

PhD thesis topic

Quantum mechanics with non-self-adjoint operators: transition from spectra to pseudospectra

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The principal objective of this PhD topic is to contribute to a systematic development of a mathematically consistent and physically relevant theory of quantum-mechanical concepts involving non-self-adjoint operators. It has become clear in recent years [3] that it is absolutely necessary and actually useful for applications to apply new, unconventional methods like *pseudospectra* to capture and rigorously describe non-self-adjoint operators in quantum mechanics. The student will apply the new techniques to concrete operators appearing in quasi-Hermitian and PT-symmetric quantum mechanics.

One direction of research will consist of applying the recently proposed robust scheme of WKB construction of pseudomodes [2] to Schrödinger operators with complex potentials. Second, we wish to examine the method of multipliers familiar in partial differential equations [1] for Schrödinger operators constrained to subdomains and manifolds and to the Dirac operator with complex potentials. It would be also useful to develop a numerical code for effective computations of the pseudoeigenvalues and pseudoeigenfunctions.

This PhD topic is a natural continuation of the topic of my current PhD student Radek Novák “Quantum mechanics with non-self-adjoint operators” concerned with spectral and pseudospectral analysis of particular Schrödinger and Fokker-Planck operators. In the present follow-up, we intend to go further and extend the methods developed in the previous thesis to larger and new classes of operators (notably to those appearing in relativistic quantum mechanics) and to apply the modern techniques mentioned above.

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References

- [1] L. Fanelli, D. Krejčířík, and L. Vega, *Spectral stability of Schrödinger operators with subordinated complex potentials*, J. Spectr. Theory (2017), arXiv:1506.01617 [math.SP].
- [2] D. Krejčířík and P. Siegl, *Pseudomodes for Schrödinger operators with complex potentials*, (2017), arXiv:1705.01894 [math.SP].
- [3] D. Krejčířík, P. Siegl, M. Tater, and J. Viola, *Pseudospectra in non-Hermitian quantum mechanics*, J. Math. Phys. **56** (2015), 103513.

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