SEMINAR
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Title: **A solvability condition for a Tokamak problem**

Abstract: We are concerned with a boundary inversion problem related to the tokamak problem. As treated by Demidov and Moussaoui, [1], the question is to evaluate, if possible, the constants a and b in

$$\begin{cases} \Delta u = au + b \geq 0 \quad on \;\; \Omega \subset \mathbb{R}^d, \; d \geq 2 \\ u = 0 \quad and \;\; (\partial_n u = \Phi) \quad on \; \partial\Omega \end{cases} \tag{1}$$

from a single reading of the outer normal derivative $\partial_n u = \Phi \in L^1(\partial\Omega)$ of the solution and where Ω is an open bounded connected Lipschitz domain in $\mathbb{R}^d$. We shall refer to $\Phi \neq 0$ as an observation, as it comes from an actual nontrivial solution generated by the real constants a and b. By using conformal mappings and asymptotics of the solution near a singularity, such as a corner, Demidov and Moussaoui in [1] show that partial data of Φ on one side of a corner is enough to compute explicitly the values a and b.

One of the open questions raised in [1] is the computation of the values $\{a, \; b\}$ in the case of a smooth boundary with no corners. In this note, we answer this question by making use of pseudo-spectral methods. More precisely by using the matrix representation of the Laplacian, under Dirichlet and Robin boundary conditions, we recast a boundary inversion problem for the Tokamak into a simple algebraic system. The solution is then obtained explicitly in terms of the Fourier coefficients of the observation.

Note that although this boundary inversion problem originated from the physics of plasma, magneto-hydrodynamics also has interesting applications in medical imaging. The Tokamak is at the heart of the production of clean energy though fusion.

All are welcome.

References

[1] A.S. Demidov and M. Moussaoui, An inverse problem originating from magnetohydrodynamics, Inverse Problems, 20(2004), 137-154