THE NEUMANN SIEVE PROBLEM REVISITED

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The Neumann sieve problem concerns the Neumann Laplacian in a domain Ω_ε consisting of two subdomains Ω^+ and Ω^- separated by a thin interface ("sieve") shrinking to a hyperplane Γ as $\varepsilon \to 0$. The interface is punctured by many passages whose number (per unit volume) tends to infinity, while the diameters of their cross-sections tend to zero as $\varepsilon \to 0$. For the case of identical straight periodically distributed passages T. Del Vecchio [1] proved that the Neumann Laplacian on Ω_ε converges in a kind of strong resolvent sense to the Laplacian on $\Omega^+ \cup \Omega^-$ subject to the so-called δ'-conditions on Γ provided the passages are appropriately scaled.

In the talk we discuss recent refinements of the above result [2]. We derive estimates on the rate of convergence in terms of various operator norms and provide the estimate for the distance between the spectra of the underlying operators in the weighted Hausdorff metrics. The assumptions we impose on the geometry and distribution of the passages are rather general; examples obeying these assumptions will be discussed . For $n = 2$ the results of T. Del Vecchio are not complete and some cases remain as open problems; in the talk we fill these gaps.

References

[1] T. Del Vecchio, The thick Neumann's sieve, Ann. Mat. Pura Appl. 147, 363–402 (1987).

[2] A. Khrabustovskyi, The Neumann sieve problem revisited, arXiv:2402.16451 (2024).