

ACP2023 – 3rd African Conference on Fundamental and Applied Physics

Engaging teachers for informal education in modern physics

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LIP and IST, Lisboa,
for the IPPOG Collaboration



CERN-PTLTP23

15^a Escola de Professores no CERN em Língua Portuguesa
15th Portuguese Language Teachers Programme

George, Western Cape, South Africa,
25–30 September 2023



CERN, Geneva, 3–8 September 2023

| Topics

- The role of scientists: **IPPOG** and its flagship activities for schools
- The role of teachers:
 - International Teachers programmes at CERN
 - National Teachers programmes at CERN
 - CERN's Portuguese Language Teachers Programmes
- Direct and indirect impact of these programmes
- Conclusions

The role of scientists

IPPOG – International Particle Physics Outreach Group

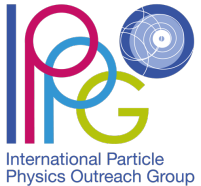
Network of Scientists, Educators, Communicators

International Scientific Collaboration to promote Education and Outreach in PP

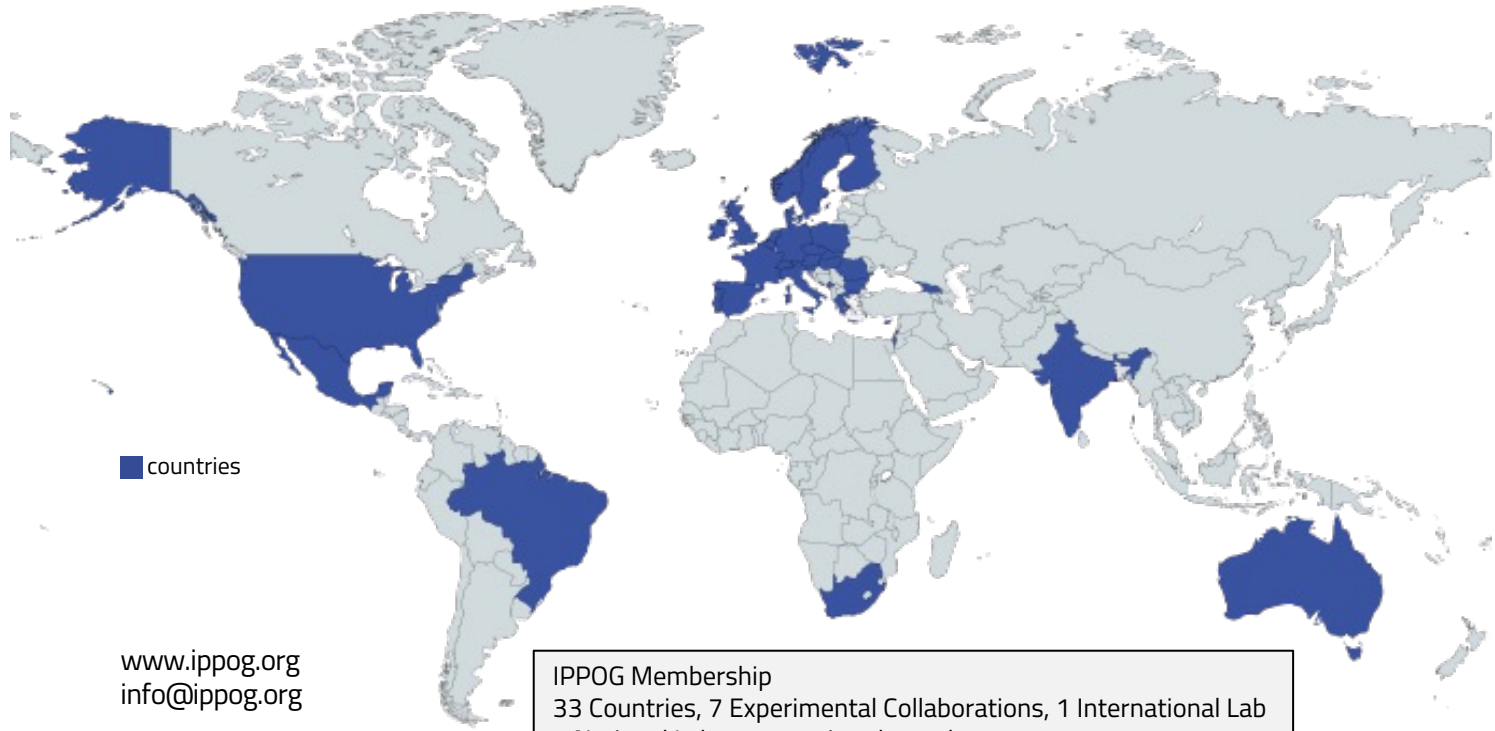


| What is IPPOG?

- International Particle Physics Outreach Group (born in Sept. 1997)
 - Researchers with experience in Education & Outreach
 - Experts in Communication and Education
- Organizes Global Activities
 - Global Cosmics
 - International Masterclasses – hands on Particle Physics launched on IYP 2005
- Supports Local Activities
- Sharing of expertise, best practices, resources database
- Collaborates with other networks (Quarknet, EPPCN, ApPEC, NuPPEC, iGRAV)



International Scientific Collaboration in Dec.2016

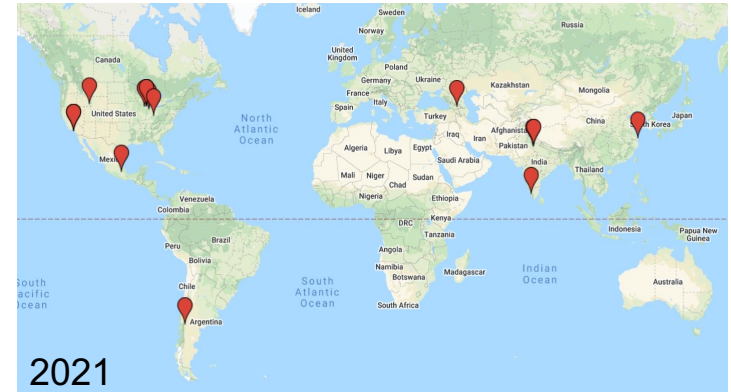
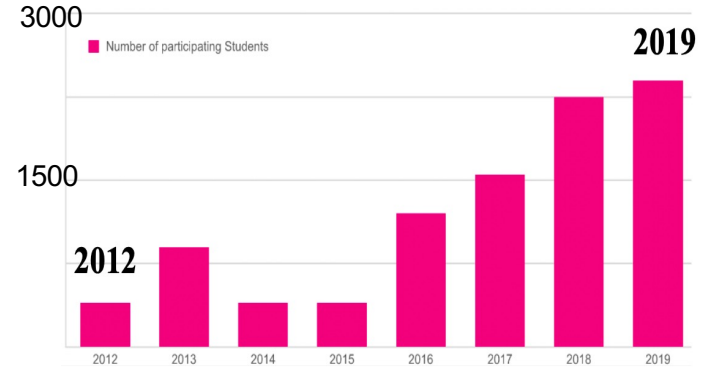


www.ippog.org
info@ippog.org

IPPOG Membership
33 Countries, 7 Experimental Collaborations, 1 International Lab
2 National Labs as associated members

Global Cosmics

- Forum of outreach projects on Cosmic Rays
<http://www.globalcosmics.org>
- International Cosmic Day organized by DESY \longrightarrow
<https://icd.desy.de>
- International Muon Week organized by Quarknet
<https://quarknet.org/content/international-muon-week>



- Several projects with data online, e.g, <http://cosmicatweb.desy.de>

IPPOG's International Masterclasses

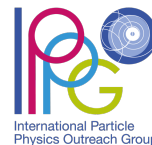
12 measurements implemented

- ATLAS Z path
- ATLAS W path
- ALICE Strangeness
- ALICE R_{AA}
- CMS WZH
- CMS J/Psi
- LHCb D0 lifetime
- BELLE II B mesons
- BELLE II quark colours
- MINERvA ν interactions
- Particle Therapy (treatment plans)
- Pierre Auger UHECR skymap



The screenshot shows the website for the International Particle Physics Outreach Group (IPPOG) International Masterclasses. The header features the IPPOG logo and the text 'INTERNATIONAL MASTERCLASSES hands on particle physics'. A navigation menu on the left lists various resources such as 'Home', 'Information for High School Students', 'Information for Teachers and Educators', 'Information for Institutes and Physicists', 'Schedule', 'Intl. Day of Women and Girls in Science', 'My Country', 'Physics', 'In the Media', 'Published Papers', 'Archive', 'Contributors', and 'Contact Us'. The main content area displays the '19th International Masterclasses 2023' logo and a grid of images representing different experiments: ATLAS, ALICE, CMS, LHCb, BELLE II, MINERvA, Particle Therapy, and Pierre Auger. A Twitter follow button for @physicsIMC is located at the bottom left of the website screenshot.

IPPOG's International Masterclasses



How to get involved:

At your institute

- Does your institute/country participate? Search <http://cern.ch/go/8V7h>
Organize an event / help as a tutor at your research lab
- How to get started: <http://cern.ch/go/9B77>

At CERN/Fermilab

- Moderate videoconferences with high school students
- Training provided
 - Moderate in pairs, 2-3 „shifts“, newcomers are paired with „veterans“

Next International Masterclasses: Feb/March 2024

Interested? Contact: uta.bilow@tu-dresden.de or kcecire@nd.edu
More info on www.physicsmasterclasses.org





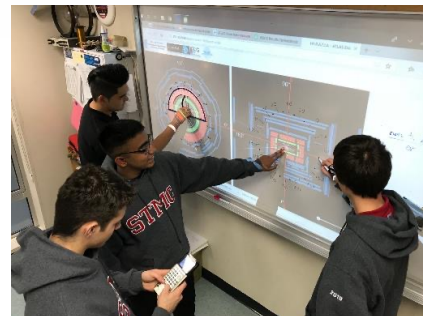
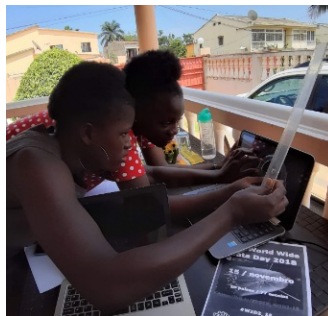
World Wide Data Day (W2D2)

A spin-off from IMC organized by Quarknet (Ken Cecire *et al*)

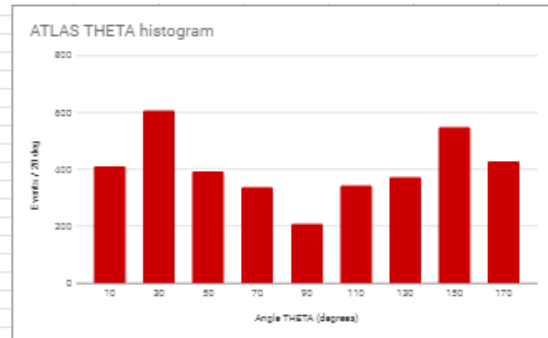
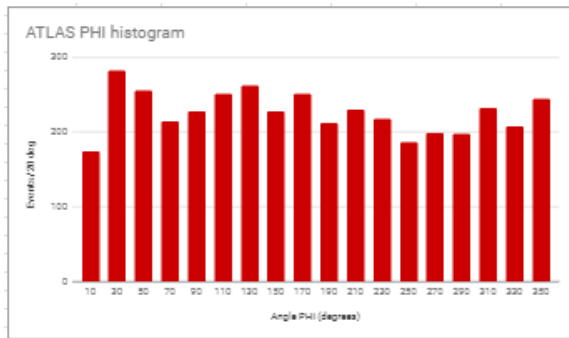
Done by ~1000 students at their ~80 high schools, guided by physics/science teachers

Simplified measurement with di-muons data from ATLAS and CMS experiments

Measurement of ϕ and θ of the muon tracks, spin off $\Delta\phi$ as a separate activity



Only in 1 day, with 24-hour-span videoconference with 30 mins. calls to share and discuss results





World Wide Data Day (W2D2)

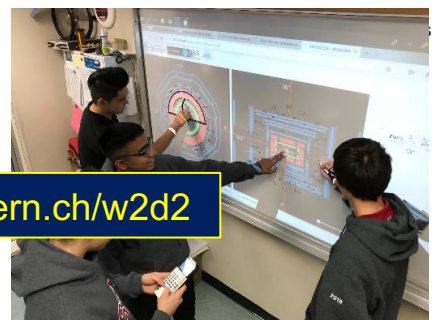
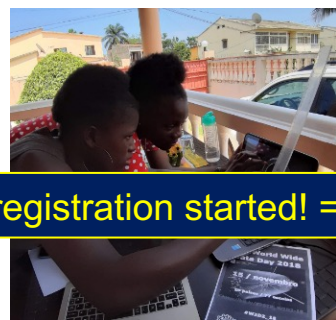
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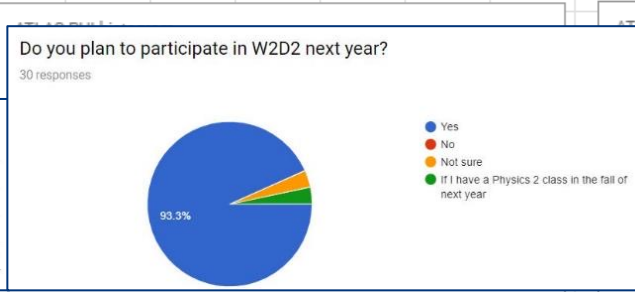
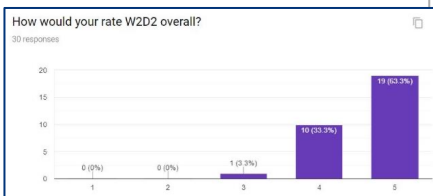
next W2D2 day: Nov.9th, registration started! => cern.ch/w2d2

Measurement of ϕ and θ of the muon tracks, spin off $\Delta\phi$ as a separate activity



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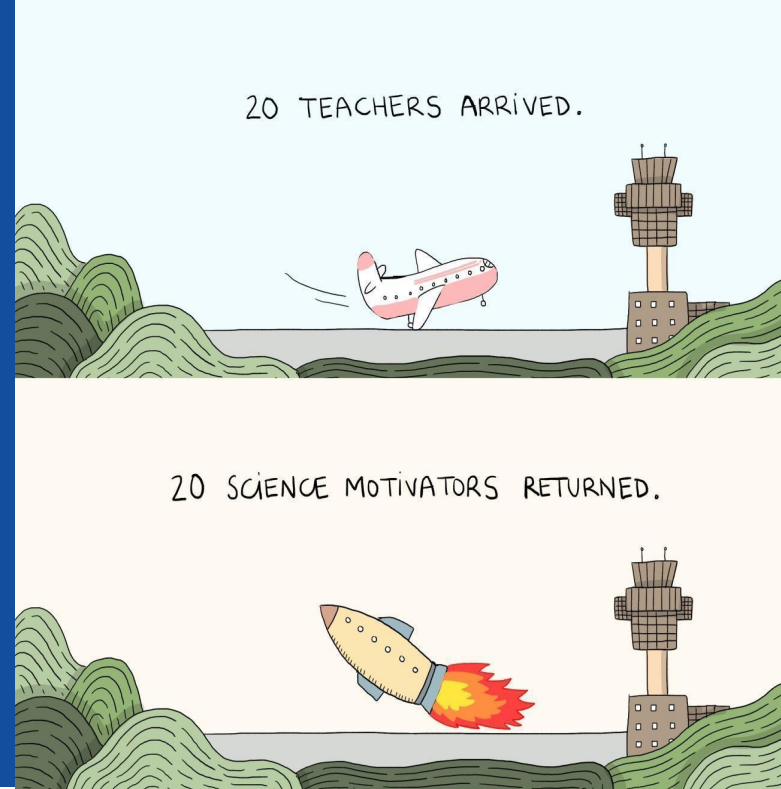
Well-received in evaluation



The role of Teachers

Teachers programmes

at CERN



Coordinator: Jeff Wiener, CERN

Teachers constitute knowledge multiplying factors!

Teachers are key partners in educating future scientists!

International Teachers programmes at CERN

- “High School Teachers” [HST] at CERN started in 1998 (duration of 3 weeks in summer)
- International, [now] duration of 2 weeks,



International High School Teacher Programme 2019

July 2019



International Teachers programmes at CERN

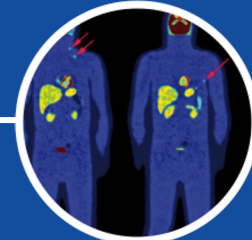
- “High School Teachers” [HST] at CERN started in 1998 (duration of 3 weeks in summer)
- International, [now] duration of 2 weeks, 2 editions/year (Jul., Aug.), vacation time
- Up to 48 teachers from many countries, in particular 1-2 from CERN member states



International
Teacher
Weeks
August 2019



CERN's National Teachers Programmes



Programmes for teachers from CERN member states in their home language

Take CERN and modern physics to the schools and communities in member states

Build networks of teachers and scientists for the informal education and learning

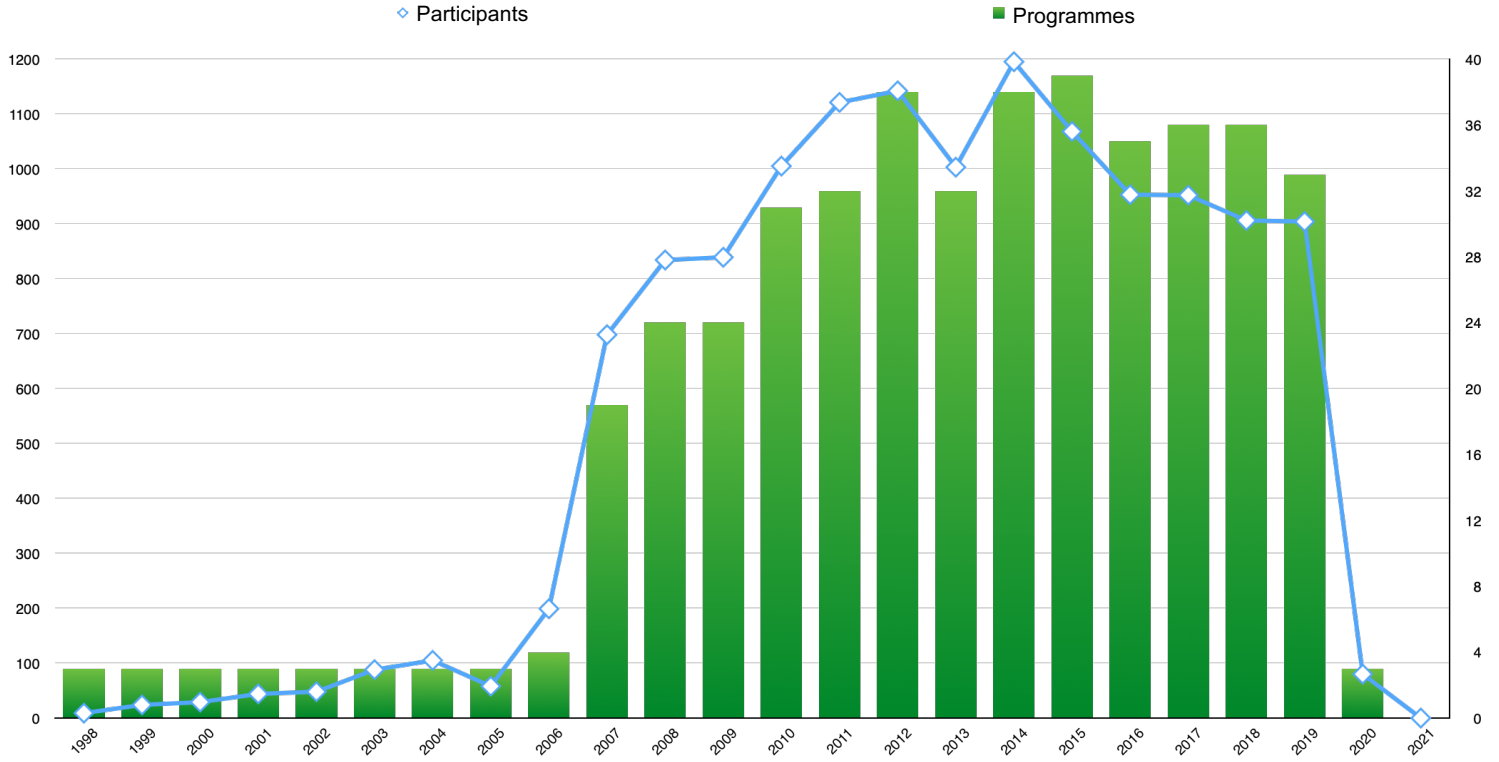
Build capacity and self-confidence in many more teachers from the member state

| The National Teachers Programmes at CERN

- Created in 2006 with a pilot programme for Hungarian teachers
- Open to all member states since 2007 (financed by the country)
- Now running about ~35 programmes / year
- Native language of the teacher => **very important** to facilitate the questions
- Many many more participating teachers every year
- Just one week, "training" time (PCD), credits/hours awarded to the teachers (after "exam")
- Many more contacts with scientists from the country
- Programmes adapted to the country (participation in experiments, contents, speakers)
- After programme follow-up much more efficient (when back at their schools)
- Many more teachers connected to CERN (what's done there, themes, etc)
- Many more school groups to visit CERN

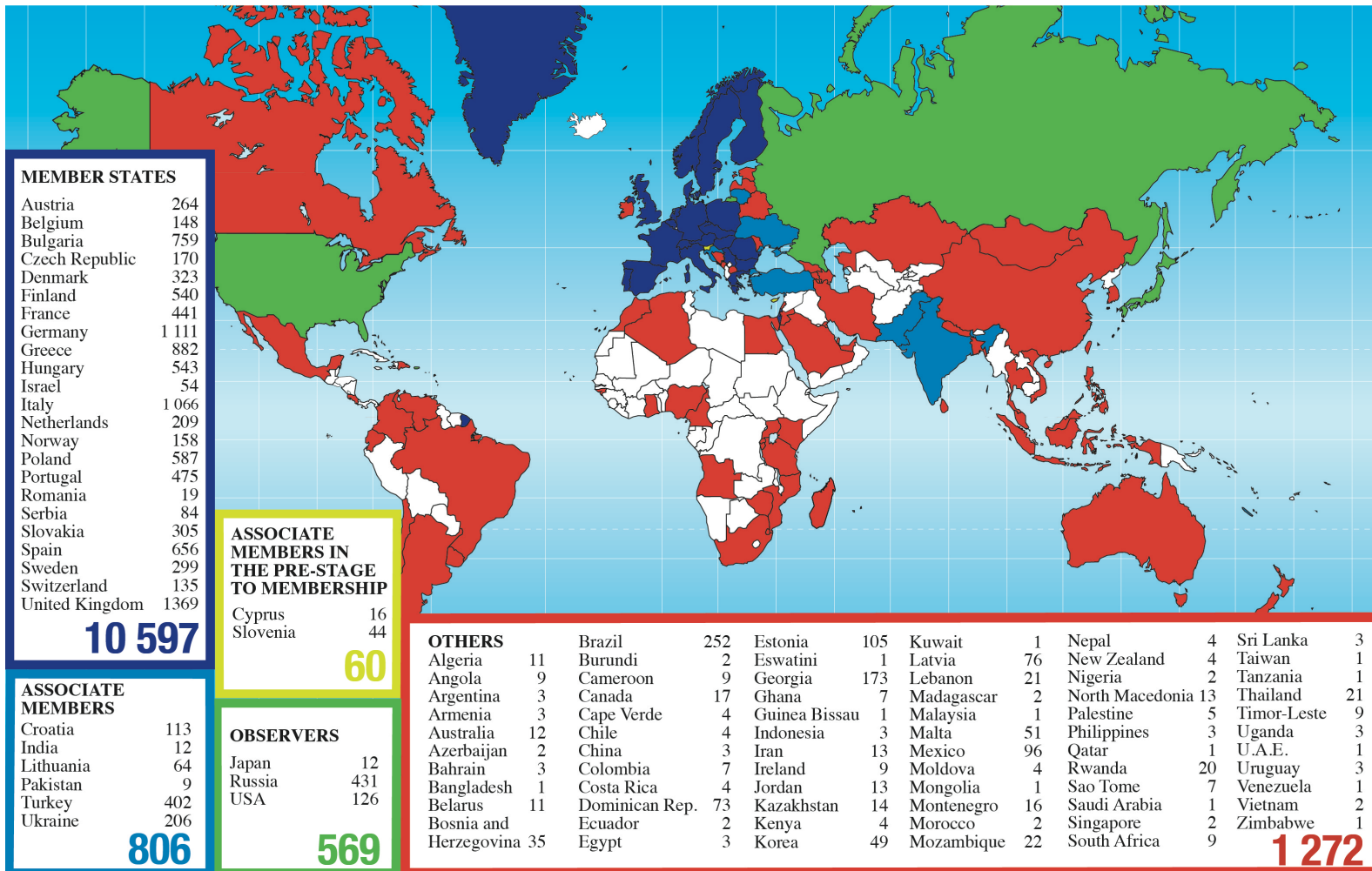


Evolution of #Participants/#Programmes@CERN

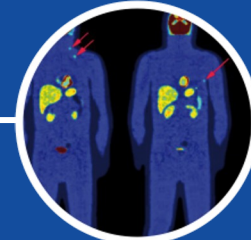


©Jeff Wiener

CERN Teacher Programme Participants 1998 - 2020 (Total: 13 304)



The CERN Portuguese Language Teachers Programmes



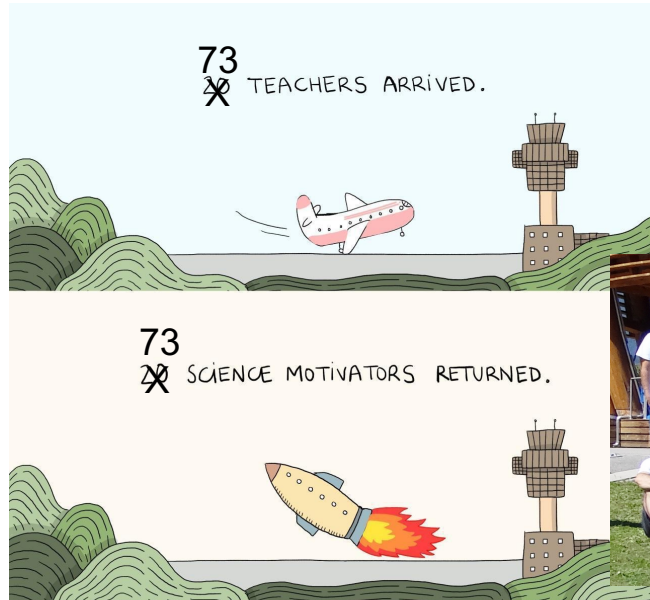
An international programme for teachers from Portuguese speaking countries

Expanding the national CERN Teachers Programmes for Portugal to teachers from Portuguese speaking countries (in 4 continents: Europe, South America, Africa, Asia)

CERN's Portuguese Language Teachers Programmes (CERN-PTLTP)

"The most important training programme that I have participated in my life" as spoken by many teachers.

- Started in 2007, no costs for the teacher
- One week only, in formation time, credits awarded to the teachers
- In Portuguese: No language barrier
- Financial support from LIP and Ciência Viva Agency (+CERN), and Camões Institute (since 2022)



- Overall evaluations above 4,8/5
- Invited teachers from other Pt speaking countries since 2009
- Selection in the country, travels [partially] supported
- **Full house in 2011:** 41 Pt, 20 Br, 4 Ao, 4 Mz, 1 CV, 1 STP, 1 GB, 1 TL



CERN-PTLTP23

15ª Escola de Professores no CERN em Língua Portuguesa
15th CERN Portuguese Language Teachers Programme

CERN, Geneva, 3-8 September 2023

Full house again in 2022 and **2023**



Dat
Car
« (e
Pt.
Br.
Mz
TL
An
STP
CV
GB



| 3 | Total |
|---|-------|
| 9 | |
| 2 | 2839 |
| 4 | 1409 |
| 0 | 468 |
| 0 | 285 |
| 2 | 26 |
| 1 | 11 |
| 2 | 10 |
| 1 | 9 |
| 1 | 7 |
| 1 | 3 |
| 8 | 819 |



CERN's Portuguese Language Teachers Programmes participants

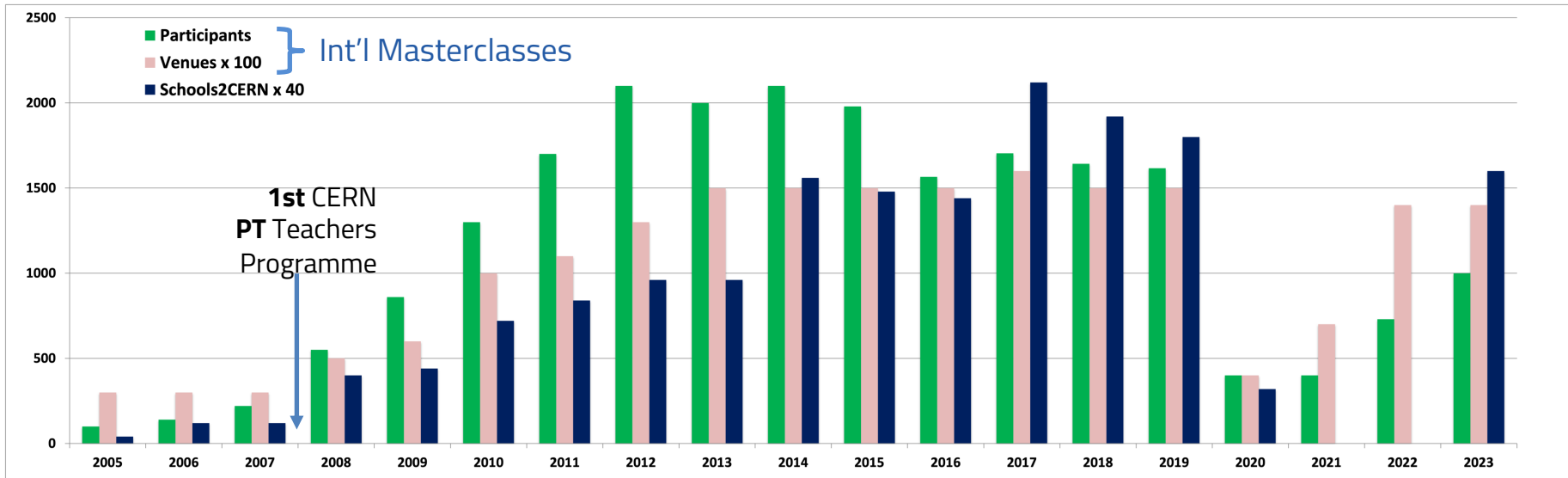
- **819** teachers so far
- Since 2022 support also from Camões I.P. (from Pt Foreign Office)
- Pt Teachers from all districts in the country (including Azores and Madeira)
- Br Teachers from almost all states (only 1 state missing: Acra)
- Networks of teachers built and used to promote HEPP

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2022 | 2023 | Total |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| Dates | 10-14/9 | 01/05/09 | 30/8-4/9 | 05/10/09 | 04/09/09 | 26-31/8 | 01/06/09 | 24-29/8 | 30/8-4/9 | 28/8-2/9 | 3/9-8/9 | 2/9-7/9 | 1/9-6/9 | 4/9-9/9 | 3/9-8/9 | |
| Candid. | 205 | 241 | 191 | 218 | 190 | 250 | 162 | 236 | 187 | 183 | 170 | 181 | 222 | 91 | 112 | 2839 |
| << (new) | 205 | 169 | 78 | 130 | 98 | 165 | 57 | 121 | 96 | 63 | 40 | 48 | 77 | 18 | 44 | 1409 |
| Pt. | 43 | 45 | 44 | 45 | 41 | 35 | 34 | 35 | 24 | 22 | 20 | 20 | 20 | 20 | 20 | 468 |
| Br. | | 1 | 11 | 20 | 20 | 30 | 31 | 30 | 22 | 20 | 20 | 20 | 20 | 20 | 20 | 285 |
| Mz. | | | 5 | 4 | 4 | 4 | | 2 | 2 | 1 | | | | 2 | 2 | 26 |
| TL | | | | | 1 | 3 | 3 | | 2 | | | | | 1 | 1 | 11 |
| An. | | | | | 4 | | | | | | | | 2 | 2 | 2 | 10 |
| STP | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 9 |
| CV | | | | 1 | 1 | 1 | | 1 | 1 | | | | | 1 | 1 | 7 |
| GB | | | | | 1 | | | | | | | | | 1 | 1 | 3 |
| Total | 43 | 46 | 60 | 71 | 73 | 74 | 69 | 69 | 52 | 44 | 40 | 40 | 42 | 48 | 48 | 819 |

↳ (limited to 48 participants)

Impact (direct)

- Increase in #talks@schools, #participants in public sessions, open days, etc
- Great increase in #participants @IPPOG's International Masterclasses
- Enormous increase in Visits to CERN (PT Schools and BR – (Virtual Visits))



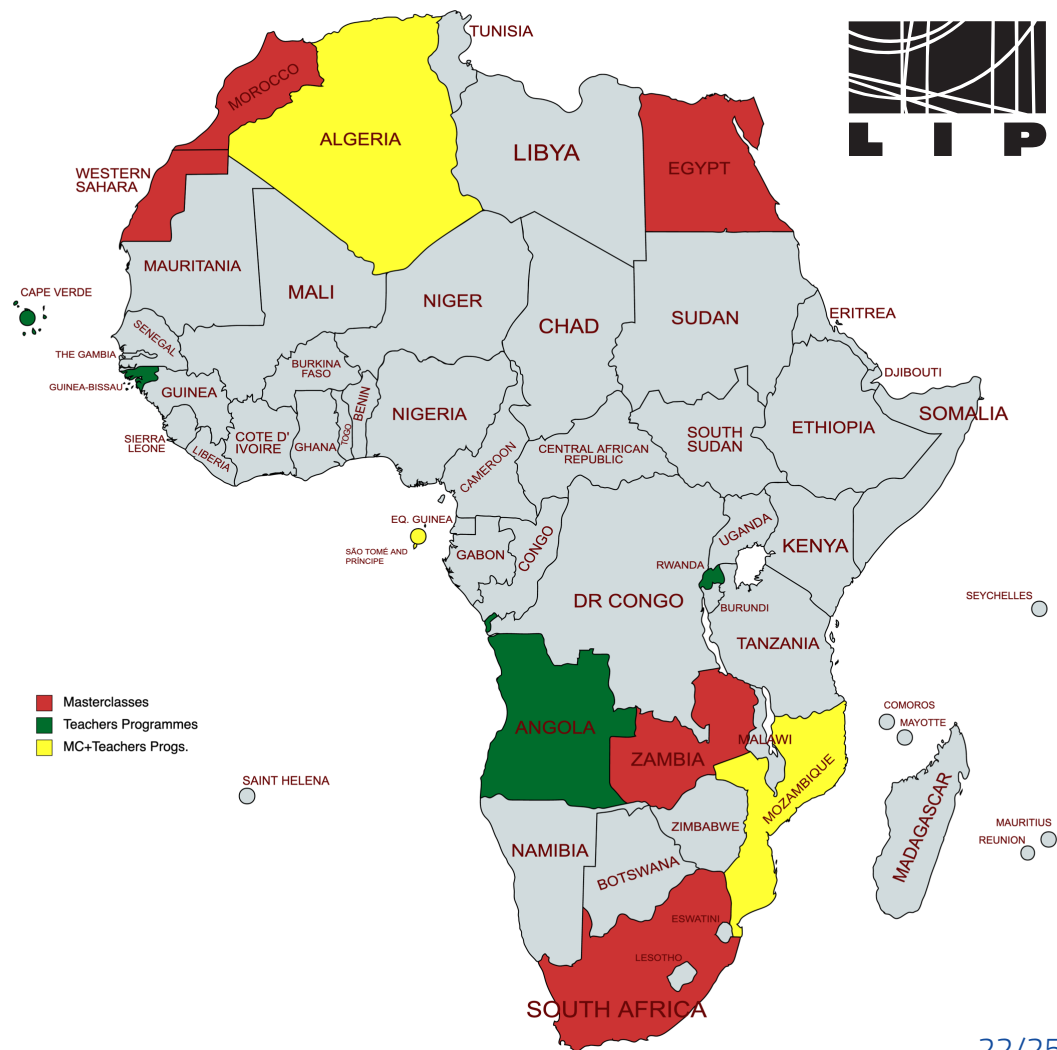
Impact in Africa (direct)

International Masterclasses

- Algeria - M'Sila and Constantine(x4)
- Egypt - Alexandria
- Morocco - Ben Guerir, Oujda, Rabat
- Mozambique - Maputo
- São Tomé and Príncipe - São Tomé
- South Africa - Cape Town
- Zambia - Lusaka

CERN Teachers Programmes

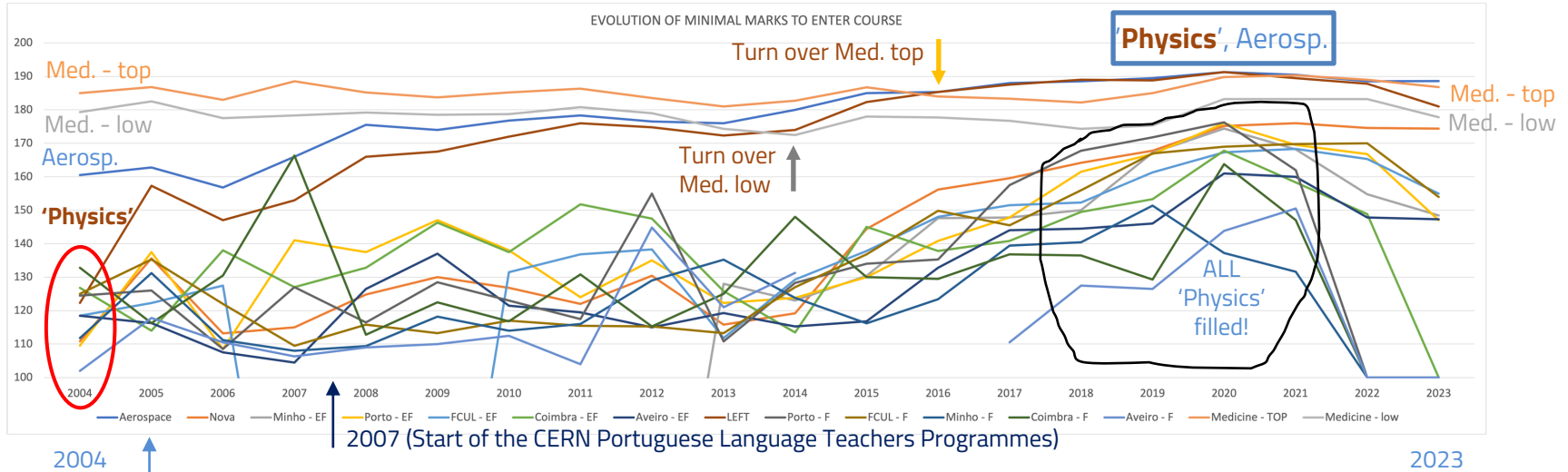
- Algeria
- Angola
- Cape Verde
- Guiné-Bissau
- Mozambique
- Rwanda
- São Tomé and Príncipe



Impact in Portugal (indirect, only “time correlation”)

Increase in interest of students to follow Physics, Engineering Physics and Engineering courses

Evolution of Threshold Marks to enter Portuguese Universities



- Threshold marks range from 100 to 200, being set at 100 for courses with vacancies left
- Note that different #places in different courses does hinder the threshold marks analysis
- This is also a result of MANY OTHER activities/groups (unrelated to Particle Physics)
- **It does pay off to go to schools, to talk to the young, to engage!**

and Conclusions

- Education, Communication and Outreach are essential pillars for the development of High Energy and Particle Physics (HEPP).
- Many scientists, at different levels of commitment, along with experts in outreach and communication, are **already engaging the public and students** in different venues and carry outwards the excitement of the field.
- Communication & Outreach in our field **need YOUR support and contribution**,
 - as actively being an **ambassador** of the field,
 - as speaker/moderator/motivator/organiser/educator/tutor,
 - as **evaluator** of projects/career assessment/applications/positions,
 - consider **experience in outreach** when evaluating people,
 - and/or helping creating the conditions for a better Edu-Comm-OR in HEPP.
- **It does pay off to go to schools, to talk to the young, to engage the teachers and students!**

Ed_ cation and O_ treach *need U*



*Planting
a future*

Thanks!

(this is a big thanks!)

to all the people collaborating in all these activities!
...and for your attention!

Any questions?

You can find me at abreu@lip.pt

