

Hypersingular Integrals And Their Applications

HECKE OPERATORS IN KK -THEORY AND THE K -HOMOLOGY OF BIANCHI GROUPS

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Abstract. Let Γ be a torsion-free arithmetic group acting on its associated global symmetric space X . Assume that X is of non-compact type and let Γ act on the geodesic boundary ∂X of X . Via general constructions in KK -theory, we endow the K -groups of the arithmetic manifold X/Γ , of the reduced group C^* -algebra $C^*(\Gamma)$ and of the boundary crossed product algebra $C^*(\partial X) \rtimes \Gamma$ with Hecke operators. The K -theory and K -homology groups of these C^* -algebras are related by a Gysin six-term exact sequence. In the case when Γ is a group of real hyperbolic isometries, we show that this Gysin sequence is Hecke equivariant. Finally, when Γ is a Bianchi group, we assign explicit unbounded Fredholm modules (i.e. spectral triples) to (co)homology classes, inducing Hecke-equivariant isomorphisms between the integral cohomology of Γ and each of these K -groups. Our methods apply to case $\Gamma \subset \mathrm{PSL}_2(\mathbb{Z})$ as well. As these results are achieved in the context of unbounded Fredholm modules, they shed light on noncommutative geometric aspects of the purely infinite boundary crossed product algebra.

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Introduction

Let G be a semi-simple algebraic group over \mathbb{Q} and $\Gamma \subset G(\mathbb{Q})$ be an arithmetic group. The cohomology of Γ can be equipped with a commuting family of endomorphisms called "Hecke operators" which arise from correspondences on the associated arithmetic manifold X/Γ . The cohomology of Γ as a Hecke module plays an important role in modern number theory. It is well-known that, as a Hecke module, the complex cohomology of Γ can be completely accounted for

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