Outreaching particle physics to Latin America: CEVALE2VE and the use of ATLAS open data

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On behalf of the ATLAS Collaboration and the CEVALE2VE community

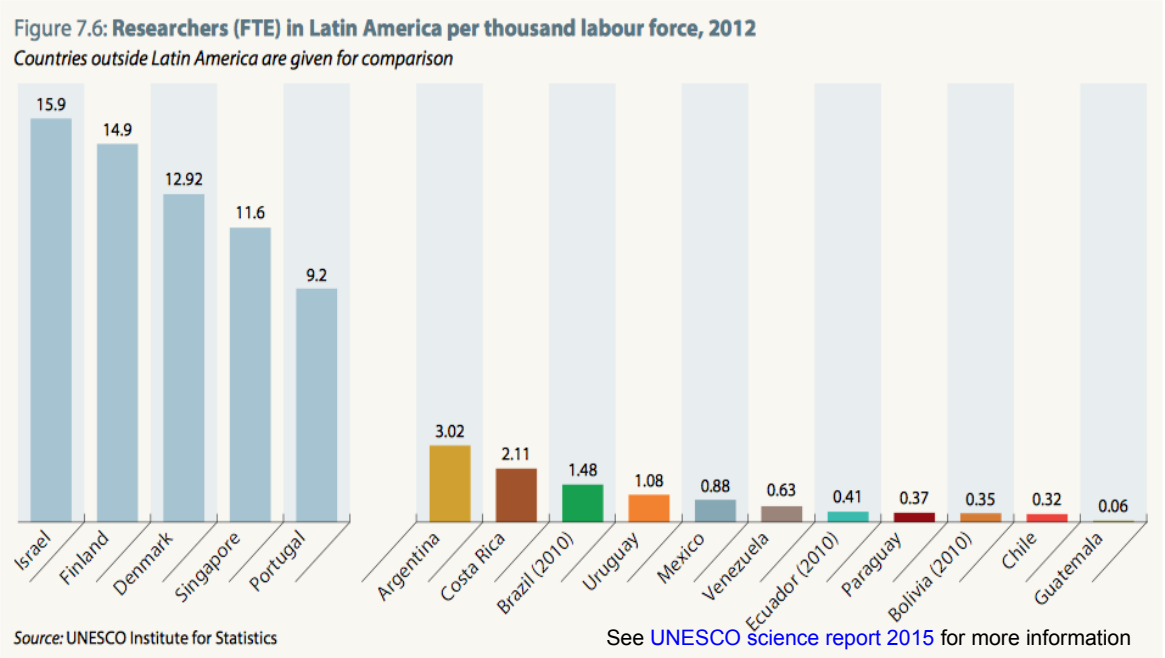
EPS Conference on High Energy Physics
Venice, Italy 5-12 July 2017

Can the next Einstein or Curie come from Latin America?

- **Why is outreaching in Latin America important?**
  - Promoting the growth and development of scientific culture and in the modernization of university education in the region
  - Economical growth directly related with scientific and cultural development

- **What are the main challenges in the region?**
  - Students are not aware of possible career paths in STEM
  - Brain drain
  - Isolation of researchers in the area and small funding for science
  - Political and economical crisis in some countries alter life in general (also at the university level)

Big potential in the region: well educated and motivated men and women looking for opportunities to study*



*Share of female researchers in LA in 2013 was 44.3%

What is CEVALE2VE?

- **Virtual Centre of Studies on High Energy Physics (CEVALE2VE, after the Spanish initials)** is a virtual research and learning community created in 2014 with the goal of promoting the scientific dissemination, education and research in the field of high energy physics (HEP) in Venezuela and Colombia.

- Main objectives:

  - **Education and outreach**: stimulate physics student's interest in HEP research
  - **Awareness of opportunities:** study opportunities in physics and possible career paths in HEP research
  - **Create networks:** in both directions!
  - **Modernization of the education and training:** through the use of e-learning tools
  - **Policy making and diplomacy:** e.g working towards formalizing the involvement of Venezuela institutions in HEP experiments

cevale2
Centro virtual de altos estudios de altas energías

Website: http://www.cevale2ve.org
@cevale2ve
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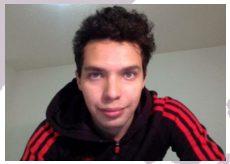
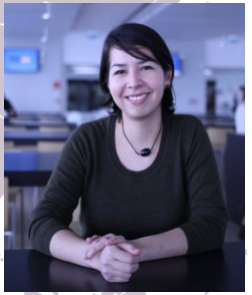
YouTube link

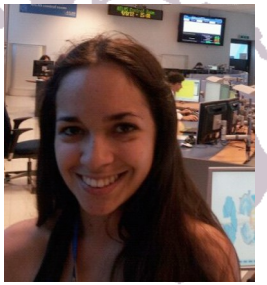
CEVALE2VE:
Members and participant institutions

We are 12 Venezuelan and Colombian researchers working in international collaborations: HEP experiments and data science, all with particle physics background



Core team + many friends/collaborators!





UNIVERSIDAD SIMÓN BOLÍVAR

Universidad Industrial de Santander

UNIVERSIDAD CENTRAL CARACAS - VENEZUELA

UAN UNIVERSIDAD ANTONIO NARIÑO

IVIC INSTITUTO VENEZOLANO DE INVESTIGACIONES CIENTÍFICAS

UNIVERSIDAD DE LOS ANDES VENEZUELA

So far 4 Venezuelan and 2 Colombian institutions participate in this project. Support from local professors!

Most of us working for European and North American universities linked to CERN (50% of the group are members of the ATLAS collaboration)

CEVALE2VE: how do we do this?

Education

- 3 editions of the postgraduate course "Introduction to Particle Physics"
  - More than 40 students attended classes
  - 20 accredited students from UCV, USB and UIS

- Supervision of physics master students and Modern Language undergrad thesis (interdisciplinarity!)

Outreach

- Public seminars

- Virtual visits to ATLAS control room
- International masterclasses in particle physics

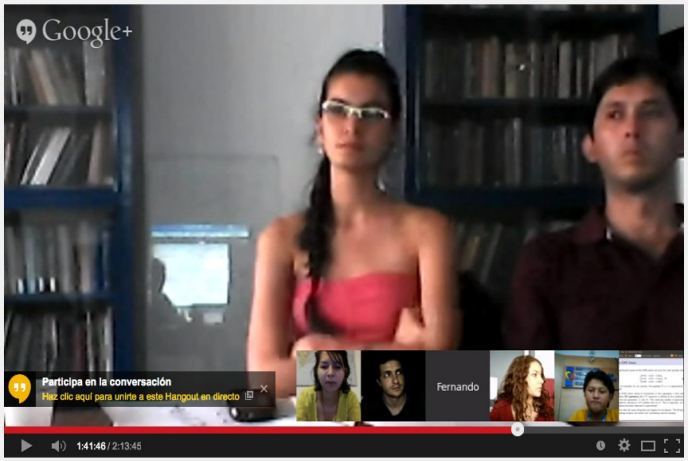
- Partnership with Abdus Salam International Centre for Theoretical Physics (ICTP)'s Physics Without Frontiers (PWF) program in 2016

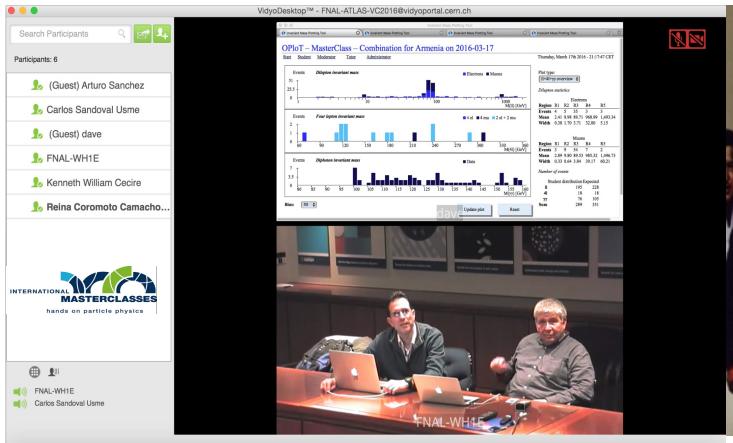
Policy

- Networking

- Communicate the projects and results to the public, diplomatic members and other governmental institutions

- Academy-industry links





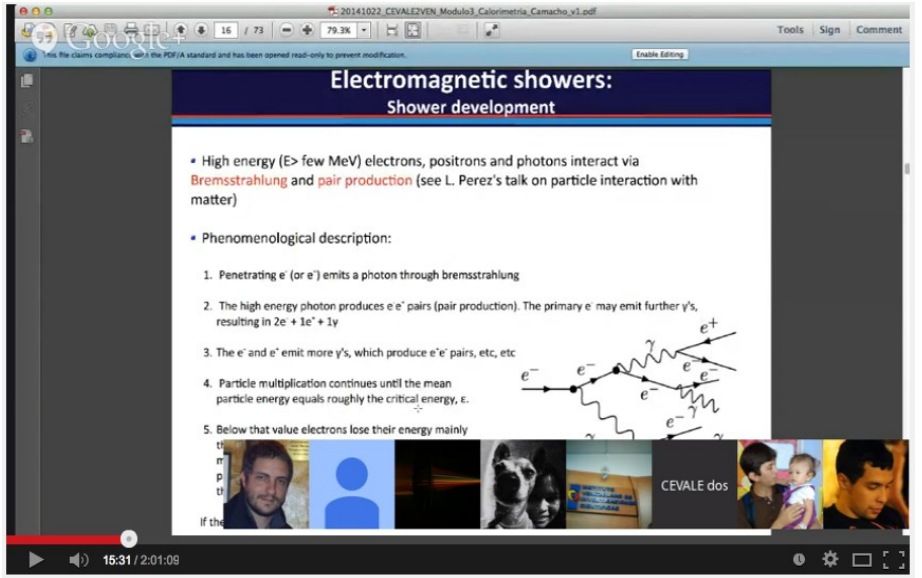
Education:
Postgraduate course “Introduction to Particle Physics”

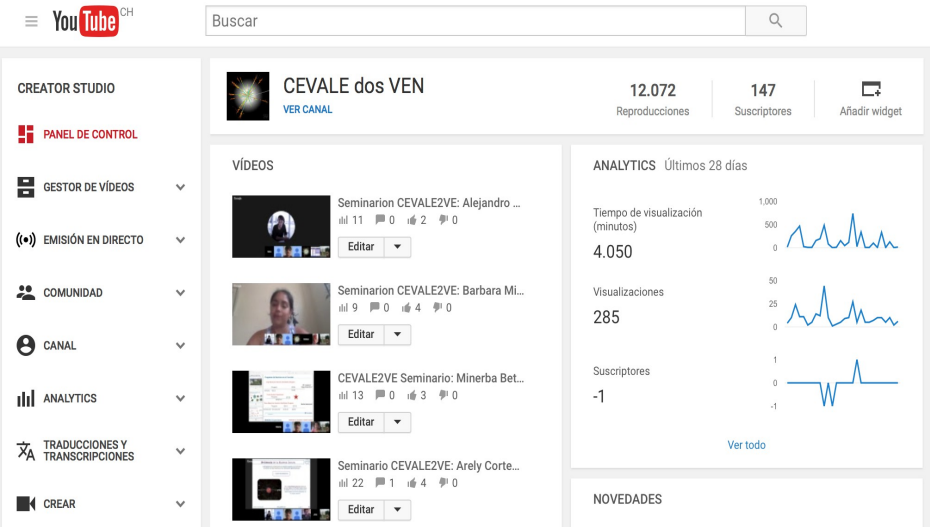
- A 60 hours virtual course developed for master and PhD students with no HEP background

- Structure of the course
  - Introduction to Standard Model (SM) and Beyond SM
  - Accelerator and particle detector principles
  - Introduction to statistics, data analysis and computer tools in HEP
  - A series of HEP seminars by invited speakers (role models and networking!)
  - Complemented with hands-on exercises using ATLAS open data

- The classes are possible using Google hangouts and transmitted and recorded in YouTube
  - >100 hours of online audio-visual content available for the public!

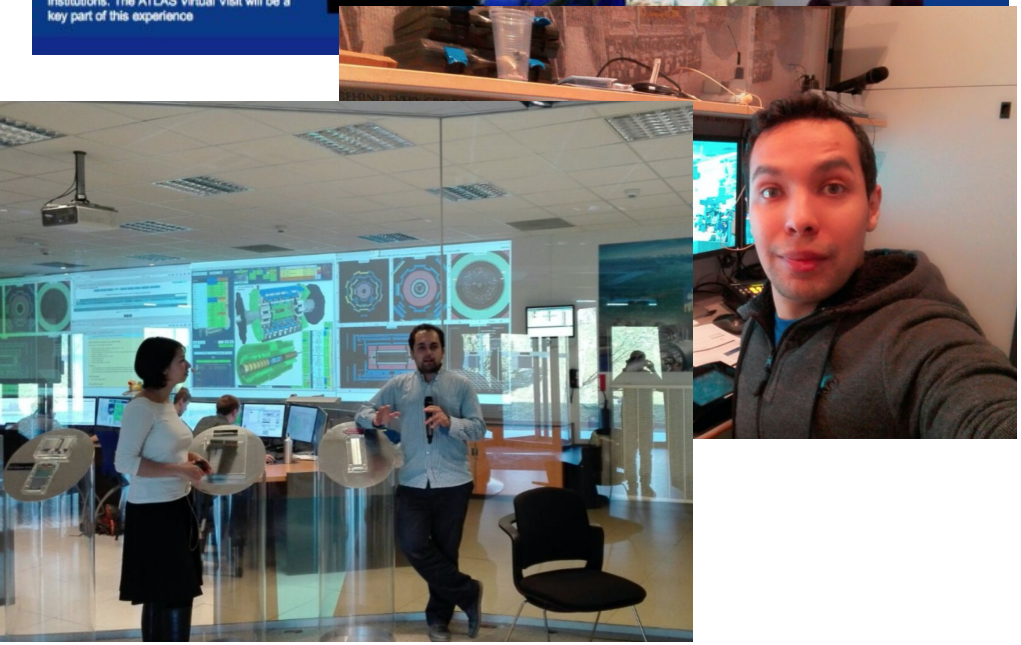
- Third successful edition of the course finished this week!





Outreach:
Virtual visits, public seminars, masterclasses, PWF

Virtual visits to the ATLAS control room and masterclasses

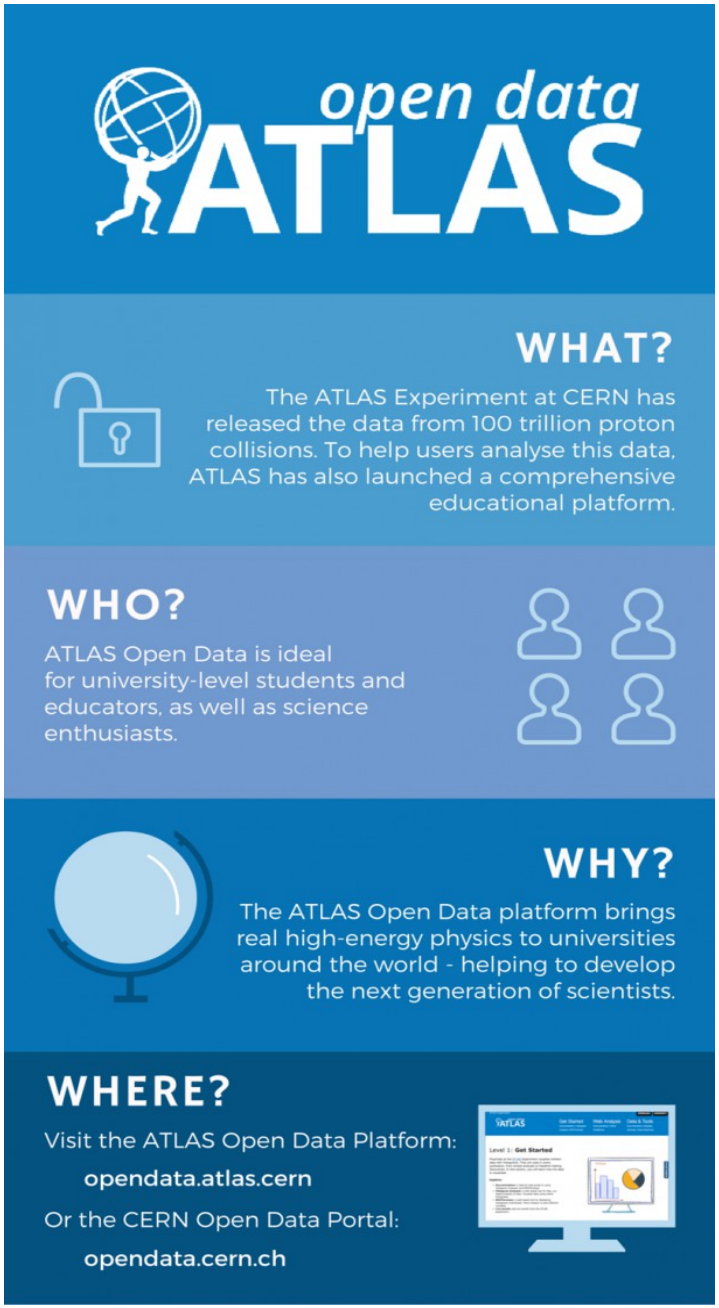


Taking the ICTP Physics Without Frontiers program to Venezuela and Colombia for the first time!

Tools used in CEVALE2VE projects

The release of the ATLAS open data in 2016 was key for the development of many of the activities in the group!

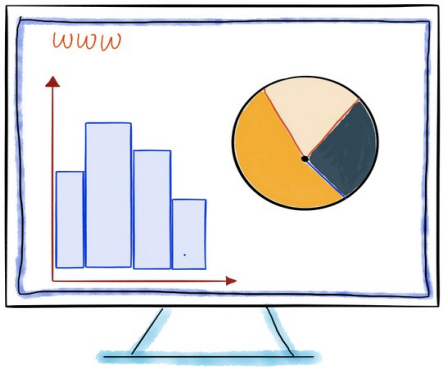
ATLAS Open Data



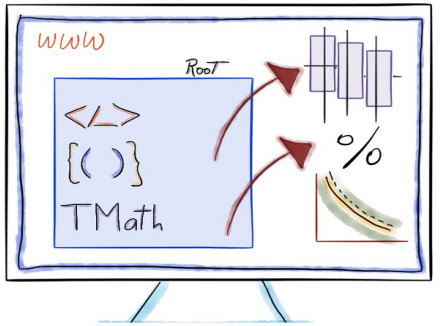
- World's first open release of 8 TeV data, gathered from the Large Hadron Collider in 2012!

- Different data complexity levels provided:

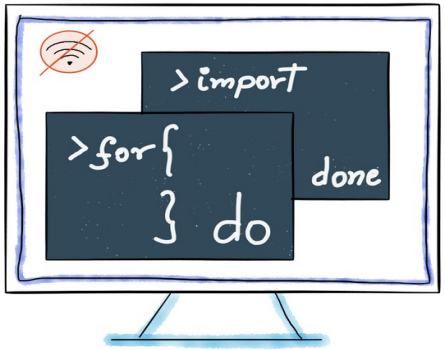
Level 1: Web visualization



Level 2: Web analysis using Jupyter notebooks and ROOT



Level 3: Complex analysis using python and C++



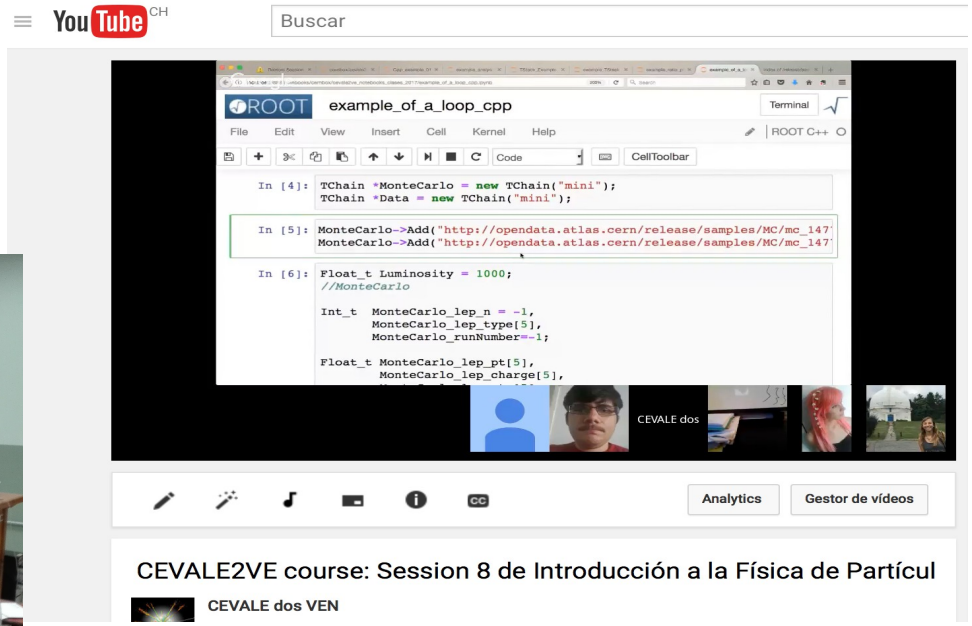
Data and tools are available at http://opendata.atlas.cern/
Small size, USB sticks size (under 11 GB)!

CEVALE2VE and ATLAS Open Data

CEVALE2VE ATLAS members helped testing the ATLAS Open Data in its earlier versions, before release

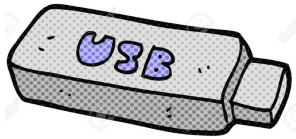
The first time we used the official released ATLAS Open Data was last year during the PWF activities!

Students used ATLAS Open Data during the 3rd version of the postgraduate course. Help improving their computer skills!



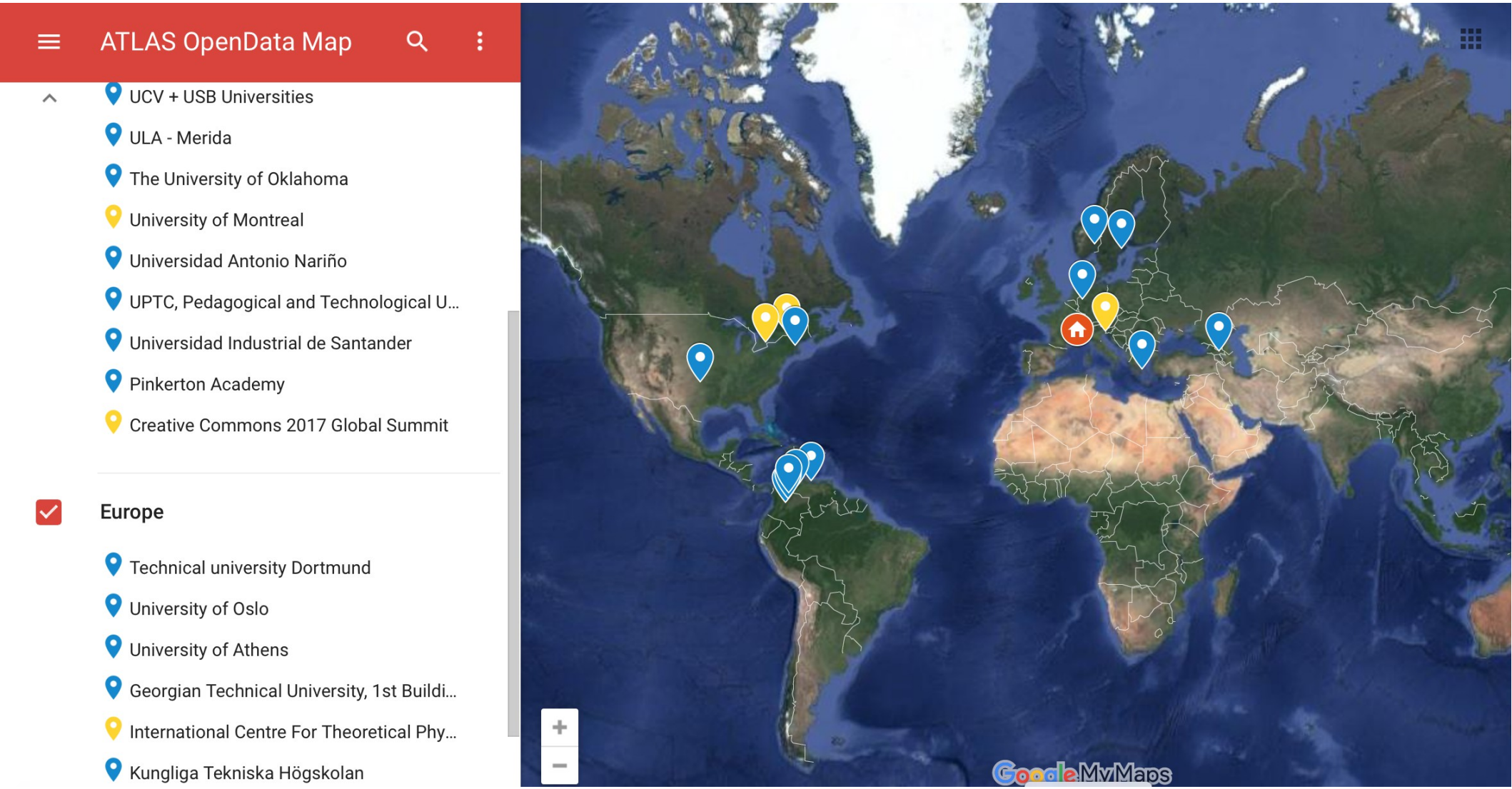
First master thesis using ATLAS Open Data

PERSPECTIVAS Y EVALUACIÓN DE PRODUCCIÓN DE MATERIA OSCURA EN ASOCIACIÓN CON UN QUARK LIVIANO, UN QUARK PESADO (QUARK b) O UN BOSÓN ELECTRO DÉBIL EN COLISIONADORES DE PARTÍCULAS A ENERGÍAS DE COLISIÓN DE $\sqrt{s} = 8$ TeV



Very useful to have a compact version of data and tools since students work sometimes in a little-to-no internet connection

Other ATLAS Open Data users



http://opendata.atlas.cern/externals/

Are you interested? Contact us!
atlas.outreach.data.tools@cern.ch

Summary and conclusions

- CEVALE2VE have implemented several HEP educational and outreach projects in Venezuela and Colombia in the last few years

- The ATLAS Open Data project has been a key element in those activities!

- There have been challenges in this process:

  - Poor internet bandwidth and service quality
  - Student-student interactions not as active as desired (local institutional barriers)
  - Challenging instructor-student interactions (the partnership with Physics Without Frontiers program was useful to improve this)
  - Student computer skills did not match the initial demands (set of tools provided by the ATLAS Open Data project very useful in this case)

- But the outcomes are invaluable: motivation+ opportunities provided to our students (some of who follow a career in HEP now)

- Hopefully we will reach more universities in the region, offer more opportunities to the students (internships on site, thesis projects, etc).

ADDITIONAL MATERIAL

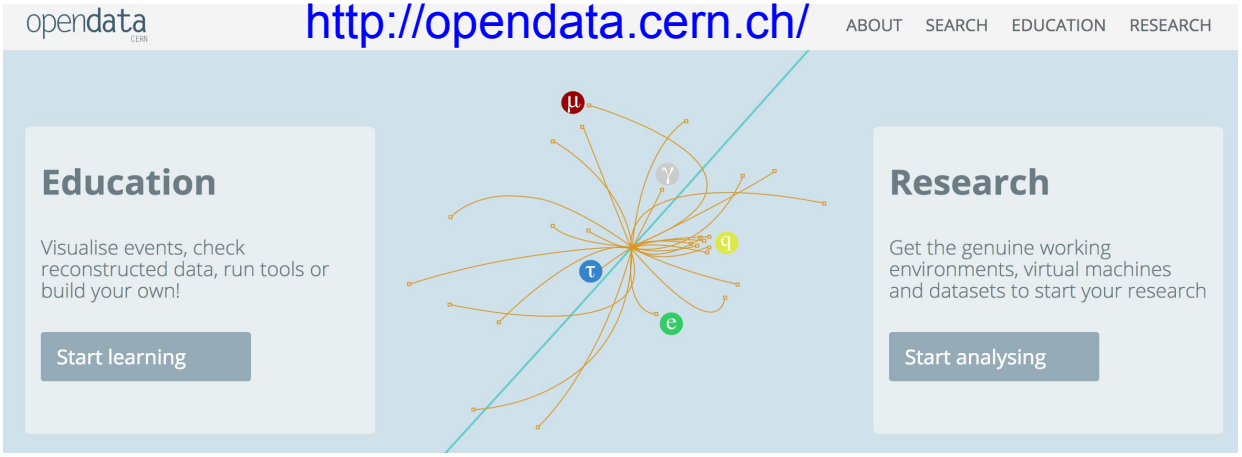
CEVALE2VE:
This would not have been possible without the support from...

- Our collaborators in Venezuela, Colombia and France
  - Alejandra Melfo (ULA)
  - Héctor Hernández (ULA)
  - Fernando Febres Cordero (USB/Freiburg University)
  - Jorge Stephany (USB)
  - Jorge Ovalle (USB)
  - José Antonio Lopez (UCV)
  - Claudio Mendoza (IVIC)
  - Luis Alberto Nuñez (UIS)
  - Carlos Sandoval (Universidad Antonio Narino)
  - Jose Ocariz (LPNHE-Universite Paris Diderot 7)
- Also to the ATLAS outreach group and the ICTP's Physics Without Frontiers program
- To the seminar speakers
- And of course to our host universities/institutions/supervisors!

Website: http://www.cevale2ve.org
@cevale2ve
/cevale2ve
YouTube link

What is open data and why is it important?

- **What?**
  - Open data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control.
  - In November 2014, CERN launched its Open Data Portal where data from real collisions produced at the Large Hadron Collider (LHC) experiments are made available to the public



- **Why?**
  - Education
  - Outreach
  - Data and citizen science

- **Challenges**
  - How much data to make public and when?
  - Data complexity: it is not the same data for outreach or for science
  - Availability of software and analysis tools

CEVALE2VE: Some numbers

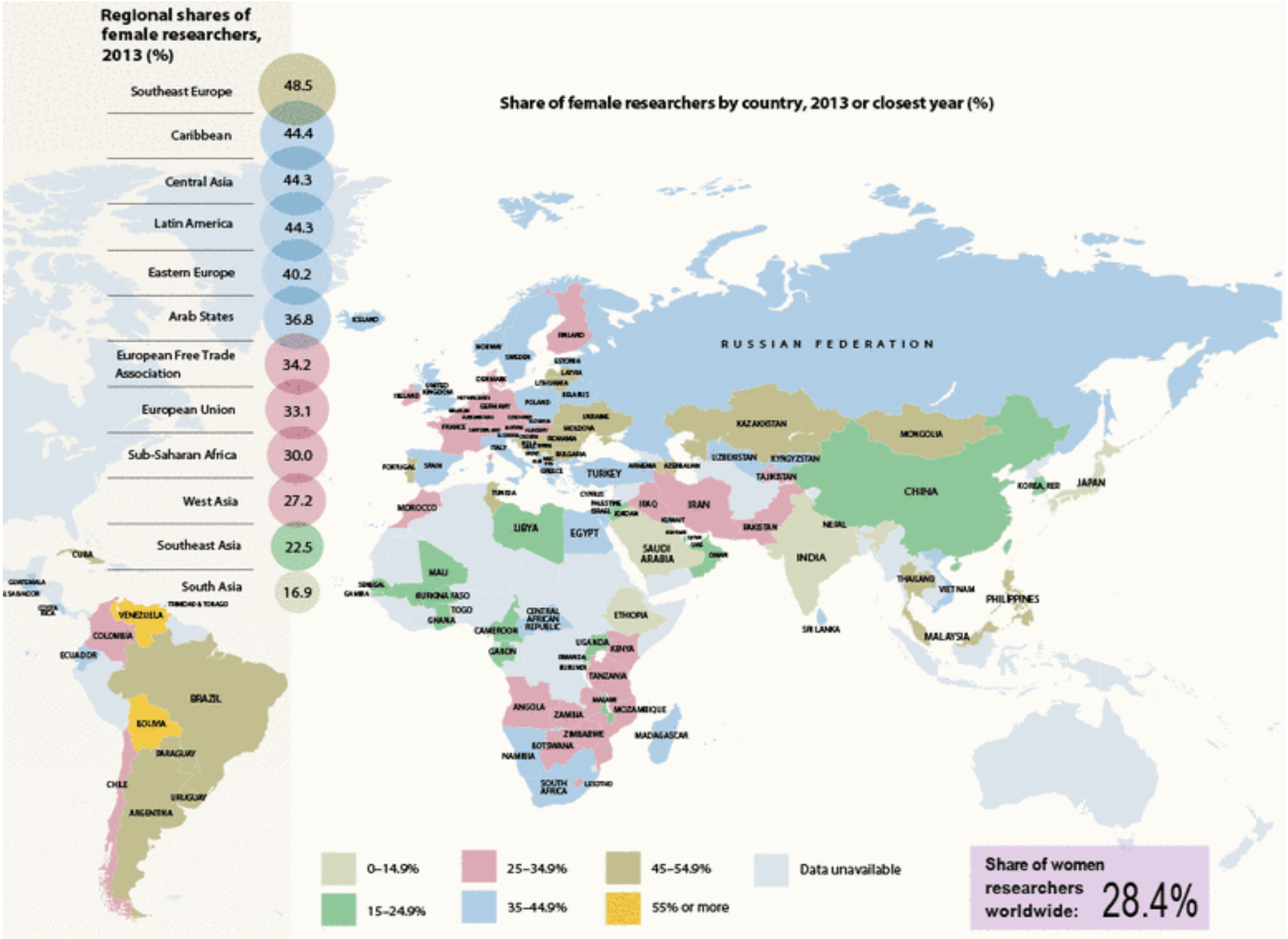
Edition	Student type	Undergraduate	Postgraduate
September 2014 – February 2015	Formal	8	3
	Informal	4	0
March 2016 – July 2016	Formal	8	4
	Informal	1	4

Table 1. Number of students in the first and second edition of the "Introduction to Particle Physics" course. Only informal students who participated in the evaluation and final projects are taken into account.

Edition	HEP international schools	Master in HEP	PhD in HEP
Sept 2014–Feb 2015	5	2	1
Mar 2016–Jul 2016	2	2	0

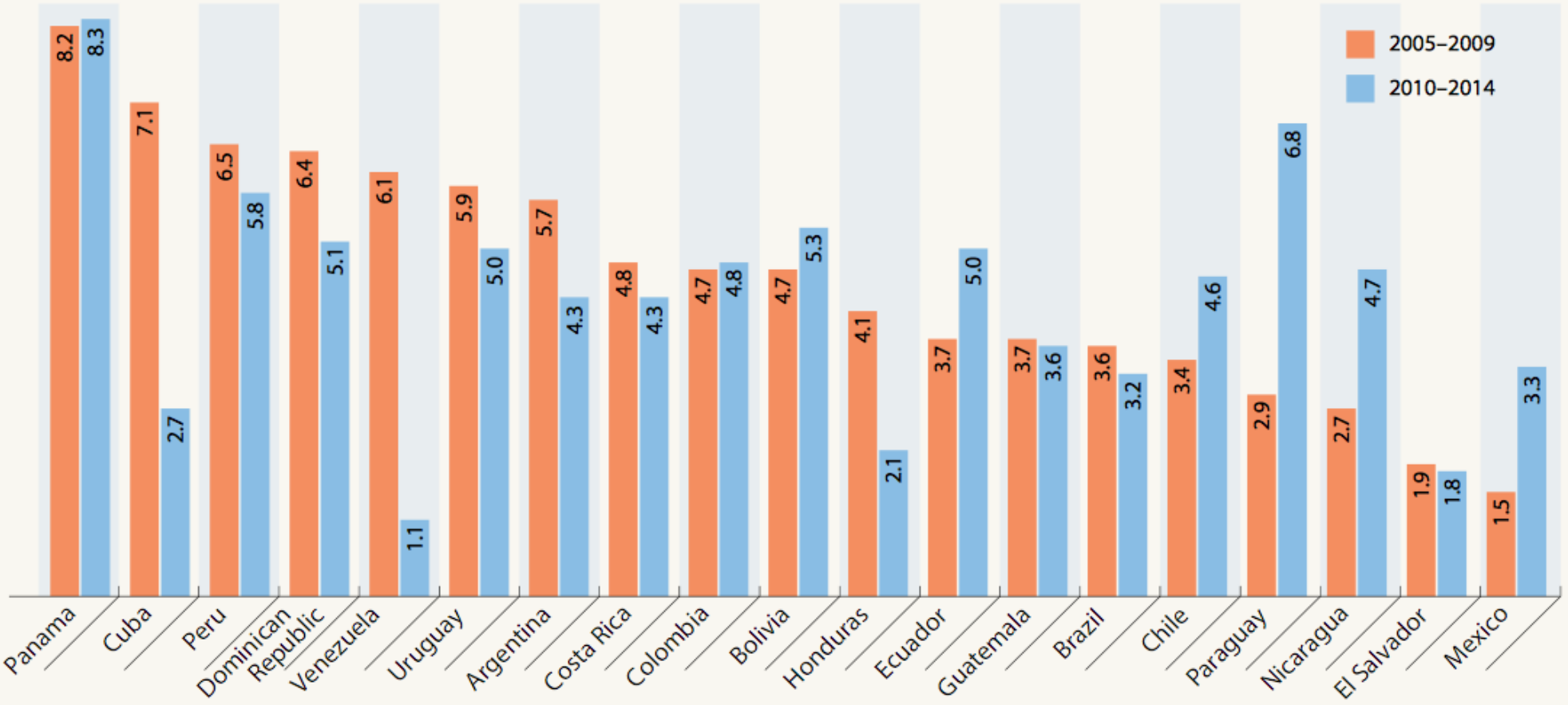
Table 2. Number of former students (formal and informal) that have participated in international HEP schools and/or are following master/PhD programs in HEP related fields.

Share of females researchers by country (2013)



Trends in GDP growth in Latin America 2005-2009 and 2010-2014

Figure 7.1: **Trends in GDP growth in Latin America, 2005–2009 and 2010–2014**

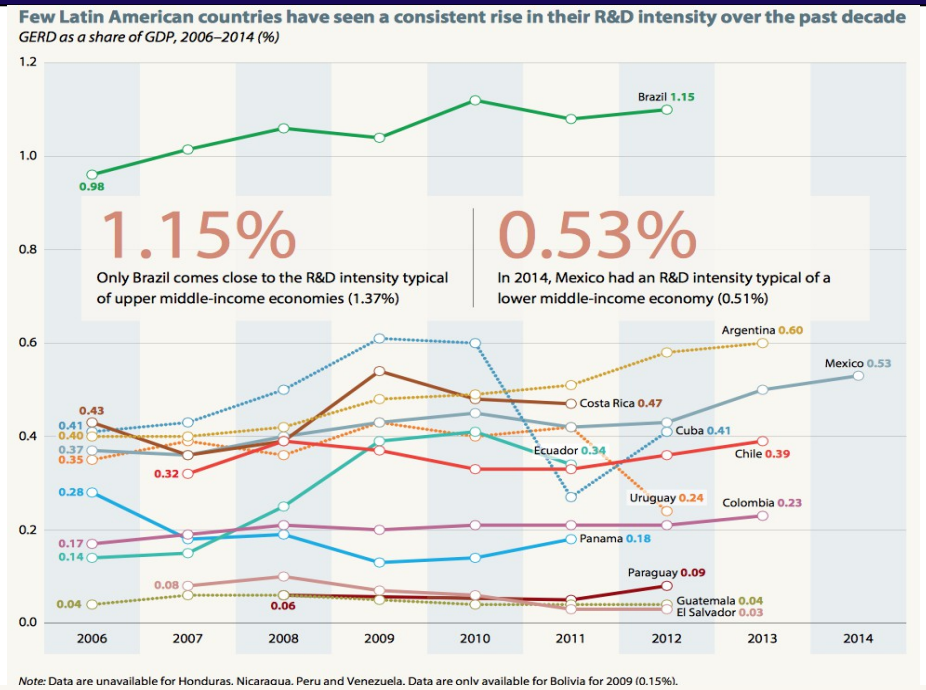


Note: Data for Cuba cover 2005–2009 and 2010–2013.

Source: World Bank's World Development Indicators, September 2015

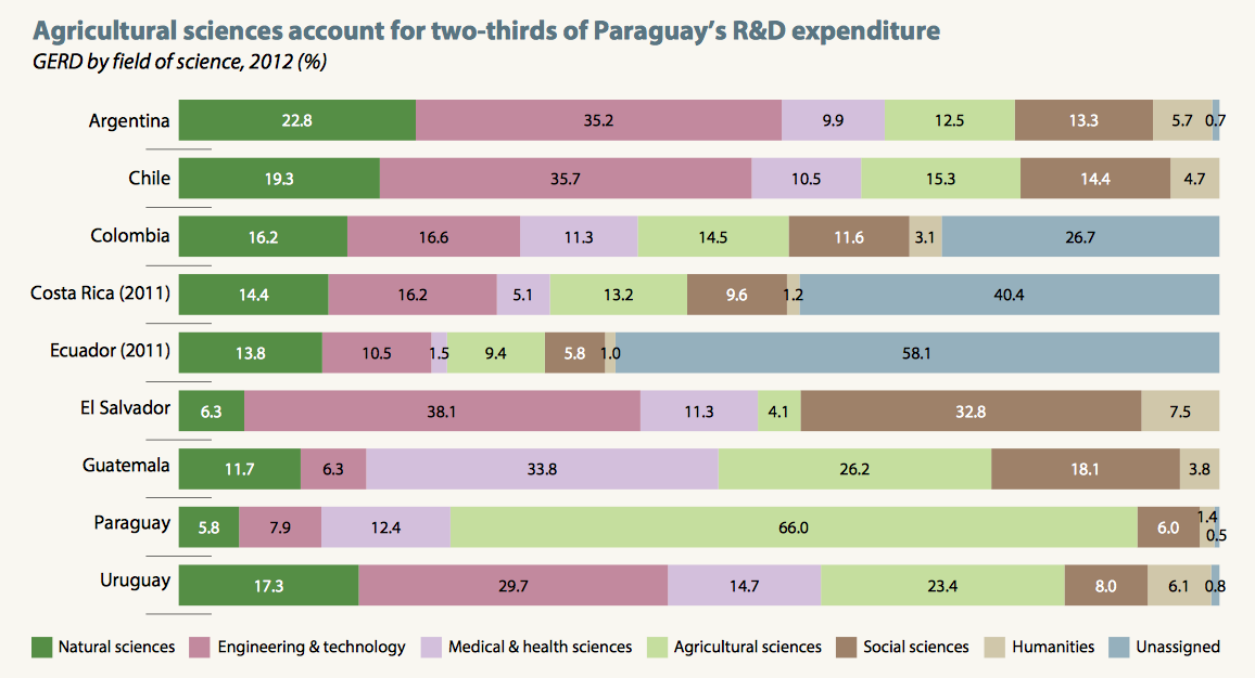
See UNESCO science report 2015 for more information

Trends in GERD in Latin America and the Caribbean 2006-2014 (%)

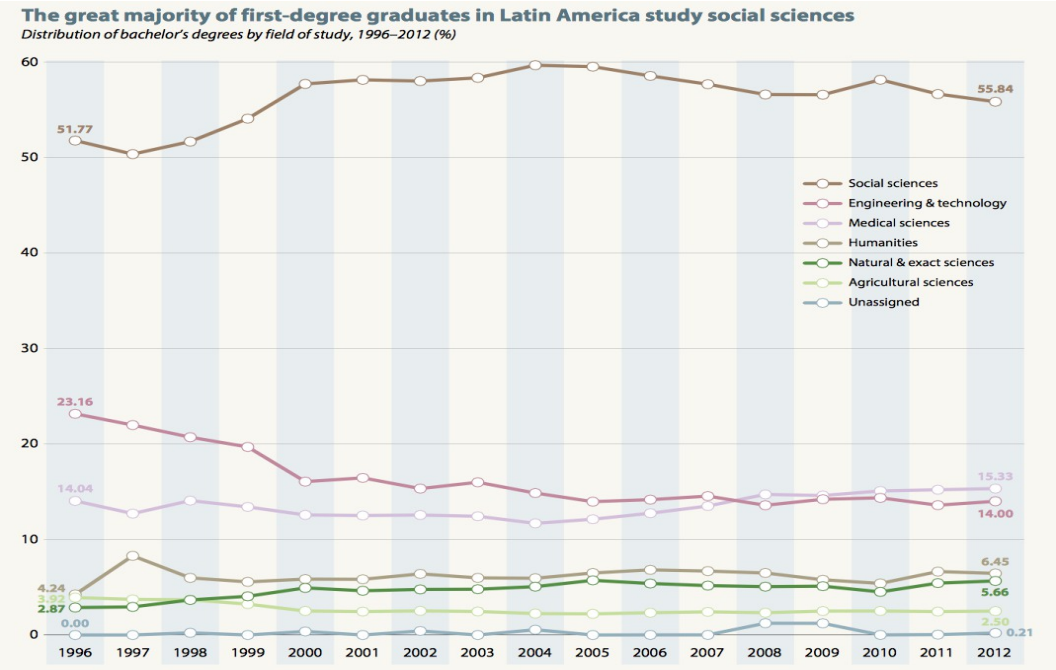


Source: RICYT database and UNESCO Institute for Statistics, July 2015; Brazilian Ministry of Science, Technology and Innovation.

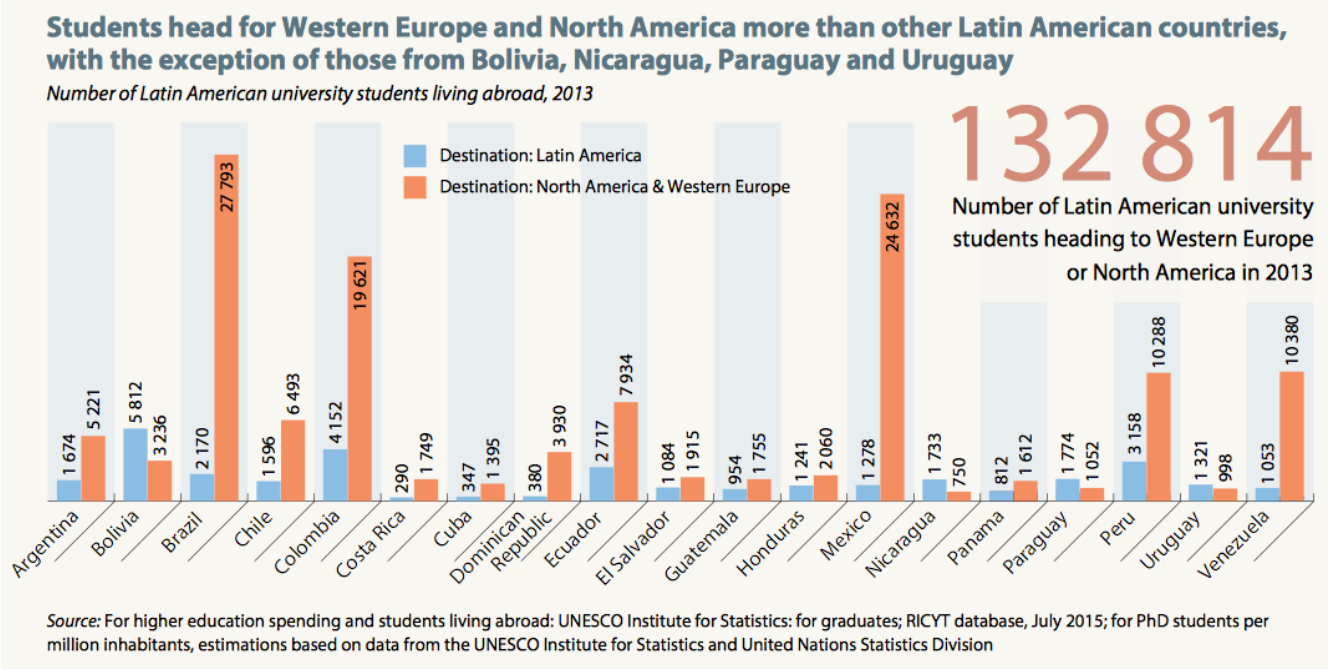
See UNESCO science report 2015 for more information



Trends in higher education in Latin America, 1996-2013



See UNESCO science report 2015 for more information



Source: For higher education spending and students living abroad: UNESCO Institute for Statistics: for graduates; RICYT database, July 2015; for PhD students per million inhabitants, estimations based on data from the UNESCO Institute for Statistics and United Nations Statistics Division