Maxwell's equations with hypersingularities at a conical plasmonic tip

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Resumé : We consider the 3D time-harmonic Maxwell's problem in some composite material formed by the junction of a dielectric and of a conical tip with negative electromagnetic parameters (see Figure 1).
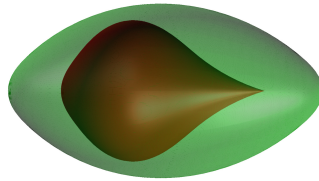
Figure 1: Inclusion of a negative material with a conical tip in some dielectric..

In certain circumstances, the electromagnetic field can exhibit a hypersingular behaviour at the conical tip and in theses cases, well-posedness in the classical $\mathbb{L}^2$ setting is lost. The goal of this talk is to explain how to take into account these hypersingularities, also called black-hole waves, to propose a new functional setting that leads to the physical solution of the problem.

The idea is to work in weighted Sobolev spaces (adapted to the conical tip) and to select the outgoing hypersingularities via the limiting absorption principle. The analysis is achieved by combining the T-coercivity approach and some new results of scalar/vector potential representations of singular fields.