OFERTA DE PROYECTO PARA CONTRATOS PREDOCTORALES PARA LA FORMACIÓN DE DOCTORES 2018 (Antiguas FPI)

REFERENCIA PROYECTO

MTM2017-82690-P

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TÍTULO PROYECTO

INVARIANTES ASINTÓTICOS DE GRUPOS

ÁREA CIENTÍFICA

Matemáticas

RESUMEN PROYECTO /PROJECT SUMMARY

Group theory is a transversal area of mathematics. The main topic of the project is the study of asymptotic invariants and its interactions with other branches of mathematics. The focus of this project will be in the study of L2-Betti numbers and p-gradients. L2-Betti numbers were introduced by M. Atiyah in order to extend the Atiyah-Singer index to non-compact manifolds, and they have play a key role in the solution of important conjectures such us the Hanna Neumman conjecture or to make significant advances in the Baum-Connes conjecture. The p-gradient, introduced by M. Lackenby, is an analogue in positive characteristic of the L2-Betti number, and appears naturally in questions about the congruence kernel of arithmetic hyperbolic 3-manifolds.

These two invariants are intimately related, however they are of different nature and are studied with different types of techniques. The study of L2-Betti numbers borrows ideas from analysis while the p-gradient uses ideas of arithmetic combinatorics. The main objective of this proyect is to create an algebraic framework that allow to work with these two invariants simultaneously. With this framework, we plan to make significant contributions to the solution of the strong Atiyah conjecture or Lück approximation conjectures.

The strategy to create this common algebraic theory consists on developing a representation theory for groups and algebras in von Neuman regular rings with a Sylvester matrix rank function. These rank functions generalize the rank function used to define the L2-Betti numbers and simultaneously, allows to construct a rank function over rings of positive characteristic.

The expected applications of the new techniques obtained in this new common framework include the solution of the Calegari-Emerton conjecture, and important contributions to Lück's approximation conjecture in positive characteristic.

One of the recent highlights in group theory has been the solution of the strong Hanna Neumman conjecture about intersections of subgroups of free groups. A. Jaikin proved the free pro-p case using asymptotic invariants, and his approach allowed him to give a new proof in the abstract case, which was proved recently and independently by J. Friedman and I. Mineyev. One of the most ambitious objectives of this proposal is to prove analogues of the Hanna Neumann beyond the free cases (both the pro-p and the abstract cases) including the limit groups in the sense of Sela.

The project will also study other asymptotic invariants including the growth of Cayley graphs, the growth of the homology, the L2 torsion, the cost or the rank gradient. These invariants will be relevant to achieve the proposed objectives and to obtain a better insight about the families of groups under study.