International Physics Masterclasses and Particle Physics Workshops
Professional Development Tools for High School Teachers in São Paulo

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SPRACE – USP
Overview

- Particle Physics in Brazilian Schools
- Objectives
- Outreach events promoted by the SPRACE team
- Methodology and some results

http://www.sprace.org.br
Brazilian official documents mention modern and contemporary physics among the topics to be taught.

São Paulo State included particle physics in the high school curriculum.

Yet most students finish high school without any contact with topics of modern physics!
Research Objectives

Evaluate contributions for the professional development of the attendee teachers

Identify strengths and weaknesses of both events
The International Physics Masterclasses

http://www.sprace.org.br

1996
2005

2006

2008

47 countries in 2016

http://cerncourier.com/cws/article/cern/55890
The International Physics Masterclasses

Lectures

Measurements

Video conference

http://www.sprace.org.br
Masterclasses Promoted by SPRACE

Two groups:
• Advanced (1 day)
• Beginners (2 days) + Teachers’ day

http://www.sprace.org.br/masterclass

- Demonstrations
  • Cloud chamber
  • Educational games and activities
  • Optics Demonstrations
- Guided visits
  • GridUnesp + SPRACE
  • Virtual visit to CMS
Particle Physics Workshops 2012 & 2015

- 35 teachers attended the 2nd edition
- Activities based on the official state curriculum for Physics;

Examples of Activities

http://www.sprace.org.br
Methodology

- Questionnaires
- Analysis
- Comparison with Scientific Literature

http://www.sprace.org.br
Questionnaires

Teachers (35+19)  Students (92)
Practices & Education  Knowledge

Contributions of the Events

Events Evaluation

http://www.sprace.org.br
Teachers’ Education

• “Teachers have difficulties related to their education, since few have learned about particle physics at the college” (T9)

• “I believe that this issue is not well addressed in teachers’ education, which makes it very difficult for this subject to be taught” (T12)

• “I am interested in learning a little more in order to feel confident in working [this topic] with students” (T14, about his previous expectations for attending Masterclasses)

http://www.sprace.org.br
Lack of Time and Materials

• “Materials for studying and teaching. The High School books do not cover these topics” (T14)

• “There are too many topics to address and the time is very short.” (T4)

• “Lack of time to cover an extensive curriculum. [...]” (T18)
“... (I) had no idea of so many possibilities to address the content that will be worked with the students” (T1)

“I learned a lot; besides learning about particle physics, I also discovered new methods and instructional experiences from other teachers. Students get excited” (T17)

“[the workshop] approaches the teacher to the reality of current researches, providing the elements to contextualize [particle physics]” (T9)
Contributions: Materials

• “... the material provided here, and some other teachers’ ideas, facilitated my life” (T10)

• “In 2015 I used the presentations and Masterclasses games to work this topic” (T10)

• “Many materials used in the workshop were important for the preparation of classes last year. [...]” (T3)
Analysis

Lack of materials

Outdated teachers’ education

Lack of time

Attending the events

• Increases teachers’ knowledge
• Makes teachers more confident
• Approaches teachers and researchers
• Provides quality materials

http://www.sprace.org.br
Conclusions

• Attending these events help to fill a gap in the education of some teachers, giving them more confidence.

• Both events provides good ideas and material to teach particle physics in high school.

• Teachers and students became more motivated to teach and study physics.

• Both events were largely approved by the attendees.
50,000 Posters to All High Schools

SPRACE Game v2

Higgs for the Elementary Schools

MasterClass: 250+ Students/year
New Projects

Webpage: Outreach Section

Facebook/Sprace

The Particle
Thank You!

http://www.sprace.org.br
Students Answers

• Masterclass 2016 included several lectures and workshops, which provided students with a new way to understand particle physics, beyond the atom, as we learned in high school. It was also possible to understand the operation of CERN's particle accelerator, the LHC, and the events that occur there. It is a unique opportunity that allows us to deepen knowledge and learn new things. (S90)

• Masterclass experience was incredibly rewarding, providing knowledge beyond the content that you can usually access, such as websites or books, besides answering my questions and letting me to know the everyday life of those who work with it. I recommend the experience! (S32)
Outlook

Efforts to include modern physics in Brazilian high school vs. Deficient teachers’ education

Outreach events promoted by SPRACE contribute as opportunities of continuous education and by providing resources and ideas for teaching particle physics.