

Fourier analysis of groups in combinatorics

CIMPA-UNESCO-MESR-MINECO-INDIA

Shillong, India, November 18-30

Shillong, November 18, 2013

Michel WALDSCHMIDT, Université de Paris 6

<http://www.math.jussieu.fr/~miw/>

<http://www.cimpa-icpam.org>



1. Introduction of CIMPA

2. Indo-French cooperation

CNRS in India

Campus-France

Service pour la Science et la Technologie

India fund at IHÉS

CEFIPRA

3. European Mathematical Society

Committee for Developing Countries



CIMPA

ICPAM

CENTRE INTERNATIONAL DE MATHÉMATIQUES PURES ET APPLIQUÉES

INTERNATIONAL CENTER FOR PURE AND APPLIED MATHEMATICS

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CIMPA's mission

To promote international cooperation for developing research in mathematics and its applications in higher education

- to this end CIMPA organizes research schools and supports schools or networks in connection with continental mathematical societies
- its actions are concentrated in locations where there is the will to further develop mathematics and where a research project is sustainable
- a main endeavour is to maintain three equilibria: gender, geography and subject

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CIMPA's history

CIMPA is:

- a non-profit organization created in 1978 by mathematicians, with offices in Nice, France
- mainly funded by France. More recently it is also funded by Spain, Norway and Switzerland.
- a category 2 centre of UNESCO since the 90's

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CIMPA Research Schools

Open call every year

- proposals for two-week schools come from everywhere
- some are encouraged by CIMPA members
- the Scientific Council analyzes, evaluates and makes recommendations
- the Steering Council selects about 15 to 20 research school projects

Schools are organized locally with scientific and administrative help from CIMPA, in a so-called North-South-South format

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CIMPA Research Schools



Barranquilla (Colombia) CIMPA Research School 2013

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CIMPA Research Schools

- Young participants from neighboring countries apply
- Among the young participants accepted both by the organizers and CIMPA, several receive full CIMPA financial support (at least 2/3 of CIMPA total support)
- Lecturers and speakers are not paid. In most cases they use their own funding for travel
- CIMPA helps through letters, discussions with organizers, explanation to authorities, fund raising etc.

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CIMPA Research Schools

- 40 K€ = average budget for a RS
12 K€ = average CIMPA participation
8 K€ - at least - for young people from neighboring developing countries
4 K€ - at most - for lecturers, speakers or local expenses
- A four-page Road map helps from the very beginning to have a successful RS
- Each RS has two final complete reports. One from the local organizers, the other from CIMPA representative.

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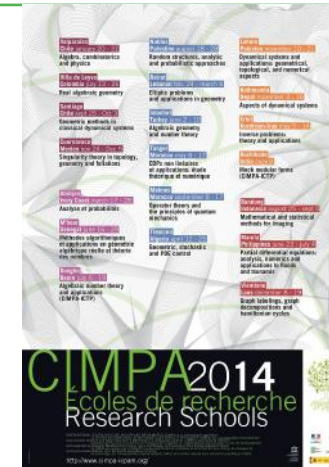
2013



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2014



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CIMPA Research Schools in India (1996–2002)

January 1996 : Pondicherry University

Nonlinear Systems

Y. Kosmann-Schwarzbach, B. Grammaticos, K. M. Tamizhmani.

September 2002, TIFR Mumbai (Bombay)

Probability measures on groups : Recent

Direction and trends, *Tata Institute of Fundamental Research, Mumbai (Bombay), S. Dani, P. Graczyk, Y. Guivarc'h.*

December 2002 : ISI Kolkata (Calcutta)

Soft Computing approach to pattern recognition and image processing.

Ashish Ghosh, Sankar K. Pal.



CIMPA Research Schools in India (2003–2008)

February 2003 : Pondicherry

Discrete Integrable Systems, Pondicherry,

Basil Grammaticos, Yvette Kosmann-Schwarzbach, Thamizharasi Tamizhmani.

January 25 - February 5, 2005 : IISc Bangalore

Security for Computer Systems and Networks.

K. Gopinath, Jean-Jacques Lévy.

January 2-12, 2008 : IIT Bombay (Mumbai)

Commutative algebra

L. L. Avramov, M. Chardin, M. E. Ross, J. K. Verma, T. J. Puthenpurakal.



CIMPA Research Schools in India (2013)

November 25-December 6, 2013 : University of Delhi

Generalized Nash Equilibrium Problems, Bilevel programming and MPEC

Didier Aussel, C. S. Lalitha.

November 18-30, 2013 : Shillong.

Fourier analysis of groups in combinatorics.

Gautami Bhowmik, Himadri Mukherjee.

July 8-19, 2013 : Indian Institute of Science Bangalore.

Current Trends in Computational Methods for PDEs

Blanca Ayuso de Dios, Thirupathi Gudi.



CIMPA Research Schools in India (2014)

August 11-22, 2014 : Kerala School of Mathematics, Kozhikode

Mock Modular Forms

Lothar Goettsche, Manickam Murugesan, Kathrin Bringmann, Lothar Goettsche, Ken Ono.



India and West Asia 2013

Current Trends in Computational Methods for PDEs

CIMPA-UNESCO-MESR-MINECO-INDIA
Bangalore, India, July 8-19

Fourier analysis of groups in combinatorics

CIMPA-UNESCO-MESR-MINECO-INDIA
Shillong, India, November 18-30

Generalized Nash Equilibrium Problems, Bilevel programming and MPEC

CIMPA-UNESCO-MESR-MINECO-INDIA
New Delhi, India, November 25-December 6

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India and West Asia 2014

Inverse problems : Theory and applications

CIMPA-KURDISTAN-IRAQ
Erbil, Kurdistan-Iraq, May 5-14

Mock Modular Forms

CIMPA-ICTP-INDIA
Research School co-sponsored with ICTP
Kozhikode, India, July 28 - August 8

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India and West Asia 2014 (continued)

Aspects of Dynamical Systems

CIMPA-NEPAL
Kathmandu, Nepal, November 3-16

Dynamical Systems and Applications : Geometrical, Topological, and Numerical Aspects

CIMPA-PAKISTAN
Lahore, Pakistan, November 10-21

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CIMPA's organization

- Our General Assembly elects 7 individual members to the Governing Board
- Permanent institutional members in the GB are UNESCO, France, Norway and Spanish Ministries, University of Nice
- The GB elects its 4 member Executive committee (Bureau in French)
- CIMPA also has a Scientific Council and a Steering Council
- The Director is appointed by the GB and selects a Management team: Regional scientific officers and Project managers.

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Bureau (Executive committee)

President: TSOU Sheung Tsun

University of Oxford (Mathematical physics)

Vice-President: Alain DAMLAMIAN

Université Paris 12 (Nonlinear analysis, nonlinear partial diff. equations)

Secretary: Jean-Marc BARDET

Université Paris 1 (Probability and statistics)

Treasurer: Marc AUBRY

Université Nice Sophia-Antipolis (Algebra, Topology and Geometry)

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Scientific Council

Chairman: Enrique ZUAZUA (Spain) (Applied Maths)

- Jean-Marc AZAÏS (France) (Probability, statistics)
- Viviane BALADI (France) (Dynamical systems)
- Edy Tri BASKORO (Indonesia) (Graph theory)
- Suzanne BRENNER (USA) (Numerical analysis)
- Maria Luiza FERNANDEZ (Spain) (Differential geometry)
- Helena NUSSENZVIG LOPES (Brazil) (PDE, Fluid dynamics)
- Youssef OUKNINE (Marocco) (Probability, stochastic equations)
- Carlos DI PRISCO (Venezuela) (Logic)
- Ragni PIENE (Norway) (Algebraic geometry)
- Ramdorai SUJATHA (India) (Number theory, K-Theory)
- Cédric VILLANI (France) (Fields Medal)

CENTRE INTERNATIONAL DE MATHÉMATIQUES PURES ET APPLIQUÉES
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Management team

Director : Claude CIBILS (U. Montpellier 2, on leave at U. Nice Sophia-Antipolis)

Scientific Officers:

- **Sub-Saharan Africa:** Sylvain DUQUESNE (U. Rennes 1), Marie-Françoise ROY (U. Rennes 1) and Giulia DI NUNNO (U. of Oslo)
- **Mediterranean:** Ahmad EL SOUFI (U. Tours)
- **Latin America and Caribbean:** Claude CIBILS
- **South-east Asia:** Brigitte LUCQUIN (U. P. et M. Curie) and Christian MAUDUIT (U. Aix Marseille II)
- **India and West Asia:** Jorge JIMENEZ URROZ (U. Politècnica de Catalunya)
- **Transverse :** Mercedes SILES MOLINA (U. Malaga)

Project manager for the Master in Cambodia: Brigitte LUCQUIN

Project manager for communication : Rosane USHIROBIRA (U. Bourgogne, on secondment at Inria Lille)

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Scientific partners

Université Nice Sophia-Antipolis (**UNS**), Institut National de Recherche en Informatique et en Automatique (**Inria**), Centre National de la recherche Scientifique (**CNRS**), Société Mathématique de France (**SMF**), Société de Mathématiques Appliquées et Industrielles (**SMAI**), International Mathematical Union (**IMU**), International Council for Industrial and Applied Mathematics (**ICIAM**), European Mathematical Society (**EMS**), International Centre for Theoretical Physics (**ICTP**), Union Mathématique Africaine (**UMA**), South East Asian Mathematical Society (**SEAMS**), Union Mathématique d'Amérique Latine et Caraïbes (**UMALCA**), Comité National Français des Mathématiciens (**CNFM**), Centro de Modelamiento Matemático (**CMM**), Bordeauxthèque, Institut de Recherche pour le Développement (**IRD**), Comité Español de Matemáticas (**CEMAT**), Real Sociedad Matemática Española (**RSME**), Societat Catalana de Matemàtica (**SCM**), Sociedad Española de Matemática Aplicada (**SEMA**), Sociedad Española de Estadística e Investigación operativa (**SEIO**)

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Numbers

260 Research Schools since 1979, see the complete list:

<http://www.cimpa-icpam.org/spip.php?rubrique70>

Represented countries by continent:

- Africa : 18
- Asia : 12
- South America and Caribbean : 13
- Middle East : 8

13000 young mathematicians with 2500 speakers, 1100 from so-called Southern countries.

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Budget 2012

512 K€

- 68% France
- 12% Switzerland
- 6% Norway
- 4% Spain
- 5% ICTP and others
- 5% Membership dues

Half of the budget for Africa (Sub-Saharan and Mediterranean)

- paid from budget : one and a half full time secretaries in Nice
- scientific officers, members of councils and lecturers are volunteers
- Not in the budget: salary of the Director, paid by Université Montpellier 2 and support by Université Nice Sophie-Antipolis and CNRS.

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CARMIN

CARMIN is an “Excellence Laboratory” in France conducted by Cédric Villani, composed of four centres:

- IHP - Institut Henri Poincaré
- IHÉS - Institut des Hautes Études Scientifiques
- CIRM – Centre International des Rencontres Mathématiques
- CIMPA

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EMALCAs, EMAs and SEAMS schools

CIMPA is a partner and encourages schools of Master level.

UMALCA (Union de Matematicos de América Latina y el Caribe) has initiated EMALCAs more than 15 years ago.

2013 EMALCAs : Salta, Tegucigalpa, Lambayeque, Morelia, Barranquilla, Mérida, Cochabamba, Coclé, Quito.

With UMA (Union des Mathématiciens d’Afrique) and SEAMS (South-East Asia Mathematical society) we have initiated recently a partnership in the same direction.

2013 EMAs : Mombasa, Brazzaville

2013 SEAMS schools : Manila, Hanoi

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International support for CIMPA-ICPAM

Convention MICINN (Ministerio de Ciencia e Innovación, Spain) – CIMPA, thanks to the former President of CIMPA, Mario Wschebor

- It allows CIMPA-ICPAM to respond to more requests of help from developing countries, much more than we can support at the moment
- It was a first step towards the internationalization of CIMPA-ICPAM

Supports from the governments of Norway and Switzerland

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**Centre National de la Recherche Scientifique
CNRS in India**
One Mixed Unit (UMI):
Indo-French Centre for Applied Mathematics,
Bangalore

CNRS/DST Department of Science and Technology
*Partial differential equations, control theory, computing
sciences, statistical physics, dynamic systems, mathematical
biology, modeling large networks.*

École Polytechnique, École Normale Supérieure, INRIA,
Nice Sophia Antipolis, Paul Sabatier
Indian Institute of Science, Tata Institute of Fundamental
Research, Indian Institutes of Technology

Indo-French cooperation in mathematics

Campus-France <http://www.inde.campusfrance.org>
Scholarships
Studies in France

**Service pour la Science et la Technologie,
French Embassy in India** <http://www.ambafrance-in.org/>

Global Technology Summit 2013
State visit to India of François Hollande, President of the
French Republic in February 2013
October 23rd and 24th, New Delhi: meeting and new
partnerships between researchers, businesses and clusters
from both countries. High level delegations, research
organizations, companies, SMEs...

List of projects (1995–1996)

- ASYMPTOTIC ANALYSIS IN PARTIAL DIFFERENTIAL EQUATIONS
Three years (February, 1995 to February, 1998)
- INTEGRABILITY ASPECTS OF DISCRETE AND CONTINUOUS EQUATIONS
Three years (August, 1995 to July, 1998)
- CHAOS, TURBULENCE AND COLLECTIVE RELAXATION IN NON-EQUILIBRIUM PLASMAS
Four years (December, 1995 to November, 1999)
- ARITHMETIC AND AUTOMORPHIC FORMS
Three years (November, 1996 to October, 1999)



List of projects (1997–1999)

- NONLINEAR HYPERBOLIC AND ELLIPTICAL EQUATIONS AND APPLICATIONS
Three years (May, 1997 to April, 2000)
- GEOMETRY
Three years (May, 1997 to April, 2000)
- RIGOROUS RESULTS ON SCHRODINGER EQUATIONS AND FOUNDATIONS OF QUANTUM THEORY AND APPLICATIONS TO PARTICLE PHYSICS AND ASTROPHYSICS
Three years and six months (March, 1999 to August, 2002)
- THEORETICAL STUDY OF ELECTRONIC AND MOLECULAR DYNAMIC
Three years and six months (March, 1999 to August, 2002)



List of projects (1999–2002)

- NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS AND CONTROL
Three years and six months (July, 1999 to December, 2002)
- NON-CUMULATIVE MARKOV PROCESSES AND OPERATOR SPACES
Three years (May, 2001 to April, 2004)
- ALGEBRAIC GROUPS IN ARITHMETIC & GEOMETRY
Three years (September 2001 to August, 2004)
- STUDIES IN GEOMETRY OF BANACH SPACES
Three years (November 2001 to October, 2004)
- MATHEMATICAL TOPICS IN HYPERBOLIC SYSTEMS OF CONSERVATION LAWS
Four years (July 2002 to June, 2006)



List of projects (2003–2008)

- ANALYTIC AND COMBINATORIAL NUMBER THEORY
Three years (October 2003 to September 2006)
- ADVANCED NUMERICAL METHODS IN NONLINEAR FLUID MECHANICS AND ACOUSTICS : NONLINEAR ANALYSIS AND OPTIMISATION
Three years (March, 2006 to February, 2009)
- CONSERVATION LAWS AND HAMILTON JACOBI EQUATIONS
Three years (September, 2006 to August, 2009)
- ARITHMETIC OF AUTOMORPHIC FORMS
Three years (September, 2007 to August, 2010)
- CONTROL OF SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS
Three years (February, 2008 to January, 2011)



- NUMERICAL TREATMENT OF INTEGRAL OPERATORS WITH NON-SMOOTH KERNELS
Three years (September 2009 to August 2012)
- KLEINIAN GROUPS : GEOMETRICAL AND ANALYTICAL ASPECTS
Three years (September, 2010 to August, 2013)
- DISCONTINUOUS GALERKIN METHOD FOR NONLINEAR ACOUSTICS
Three years (September, 2010 to August, 2013)

Seminar on Successful Indo–French
S&T Cooperation

Indo–French cooperation in mathematics

Michel Waldschmidt

Université Pierre et Marie Curie (Paris 6)
Institut de Mathématiques de Jussieu

<http://www.math.jussieu.fr/~miw/>



Indo–French relations in mathematics

The relations between mathematicians from France and from India are old. The first links were established by A. Weil in 1930, and shortly after that, Father Racine played a major role in the development of mathematical research in India.

Father Racine

Father Racine (1897–1976) reached India in 1937 as a Jesuit missionary after having taken his Doctorate in Mathematics in 1934 under Élie Cartan. He taught mathematics first at St Joseph's College in Tiruchirappally (Trichy, Tamil Nadu) and from 1939 onwards at Loyola College (Madras). He had connections with many important French mathematicians of that time like J. Hadamard, J. Leray, A. Weil, H. Cartan. His erudition was clear from his lectures, his courses were research oriented in contrast with the traditional way of teaching which aimed only at leading the largest number of students to success in their exams.



Two Indo–French achievements

The most important part of cooperation between France and India in mathematics is constituted by the new results proved by the joint works of mathematicians from both countries. We give two such outstanding results.

Waring's Problem

The final step to the determination of Waring's constant $g(4) = 19$ in 1986 by R. Balasubramanian, J–M. Deshouillers and F. Dress :

Any positive integer is the sum of at most 19 biquadrates.

Problème de Waring pour les bicarrés. I : schéma de la solution, II : résultats auxiliaires pour le théorème asymptotique, C. R. Acad. Sci. Paris, 303, (1986), 4, 85–88 & 5, 161–163



Serre's Modularity Conjecture

Serre's Modularity Conjecture was proved in 2006 in a joint work by Chandrashekar Khare and Jean–Pierre Wintenberger :

Let

$$\rho : G_{\mathbb{Q}} \rightarrow GL_2(F).$$

be an absolutely irreducible, continuous, and odd two–dimensional representation of $G_{\mathbb{Q}}$ over a finite field $F = \mathbb{F}_{\ell^r}$ of characteristic ℓ , There exists a normalized modular eigenform

$$f = q + a_2q^2 + a_3q^3 + \dots$$

of level $N = N(\rho)$, weight $k = k(\rho)$, and some Nebentype character $\chi : \mathbb{Z}/N\mathbb{Z} \rightarrow F^*$ such that for all prime numbers p , coprime to $N\ell$, we have

$$\text{Trace}(\rho(\text{Frob}_p)) = a_p \quad \text{and} \quad \det(\rho(\text{Frob}_p)) = p^{k-1}\chi(p).$$



**European Mathematical Society
Committee for Developing Countries**
<http://euro-math-soc.eu/EMS-CDC/>



Workshops on electronic access
<http://workshop.ems-cdc.org/doku.php>

**Finding Online Information in
Mathematics**