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Research fields: Operator Algebras, Functional Analysis/Real Analysis

Keywords: Ergodic group theory, discrete groups, orbit equivalence relations

Present research:

Ergodic group theory was launched under recent development of studies of discrete groups, and is rooted in theories of unitary representations and von Neumann algebras. Von Neumann algebras, which are rings of bounded linear operators on a Hilbert space, were originally introduced in mathematical foundation of quantum mechanics, and have since then supplied a framework in mathematical physics and unitary representation theory. Many examples of von Neumann algebras are produced from a group-action on a measure space. One of subjects in ergodic group theory is such a group-action and its orbit equivalence relation, which reflects an aspect of the associated von Neumann algebra. Since Connes and others clarified structure of von Neumann algebras coming from unitary representations and actions of amenable groups around 1970s, studies toward non-amenable groups have vastly been developed in recent decades.

Among others, ergodic group theory aims to find out an interesting aspect of discrete groups through various approaches. It involves not only theories of operator algebras and unitary representations, but also ergodic theory, harmonic analysis, Lie group theory, geometric group theory, differential geometry, topology, probability theory, etc. My first work was devoted to showing that if a group is very special, its action enjoys *rigidity*, namely all information of the action can be recovered from its orbit equivalence relation. This kind of rigidity is originated from Zimmer's 1980 result for a higher rank simple Lie group. This is related with the Mostow rigidity, a cerebrated theorem in geometry. So far I have dealt with the mapping class group of a surface, curious amalgamated free products of rigid groups, the Baumslag-Solitar groups, etc. Rigidity of their actions depends on special characters of the groups, and has an application to the isomorphism problem of von Neumann algebras. My recent work is concerned with central sequences (which often play an important role in understanding operator algebras) in the framework of orbit equivalence relations, and pursues their relationship with the acting group.

Notice for the students:

I hope you are good at measure theory and functional analysis. I also hope you get interested in various mathematics.