



International Particle  
Physics Outreach Group

EPS HEP 2019 – July 10-17, Ghent, Belgium

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# Future Challenges in Particle Physics Education and Outreach

H.P. Beck, *Universität Bern, IPPOG Chair*

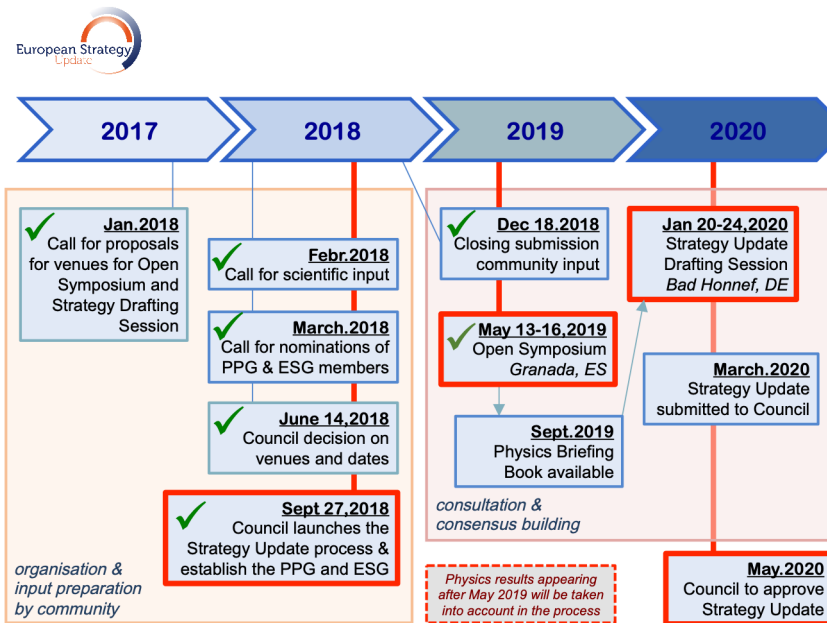
S. Goldfarb, *University of Melbourne, IPPOG Chair*

On behalf of the IPPOG Collaboration

# What Future ?

## The European Particle Physics Strategy Update defines the next big steps

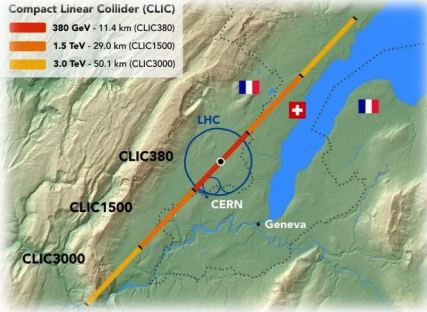
- taking into account the **worldwide particle physics landscape** and developments in related fields
- Long process that shall conclude by May 2020
- Will involve construction of new **very large-scale infrastructure(s)** and **ultra-long time scales** for planning, R&D, construction, running, and analysis – in multiple stages



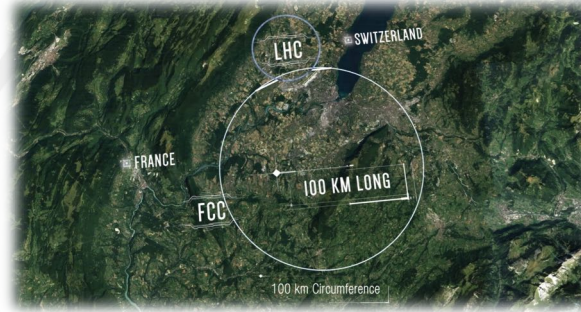
# What Future ?

## Landscape of proposed large-scale infrastructures

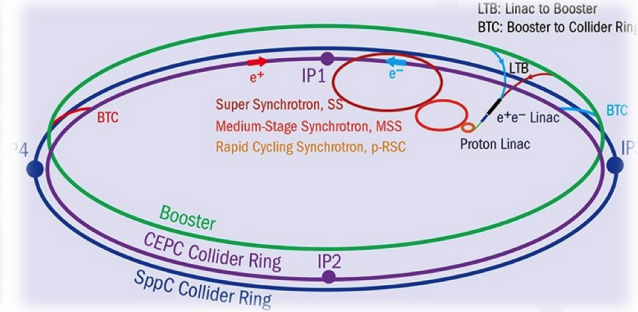
Compact Linear Collider (CLIC)  
 380 GeV - 11.4 km (CLIC380)  
 1.5 TeV - 29.0 km (CLIC1500)  
 3.0 TeV - 50.1 km (CLIC3000)



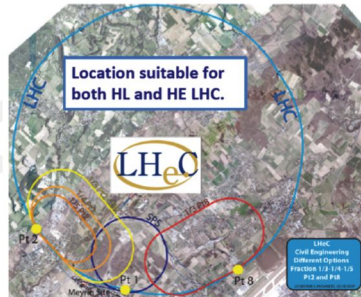
CLIC



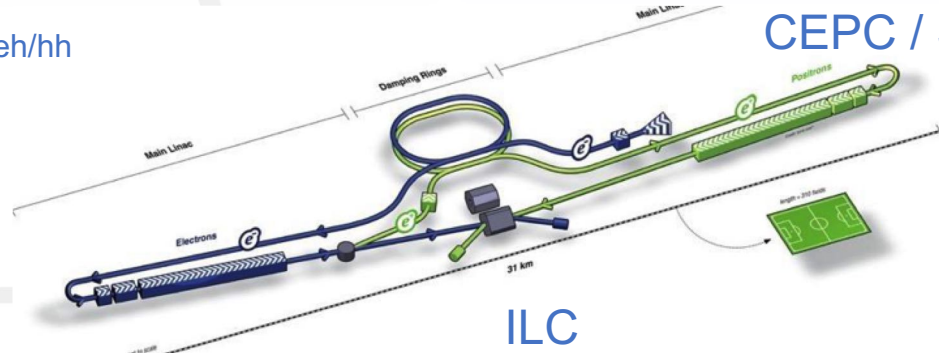
FCC<sub>ee/eh/hh</sub>



CEPC / SppC



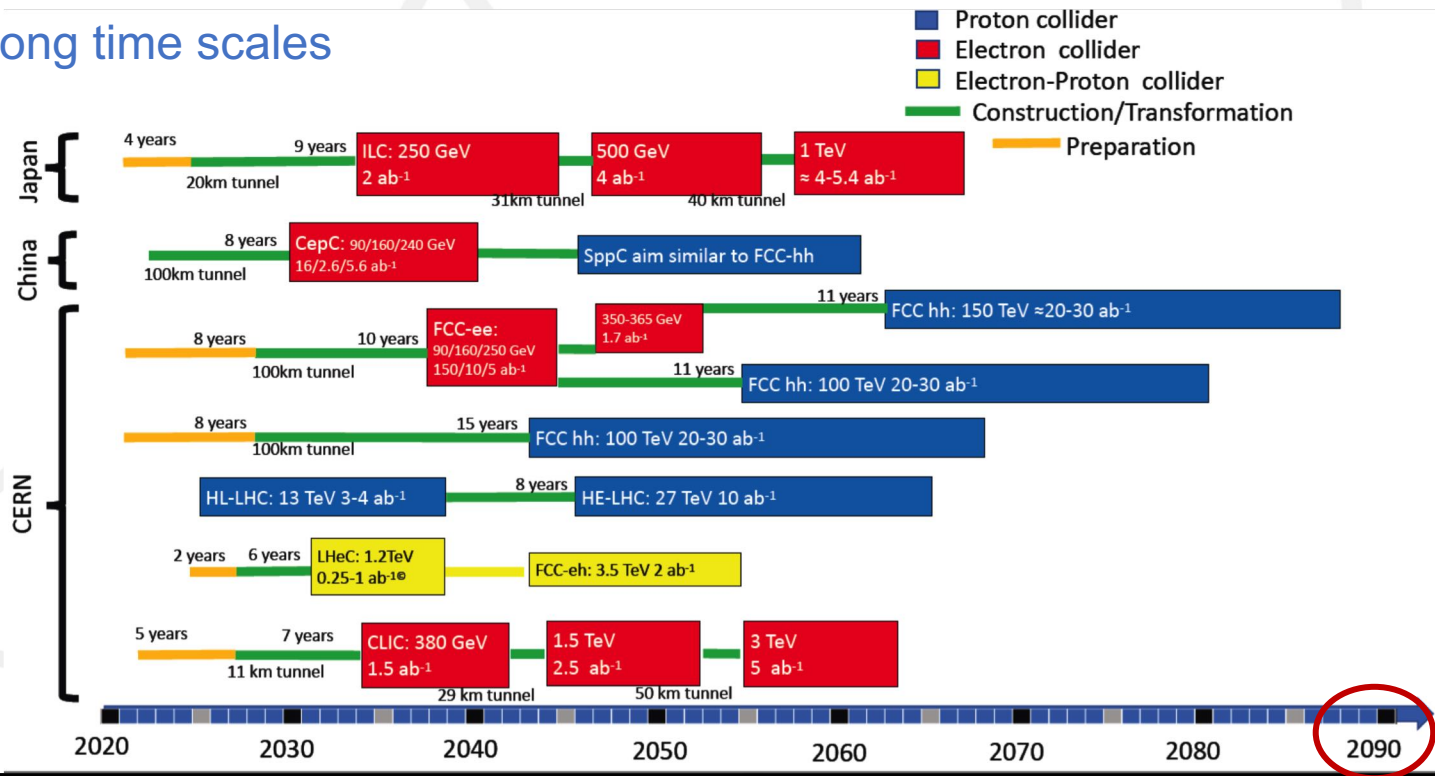
LHeC



ILC

# What Future ?

## Ultra-long time scales





# 2013: Education and Outreach a wider impact

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The **past EPPSU** report from 2013 recognizes Education, Outreach, and Communication under ‘*wider impact*’

- i.e. Education, Outreach, and Communication is what you do as an ‘**aftermath**’
  - We found the Higgs, so we need to communicate and explain to the public what it is all about.

There is good rational for such an approach

*It is crucially important that the general public has the opportunity to inform itself knowledgeably and intelligibly on the endeavors and results of scientific research. Restricting scientific findings to a small group of people **weakens the philosophical spirit of a nation** and leads to its **intellectual impoverishment**.*

**Albert Einstein**, Princeton 1948

However, today and for the future, more strategic thinking is required

# Outreach, Education & Communication

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## Education & Outreach

- **Establish deep appreciation** of fundamental research
- **Build trust** with communities who provide support
  - Requires full engagement of active researchers
- **Train next generation** of physicists, engineers & technicians

## Communication

- **Help the scientists** with their expertise in communication strategy and methods
- Establish communication networks for reaching large & key audiences

# Education and Outreach a Strategic Pillar

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The realization of new large scale infrastructure(s) with their research programs requires

- **deep and long R&D**
  - accelerators incl. magnets, detector incl. electronics, trigger, readout, computing,
- **long-term funding scheme**
  - sustainable, reliable
- **good vision**
  - scientific leadership and flat hierarchies for allowing good ideas to be followed up, bottom-up
- **people**
  - physicists, engineers, technicians, ...
  - politicians, stake holders, ...

# Education and Outreach a Strategic Pillar

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The realization of new large scale infrastructure(s) with their research programs requires

- **world-wide collaboration**
  - **broadest world-wide support**
    - **public at large** elects stake holders and politicians who can support fundamental science
    - every physicist, engineer, technician was once a child, and most likely enrolled in a public school, in some place in the world

Education and Outreach vitally required

- in a **global, concerted and systematic effort** for the **current** and more importantly the **next generation**.

*More concerted and systematic effort toward presentation and popularization of science would be helpful in many respects; it would provide a potent antidote to overspecialization; it would bring out clearly what is significant in current research, and it would make science a more integral part of the culture of today.*

**Victor F. Weisskopf, SCIENCE, VOL.176 (1972)**

## International Particle Physics Outreach Group

an example for concerted and systematic effort for outreach

### Enabling Outreach Globally

as a Collaboration in a collaborative effort

# IPPOG: A Scientific Collaboration since 2016





# About IPPOG

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## IPPOG is an International Scientific Collaboration

- Active Particle Physicists with Experience in Research, Education & Outreach
  - CB Representatives: Respected Leaders in the Field representing experiments, countries, international laboratories
  - Group Members: Wide Range of Expertise (Theorists, Experimentalists, Coders, Educators, Communicators)

## IPPOG spans a Global Network

- 25 Countries, 5 Experiments, 1 International Lab
- Linked with national networks
  - National research groups are asked to work together in IPPOG matters
  - Connecting with National educational networks (teachers, middle & high schools...)

## IPPOG concerts Global Activities

- International Particle Physics Masterclasses
- Global Cosmics

see talk by Uta Bilow in this session

## IPPOG helps in Local Activities

- Enabling and Facilitating local events and activities via local teams through expertise, sharing of best practices, maintaining an outreach DB.



# IPPOG Reach: The 2019 Masterclasses



## Coord.: QuarkNet

- 51 institutes (48)
- 54 LHC Masterclasses (50)
  - 22 ATLAS (19)
  - 32 CMS (31)  
(Incl. TRIUMF program)
- 12 MINERvA Masterclasses

Masterclass date: 7.3. - 16.4.2019

54 countries

239 institutes

15k students (preliminary number)

1k teachers (preliminary number)

## Coord.: TU Dresden

- 188 institutes (177)
- 266 LHC Masterclasses (257)
  - 30 ATLAS W (35)
  - 101 ATLAS Z (104)
  - 64 CMS (58)
  - 41 LHCb (39)
  - 27 ALICE SP (18)
  - 3 ALICE R\_AA (3)



# Brief History

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## Evolving IPPOG

- 1997 CERN DG Chris Llewellyn-Smith
  - Invoked the European Particle Physics Outreach Group - EPPOG
  - First chair: Frank Close, University of Oxford, UK
  - Report to ECFA
  - LEP based Masterclass program as a small-scale uni-national initiative that then evolved involving more and more countries
- 2011 Transition of EPPOG → IPPOG
  - To recognize the global role of education and outreach
- 2011 First time LHC based Masterclass program
- 2013 EPPSU → IPPOG recognized as a wider impact
  - shall receive adequate funding & report to Council
- 2016 International Collaboration with MoU
  - Countries pay a membership fee – depending on GDP and PP community size
  - Intl. Laboratories provide Stronger support: Monetary and in-kind
  - Experiments support by providing means for E&O program, e.g. providing tools, methods, documentation, and manpower for masterclass measurement
- 2019 25 Countries, 1 intl. Lab, 5 experiments; five more countries about to sign
- 2020 Education and Outreach recognized as a strategic pillar

# Vision & Strategy

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## Geographic Expansion

- Asia
- Africa
- The Americas
- Other International Labs and Collaborations

## Expansion in Physics Topics

- Particle Physics beyond LHC
- Neutrinos
- Astro-Particle Physics

## Goals

- Bring Excitement of particle physics to students and audiences around the globe
- Instill deeper understanding of the importance of evidence-based reasoning
  - Essential for all aspects of fundamental research
  - Necessary to establish support for next generation of large-scale research infrastructure

**Form a next generation of General Public, Stakeholders, Physicists & Engineers**

# Achieving Our Goals

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## IPPOG

- Is on track
- Expansion already happening in terms of global reach and physics scope
- Additional human resources at core team level will be needed to support the growth
- Human resources for Masterclass coordination need to be secured

## What is Needed

- Full Recognition of IPPOG as a strategic pillar in EPPSU 2020
  - Crucial strategic importance of coordinated Education & Outreach at the Global Scale
  - This is in view of the next generation of large-scale projects in our field
  - Implying continued, increased and sustainable funding (monetary, FTEs, in-kind), and Full recognition of Physicists engaging in Education & Outreach



# IPPOG In Conferences

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## APS April Meeting, 14 Apr, Denver, Colorado, USA

“International Masterclasses: Particle Physics for High School Students and Teachers”

- Ken Cecire, IPPOG Masterclass Coordination

## LHCP 2019, 20-25 May, Puebla, Mexico

“Particle Physics Outreach as a Strategic Pillar for Society: A report from IPPOG,”

- Sascha Mehlhase, ATLAS IPPOG Representative

## EPS HEPP 2019, 10-17 July, Ghent, Belgium

“Future Challenges in Particle Physics Education and Outreach,”

- Hans Peter Beck, IPPOG Chair
- “Developments in International Masterclasses”
- Uta Bilow, IPPOG Masterclass Coordination

## ICNFP 2019, 21-29 Aug, Kolymbari, Crete, Greece

“The International Particle Physics Outreach Group,”

- Despina Hatzifotiadiou, ALICE IPPOG Representative

## CHEP 2019, 4-8 Nov, Adelaide, Australia

“International Particle Physics Masterclasses”

“The IPPOG Resource Database”

“The International Particle Physics Outreach Group”

# IPPOG In The Media

LE NOTIZIE DALLA CITTÀ CHE CAMBIA

## NT NEWSTOWN

POLITICA ECONOMIA CRONACA CULTURA E SOCIETÀ TECNOLOGIE MONDO SPORT

Martedì, 27 Novembre 2018 16:44

### I Laboratori Nazionali del Gran Sasso e il Gssi per la prima volta all'International Cosmic Day

di Redazione

Condividi: 0

Stampa Email

**I Laboratori Nazionali del Gran Sasso dell'INFN e il GSSI - Gran Sasso Science Institute partecipano, per la prima volta, all'International Cosmic Day, alla settima edizione.**

**L'International Cosmic Day, il 29 novembre, vedrà scienziati di tutto il mondo coinvolti in progetti di divulgazione scientifica in grado di far vivere agli studenti un giorno da ricercatori.**

**A L'Aquila l'iniziativa si svolgerà presso i Laboratori Nazionali del Gran Sasso e sarà rivolta a 60 studenti dell'ultimo triennio delle scuole secondarie di secondo grado delle province di L'Aquila e Teramo. Alcuni seminari,**



**Italy, 17 Nov 2018**

## Четири училища се събират в Смолян за майсторски клас на ЦЕРН

# IPPOG In The Media

## Giornata Internazionale delle Donne nella Scienza: l'INFN partecipa con numerose iniziative

Si celebra l'11 febbraio la Giornata Internazionale per le Donne e le Ragazze nella Scienza

A cura di Filomena Fotia 5 Febbraio 2019 10:11



Anche quest'anno l'INFN partecipa all'International Day of Women and Girls in Science con numerose iniziative.

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NAPOLI V LAZIO V

**UNIBO** **MAGAZINE**  
ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA

Home • Incontri e iniziative • Lezioni ed esperimenti di fisica come al CERN per gli studenti delle superiori

25 Febbraio 2019

**Lezioni ed esperimenti di fisica come al CERN per gli studenti delle superiori**

Torna all'Unibo l'iniziativa internazionale che porta gli studenti delle scuole superiori in un viaggio nel cuore della materia e alla scoperta dell'infinitamente piccolo.



**Lunedì 25 e martedì 26 febbraio** studenti delle scuole superiori dell'Università di Bologna parteciperanno a una giornata di come funzionano i grandi esperimenti di fisica che lavorano al CERN. L'Alma Mater torna infatti **Masterclass**, l'iniziativa coordinata in Italia dall'**Istituto Nazionale di Fisica Nucleare (INFN)**, che porta quasi 3500 studenti di tutta Italia nelle università, dove verranno accompagnati dai ricercatori in un viaggio alla scoperta delle proprietà delle particelle ed esploreranno i segreti della grande macchina LHC (Large Hadron Collider) del CERN, dove nel luglio 2012 è stato scoperto l'ormai celebre bosone di Higgs.

In primis  
climat

# IPPOG In The Media

**Jornal da USP**

CIÊNCIAS | TECNOLOGIA | EDUCAÇÃO | CULTURA | ATUALIDADES | UNIVERSIDADE | INSTITUCIONAL

Home > Universidade > Na USP, jovens descobrem como é trabalhar com física de partículas

Universidade - 26/03/2018

## Na USP, jovens descobrem como é trabalhar com física de partículas

No Instituto de Física, alunos do ensino médio vão interagir com pesquisadores de outros países e com os pesquisadores do Cern

Por Redação - Editorias: Universidade - URL Curta: [usp.br](#)

f t in + Curtir 86

**Brazil, 26 Mar 2019**



Alunos durante a Masterclasses de 2017, realizada no Instituto de Física da USP - Foto: Divulgação/IF

O Instituto de Física (IF) da USP é uma das sedes brasileiras da *International Masterclasses Hands on Particles Physics*, iniciativa que aproxima alunos do ensino médio do cotidiano dos cientistas do Cern, o maior

Takmer 200 stredoškóľákov zo Žilinského kraja sa opäť ponorilo do hlbín sveta častíc



Foto: Otvorenie 15. ročníka Masterclasses. Zdroj: Žilinská univerzita v Žiline

Žilinská univerzita bola 3. apríla 2019 hostiteľom už 15. ročníka Majstrovských tried v časticovej fyzike – Masterclasses. Účastníci sa na jeden deň ponorili do fascinujúcej oblasti časticovej fyziky. Základnou myšlienkou programu je nechať študentov, aby čo najviac pracovali ako skutoční vedci.



# IPPOG In The Media

**Novinky.cz**  [Hledaj](#) | [Přihlásit](#) | [Seznam.cz](#)

[Hlavní stránka](#) » [Věda a školy](#) Podrubriky: [Vzdělávání](#)

## Středoškoláci budou na ČVUT pátrat po půvabných částicích

Pracovat na mezinárodních výzkumech Evropské organizace pro jaderný výzkum (CERN) se sídlem ve švýcarské Ženevě má šanci každý žák střední školy. Stačí se zúčastnit 14. mezinárodního programu "Masterclasses - Hands on Particle Physics". U ovom obrazovno-istraživačkom programu će u okviru 225 naučnih institucija aktivno učestvovati oko 13000 učenika iz 55 zemlji širom sveta.

U Srbiji će Međunarodni čas za 2019. godinu (MC) biti održan u vremenu od 09.30 do 17.00 časova:

- 2. aprila na Fizičkom fakultetu u Zagrebu,
- 3. aprila na Departmanu za fiziku u Novom Sadu,
- 4. aprila na Departmanu za fiziku u Nišu,
- 6. aprila na Institutu za fiziku u Kragujevcu.

Prijavu za učesnike učenički list popuniti online na [web stranici programa](#) (u delu za registraciju). Prijavu za program je potrebno popuniti do **nedelje 31. marta 2019. godine** (do 12 časova).

Prvi deo programa obuhvata **uvodna izlaganja o teorijskim i eksperimentalnim aspektima elementarnih čestica i njihovih interakcija**. Drugi deo programa se sastoji od **vežbi koje uključuju analizu podataka i identifikaciju čestica** na osnovu eksperimentalnih događaja evidentiranih na eksperimentima u CERN-u.

**Čzech Rep. 26 Feb 2019**



úterý 26. února 2019, 15:32  
fš, Novinky

▲ Součástí akce ČVUT bude i experiment na urychlovací častici. Ilustrační foto

**REKLAMA**

**DATART**

**CHYTRÉ HODINKY**  
[vice zde >](#)

▼ Komerční sdělení

[Zadejte svou adresu a ověřte si dostupnost i nabídku rychlosti](#)

[Naši zákazníci šetří dlouhodobě. Zvažte změnu a ušetřete také!](#)

**MND**

[Home](#) > [Događaji](#) > CERN Masterclass 2019 u Srbiji

## CERN Masterclass 2019 u Srbiji

[SVET NAUKE](#) 18. 03. 2019. [Događaji](#)

U periodu od 7. marta do 16. aprila 2019. godine pod pokroviteljstvom CERN-a i grupe **IPPOG** (International Particle Physics Outreach Group) održaće se **14. međunarodni program "Masterclasses - Hands on Particle Physics"**. U ovom obrazovno-istraživačkom programu će u okviru 225 naučnih institucija aktivno učestvovati oko 13000 učenika iz 55 zemlji širom sveta.


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**Serbia, 18 Mar 2019**



# IPPOG In The Media

MEĐUNARODNI ČAS FIZIKE POMOGAO U ODABIRU

## Žele da se bave naukom: David će studirati automatiku, Milici je zanimljiva struja

Međunarodni čas zainteresovao crnogorske srednjoškolce da se bave naukom

3741 pregleda · 2 komentar(a)



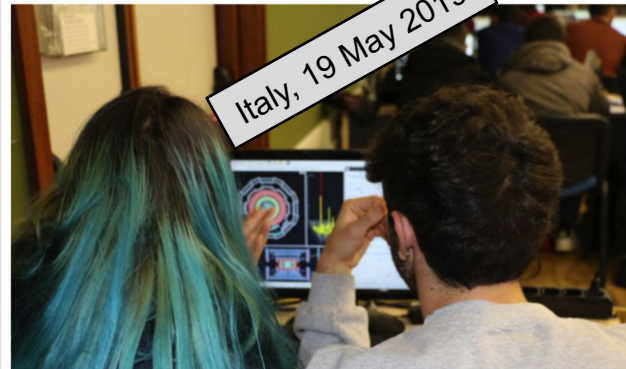
Mladi fizičari: David Pantović i Milica Sošić (Foto: Luka Zeković)

## Studenti delle superiori alle prese con i dati del CERN a Cosenza

Cosenza: sono 120 gli studenti delle scuole superiori calabresi che dopodomani potranno fare esperienza diretta di come funzionano le ricerche dei fisici del CERN nell'Università della Calabria

18 Marzo 2019 12:16 | Danilo Loria

Like 138K



Sono 120, quest'anno, gli studenti delle scuole superiori calabresi che dopodomani (20 marzo) potranno fare esperienza diretta di come funzionano le ricerche dei fisici del CERN nell'Università della Calabria, grazie all'iniziativa Masterclass, coordinata in Italia dall'Istituto Nazionale di Fisica Nucleare (INFN) e realizzata in collaborazione con l'Ateneo calabrese. I ragazzi

bet365			
Gioca responsabilmente 18+			
EIBAR V BARCELONA		MILAN V FROSINONE	
LIVE	45:00 2-2	DOM	18:00
1	4.75	1	1.14
X	3.20	X	8.50
2	1.83	2	17.00
JUVENTUS V ATALANTA		NAPOLI V INTER	
DOM	20:30	DOM	20:30



# IPPOG In The Media

HN Science

HOME MEDICÍNA BIOLÓGIA A CHÉMIA KLÍMA A FYZIKA ASTRONÓMIA A VESMÍR NOVE

## Príbehy vedkýň a vlastné experimenty. CERN láka dievčatá na fyziku

SAN

11.02.2019, 22:25

DISKUSIA

Dnešný deň patril všetkým ženám a dievčatám, ktoré majú príležitosť navštíviť Európske laboratórium jadrového výskumu (CERN) a zúčastniť sa na Medzinárodnej skupine popularizácie fyziky (IPPOG), pripravili niekoľko projektov, na ktorých sa podieľa aj Dr. Barbora Bruant Gulejová.

Slovakia, 11 Feb 2019



Zdroj: CERN

## Colombian students analyse LHC data



CERN Courier, 8 Mar 2019

### Masterclass

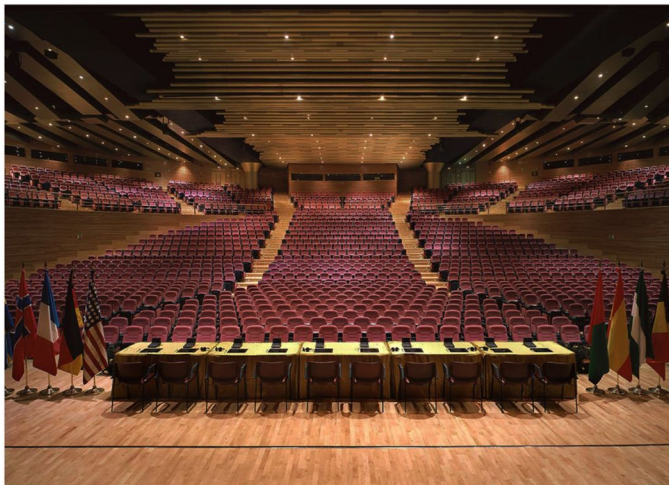
The annual Colombian national high-energy physics conference (COMHEP), held this year in the city of Cali, provided an opportunity for youngsters from the Tecnocentro "Somos Pacifico", an out-of-school activity centre, to participate in a one-off masterclass analysing data from the LHC. The masterclass used the tools and setup from the International Particle Physics Outreach Group (IPPOG) international masterclasses, and was coordinated by ATLAS member Carlos Sandoval from the Universidad Antonio Nariño in Bogotá, and included a virtual visit to the ATLAS control room. The Tecnocentro is in a disadvantaged area of Cali, many of whose inhabitants have been displaced from the countryside by civil conflict.

# IPPOG In The Media

VIEWPOINT

## Strategy update: Communicating the next collider

13 May 2019



*Reaching out* The main auditorium at the Granada Conference Centre, where the update of the European Strategy for Particle Physics is taking place this week. Credit: Palacio de Congresos de Granada.

These days, in certain parts of the world at least, “hadron collider” and “Higgs boson” are practically household names. This is a consequence of the LHC, and the global communications that [surrounded](#) its construction, switch-on and eventual discovery of the Higgs boson. How should the next major project in particle physics be communicated to ensure its reach and success?

CERN Courier, 13 May 2019

<https://cerncourier.com/strategy-update-communicating-the-next-collider/>

# Strategic consideration

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Any new big-scale project to be proposed in particle physics will need concerted, global education, outreach, and communication efforts, with a strong and engaging dialogue with the public and stakeholders, and adequately educating pupils and students at all ages.

To achieve this, physicists are needed who can engage in a scientific collaborative way, together with educators, writers, coders, communicators.

In addition, there is a much wanted side effect when engaging with the public...

# For an Open Dialogue with Society

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As we entered the so-called “post-factual world” emerging from political ideologies in a growing number of modern democracies, it is **more important than ever for science and society to maintain an open and transparent dialogue.**

It has also become evident that the tools and methods currently used to support such a dialogue have not been as successful as we would have hoped.

Indeed, many excellent outreach activities at research centres, universities and museums often attract only those people who are already interested and appreciative of the basic and fundamental relevance of science.

**Without compromising established methods, we must explore new paths to engage citizens** – especially the young.

**While only a fraction of young students will become scientists, and fewer still will become particle physicists, all will become ambassadors for the scientific method and evidence-based decision-making.**

— HP Beck

CERN Courier (March 2017)



# IPPOG – Enabling Outreach globally

a strategic pillar for future particle physics ...  
and society

