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CENTRE NATIONAL  
DE LA RECHERCHE  
SCIENTIFIQUE

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Institut de Mathématiques

«Théorie des Nombres», Case 247

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**Report on the CIMPA-UNESCO-MICINN-PAKISTAN  
Research School on Local analytic geometry  
February 4 - 14, 2012  
Abdus Salam School of Mathematical Sciences ASSMS, Lahore**

**Objectives :**

*Local analytic geometry is concerned with germs of zero sets of analytic functions, that is, the study of such sets in the neighborhood of a point.*

*The school intends to introduce PhD students and young researchers to local analytic geometry and to enable them to receive the required knowledge for doing significant research in this area of mathematics. In this school we plan to give introductions to topics related to local analytic geometry and computational algebra. A basis for the courses will be the book of Theo de Jong and Gerhard Pfister : 'Local Analytic Geometry'. The aim of the school is to give an overview of local methods in geometry and their applications in various fields of mathematical and non-mathematical sciences. We also want to give a course in which it is shown how the existing computer algebra systems can be used to handle non-trivial examples in the above mentioned theories and how the algorithms based on Gröbner bases are implemented in these systems.*

There were 20 foreign candidates (not including Andreas Steenpass), all were selected, only 11 came: three participants from Nepal, two from Vietnam, from Philippines and from Ouzbekistan, one from Indonesia and from Iran. Only one of them (from Nepal) was a female.

The number of Pakistanese participants was 29 (13 females and 16 males), including one Pakistanese postdoc with a scholarship for 2 years in ICTP, 18 participants from ASSMS Lahore, 7 from other places in Lahore (University of Education, GCU, COM-SATS, NU-FAST), 2 from Karachi (Institute of Business administration, Federal Urdu University of Arts, Sciences & Technology), one from Islamabad (Air University).

The 11 foreign participants and myself were accommodated in a hotel downtown, the speakers were in the guest houses of Defence Housing Authority Lahore. The participants and the lecturers were together at the Abdus Salam School of Mathematical Sciences from 9:30 am to 4:30 pm, the interaction between them was quite good.

The initial program was slightly modified after some speakers withdrew their parti-

icipation. The French organizer, Alexandru Dimca, did not come, he was replaced by Stefan Seidel (Germany). Also Viviane Ene, the only female speaker, told the organizers one year before that she would not be able to join, she was replaced by Arnfinn Laudal (Norway). Moreover some tutorials, which were not included in the initial project, have been given by Andreas Steenpass (Germany). These training sessions have been a great success, and this is indeed one of the very positive consequences of this research school.

The format was original: each day one speaker gave two lectures of one hour each in the morning and one tutorial in the afternoon; most often there was another tutorial on SINGULAR by Andreas Steenpass. The participants liked this format: they could concentrate on one specific aspect of the different topics each day.

- Saturday, Feb. 4 — Gerhard Pfister : SINGULAR and Applications
- Sunday, Feb. 5 — O. Arnfinn Laudal : Basic of analytic geometry
- Monday, Feb. 6 — Barbu Berceanu : Basics of Local Algebra
- Tuesday, Feb. 7 — Stefan Seidel : Standard Bases
- Wednesday, Feb. 8 — Peter Schenzel : Local cohomology
- Thursday, Feb. 9 — Dorin Popescu : Approximation Theorems
- Friday, Feb. 10 — Marius Vladioiu : Algorithms and Computing in Local Algebra
- Saturday, Feb. 11 — Jürgen Herzog : Regularity and smoothness
- Monday, Feb. 13 — Gerhard Pfister : Classification of singularities and closing ceremony.

Hence the courses involved a number of different but related topics, using tools from algebra, algebraic geometry, commutative algebra and analysis. Some students were surprised that there were such strong relations and interconnections between such various subjects!

Some notes were available in electronic form from the [website of the school](#), including [a book by Theo de Jong and Gerhard Pfister](#) which included a fair amount of the content of the courses. Some of the students understood very well: in particular those of Pakistan, Iran and Vietnam benefited a lot from the courses. The participants from Indonesia and Philippines learnt a lot. But the background of some other foreign participants was not sufficient, and some of the speakers lowered the level of their course. This turned out to be a good move. Even some Pakistani students who were preparing a PhD in commutative algebra told me that they learned the connection with algebraic geometry. Each day everybody had to sign their name on a list of participants; almost all foreign participants were present to all courses, very few of them missed some tutorials. Some Pakistani participants missed the introductory courses they already knew very well, otherwise the participation was intense till the end of the program. The background of some foreign participants was not good enough to enable them to understand really what was going on; nevertheless this school was a useful experience for them, they are motivated to learn more, and they had fruitful contacts with other young mathematicians.

The program of Friday included a defense of a PhD thesis on Stanley depth by Muhammad Ishag, a student of Dorin Popescu; this was appropriate, on line with the main

topic of the school, and it was an opportunity for the participants to attend the defense of a thesis.

A tourist visit for the foreign participants took place on Sunday, February 12.

The closing ceremony on Monday, February 13 was presided by the Rector of GCU. A representative of the French Embassy was invited but there was no answer.

On February 10, I visited the **Centre for Advanced Studies in Mathematics (CASM)**, **Lahore Faqir University of Management Sciences (LUMS)** where I was invited by Faqir M Bhatti. There I gave a talk on **Number theory: Challenges of twenty-first century**. I met Mrs Shamin (Akhtar) Arif , who was the first PhD Student of Bryan Birch (University of Manchester,1967). I also discussed with Faqir M Bhatti a project of CIMPA School in LUMS in 2014. There may be three proposals for a CIMPA School in 2014, one in LUMS and two in ASSMS.

### **Budget**

The support for this school came from international sources:

- ICTP (10 000 Euros), CIMPA (5 000 Euros), IMU (2000 Euros)

and from Pakistanese sources

- Government of Punjab (6 000 Euros) and Higher Education Commission HEC (3 000 Euros).

The expenses were the travels fare for 11 foreign participants (7400 Euros), for 4 speakers (3900 Euros), the expenses for the participation of the post-doc from ICTP (2000 Euros) and the local expenses for speakers and all participants for 9 days (12 700 Euros).

I conclude by thanking Raza Choudari for the local organization of the school and for his warm hospitality, Gerhard Pfister for the organization of the scientific part of the school, the speakers for their talks and the time they spent to prepare them, and the students for their assiduity, the sponsors of the School (not only CIMPA and ASSMS but also ICTP, IMU, Government of Punjab, HEC) for their support. The friendly atmosphere has been appreciated by everybody.

Thanks are also due to Faqir M Bhatti for his invitation to LUMS.

This report is available on my website

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

The CIMPA website for this Research School is

<http://www.cimpa-icpam.org/spip.php?article408>

and the school's local website is

<http://www.sms.edu.pk/cimpa2012.php>