeneities (see for example [1],[9],[10] and [11]) as well as more recent material about "boundary" inhomogeneities [7]. I shall derive the first non-trivial term in an asymptotic (Rayleigh) expansion and contrast that with the small amplitude asymptotic expansion (Born approximation). Using such asymptotic formulas, I will discuss numerical methods to approximately determine the total volume of the inhomogeneities as well as their individual locations, based on electrostatic boundary measurements [8], [10]. In the second lecture I shall discuss the issue of uniformity of the asymptotic formulas, and some consequences of such uniformity [12],[14]. At this point I shall introduce so-called cloaking by mapping techniques (transformation optics) [5],[13]. In particular I will show how uniform estimates enable one to demonstrate the viability of cloaking-by-mapping schemes (electromagnetic invisibility shields).

The third lectures is somewhat independent of the first two (though it discusses related matters) and in that lecture I will discuss some recent results about non-scattering wave-numbers in the context of the Helmholtz equation and penetrable scatterers [15]. In particular, I will discuss the dependence of the number of such wave-numbers on the geometry of the scatterer. I will also introduce the notion of (interior) transmission eigenvalues and relate the non-scattering wave-numbers to these [2].
Books


Survey articles


Articles


