

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?

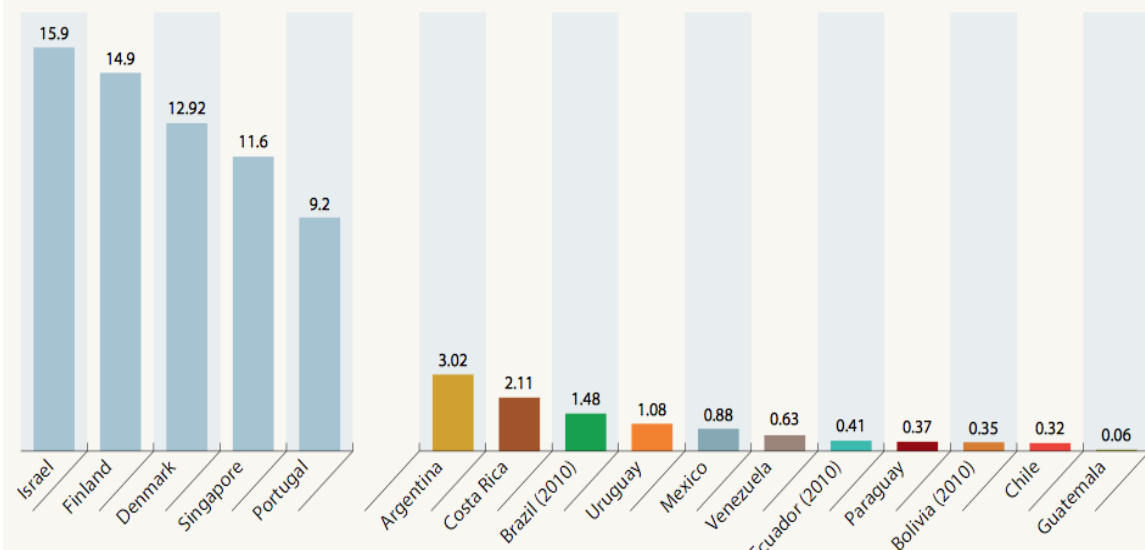
- Students are not aware of possible career paths in STEM
- Brain drain
- Isolation of researchers in the area and small funding for science
- Political and economical crisis in some countries alter life in general (also at the university level)

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%

Figure 7.6: Researchers (FTE) in Latin America per thousand labour force, 2012

Countries outside Latin America are given for comparison



Source: UNESCO Institute for Statistics

See [UNESCO science report 2015](#) for more information

What is CEVALE2VE?

- **Virtual Centre of Studies on High Energy Physics of Venezuela (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



Website: <http://www.cevale2ve.org>



@cevale2ve



/cevale2ve

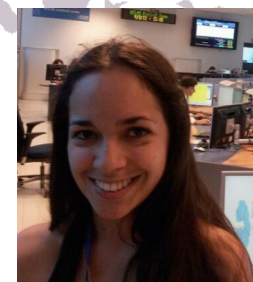
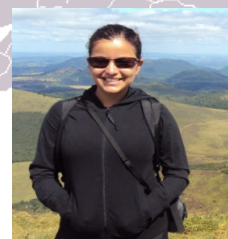
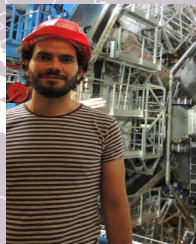
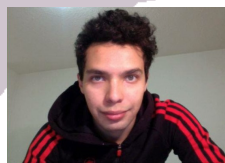


YouTube link

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!*



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

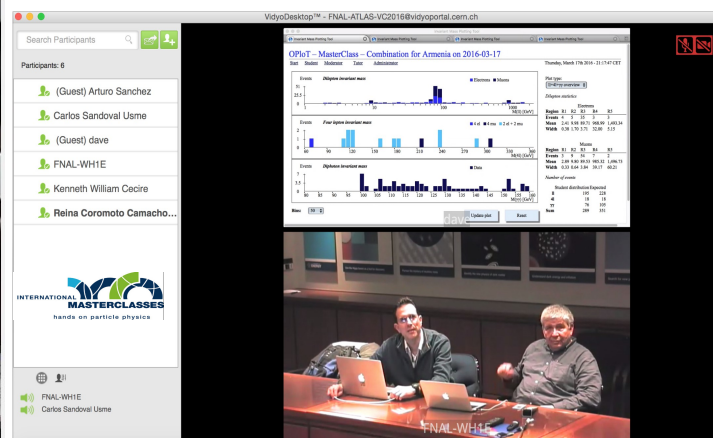
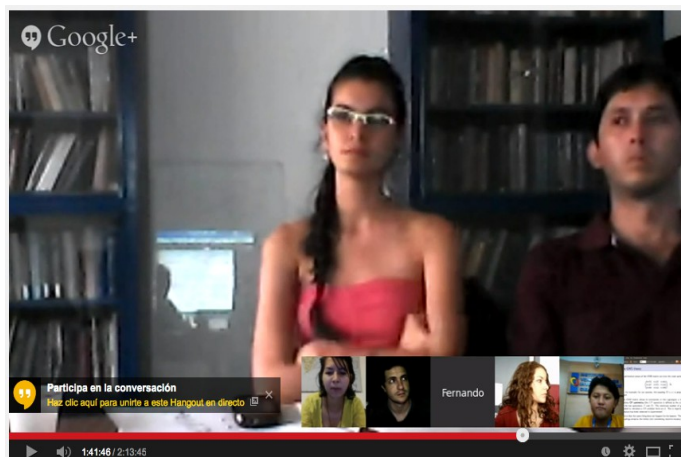
- 3 editions of the **postgraduate course** "Introduction to Particle Physics"
 - More than 40 students attended classes
 - 20 accredited students from UCV, USB and UIS
- Supervision of physics master students and Modern Language undergrad thesis (interdisciplinarity!)

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!

The screenshot shows a PDF document titled "Electromagnetic showers: Shower development". The text describes the interaction of high-energy electrons and positrons, leading to pair production and bremsstrahlung. A diagram illustrates the shower development process, showing an electron emitting a photon, which then produces an electron-positron pair, and so on. The diagram includes labels for e^- , e^+ , and γ .

The screenshot shows the YouTube channel page for "CEVALE dos VEN". The channel has 12,072 reproducciones and 147 suscriptores. The page displays a list of videos, including "Seminario CEVALE2VE: Alejandro...", "Seminario CEVALE2VE: Barbara Mi...", "CEVALE2VE Seminario: Minerba Bet...", and "Seminario CEVALE2VE: Arey Cort...". The analytics section shows 4,050 visualizaciones and 285 suscriptores in the last 28 days.

Outreach:

Virtual visits, public seminars, masterclasses, PWF

Virtual visits to the ATLAS control room and masterclasses



ATLAS EXPERIMENT VIRTUAL VISITS

Virtual Center of High Energy Studies, Venezuela-Colombia

Colombia Venezuela

05 June 2014 - 21:00 CET

The Virtual Center of High Energy Studies (Centro Virtual de Altos Estudios en Altas Energías CeVALE2) is a Colombian-Venezuelan initiative to promote the research on particle physics in the region. It groups four Colombian universities and four Venezuelan institutions. The two main objectives of CeVALE2 are the development and transfer of collaborative and organizational platforms in the area and the creation of opportunities for the dissemination of particle physics such as courses and seminars. A cycle of conferences has been organized during June 2014 for teachers and students from the member institutions. The ATLAS Virtual Visit will be a key part of this experience.

Acelerador de partículas

¿Qué acelerar? Partículas cargadas eléctricamente

Motor Cargas eléctricas

Dirección y control Cargas magnéticas

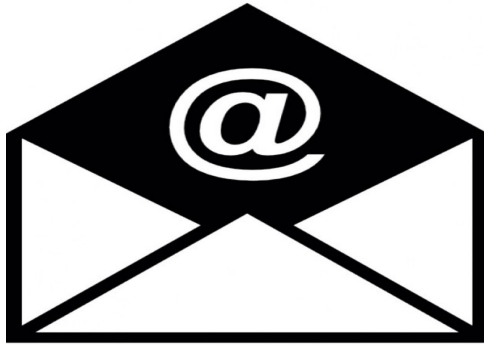
Por qué vamos acelerando? Colisiones a altas energías o interacción para crear nuevas o descubrir más partículas.



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



Tools used in CEVALE2VE projects




Google Hangouts



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




WHAT?

The ATLAS Experiment at CERN has released the data from 100 trillion proton collisions. To help users analyse this data, ATLAS has also launched a comprehensive educational platform.




WHO?

ATLAS Open Data is ideal for university-level students and educators, as well as science enthusiasts.




WHY?

The ATLAS Open Data platform brings real high-energy physics to universities around the world - helping to develop the next generation of scientists.



WHERE?

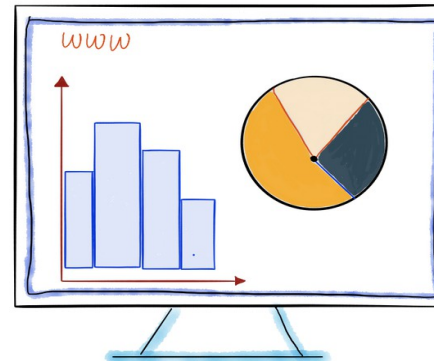
Visit the ATLAS Open Data Platform:
opendata.atlas.cern
Or the CERN Open Data Portal:
opendata.cern.ch



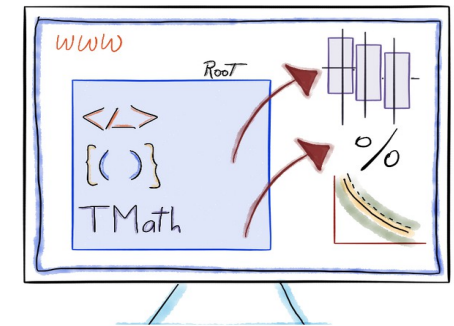
- World's first open release of 8 TeV data, gathered from the Large Hadron Collider in 2012!

- Different data complexity levels provided:

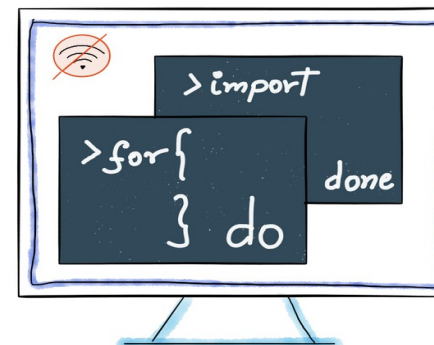
Level 1: Web visualization



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

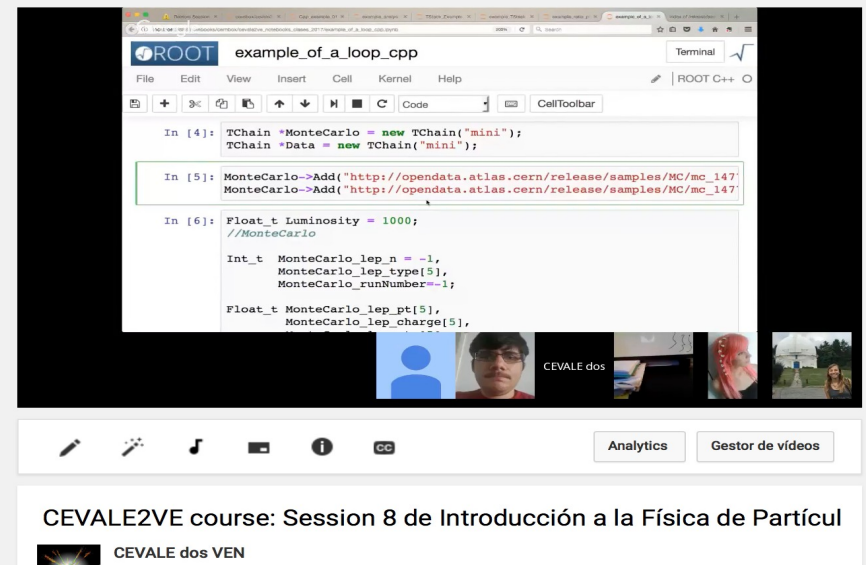
CEVALE2VE ATLAS members helped testing the ATLAS Open Data in its earlier versions, before release

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!

YouTube

Buscar



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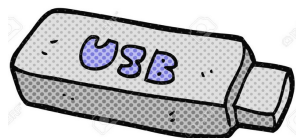
example_of_a_loop_cpp
ROOT C++
File Edit View Insert Cell Kernel Help
+ - 9c | < > | C Code CellToolbar
In [4]: TChain *MonteCarlo = new TChain("mini");
        TChain *Data = new TChain("mini");
In [5]: MonteCarlo->Add("http://opendata.atlas.cern/release/samples/MC/mc_147");
        MonteCarlo->Add("http://opendata.atlas.cern/release/samples/MC/mc_147");
In [6]: Float_t Luminosity = 1000;
        //MonteCarlo
Int_t MonteCarlo_lep_n = -1,
MonteCarlo_lep_type[5],
MonteCarlo_runNumber=-1;
Float_t MonteCarlo_lep_pt[5],
MonteCarlo_lep_charge[5],
    
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CEVALE2VE course: Session 8 de Introducción a la Física de Partículas

CEVALE dos VEN

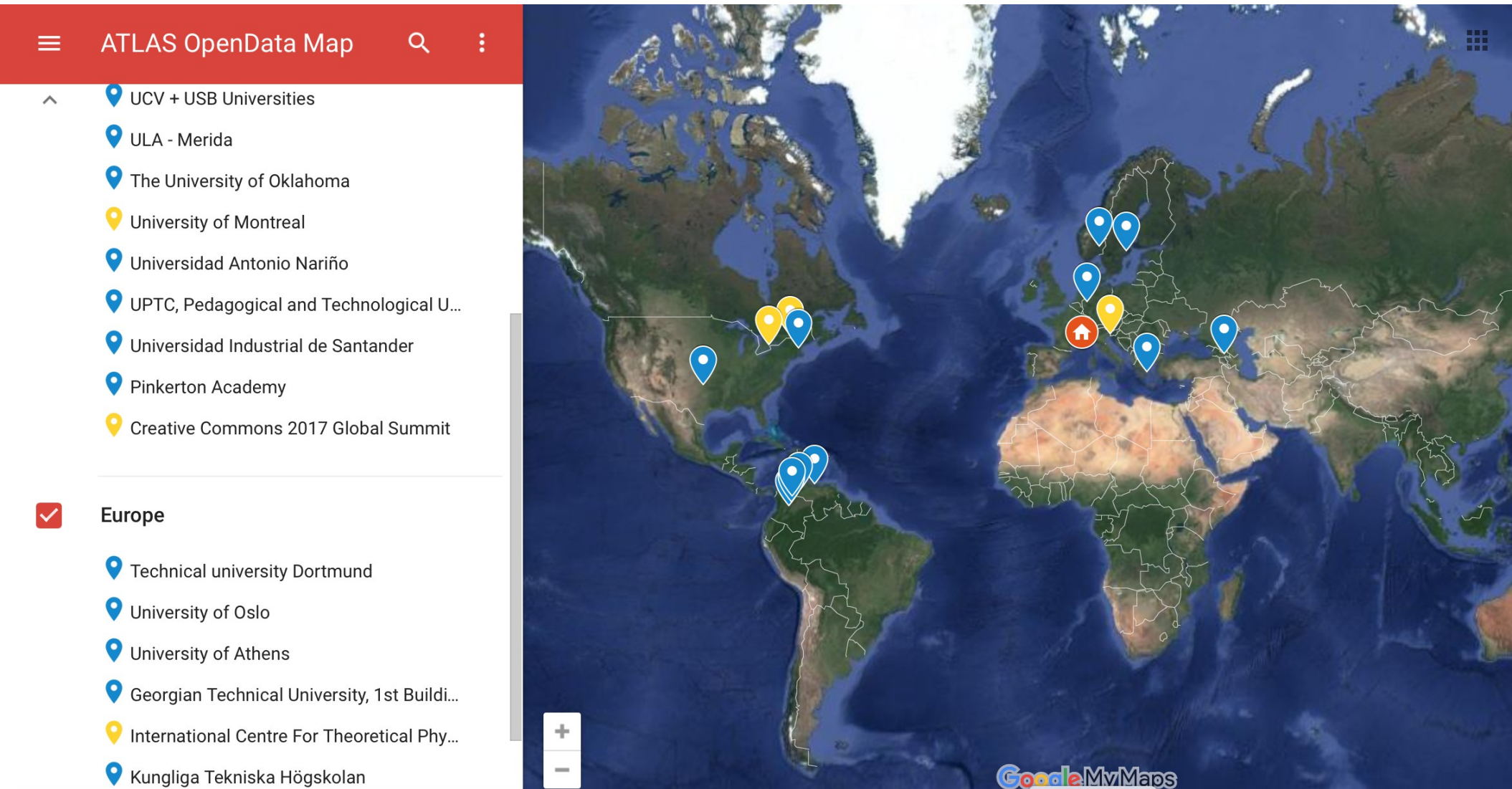
First master thesis using ATLAS Open Data

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
 $\sqrt{s} = 8 \text{ TeV}$



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



The screenshot displays the 'ATLAS OpenData Map' interface. On the left, a sidebar lists various users and institutions, categorized by region. The 'Europe' category is currently selected, indicated by a red checkmark. The main area shows a satellite-style map of the world with several location pins. A red home button is visible on the map. The Google My Maps logo is in the bottom right corner of the map area.

ATLAS OpenData Map

- UCV + USB Universities
- ULA - Merida
- The University of Oklahoma
- University of Montreal
- Universidad Antonio Nariño
- UPTC, Pedagogical and Technological U...
- Universidad Industrial de Santander
- Pinkerton Academy
- Creative Commons 2017 Global Summit

Europe

- Technical university Dortmund
- University of Oslo
- University of Athens
- Georgian Technical University, 1st Buildi...
- International Centre For Theoretical Phy...
- Kungliga Tekniska Högskolan

<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

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



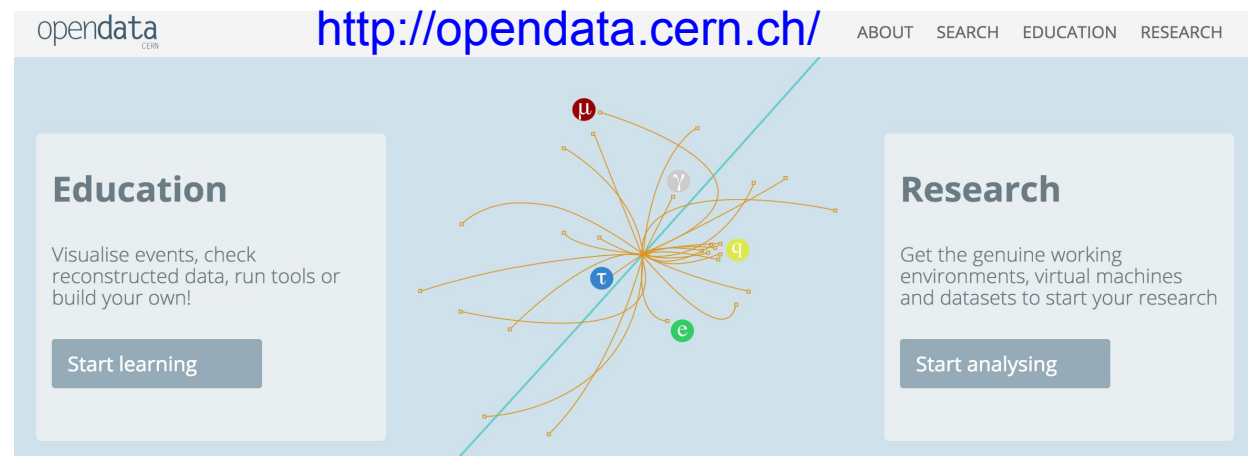
What is open data and why is it important?

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



The screenshot shows the CERN Open Data Portal homepage. At the top left, it says "opendata CERN". To the right is the URL "http://opendata.cern.ch/". Further right are navigation links: "ABOUT", "SEARCH", "EDUCATION", and "RESEARCH". The main content area is divided into three sections. On the left is the "Education" section with the text "Visualise events, check reconstructed data, run tools or build your own!" and a "Start learning" button. In the center is a network diagram with a central point and many lines radiating outwards, some ending in colored circles labeled with Greek letters like μ , γ , q , τ , and e . On the right is the "Research" section with the text "Get the genuine working environments, virtual machines and datasets to start your research" and a "Start analysing" button.

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

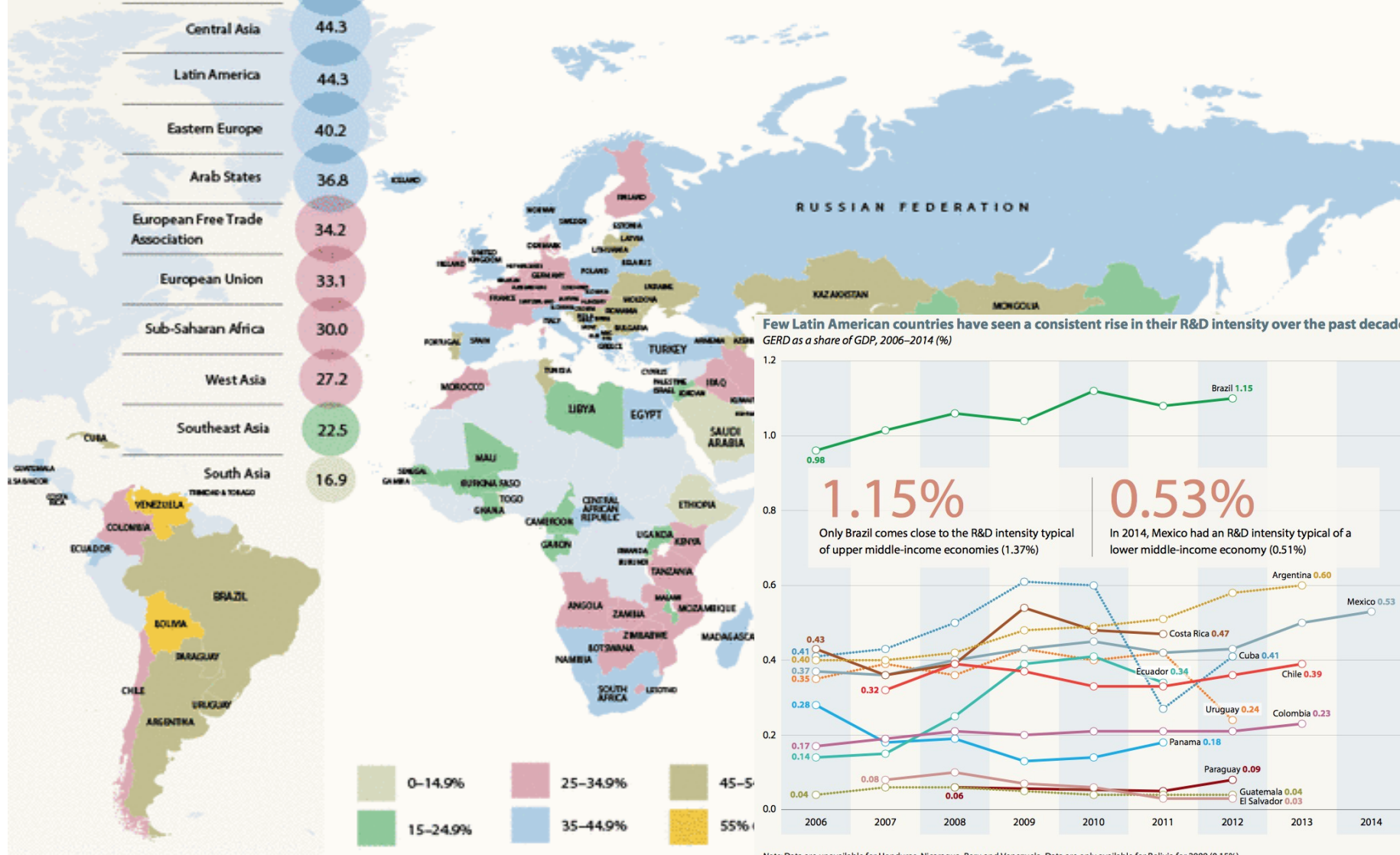
Table 2. Number of former students (formal and informal) that have participated in international HEP schools and/or are following master/PhD programs in HEP related fields.

Share of females researchers by country (2013)

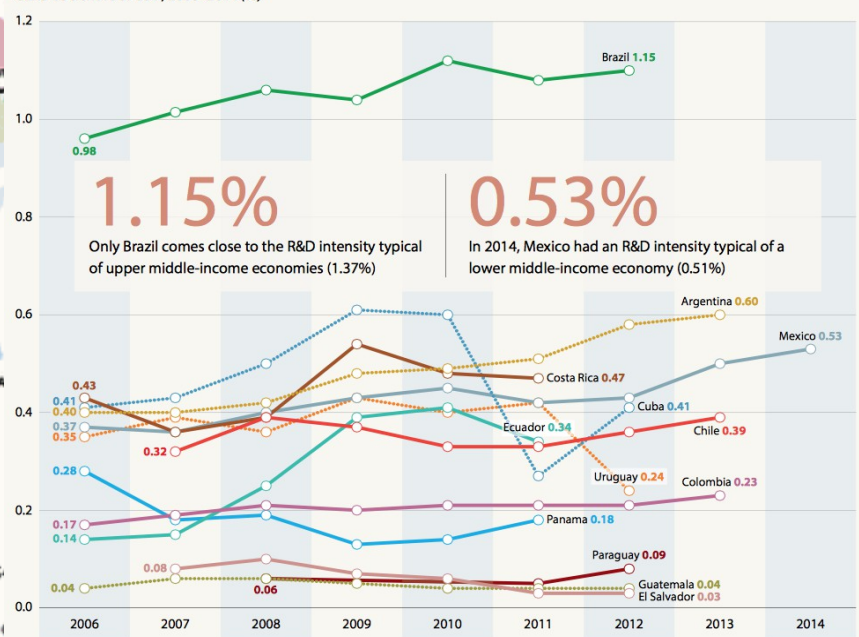
Regional shares of female researchers, 2013 (%)

Southeast Europe	48.5
Caribbean	44.4
Central Asia	44.3
Latin America	44.3
Eastern Europe	40.2
Arab States	36.8
European Free Trade Association	34.2
European Union	33.1
Sub-Saharan Africa	30.0
West Asia	27.2
Southeast Asia	22.5
South Asia	16.9

Share of female researchers by country, 2013 or closest year (%)



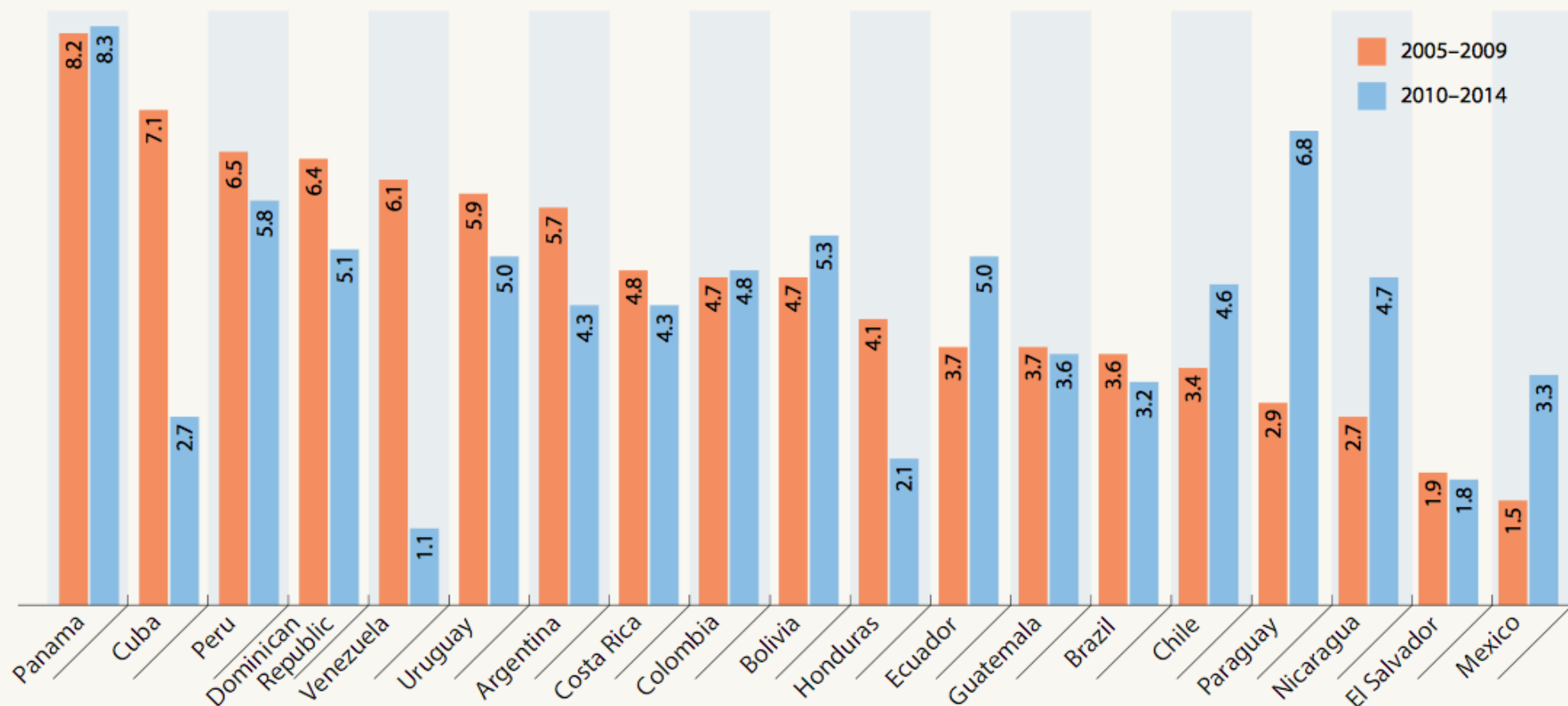
Few Latin American countries have seen a consistent rise in their R&D intensity over the past decade GERD as a share of GDP, 2006-2014 (%)



Note: Data are unavailable for Honduras, Nicaragua, Peru and Venezuela. Data are only available for Bolivia for 2009 (0.15%).

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



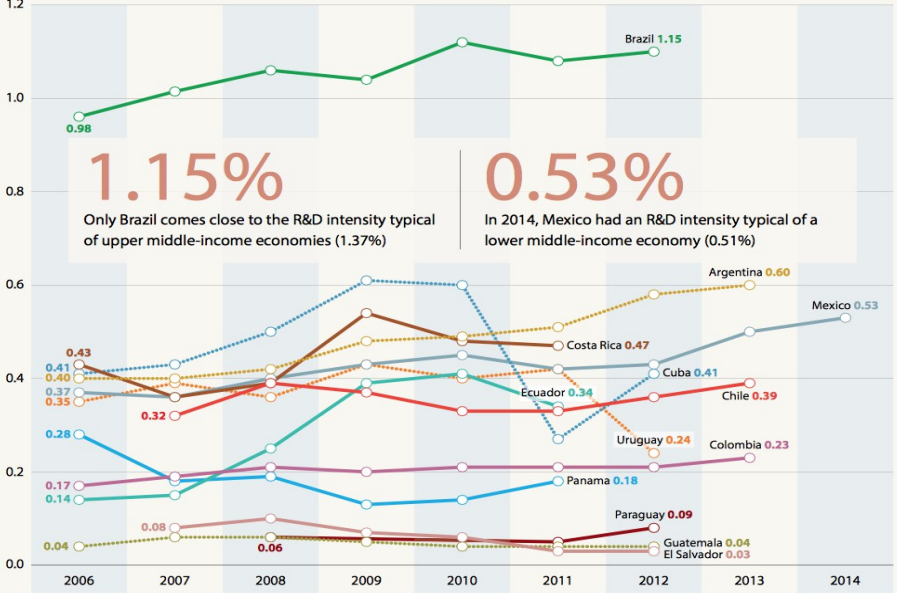
Note: Data for Cuba cover 2005–2009 and 2010–2013.

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 (%)

Few Latin American countries have seen a consistent rise in their R&D intensity over the past decade
GERD as a share of GDP, 2006-2014 (%)

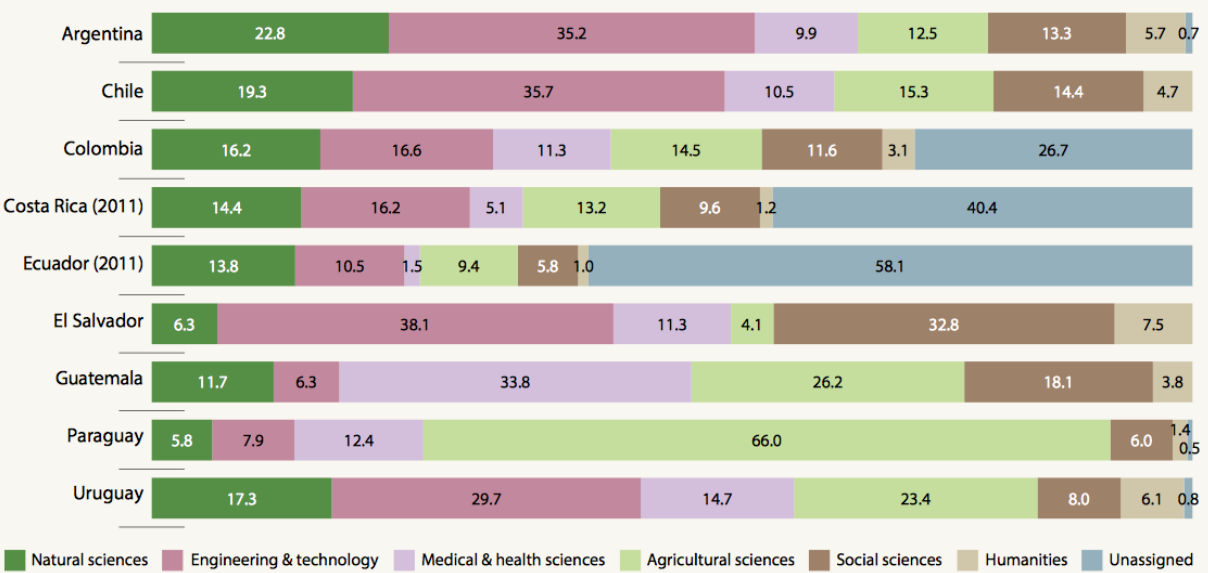


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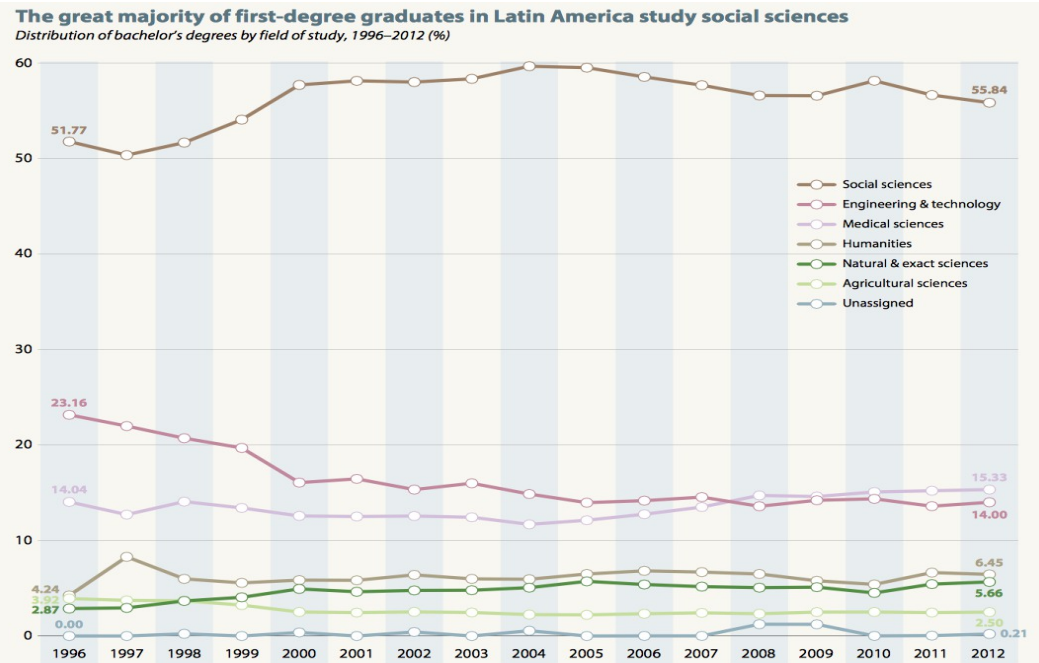
Source: RICYT database and UNESCO Institute for Statistics, July 2015; Brazilian Ministry of Science, Technology and Innovation.

See [UNESCO science report 2015](#) for more information

Agricultural sciences account for two-thirds of Paraguay's R&D expenditure
GERD by field of science, 2012 (%)



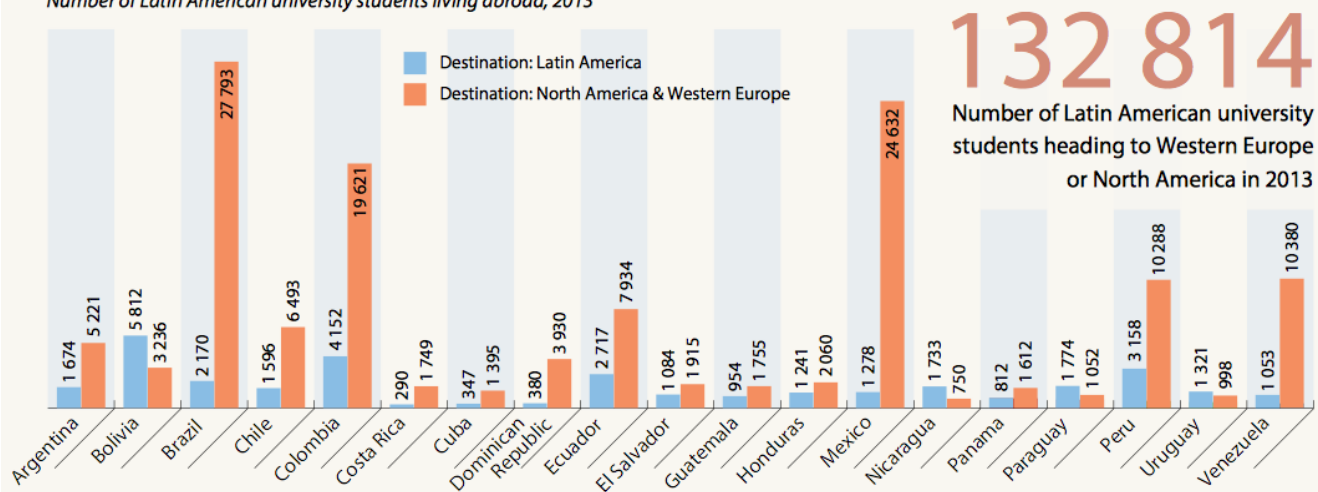
Trends in higher education in Latin America, 1996-2013



See [UNESCO science report 2015](#) for more information

Students head for Western Europe and North America more than other Latin American countries, with the exception of those from Bolivia, Nicaragua, Paraguay and Uruguay

Number of Latin American university students living abroad, 2013



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