

CERN – Latin-American Schools of High-Energy Physics

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Director, CERN Schools of Physics

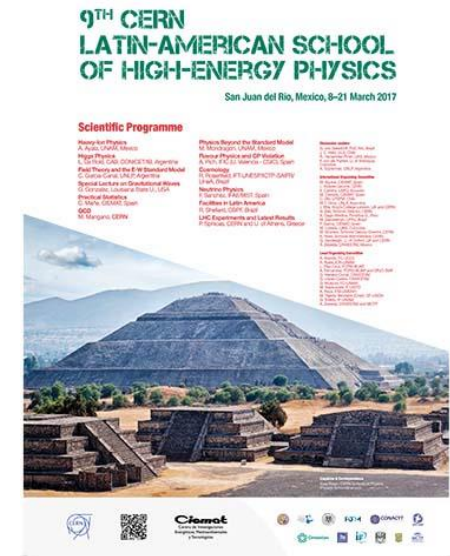
Martijn Mulders

Deputy Director, CERN Schools of Physics

History of these Schools

- CERN – Latin-American Schools of High-Energy Physics (HEP) held every two years since 2001
 - Modeled on European Schools started in 1960s
- Previous Latin-American Schools
 - 2001 Brazil
 - 2003 Mexico
 - 2005 Argentina
 - 2007 Chile
 - 2009 Colombia
 - 2011 Brazil
 - 2013 Peru
 - 2015 Ecuador

2017 Mexico





Motivation

- An example of CERN's mission in Education, and also in bringing people from different countries together
 - Provide advanced training to young scientists in Latin America who are interested in pursuing a career in HEP (related to experiments)
 - Substantially more advanced than CERN Summer Student programme (that is a very useful ingredient to be prepared for this School)
 - Foster cultural exchange and networking between participants from different Latin-American countries, and also with those who come from Europe
 - Use the Schools to promote science in the host country, e.g. through Outreach events organized around the Schools, benefitting from the presence of leading scientists who come to teach

Scope and target audience

- Teach HEP phenomenology and associated experimental techniques
 - Also a couple of topical lectures, this year on gravitational waves and on experimental facilities in Latin America
 - Plus cosmology where the “dark universe” poses fundamental questions some of which may be answered in HEP experiments
- Target audience is mainly PhD and MSc students
 - Also take some outstanding BSc students, especially from countries or regions with limited possibilities for postgraduate study

CLASHEP 2017



Students at the 2017 School

- We had 75 students at this School
 - From 19 different countries!
 - Including 27 students from Mexico
- About $\frac{3}{4}$ from Latin America
 - Other students mainly from Europe
- The School was strongly oversubscribed
 - More than twice as many applications as available places
 - Selection based on application forms and letters of recommendation
 - Many very valid candidates had to be rejected

Mexican students from many places



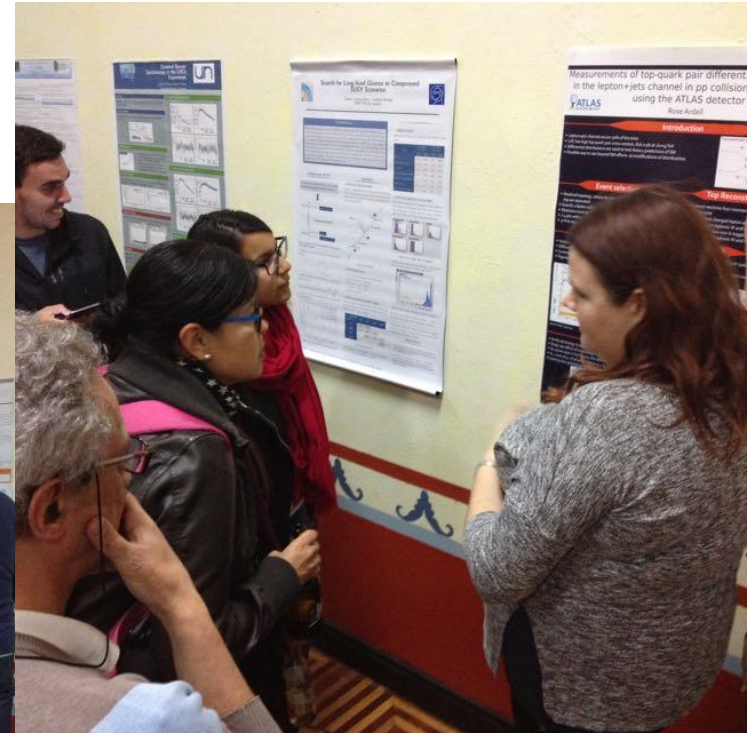
Lectures and discussion sessions

- A total of ~50 hours of plenary lectures
 - Detailed programme can be found [here](#)
- Five discussion groups that met in parallel for 1.5 hours most afternoons
 - Each group taught by an experienced physicist who led (or stimulated) the discussion and helped to answer questions
 - The lecturers also visited the discussion groups to answer more detailed questions on their courses
- Many one-on-one interactions outside of formal teaching periods
 - Teachers asked to be available for this

Active student participation

- Poster session
 - Students encouraged to bring posters describing the research projects on which they are working
 - After-dinner session near start of School
 - Unique opportunity for students to discuss their own work informally with each other and also with senior scientists present at the School
- Collaborative group projects
 - Same 5 groups as for discussion sessions asked to study (different) published experimental data analyses
 - Exercise in collaborative working as well as in physics!
 - Which analysis to study? How to share the work? Who will present it? Etc.
 - Work on projects performed in “free time”
 - After-dinner session near end of School
 - Student representative from each group presents the results of the collaborative project
 - Token prize for best group (peer-review process)

Poster session



Project presentations

- The winning team



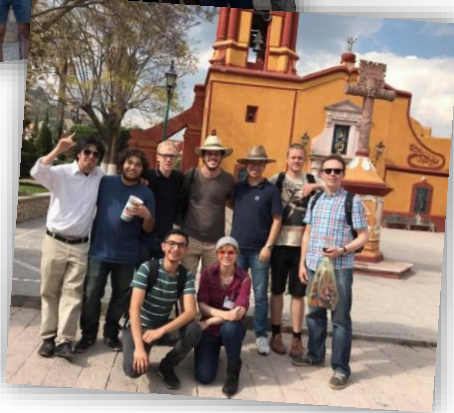
Karla Peña Rodriguez

- 2013 CERN Summer Student (won national competition in Mexico)
- 2015 BSc Univ. de Sonora
- Present: Combined Masters programme ETH, Zürich & École Polytechnique, Paris

Cultural exchange and networking

- In addition to teaching the science, the School aims to promote cultural exchange and networking between young scientists from different countries
- Actions taken to promote this include
 - Select a venue for the School that encourages interactions between the participants (including the staff) outside of the formal teaching time
 - All participants in the same hotel, in somewhat isolated location
 - The projects and the student poster session promote discussion and perhaps even future scientific collaboration between participants
 - Mix students from different countries (Latin America / Europe, etc.) in the groups for the discussion sessions and collaborative projects, and also in shared sleeping accommodation

Cultural programme



- One half-day, and one full-day excursion over two weeks
- There were also possibilities for sports and leisure activities at the hotel
 - Albeit with very limited time to enjoy them!

Funding

- Students from Europe (also USA and Canada) pay a fee that covers the full cost of their participation
- Essentially all Latin-American students receive full or partial support
 - Reduced fees
 - Fee waiver
 - Full support including travel
- Regular sponsorship from CERN and CIEMAT
 - In the past also from Brazil, even when the School was held elsewhere
- Sponsorship from the host country
 - As said yesterday by Charlotte, thanks very much to CONACyT and other Mexican sponsors for their generous support!
 - This allowed us to take ~20 more students than would otherwise have been possible
- It helps enormously when students from the most-developed Latin-American countries come with support, at least for their travel and preferably also for the fee (covering their accommodation and meals)

Organization

- Practical organization handled by CERN together with the local director of the School and others from the host country
 - Thanks very much to Malena Tejeda from the university of Sonora who did fantastic job for this year's School!
- IOC
 - Representatives from LA countries
 - Arnulfo Zepeda for Mexico
 - Representatives from CERN and CIEMAT
 - Local director in attendance
- LOC
 - A. Aranda, FC-UCOL
 - A. Ayala, ICN-UNAM
 - L. Díaz-Cruz, FCFM-BUAP
 - A. Fernandez, FCFM-BUAP & DPyC-SMF
 - G. Herrera-Corral, CINVESTAV
 - G. López-Castro, CINVESTAV
 - G. Murguía, FC-UNAM
 - M. Napsuciale, IF-UGTO
 - A. Raya, IFM-UMSNH
 - M. Tejeda-Yeomans (Local Director), DF-USON
 - G. Toledo, IF-UNAM
 - A. Zepeda, CINVESTAV & MCTP

Education & Outreach around School

- Aim to benefit the local community, in addition to our primary objective of training our own students
- Before the School started, there was a one-week intensive preparatory course on physics topics for undergraduate students in Queretaro
- Major Outreach event in Queretaro on 8 March
 - International Women's Day, and arrival of our students
- Followed by a series of Events in Queretaro with teachers from our School
 - Additional Outreach lectures
 - Seminars for undergraduate physics students

Undergraduate training

HORARIO	LUNES (27 FEB)	MARTES (28 FEB)	MIERCOLES (1 MAR)	JUEVES (2 MAR)	VIERNES (3 MAR)
10h00-11h00	APERTURA DEL CURSO	MECANICA ANALITICA	MECANICA CUANTICA	MECANICA CUANTICA	TEORIA CUANTICA DE CAMPOS
11h00-12h00	MECANICA ANALITICA	MECANICA ANALITICA	MECANICA CUANTICA	TEORIA CUANTICA DE CAMPOS	TEORIA CUANTICA DE CAMPOS
16h00-17h00	MECANICA ANALITICA	MECANICA ANALITICA	MECANICA CUANTICA	TEORIA CUANTICA DE CAMPOS	TEORIA CUANTICA DE CAMPOS
17h00-18h00	MECANICA ANALITICA	MECANICA CUANTICA	MECANICA CUANTICA	TEORIA CUANTICA DE CAMPOS	CIERRE DEL CURSO



- Around 30 students from new Applied Physics course in Queretaro
- Teaching given by young Mexican faculty members from other universities

International women's day


- Talk by Gabriela Gonzalez, spokesperson of LIGO collaboration and teacher at our School
- Introduced by Julia Tagüeña, Fabiola Gianotti et al.
- Full lecture theatre (~500 people) in Queretaro with live webcast; watched also in other universities in Mexico

En el marco de la Escuela Latinoamericana de Física de Alta Energía del CERN
y del Día Internacional de la Mujer
A todo público se le invita a la

Conferencia Magna


Einstein, Agujeros Negros y Ondas Gravitacionales

Dra. Gabriela Gonzalez

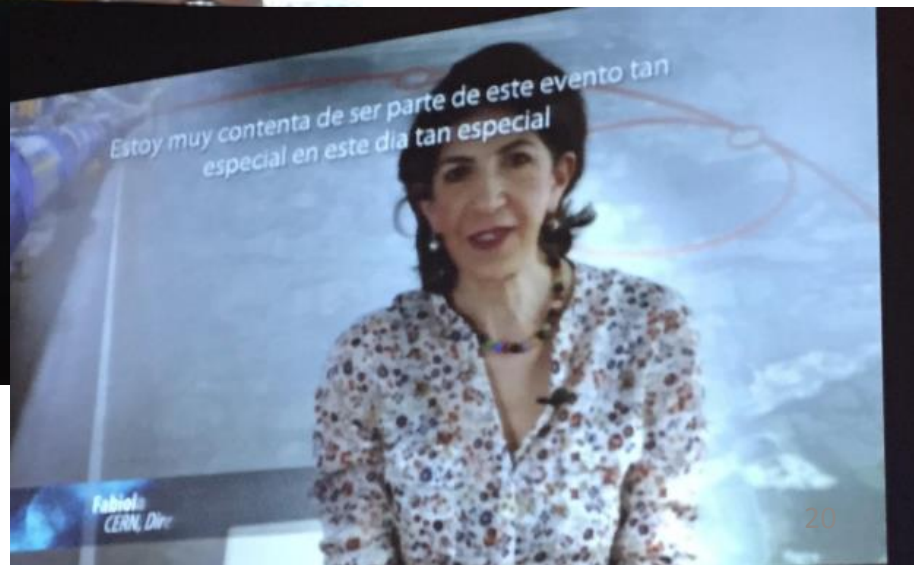


Investigadora de Louisiana State University
Portavoz del Observatorio LIGO

Centro Académico Cultural,
UNAM, Campus Juriquilla
8-Marzo 2017, 15:30 hrs



International women's day



Outreach and seminars for undergrads

- Total of 9 Events organized over a period of 10 days during School
 - Several with webcast
- Talks and seminars given by staff from our School
- Well attended with a lot of interest from the audiences
- Excellent opportunity to promote and develop an interest in science

En el marco de la Escuela Latinoamericana de Física de Altas Energías del CERN
A todo público en general
se les invita a las

CONFERENCIAS MAGISTRALES

MARZO 8-17, 2017
Querétaro, Qro

Entrada Libre

<p>Dra. Gabriela Gonzalez Louisiana State University Agujeros Negros y Ondas Gravitacionales 8 Marzo, 16:30hrs, Centro Académico Cultural, UNAM*</p>	<p>Dr. Carlos Gavala Canal Universidad Nacional de la Plata Evolución del Concepto de Elementaridad 10 Marzo, 13:00hrs, Sala Audiovisual II, Centro Académico Cultural, UNAM*</p>	<p>Dra. María Elena Tejada Universidad de Sonora La sopa de partículas más caliente, nos revela sus secretos 13 Marzo, 14:30hrs, Auditorio Fernando Díaz Ramírez, UAQ**</p>
<p>Dr. Michelangelo Mangano Scuola Normale Superiore Introduction to Particle Physics 13 Marzo, 14:30hrs, Auditorio Fernando Díaz Ramírez, UAQ**</p>	<p>Dr. Antonio Pich Universidad de Valencia El Bosón de Higgs 15 Marzo, 10:00hrs, Auditorio Javier Mena, Centro Académico Cultural, UNAM*</p>	<p>Dr. Paris Sphicas Universidad de Atenas Estudiando la naturaleza con billones de electron-volts 16 Marzo, 14:30hrs, Auditorio Parque Biotecnológico, UAQ**</p>
<p>Dr. Federico Sánchez Universitat de València Los neutrones: las partículas invisibles 16 Marzo, 10:00hrs, Auditorio Parque Biotecnológico, UAQ**</p>	<p>Dr. Alejandro Ayala ICN, UNAM Las muchas caras de la materia nuclear 17 Marzo, 10:00hrs, Centro Académico Cultural, UNAM*</p>	<p>Dra. Myriam Mondragón Instituto de Física, UNAM La física de astrofísica: del cielo a la Tierra, de lo más grande a lo más pequeño 17 Marzo, 14:30hrs, Auditorio Parque Biotecnológico, UAQ**</p>

* Campus Juriquilla, Querétaro
** Centro Universitario, Universidad Autónoma de Querétaro, Qro.

Concluding remarks

- The School in San Juan del Rio was a big success
 - Thanks very much to CONACyT and the other Mexican sponsors for their support
 - Thanks also to the members of the LOC and especially the local director, Malena Tejeda, for sharing the organization of the Event with us
- Extensive programme of public Outreach, and undergraduate courses and seminars
 - Benefit from lectures who came to teach at the School
 - Thanks to CONACyT for their support and help with publicity, press coverage, etc.
- The next School will be in 2019
 - We hope that many Mexican students will apply and that funds can be found to support their participation

Remarks from the students

- Ha sido una experiencia inspiradora y gratificante
- En cuanto a la física, fue una de las mejores experiencias que he tenido. Aprecié mucho todas las respuestas, vinculadas a distintos aspectos de física, que me han dado tanto profesores como estudiantes que muchos ahora los considero amigos. Acercarme a otras personas de distintas nacionalidades que sienten con mucho cariño a la física enriqueció mi ser. Una experiencia invaluable. Muchas gracias,
- enormemente agradecido de haber tenido la oportunidad de expandir y profundizar nuevos conocimientos, matizados con el rico sabor de México, Thanks for such a great experience!!
- La escuela ha sido una de las mejores cosas que me ha pasado, aprendí mucho no solo de física sino también de otras culturas. Me alegró mucho que me hayan dado la oportunidad y espero que no sea la primera y la última vez que acepten alumnos hondureños. Gracias!
- Una gran mezcla de temas muy interesantes, expositores de calidad, gran organización y un ambiente de aprendizaje y complicidad ... una gran experiencia.

Impact: Examples from Ecuador (2015)

- Before the School, no direct involvement in CERN experiments from Ecuador, although individual scientists participated via groups in the USA
- Discussions around the School changed this, and two universities now formally participate in CMS with support from their national funding agency, SENE Cyt
- Very nice news for us was that the local director of the last School, and leader of the CMS team, recently won prize as top emerging researcher in Ecuador



Impact: Example from Peru (2013)

- The School catalyzed much increased interest in HEP in the country
 - Special issue of PUCP magazine
 - Students from other universities in Peru started attending HEP classes at PUCP
 - Very positive for ongoing experimental programme, including in ALICE



Lecture courses

Scientific Programme

Heavy-Ion Physics

A. Ayala, UNAM, *Mexico*

Higgs Physics

L. Da Rold, CAB, CONICET/IB, *Argentina*

Field Theory and the E-W Standard Model

C. Garcia-Canal, UNLP, *Argentina*

Special Lecture on Gravitational Waves

G. Gonzalez, Louisiana State U., *USA*

Practical Statistics

C. Maña, CIEMAT, *Spain*

QCD

M. Mangano, CERN

Physics Beyond the Standard Model

M. Mondragon, UNAM, *Mexico*

Flavour Physics and CP Violation

A. Pich, IFIC (U. Valencia - CSIC), *Spain*

Cosmology

R. Rosenfeld, IFT-UNESP/ICTP-SAIFR/
LineA, *Brazil*

Neutrino Physics

F. Sanchez, IFAE/BIST, *Spain*

Facilities in Latin America

R. Shellard, CBPF, *Brazil*

LHC Experiments and Latest Results

P. Sphicas, CERN and U. of Athens, *Greece*

Nationalities of students

- Passport

- Argentina 5
- Brazil 7
- Chile 2
- Colombia 6
- Costa Rica 2
- Cuba 4
- Denmark 1
- Ecuador 2
- Finland 1
- Germany 1
- Honduras 1
- Italy 1
- Mexico 27
- Norway 1
- Peru 5
- UK 4
- Uruguay 1
- Venezuela 4

- Institute

- Argentina 5
- Australia 1
- Brazil 7
- Chile 2
- Colombia 5
- Costa Rica 2
- Cuba 4
- Denmark 1
- Ecuador 2
- Finland 1
- Honduras 1
- Mexico 26
- Norway 1
- Peru 4
- Switzerland 2
- UK 6
- US 1
- Uruguay 1
- Venezuela 3

Mexican sponsors

- Sponsors
 - DF-USON
 - ICN-UNAM
 - FC-UCOL
 - IFM-UMSNH
 - FCFM-BUAP
 - Cinvestav
 - FC-UNAM
 - IF-UGTO
 - IF-UNAM
 - DPyC-SMF
 - MCTP
 - CONACyT
- Also acknowledge a lot of practical help and support from the local universities in Queretaro, both UNAM and UAQ