**Workshop on von Neumann algebras, Ergodic Theory and Geometric Group Theory**

*IMSc, Chennai, February 2-13, 2009*

A two week workshop on the above theme will be held at the Institute of Mathematical Sciences, Chennai during the first two weeks of February, 2009. The workshop will feature two ten-lecture-courses by Professor Nicolas Monod (EPFL, Lausanne, Switzerland) and Professor Narutaka Ozawa (Univ. of Tokyo, Japan). The workshop will assume little specific prior background other than a reasonable amount of mathematical maturity. Additional lectures covering basic background material will be given as and when a need is felt. Abstracts of the two courses follow.

**Ozawa: von Neumann algebras and ergodic theory**

The lectures will focus on the classification problems of orbit equivalence relations and von Neumann algebras arising from measure preserving actions of countable discrete groups on finite measure spaces. Given a measure preserving action $\Gamma \curvearrowright X$ of a countable group $\Gamma$ on a finite measure space $X$, one can associate the orbit equivalence relation (i.e., the partition of $X$ into the $\Gamma$-orbits) and the crossed product von Neumann algebra. We investigate to what extent the orbit equivalence relation or the crossed product von Neumann algebra remembers the group $\Gamma$ and the action $\Gamma \curvearrowright X$. The Ornstein–Weiss (or Connes–Feldman–Weiss) theorem states that in case where the group is amenable, they do not remember anything (except for being amenable). So, we concentrate on non-amenable case. We first study the relationships among orbit equivalence, measure equivalence and von Neumann equivalence of group actions (after Feldman-Moore, Zimmer, Furman). Then, we prove a certain cocycle super-rigidity result, which recovers the group action from the orbit equivalence relation (after Popa, Ioana). Second, we look at the theory of $L^2$-Betti numbers and its applications (after Gaboriau, Lück). Finally, we proceed to study closable derivations on von Neumann algebras and give an application to the classification problem of von Neumann algebras (after Peterson, Popa, Ozawa).

**Monod: Ergodic and geometric group theory**

The lectures will centre on the interplay between group theory and ergodic theory, with particular attention paid to geometric aspects. The series should naturally fall into two or three clusters which, though related and complementary, are not necessary prerequisites for one another.

A first part will concern the topic 'Littlewood and forests'. Starting from the XIX century theory of electric networks, we shall expose how contemporary ideas from percolation and random graphs can be used to investigate invariants of groups such as the $L^2$-Betti numbers and the cost. After a brief detour through Littlewood functions, we will apply these ideas to a well-known problem of Dixmier's posed in 1950: does unitarisability of uniformly bounded representation characterise amenable groups? (This problem is naturally suggested by Sz.-Nagy's 1947 result stating that uniformly bounded operators are conjugated to unitaries.) We shall present a very modest contribution to this question (made with I. Epstein).

A second part will regard the notion of measure equivalence of groups (and the related concept of orbit equivalence for equivalence relations), as well as the use of bounded cohomology in this context. We will explain how to use geometric ideas for the study of measure equivalence and expose the viewpoint of "randomorphisms". An introduction to bounded cohomology might secede and form its own cluster, depending on time and interest. A motivating goal in that subject would be the Vanishing-below-the-rank theorem, which is based on an ergodic-theoretical analogue of the classical Solomon-Tits theorem. As we shall recall, the latter classifies the homotopy type of spherical buildings; a topological version was used by Borel–Serre in order to study the cohomology of arithmetic groups, whilst the measure-theoretical version allows us to investigate the bounded cohomology of those groups.

**Confirmed Participants from outside IMSc:**

- *Faculty in Indian math depts:*
    1. Siddhartha Bhattacharya, TIFR, Mumbai
    2. Mahan Mj, Belur Math, Kolkata
    3. Varadharajan Muruganandam, Univ. of Pondicherry
    4. A.K. Vijayarajan, NIT Calicut
- *Post docs:*
    1. Krishnendu Gongopadhyay, TIFR, Mumbai
    2. Jijo Sukumaran, GEC, Idukki
    3. Ved Gupta, KU, Leuven

- *Ph. D. students:*

    1. Khairnar Arati Bansilal, TIFR, Mumbai
    2. Bodisattwa Basu, Belur Math, Kolkata
    3. Jyotishman Bhowmick, ISI, Kolkata
    4. Doris Bohnet, Univ. of Hamburg, Germany
    5. Biswarup Das, ISI, Kolkata
    6. Steven Deprez, KU, Leuven
    7. Masato Mimura, Univ. of Tokyo, Japan
    8. Kunal Mukherjee, Texas A & M, USA
    9. Dave Penneys, UC Berkeley, USA
    10. Pranab Sardar, Belur Math, Kolkata

**Expected participants from Chennai:**

- *Faculty members:*

    1. Pralay Chatterjee, IMSc
    2. Vijay Kodiyalam, IMSc
    3. Anilesh Mohari, IMSc
    4. K.N. Raghavan, IMSc
    5. Parameswaran Sankaran, IMSc
    6. Raman Srinivasan, CMI
    7. V.S. Sunder, IMSc

- *Ph.D students:*

    1. Madhushree Basu, IMSc
    2. Tupurani Srikanth, IMSc
    3. S. Sundar, IMSc

## PROGRAMME FOR THE WORKSHOP

There will be a brief registration/introduction at 0915 on the opening day 2/2/9.

| Date | 0930-1100 | 1100-1130 | 1130-1300 | 1300-1400 |
|---|---|---|---|---|
| 02/2 | VSS | C | VPG | L |
| 03/2 | NO | C | NM | L |
| 04/2 | NO | C | NM | L |
| 05/2 | NO | C | NM | L |
| 06/2 | NO | C | NM | L |
| | | WEEK | END | |
| 09/2 | NO | C | NM | L |
| 10/2 | NO | C | NM | L |
| 11/2 | NO | C | NM | L |
| 12/2 | NO | C | NM | L |
| 13/2 | NO | C | NM | L |

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|---|---|---|---|---|
| VSS | : | V.S. Sunder | : | (Finite) von Neumann algebras |
| C/T | : | Coffee/Tea | : | Break |
| VPG | : | Ved Prakash Gupta | : | Equivalence relations |
| L | : | Lunch | : | Break |
| NO | : | Narutaka Ozawa | : | von Neumann algebras and Ergodic theory |
| NM | : | Nicolas Monod | : | Ergodic theory and Geometric group theory |

**All lectures will be held in Room 423 (Alladi Ramakrishnan Hall).**