

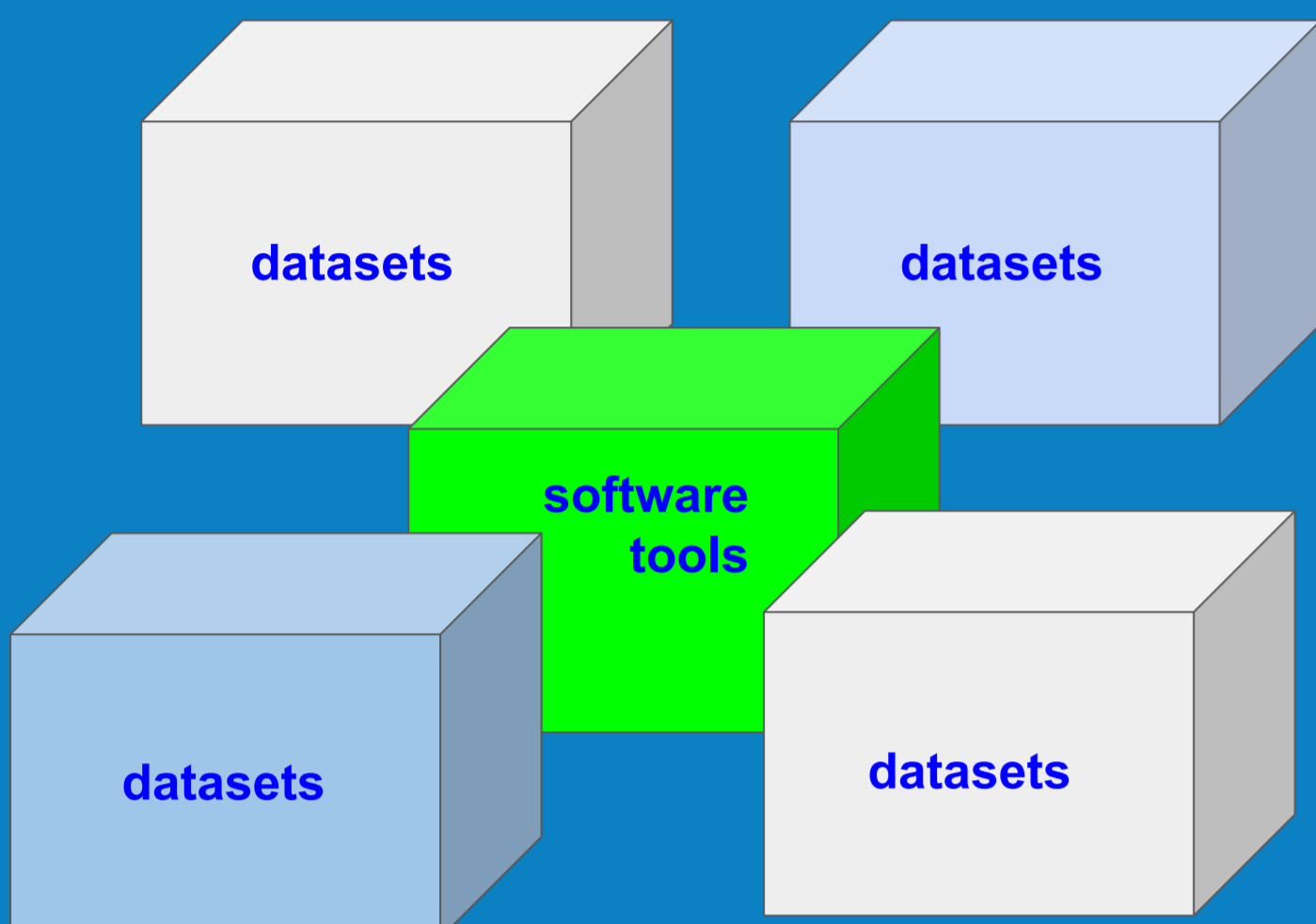
on the dissemination of High Energy Physics and Computer Sciences

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The members of large High Energy Physics (HEP) collaborations come from all over the world. In the case of ATLAS, many of its members come from Latin-American, Middle Eastern and Sub-Saharan countries, and so, they understand that in many places, it can be a challenge to teach experimental HEP. But the entire members of the collaboration also recognise the massive potential that the always-increasing university student population has, not only concerning the fundamental physics but also regarding computing sciences skills. For that reason, several outreach teams, which include ATLAS, IPPOG, CEVALE2VE members and many other researchers, have been developing and examining costless Open Source technologies to release data and to provide effective web-based and offline environments to run, produce, save and share HEP physics analyses. After several years, and with the help of other outreach programmes like the Virtual Visits, ATLAS established an active community that is not just releasing knowledge, data and resources but genuinely training new physicists who are pursuing advanced studies in experimental HEP right now.

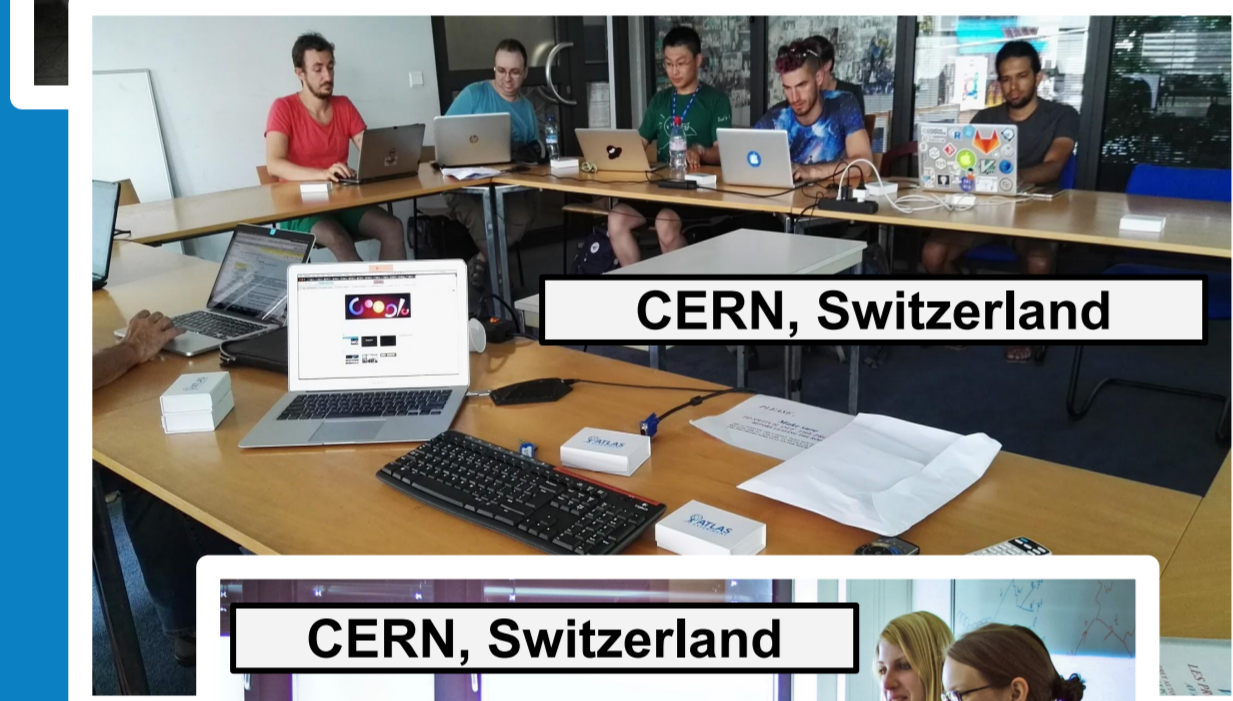
open data
ATLAS



We deploy the resources on the CERN and ATLAS Open Data websites

- Data samples (real and simulated) in ROOT CERN ntuple format
- Software and Jupyter Notebooks in Python and C++ to analyse the samples and produce physics analyses
- JavaScript (JS) applications to produce cut-and-count analyses
- Virtual Machines with several Linux-based OS and ROOT CERN analysis framework
- GitHub & GitLab repositories
- GitBooks to document the several possible activities

ATLAS Open Data and Virtual Visits projects play a key role in the inclusion of more institutions, students and general public into the fundamental research performed by the ATLAS Collaboration!



Provides public ATLAS samples and Open Source software for teaching and training of students and researchers

Boosting high-energy physics education around the world with ATLAS Open Data
<http://cern.ch/go/7nv8>

Two case studies: studying HEP in Venezuela

Several Venezuelan universities now use the ATLAS Open Data resources to teach and to develop HEP university theses. This is happening at both the undergraduate and graduate levels.

Iskya Garcia, a graduate student of Universidad Central de Venezuela (UCV), had experience working with large collaborations and datasets before working with ATLAS Open Data. During her undergraduate years at UCV, Iskya wrote a thesis based on data from the Latin American Giant Observatory (LAGO) collaboration at the Pierre Auger Observatory located in Argentina. When she started her master's program at UCV under my supervision, Iskya used data from the ATLAS Open Data repository, which was collected in 2012.

"The main subject was the development of cut-and-count analyses for the search of dark matter candidates using reconstructed jets of particles," Iskya explained. "These are produced due to the presence of quarks and gluons after the proton-proton collisions at the LHC."

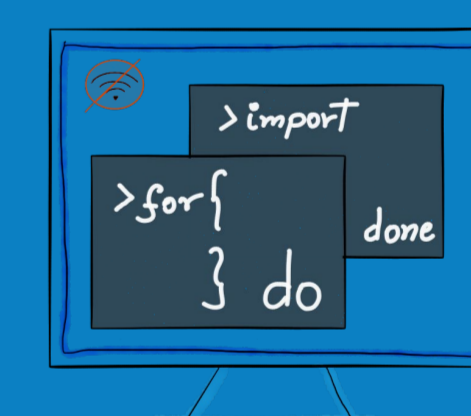
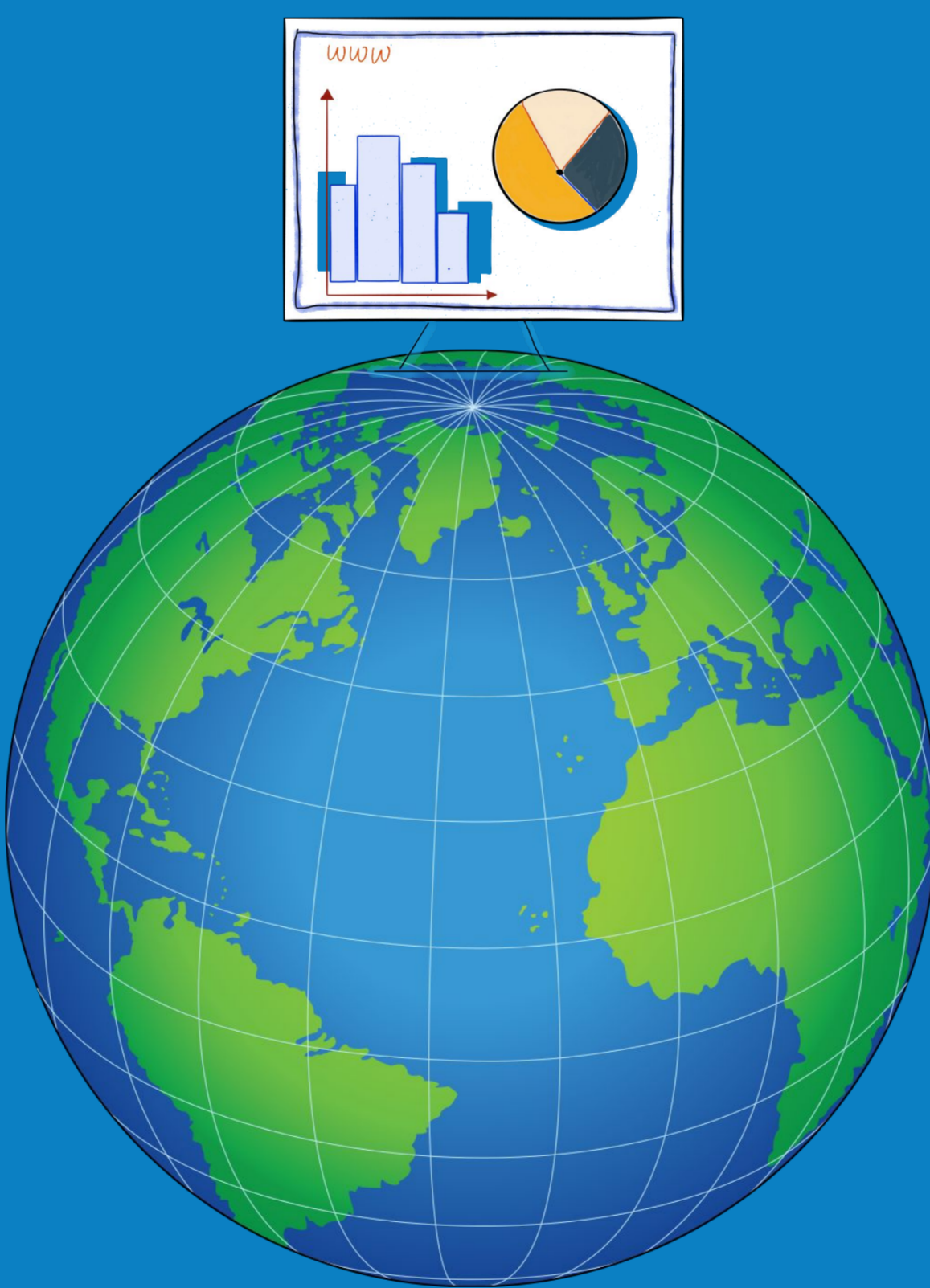
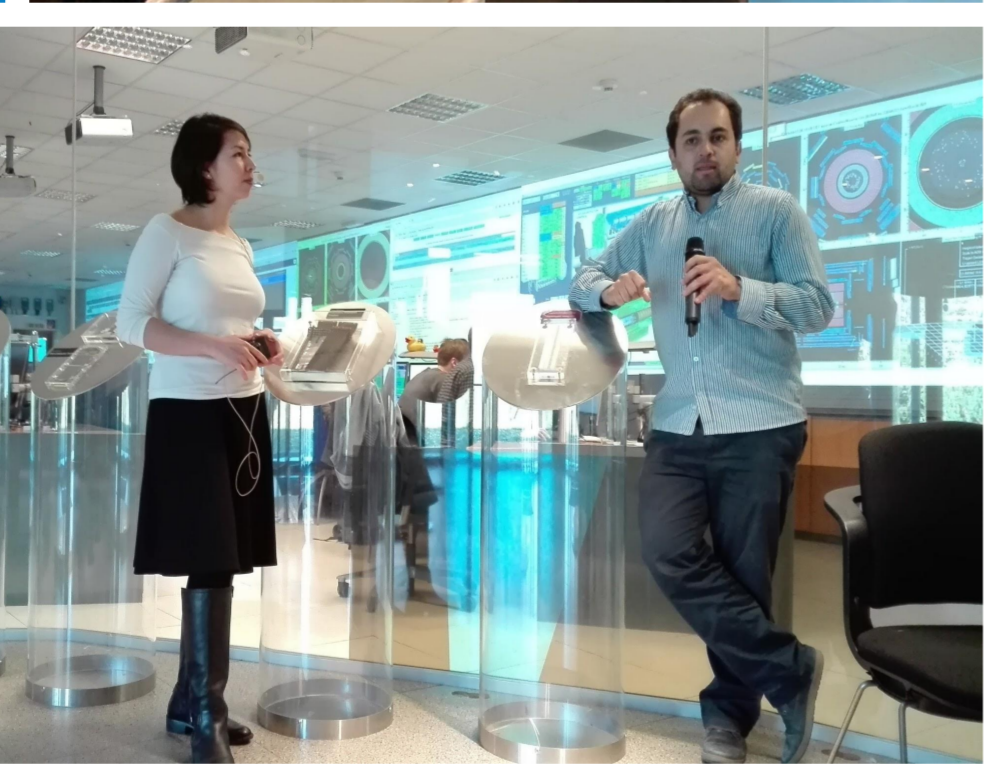
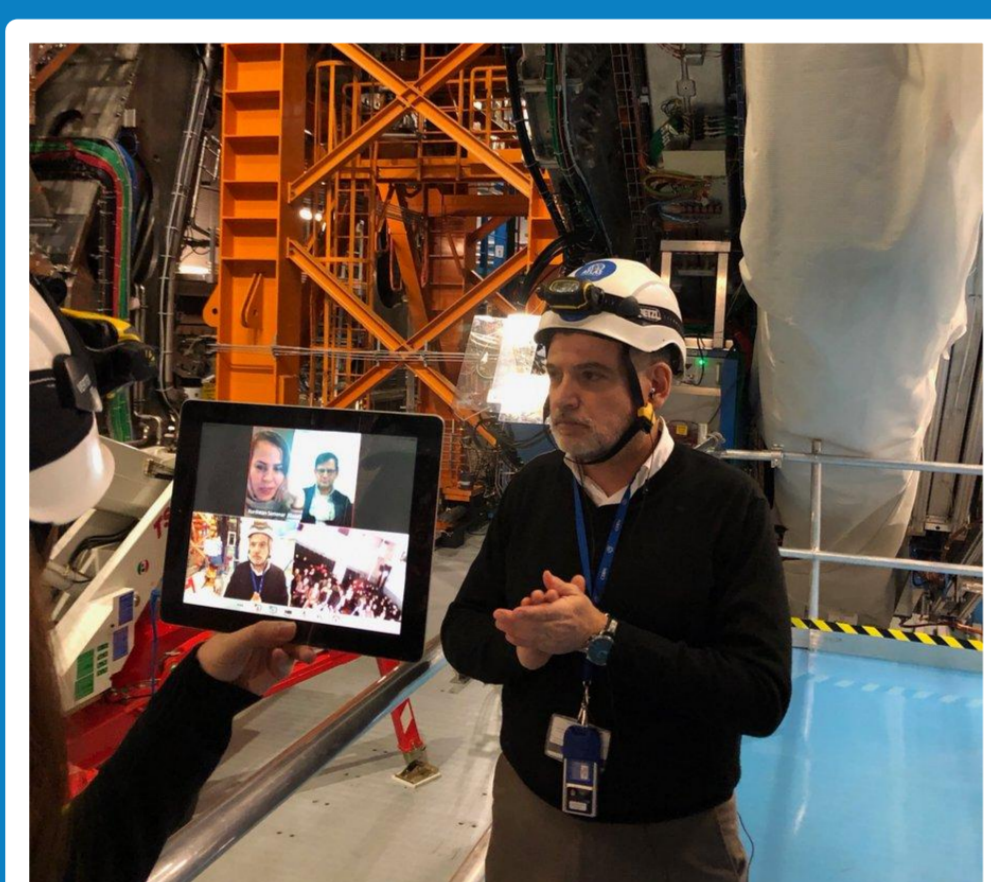
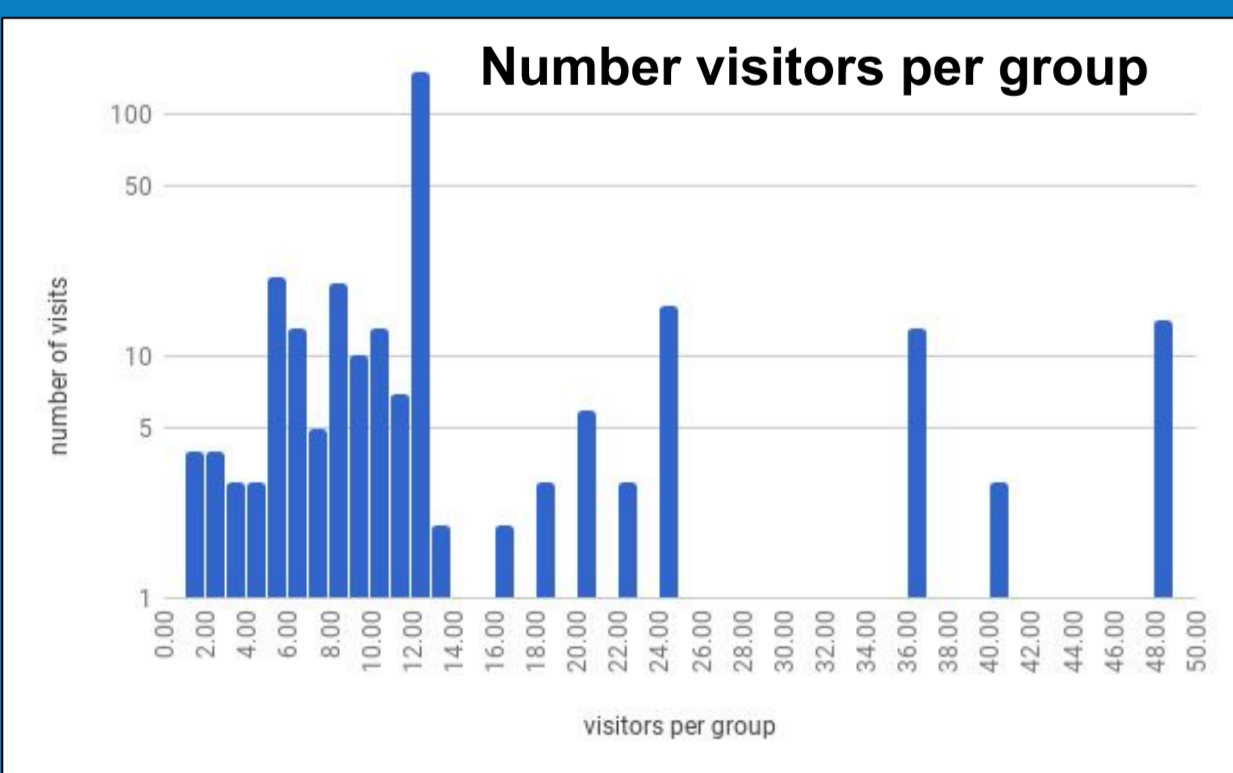
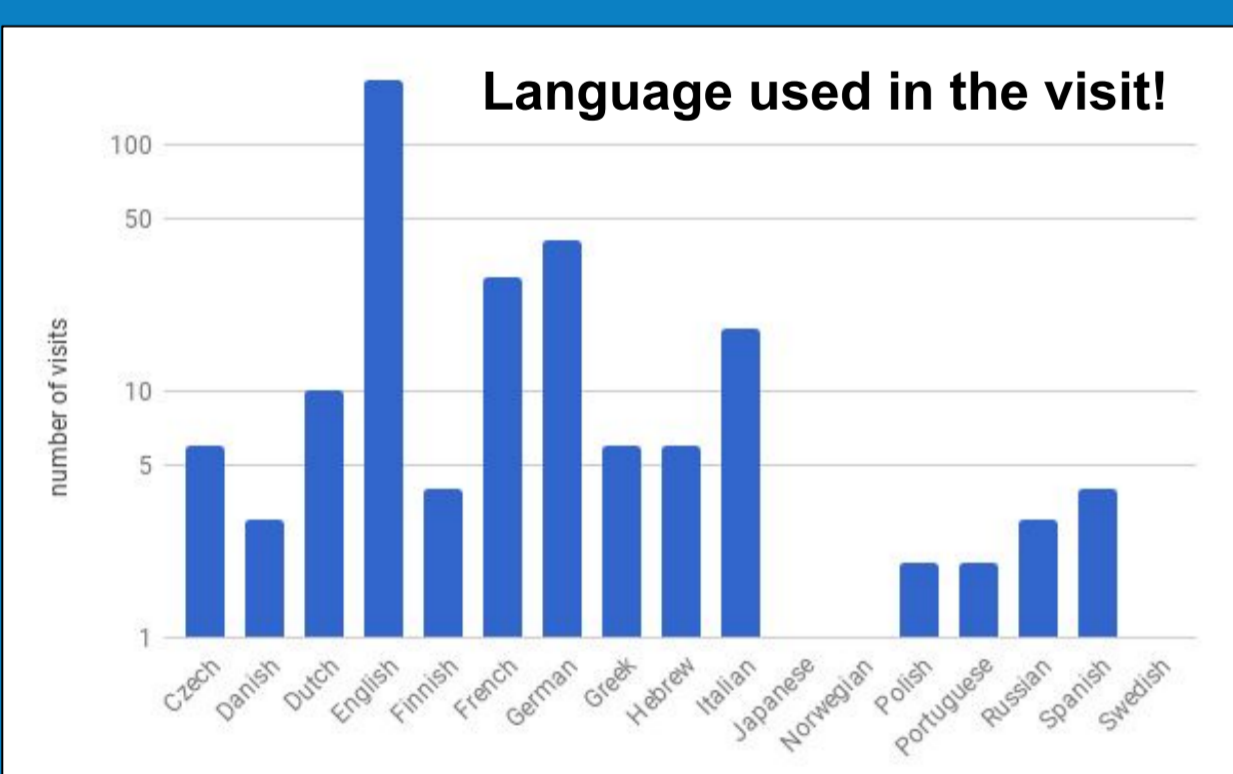
Iskya simulated other dark matter candidates using open sources HEP software like Pythia and Delphes. Before her thesis defense, Iskya moved to Argentina to develop her professional activities. But thanks to the wonders of modern communication, Iskya was able to present her thesis from Argentina, while the jury qualifier was in Caracas and her supervisor in Geneva.

Another student at UCV, Maria Di Domenico, did her undergraduate thesis in physics using the ATLAS Open Data resources. "In my thesis, I studied and produced a set of analyses with the end of reconstructing the invariant masses of the W, Z and Higgs bosons," Maria said. "My work was performed using a cloud computing platform called SWAN, developed and localised at CERN, and based on Jupyter notebooks (Open Source web-based technology) and ROOT. The final product: a set of self-explained notebooks showing the physics and the programming elements needed for this kind of 'cut-and-count' reconstruction. These notebooks will be used as educational resources for university-level HEP teaching and outreach in the ATLAS Open Data portal."

Maria has since graduated from UCV and is now a CMS PhD candidate living in Pisa, Italy. Unlike Iskya, Maria, her supervisor, and her jury were all present at UCV for her thesis defence in October 2017.

These two beautiful stories of collaboration and passion remind us of the importance of sharing knowledge and resources worldwide. We continue following this path of openness, already working with new students from around the world.

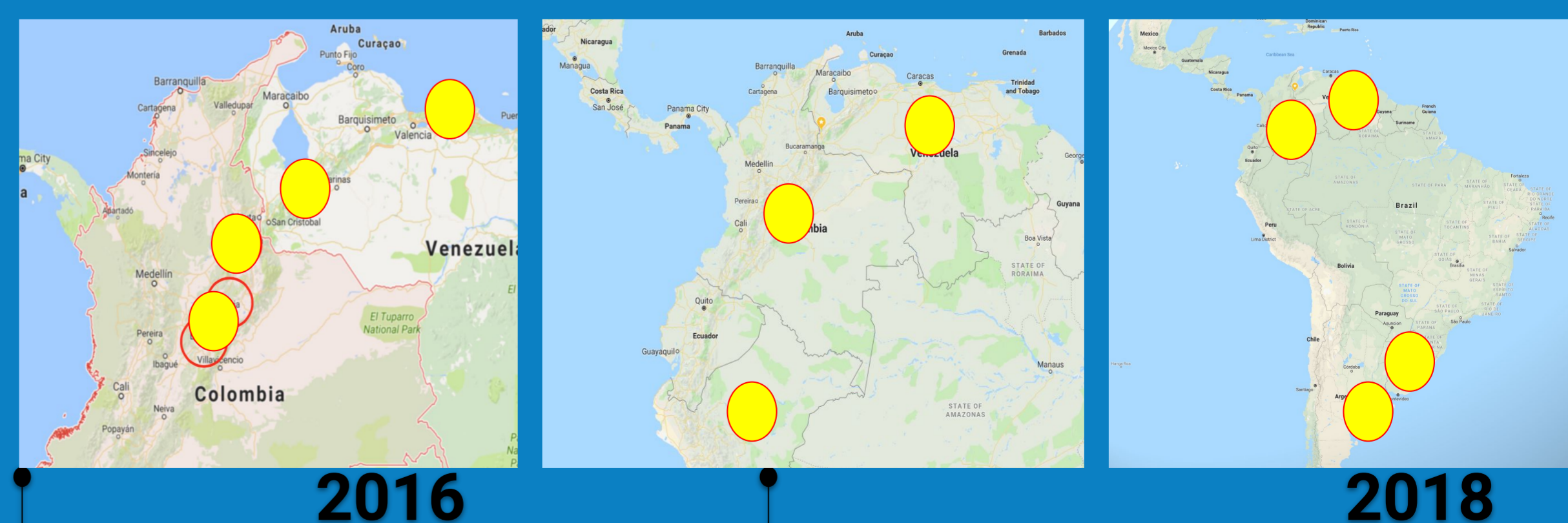
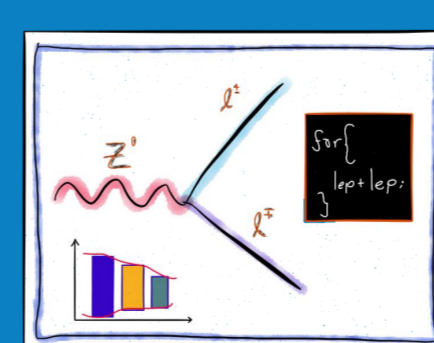
The release of resources, documentation in web-based and offline systems enhance the education in Computer Sciences



The ATLAS Collaboration and HEP experiments rely on public funding to support their programmes. Even more important, their continuity depends on a constant integration and replacement of human power. Students / professionals that need to be trained by other senior members of those collaborations. We can call it Knowledge Transfer, and it goes in both ways: to retribute to society and to keep running the large scientific endeavours worldwide. No single nation or entity can do this job alone. When knowledge is everybody's property, progress is possible and equally distributed.

ATLAS Open Data + CEVALE2VE + ICTP Physics Without Frontiers program (ICTP-PWF) in Latin America

- The Latin American section of the ICTP PWF is an effort leading by Latin-American ATLAS researchers.
- The team has organised roadshows annually since 2016.
 - The roadshows were also supported by the ATLAS Collaboration and the CEVALE2VE group together with local contacts in universities.
- Several educational activities take place during the roadshows including seminars by LHC physicist, hands-on sessions where the students analyse LHC data collected by ATLAS, Virtual Visits directly to scientists working at CERN and career and opportunities sessions in HEP.



- 2015**
First conversations with the ICTP Venezuelans and Colombian researchers starts to coordinate a pilot project for their countries
- 2016**
The 1st edition of the PWF-LA
The first edition took place in six institutions in five cities in Colombia and Venezuela
- 2017**
The 2nd edition of the PWF-LA
Three countries visited: Peru, Colombia and Venezuela. Peruvian students started to follow the CEVALE2VE course
- 2018**
The 3rd edition of the PWF-LA
Four countries visited: Argentina, Uruguay, Colombia and Venezuela. In 2019 we plan to add Ecuador!