

Uncertainty Principles on Riemannian Manifolds

Wolfgang Erb



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In this thesis, the Heisenberg-Pauli-Weyl uncertainty principle on the real line and the Breitenberger uncertainty on the unit circle are generalized to Riemannian manifolds. The proof of these generalized uncertainty principles is based on an operator theoretic approach involving the commutator of two operators on a Hilbert space. As a momentum operator, a special differential-difference operator is constructed which plays the role of a generalized root of the radial part of the Laplace-Beltrami operator. Further, it is shown that the resulting uncertainty inequalities are sharp. In the final part of the thesis, these uncertainty principles are used to analyze the space-frequency behavior of polynomial kernels on compact symmetric spaces and to construct polynomials that are optimally localized in space with respect to the position variance of the uncertainty principle.

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