Mapping properties of X-ray transforms near convex boundaries

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Abstract: On a Riemannian manifold with boundary, the X-ray transform integrates a function or a tensor field along all geodesics through the manifold. The reconstruction of the integrand of interest from its X-ray transform is the basis of important inverse problems with applications to seismology and medical imaging.

The inversion of the X-ray transform is often done by inverting the normal operator (composition of the X-ray transform and its adjoint, the "backprojection" operator). The inversion problem includes the design of appropriate function spaces where to formulate forward and backward mapping properties of the X-ray transform, the backprojection operator, and their composites. Such spaces need to incorporate boundary behavior, and include Frechet spaces of 'polyhomogeneous conormal' type, or non-standard Sobolev scales (e.g., transmission spaces a la Hormander, or modeled after degenerate elliptic operator of Kimura type).

In this talk, I will survey recent results attempting to shed additional light on the (forward and backward) mapping properties of the X-ray transform and its normal operator(s) on convex, non-trapping manifolds. I will discuss recent joint works with Gabriel Paternain and Richard Nickl; Rafe Mazzeo; Rohit Mishra and Joey Zou; Joey Zou.