



UNIVERSIDAD DE BUENOS AIRES
FACULTAD DE CIENCIAS EXACTAS Y NATURALES
DEPARTAMENTO DE MATEMÁTICA

REPORT

III Escuela Luis Santaló-Cimpa School
Topics in Noncommutative Geometry
Buenos Aires, July 26-August 6, 2010

Scientific Activity

The school had 105 participants from Argentina, Belgium, Brazil, Canada, Chile, China, Colombia, France, Germany, Holland, Italy, Netherlands, New Zealand, Peru, Poland, Portugal, Serbia, Spain, Sweden, United States and Venezuela. The gender breakdown was 27 women and 78 men. Most of the participants were graduate students, but there were also a significant number of researchers and advanced diploma students. The scientific program included 10 courses of 4/5 lectures each, and 11 individual lectures. The school courses covered a wide range of subjects -see below for an overview- and had varying degrees of difficulty, but were generally directed to graduate students. Some of the individual lectures presented surveys of a particular area, and others were about recent results, but generally speaking, they were accessible to a wide audience. Max Karoubi came 2 weeks prior to the school and gave an elementary K-theory course for Buenos Aires students, as a preparation for his lectures in the NCG school. Andrzej Zuk stayed on in Argentina to take part in the National Algebra Meeting, which took place in La Falda during the week immediately after our school (August 9-14); he gave a lecture on his work with Thomas Schick on Atiyah's conjecture on L^2 -Betti numbers.

Some of the lecturers have prepared lecture notes which are available at the school's website:

<http://cms.dm.uba.ar/Members/gcorti/workgroup.GNC/3EILS>

In addition, a proceedings volume containing lecture notes of the courses as well as some research articles is under preparation, and will be submitted to the Clay Mathematics Institute Proceedings series.

Impact in the development of mathematics in the region

The school had a strong impact at several levels.

1. It brought together local and regional students working towards a phd on these subjects in contact with the some of the main researchers in the area, as well as with



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each other and with students from the northern hemisphere. This helped develop contacts which will be important in their professional careers.

2. It established a contact between the different research groups both from the region and abroad who work in different aspects of noncommutative geometry and rarely attend the same scientific meetings.

3. It increased the international visibility of the NCG research in our region and helped promote the subject among local students and researchers.

4. It helped promote mathematics in general and the Luis Santaló Math Department series of Winter Schools in particular.

4. It helped reinforce existing cooperation activities and develop new ones. A cooperation project of our group in Buenos Aires with that of Prof. Reich, one of the main lecturers, has emerged as a consequence of discussions we had during the school. Another of the main lecturers, Prof. Zuk, is coming back to Buenos Aires next year to give a 2-month PhD course. Prior to the school, a number of Latin-American and French research groups --including ours-- working in operator algebras and related subjects applied for funding within the Mathamsud program to form a LatAm-France network on the subject. Representatives of some of the groups were present at the School, which thus served as a launching event of the network.

Overview of the lectures

The courses introduced different topics within Noncommutative Geometry. Boris Tsygan lectured during the first week about his joint work with Dolgachev and Tamarkin on formality theorems. A related course on Deformation-Quantization, explaining motivations from theoretical physics, and with emphasis on the classification of star products modulo Morita equivalence, was given by Bursztyn and Waldmann in the second week. Mathematical physics was also present in the lectures of Victor Kac on vertex and Poisson vertex algebras; it covered from the definition of such algebras to recent work with Bakarat and De Sole on



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integrable infinite-dimensional Hamiltonian systems. Different aspects of K-theory were the subject of three of the courses. Max Karoubi's lectures (including those given before the actual NCG School) discussed some of the many topics he has worked in, ranging from hermitian to twisted K-theory. As a tribute to the late Orlando Villamayor (Sr) who was a professor in our department, some of Karoubi's lectures prior to the NCG school were devoted to Karoubi-Villamayor K-theory; their theory was developed here when Karoubi was visiting Villamayor in the late 1960's. Holger Reich gave a very well-structured course on the isomorphism conjectures, starting with the different definitions of a projective module (and the proof of their equivalence), and finishing with the general formulation of the isomorphism conjecture for algebraic K-theory (K-theory Farrell-Jones conjecture) and some recent positive results. Jonathan Rosenberg's lectured on different topics, including KK-theory and the UCT, and the classification and uses of non-commutative torii. Ralf Meyer talked about his ongoing work with Buss and Zhu on full C^* -algebra crossed products and their symmetries. The lectures by Andrzej Zuk explained how groups generated by automata provide a number of striking examples, including infinite finitely generated torsion groups, groups with intermediate growth, and groups without uniform exponential growth. Noncommutative algebraic geometry was represented in Victor Ginzburg's lectures, who talked about noncommutative Calabi-Yau algebras, especially Jacobi algebras. Henri Moscovici talked about his work with Alain Connes and others about characteristic classes of noncommutative spaces, covering from the noncommutative local index formula to recent developments on extension of characteristic classes for twisted spectral triples.

As mentioned above, some of the individual lectures surveyed a particular subject, and others were about recent results. For example Ruy Exel gave an overview of crossed products for partial group actions, and Travis Schedler of crepant resolutions. Gonçalo Tabuada presented his spectacular progress with the Drinfel'd-Kontsevich noncommutative motives program, and the characterization of K-theory as a universal functor of DG-categories satisfying certain axioms. The rest of the talks covered results on spectral triples (Mesland and Trinchero's lectures), Baum-Connes (María Gómez and Rubén Sánchez lectures), and the OCHA operad (Eduardo Hoefel).



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Suggested follow-up activities

Apart from the specific activities of our group (including cooperation projects and Prof. Zuk's planned course in Buenos Aires), there are at least two NCG-related activities planned in the region for next year which we will attend and encourage our students to do so, namely the Brazilian Operator Algebras Symposium (January 31- February 4) and the Latin-American School (ELAM) on Noncommutative Algebra and Lie Theory (May 16-27). Concerning the broader picture of the furthering of mathematical research in our region, the next Luis Santaló Winter School is a more than adequate follow-up to our school.

Financial Report

We received funding from the following institutions (all amounts in US dollars)

NSF	30000
CIMPA	15360
Clay Mathematics Institute (CMI)	10000
ICTP	3840
Ministry of Science, Technology and Innovation	7500
Franco-Uruguayan Math. Insitute (IFUM)	5120
National Council for Science and Technology	3750
French Embassy in Argentina	3072
French cooperation for the Southern Cone	2560
International Mathematical Union (IMU)	1000
Exact Sciences Foundation	750
Mathematics Department	625
TOTAL	83577



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Funding from CIMPA, ICTP and IFUM, as well as that from the French Cooperation was used to cover expenses of lecturers and students from Latin-America, and, in the case of CIMPA, also to pay for the airplane ticket of the Spanish lecturer. French embassy funding covered the travel costs of the French lecturers. US participants were funded by NSF. Clay Math and IMU funding was used to cover lodging and travel costs of Northern Hemisphere participants and lecturers not from the USA. Funding from Argentine sources was mostly used for expenses of local participants, coffee breaks, office materials, and other expenses.

Guillermo Cortiñas
Organizer

Buenos Aires, September 2, 2010.