

**REPORT OF THE CIMPA SCHOOL “ELLIPTIC CURVES: ARITHMETIC  
AND COMPUTATION”  
MONTEVIDEO (URUGUAY), FEBRUARY 11–22, 2019**

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This Research School took place at the Universidad de la República, in Montevideo. I was only present there the first week.

The school begun on February 11th, with the opening ceremony. The people who spoke were

- Prof. Gonzalo Tornaria, local organizer.
- Mr. Alessandro Costa, First Secretary of the Italian Embassy.
- Mr. Asís Barrera, Cultural Councillor from the Spanish Embassy.
- Prof. Jorge Mozo Fernández, representing CIMPA.
- Prof. Fernando Rodríguez Villegas, representing ICTP.
- Prof. Valerio Talamanca, organizer, representing Roman Number Theory Association.

There was 8 scheduled courses in this school, that were:

1. Christophe Ritzenthaler (France): Introduction to algebraic curves.
2. Fernando Rodríguez Villegas (Italy): Galois cohomology. Diophantine equations and elliptic curves. The Weak Mordell-Weil Theorem.
3. Elisa Lorenzo García (France): Elliptic curves.
4. Peter Stevenhagen (Netherlands): Complex elliptic curves. Elliptic curves over finite fields. Explicit 2-descent.
5. René Schoof (Italy): Elliptic curves over local fields. Counting points on elliptic curves. The Birch-Swinnerton-Dyer conjecture.
6. Gonzalo Tornaria (Uruguay): Modular forms and elliptic curves.
7. Valerio Talamanca (Italy): Heights in projective spaces. The Mordell-Weil Theorem. Canonical heights.
8. Francesco Pappalardi (Italy): Computations with GP/PARI. L-functions
9. Laura Geatti (Italy): Elliptic curves algorithms.

In the second week, two exercises sessions were scheduled, on Tuesday and Thursday, after the talks, with great success and good participation of the students. All speakers were very accessible to the students, and effectively, many of them asked questions after the talks. The level was good: most of the courses started from a very basic level, so (almost) every student could follow them. Most of the speakers stayed there the two weeks, so the students could speak with them even after their courses.

There were 67 participants coming to the school: 6 students from Brazil, 9 from Argentina, 10 from Colombia, 7 from Chile, 3 from Mexico, 2 from Peru, 3 from Croatia, 2 from Tahiti, 1 from Poland, 1 from France, and about 13 students from Uruguay. Among these students 10 of them received total funding from CIMPA, another 2 received partial funding. Moreover, thank to a very generous funding from ICTP, another 21 students were totally funded, and three



FIGURE 1. Excursion to Cerro Pan de Azúcar



FIGURE 2. Lectures of Christophe Ritzenthaler and Fernando Rodríguez

more received funding for lodging. As three students didn't confirm, or directly cancelled, this funding was transferred to other students. The travel cost of three students was paid by IMPA, and one student received funding from PUC-Chile. So, more than 35 foreign students could come totally funded to these schools, which represents a very big number.

The courses took place at the Facultad de Ingeniería of the Universidad de la República, conveniently located in a nice part of the town. The room was well equipped with a whiteboard and a projector. Funded students were lodged in Medio Mundo Hostel (<https://www.mediomundohostel.com/>), some of the speakers (and also me) in Intercity Hotel (<https://www.intercityhoteles.com.br/hotel-montevideo/hotel-intercity-montevideo/26/>), and another speakers rented an apartment through Airbnb. All these residence places were at walking distance from the university.

An excursion, totally paid by the faculty, was organised on Saturday 16th. We went to Cerro Pan de Azúcar, a hill at about 90 minutes from Montevideo, where you could go up the hill and/or visit a small wildlife reserve in the neighbourhood. It was a good socializing experience, and a

great opportunity to make great pictures from the top. I would like to highlight that Francesco Pappalardi went to the excursion directly from the airport, after a long flight from Europe!

The organizers made a great job. Specially Gonzalo Tornaria (local organizer), and Valerio Talamanca, who has a great experience in organizing these kind of events, and made everything look very easy. They are the main responsables of the success of this school, that is among the best organized ones I have ever been.

The final contribution of CIMPA was 8236,36 €. They were distributed as follows:

|                                  |                      |
|----------------------------------|----------------------|
| Tickets of the students          | 2815 €               |
| Lodging of the students          | 3473 USD (3106,25 €) |
| Lodging (hotel) of some speakers | 1470 USD (1317,51 €) |
| Appartment of some speakers      | 997,60 €             |
| <b>Total</b>                     | <b>8236,36 €</b>     |

FIGURE 3. CIMPA expenses

Other contributions, not from Uruguay, came from ICTP (10000 €), IMU (4000 €), Gruppo nazionale per le strutture algebriche, geometriche e applicazione, INdAM-GNSAGA (René Schoof's ticket), Ministero per gli affari esteri e cooperazione from Italy (80% of the tickets of Valerio Talamanca, Laura Geatti and Francesco Pappalardi), Lia-Ifum (tickets of Elisa Lorenzo and Christophe Ritzenthaler). The precise details of the budget will be included in the organizers' report.

To these quantities it is necessary to add my travel and visa expenses, that are 949,16 €.



FIGURE 4. Group picture of Montevideo school

Montevideo and Valladolid, March 2019.