STEPHAN TORNIER

SHORT RESEARCH DESCRIPTION

Just this year, I've started a PhD program under the supervision of Marc Burger at ETH Zurich. As my master's project, I had a close look at Shalom's theorem [Sha00, Theorem 0.1] on Property (T) for quotients of irreducible, cocompact lattices in certain product groups, and gave a concise and transparent proof in a special case. In doing so, I rigorously developed some *continuous cohomology* and *reduced continous cohomology* for locally compact groups, including a *Künneth*-type theorem for the latter; thus underlining the utility of cohomological methods in geometric group theory.

Theorem (Shalom). Let G_1 and G_2 be locally compact, compactly generated groups. Let Γ be an irreducible, cocompact lattice in $G_1 \times G_2$ and let N be a normal subgroup of Γ. Then Γ/N has Property (T) if and only if for $i \in \{1,2\}$ the quotient $G_i/\overline{\mathrm{pr}_i(N)}$ has Property (T) and every continuous homomorphism from G to $(\mathbb{R},+)$ which vanishes on N is identically zero.

The importance of Shalom's theorem lies in the fact that it constitutes one half of the proof of the Bader-Shalom [BS06, Theorem 1.1] normal subgroup theorem.

Theorem (Bader, Shalom). Let G_1 and G_2 be locally compact, compactly generated, topologically just non-compact and non-discrete groups, not both isomorphic to $(\mathbb{R},+)$. Then any irreducible, cocompact lattice $\Gamma \leq G_1 \times G_2$ is just infinite.

Note that the theorem of Bader-Shalom does not rely on the ambient group being differentiable or algebraic in contrast to Margulis' normal subgroup theorem in the context of higher rank semisimple Lie groups. It thus constitutes an important ingredient to the study and discovery of further infinite, finitely generated, discrete and (almost) simple groups.

References

[BS06] U. Bader and Y. Shalom, *Factor and normal subgroup theorems for lattices in products of groups*, Inventiones Mathematicae **163** (2006), no. 2, 415–454.

[Sha00] Y. Shalom, *Rigidity of commensurators and irreducible lattices*, Inventiones Mathematicae **141** (2000), no. 1, 1–54.

Date: August 20, 2013.