Modern Science in the Classroom

Dr. Sascha Marc Schmeling

CERN – European Organization for Nuclear Research

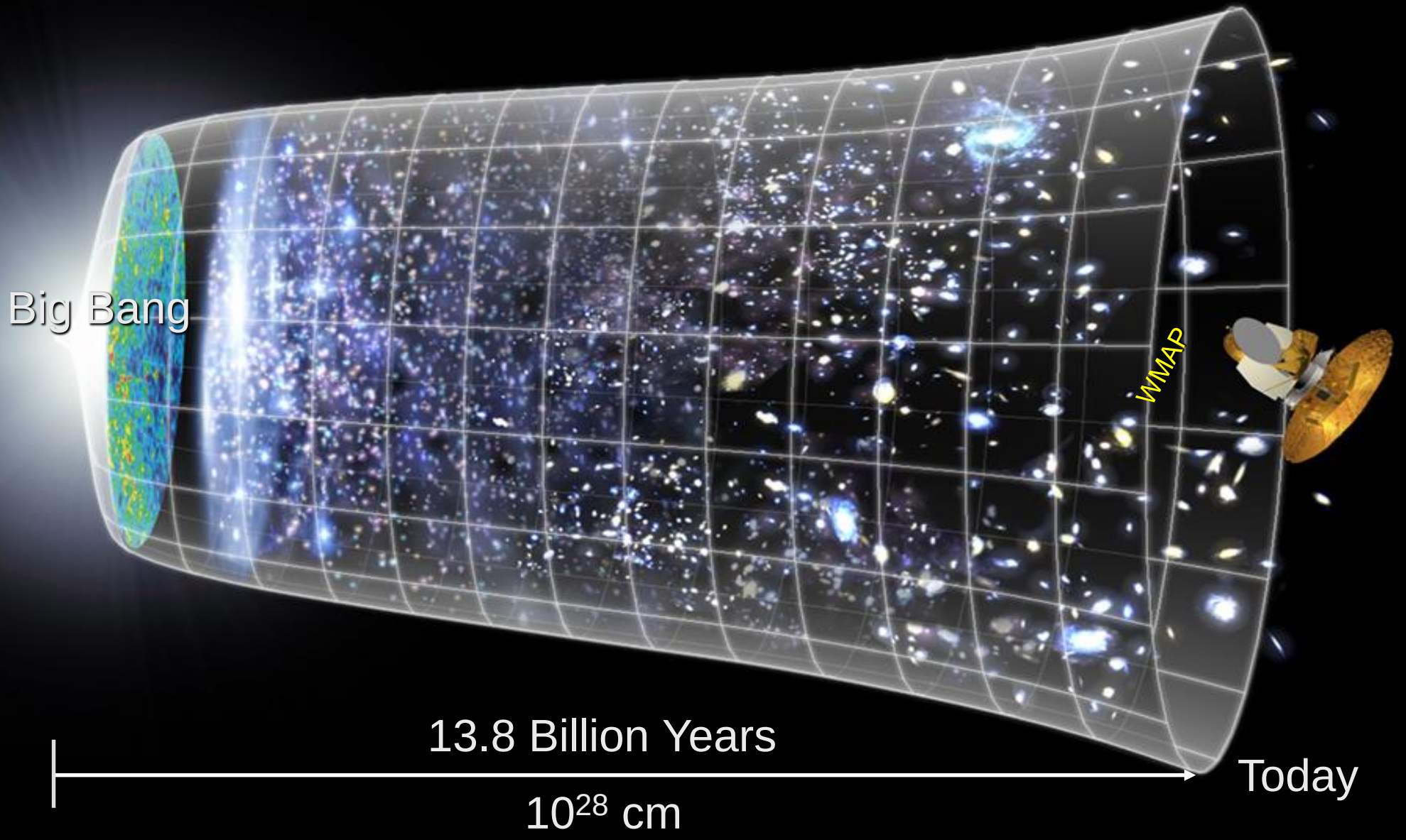
UN/Austria Symposium

"Access to Space: Holistic Capacity-Building for the 21st Century"

Graz, September 2017

Scientific Challenge:

Explore the Evolution of the Early Universe



CERN was founded in 1954 by 12 European States

"Science for Peace"

Today there are 22 Member States

~ 2.514 staff (all numbers dated 31.12.2016)
~ 2.000 other paid personnel
~12.400 users
Budget (2017) ~1.142 MCHF

Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom

Associate Member States: India, Pakistan, Turkey, Ukraine; States in Accession to Membership: Cyprus, Serbia, Slovenia

Interested States: Australia, Brazil, Canada, Croatia, Ireland, Lithuania, Republic of Korea, Russian Federation

Observers to Council: Japan, Russian Federation, United States of America; EUCOM, JINR, and UNESCO

- Push back the frontiers of knowledge
  - unveil the secrets of the Big Bang
  - understand the universe
- Develop new technologies
  - create the opportunities to perform fundamental research
- Train the scientists and engineers of tomorrow
  - make the research sustainable
- Unite people from different countries and cultures
  - use science as a means of “universal” communication

CERN Convention

Article II. Purpose

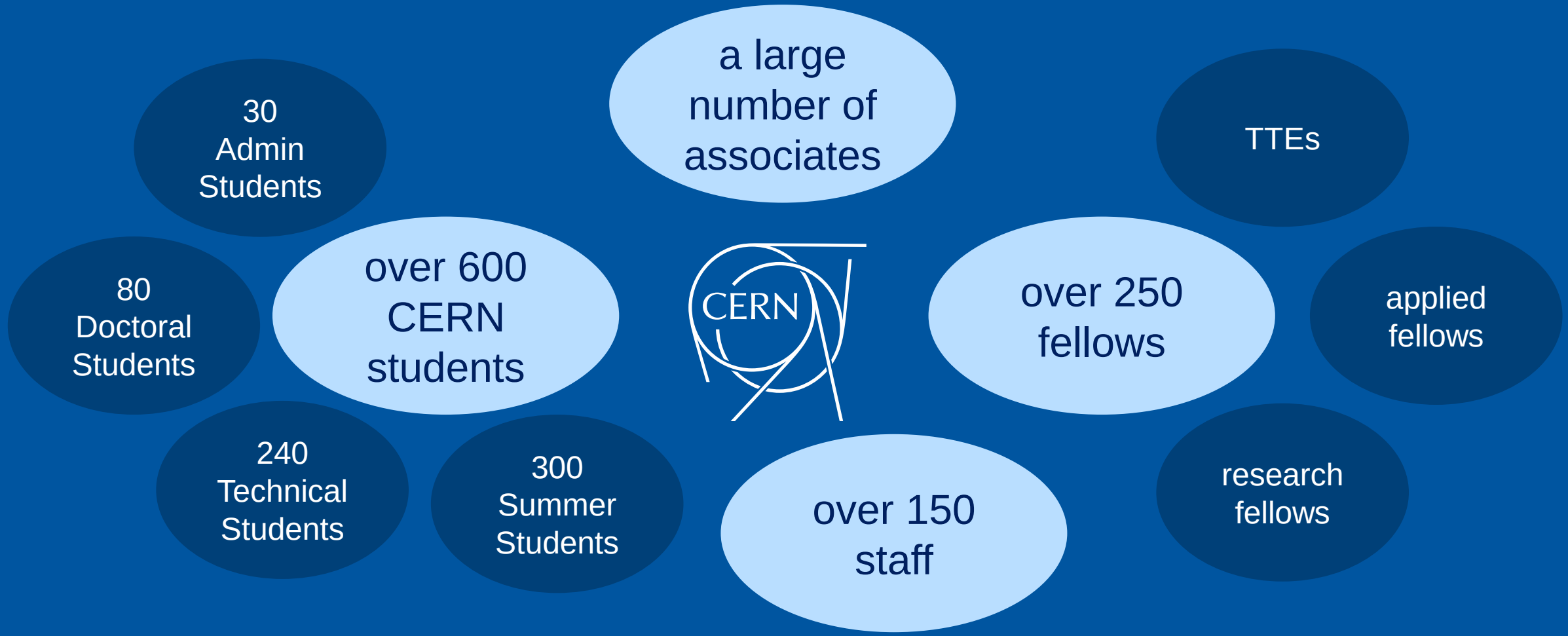
2. The Organization shall […] confine its activities to the following: […]

b. the organization and sponsoring of international co-operation in nuclear research, including co-operation outside the Laboratories; this co-operation may include […]

ii. […] **the dissemination of information** and **the provision of advanced training** […]

CERN’s Mission

Every year …


a large number of associates
30 Admin Students
TTEs
over 600 CERN students
CERN
over 250 fellows
80 Doctoral Students
applied fellows
240 Technical Students
300 Summer Students
over 150 staff
research fellows

EPPCN

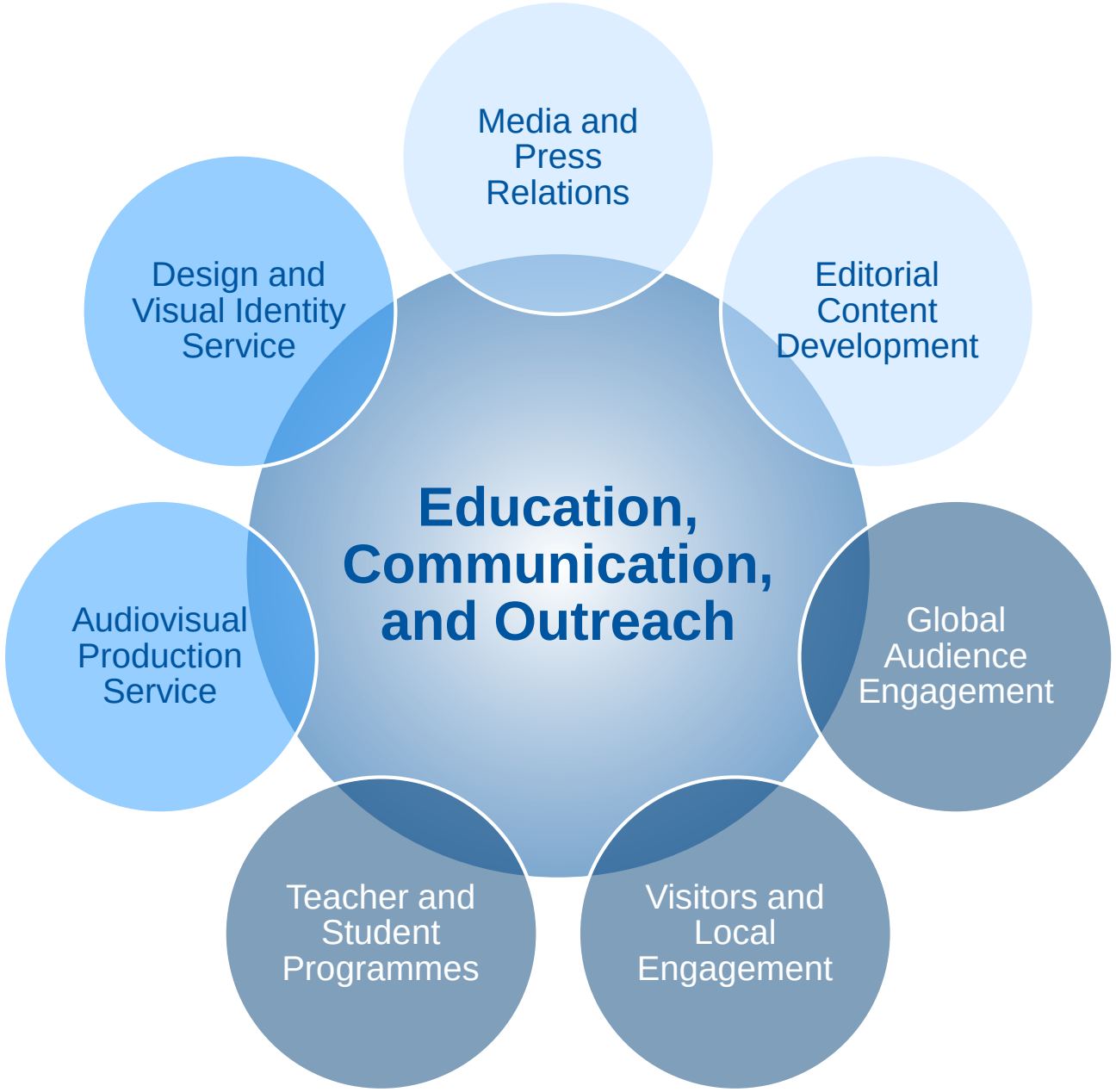
European
Particle Physics
Communication
Network

International Particle
Physics Outreach Group

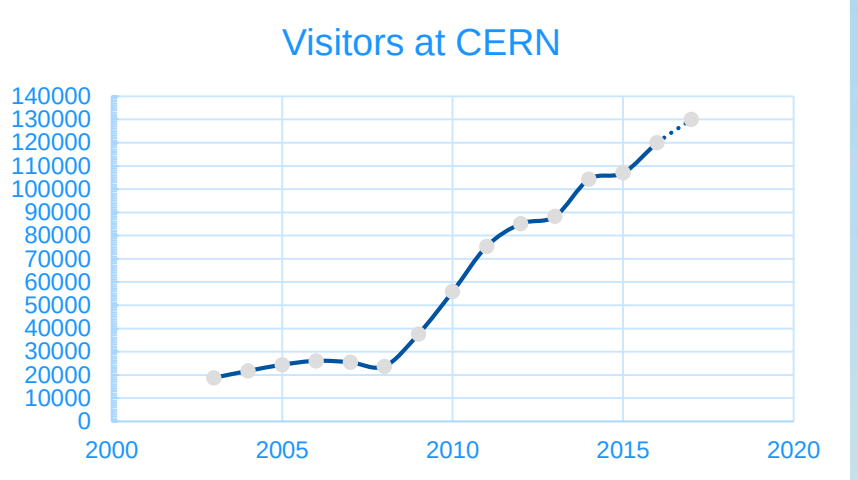
CERN

International Relations Sector

Secteur Relations Internationales

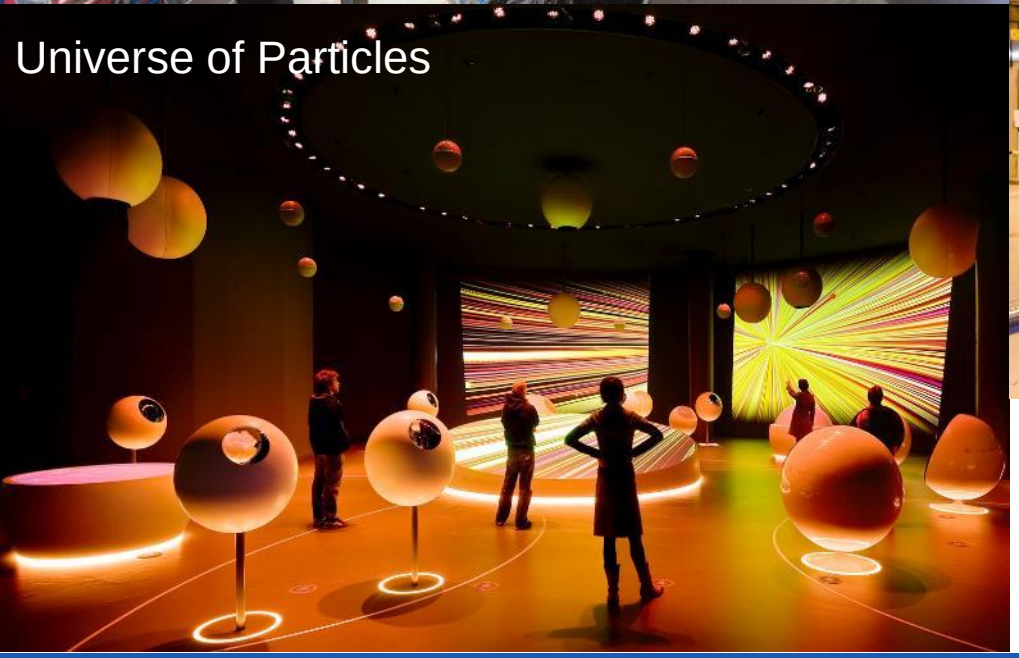


Education, Communication, and Outreach @CERN



Various activities for locals, regionals, and, internationals on the CERN sites.

Visiting CERN • A Classical Approach



Creation of

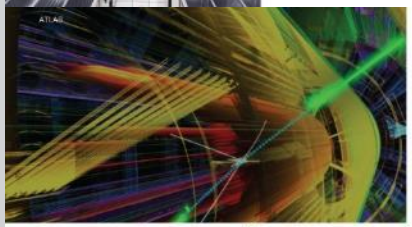
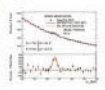
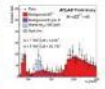
- immersive exhibitions
- interactive visits points

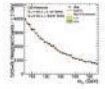
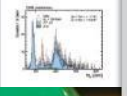
Visiting CERN • A Classical Approach cont'd

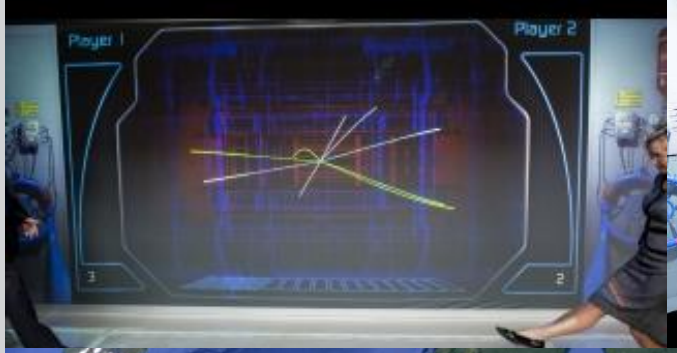






Travelling Exhibitions • Another Classical Approach

How to bring Modern Science into the Classroom?

Several steps to integrate modern science …

… activate and motivate teachers …

… instil curiosity in high-school students and motivate them …

… convince countries to include science into the curricula.

CERN Teacher Programmes

National Teacher Programmes | International Teacher Programmes | Contact

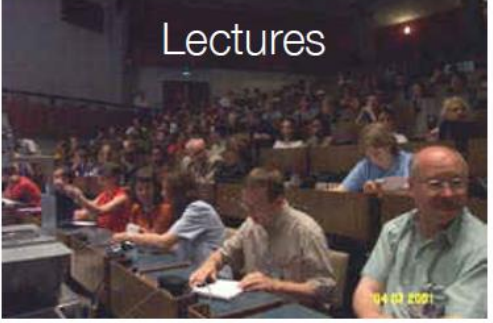
"There is nothing more enriching and gratifying than learning." [Fabiola Gianotti, CERN Director-General]

Every year, CERN offers various professional development programmes for teachers to keep up-to-date with the latest developments in particle physics and related areas, and experience a dynamic, international research environment. All programmes are facilitated by experts in the field of high energy physics and include an extensive lecture and visit itinerary.

Furthermore, CERN's teacher programmes enable you to meet with teaching colleagues from your country or from all around the World. We offer teacher programmes in English or in one of the national languages of CERN Member States, lasting between 3 days and 3 weeks. Take part!

National Teacher Programmes & International Teacher Programmes

Teacher Programmes



10.000th participant in last year's HST

National Teacher Programmes in the language of the country | 4-6 days

focus on visits and lectures

International Teacher Weeks in English | *2 weeks*

new started this year

focus on visits and lectures

International Teacher Programme "HST" in English | 3 weeks

focus on collaboration

Teacher Programmes

International Relations Sector
Secteur Relations Internationales

Teacher Programmes

2017

~35 National Language Teacher Progr

4-6 days

va

In

A

E

These teachers are all connected through an alumni network, helping to raise awareness of all educational tools and ideas across the world!

	8	anada	9	Ghana	6	Malta	36	Sao Tome	7	Uganda	3
	7	Cape Verde	4	Guinea Bissau	1	Mexico	27	Saudi Arabia	1	U.A.E.	1
Armenia	1	Chile	3	Iran	7	Mongolia	1	Singapore	2		
Australia	7	China	2	Ireland	8	Montenegro	15	Slovenia	21		
Azerbaijan	1	Costa Rica	4	Jordan	12	Morocco	2	South Africa	8		
Bahrain	2	Croatia	23	Kazakhstan	8	Mozambique	22	South Korea	48		
Belarus	3	Dominican Rep.	71	Kenya	4	Nepal	2	Swaziland	1		
Brazil	187	Ecuador	2	Latvia	25	New Zealand	2	Taiwan	1		
Burundi	2	Egypt	2	Lebanon	1	Palestine (O.T.)	4	Thailand	14		
Cameroon	5	Estonia	79	Lithuania	51	Qatar	1	T.F.Y.R.O.M.	12		
	68	Georgia	121	Madagascar	2	Rwanda	20	Timor-Leste	9		

	8		
sia	379		
USA	102		


S'Cool
LAB
There is always a way to do it
better... find it!
If you can't explain it simply,
you don't understand it well enc

What is S’Cool LAB?

S'Cool LAB

HANDS-ON PARTICLE PHYSICS LEARNING LABORATORY

For high-school students and teachers
International audience from more than 20 countries
Independent experimentation in small groups

S'Cool LAB

TEST BED FOR PHYSICS EDUCATION RESEARCH

Development and evaluation of student activities accompanied by research in physics education

Aims of S’Cool LAB

Make CERN’s physics and technologies understandable to students through hands-on experimentation

Give insights into the working methods, technologies, and research of the world's largest particle physics laboratory

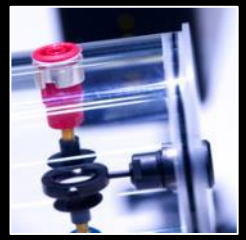
Experiments

Particle Acceleration

electrons & electric fields

supercon-ductivity

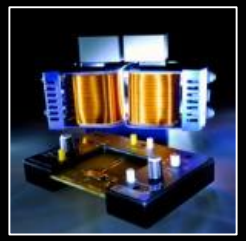
electrons & magnetic fields



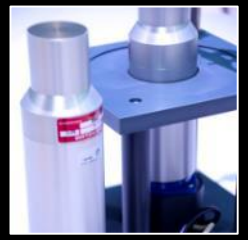
particle traps

Basics & Applications

HALL effect



FRANCK-HERTZ experiment



PET

RUTHER-FORD experiment

PLANCK's constant

X-ray machines

Particle Detection

cloud chambers

scintillation detectors

pixel detectors (MEDIPIX)

ionisation chambers

… and many more to come

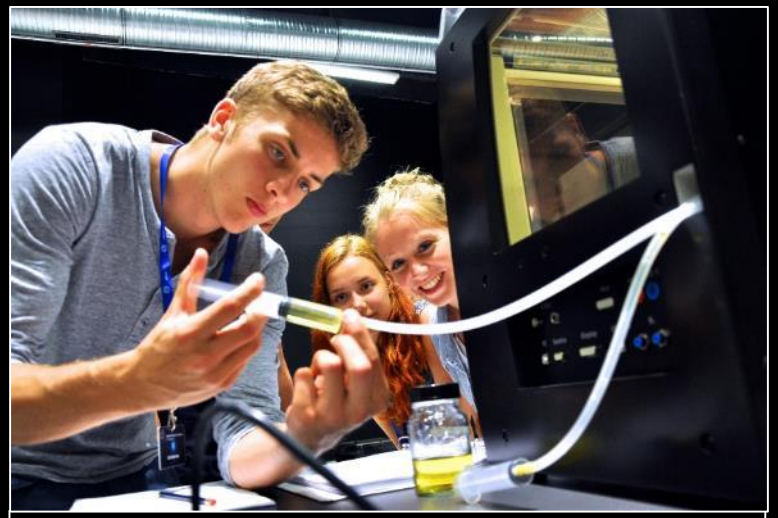
Current opportunities

S’Cool LAB Days

A full-day programme of hands-on particle physics experiments & CERN tours for groups of high school students aged 16-19.

1000 participants in 2016

Summer CAMP



A two-week residential particle physics summer camp for 24 high school students aged 16-19 from all around the world.

first camp in 2017
24 participants

Cloud Chamber WS

A 90-minute hands-on particle physics workshop for high school students (aged 14 and above) and teachers.

4400 participants in 2016
(3400 students & 1000 teachers)

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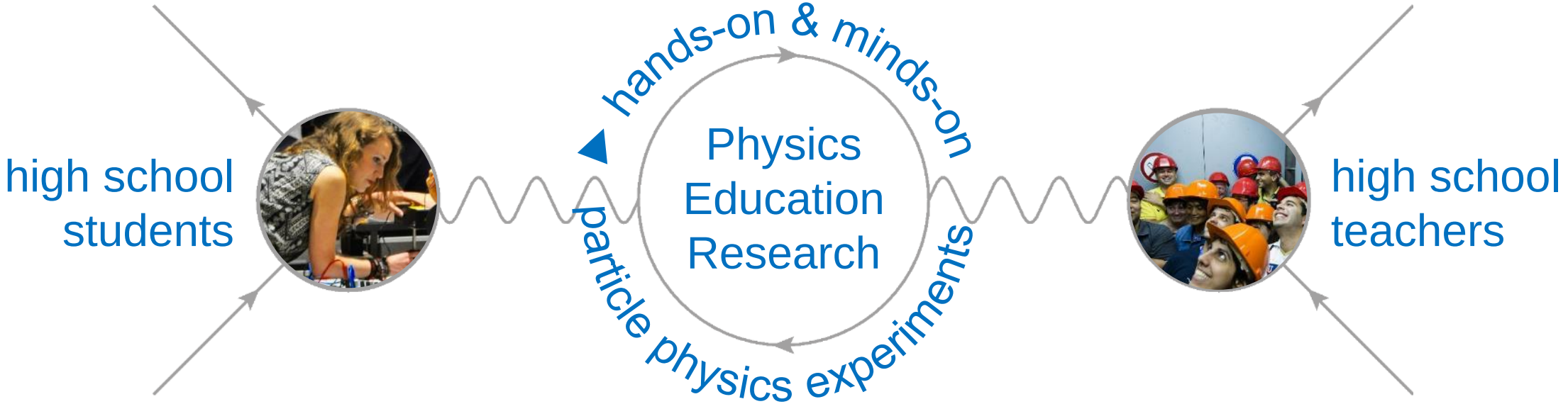
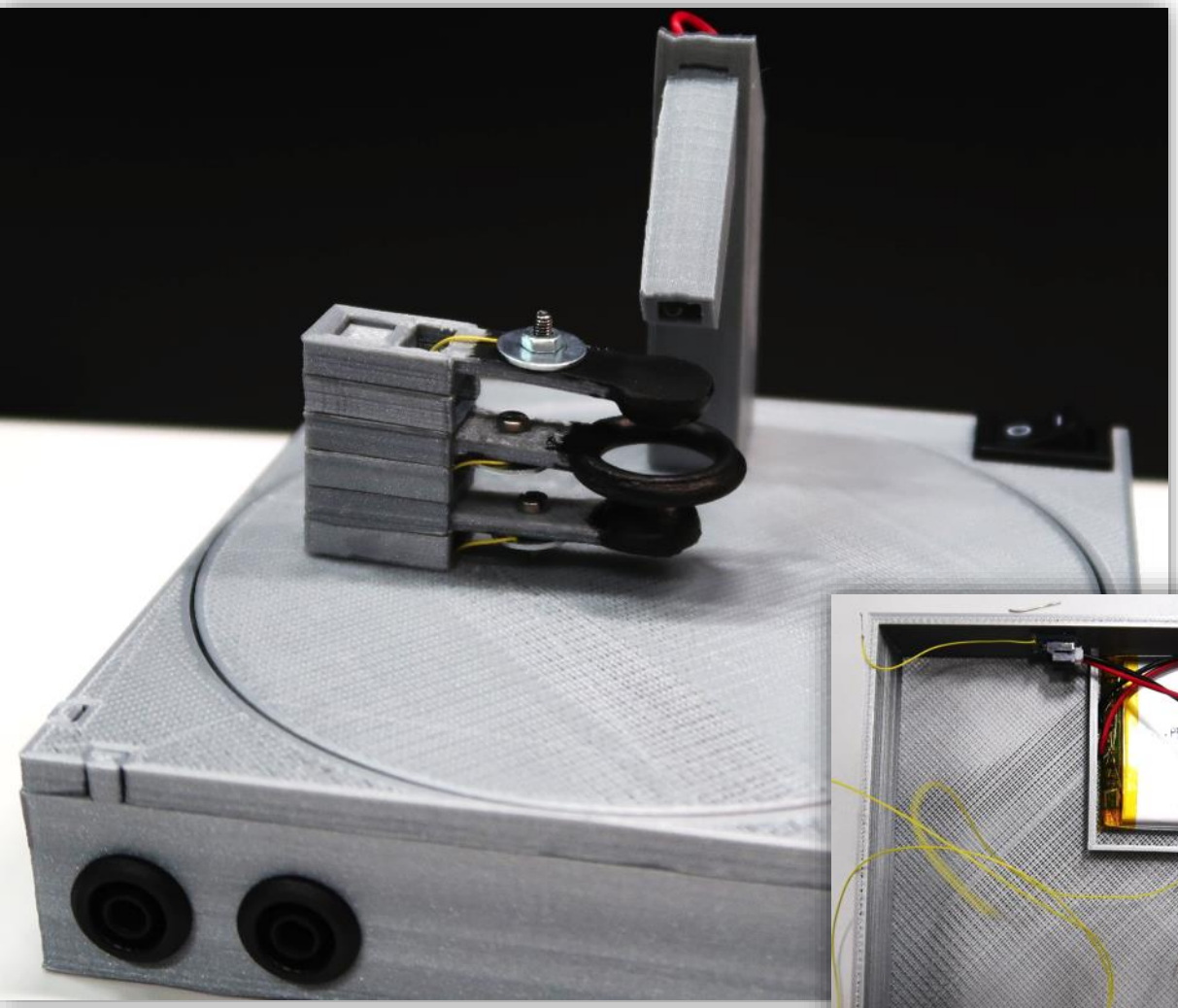
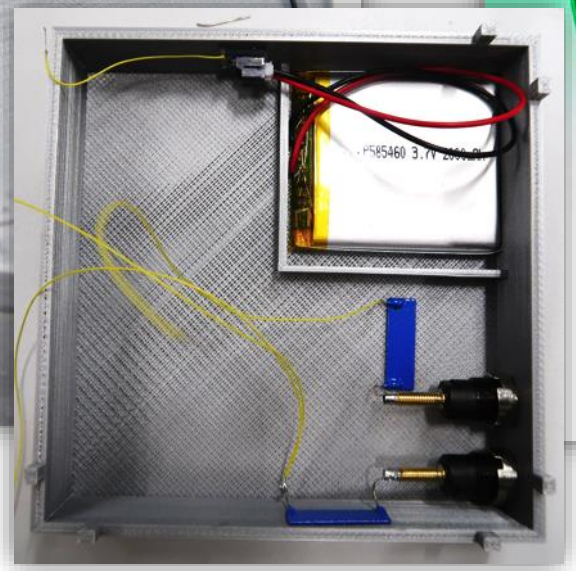
S'Cool LAB

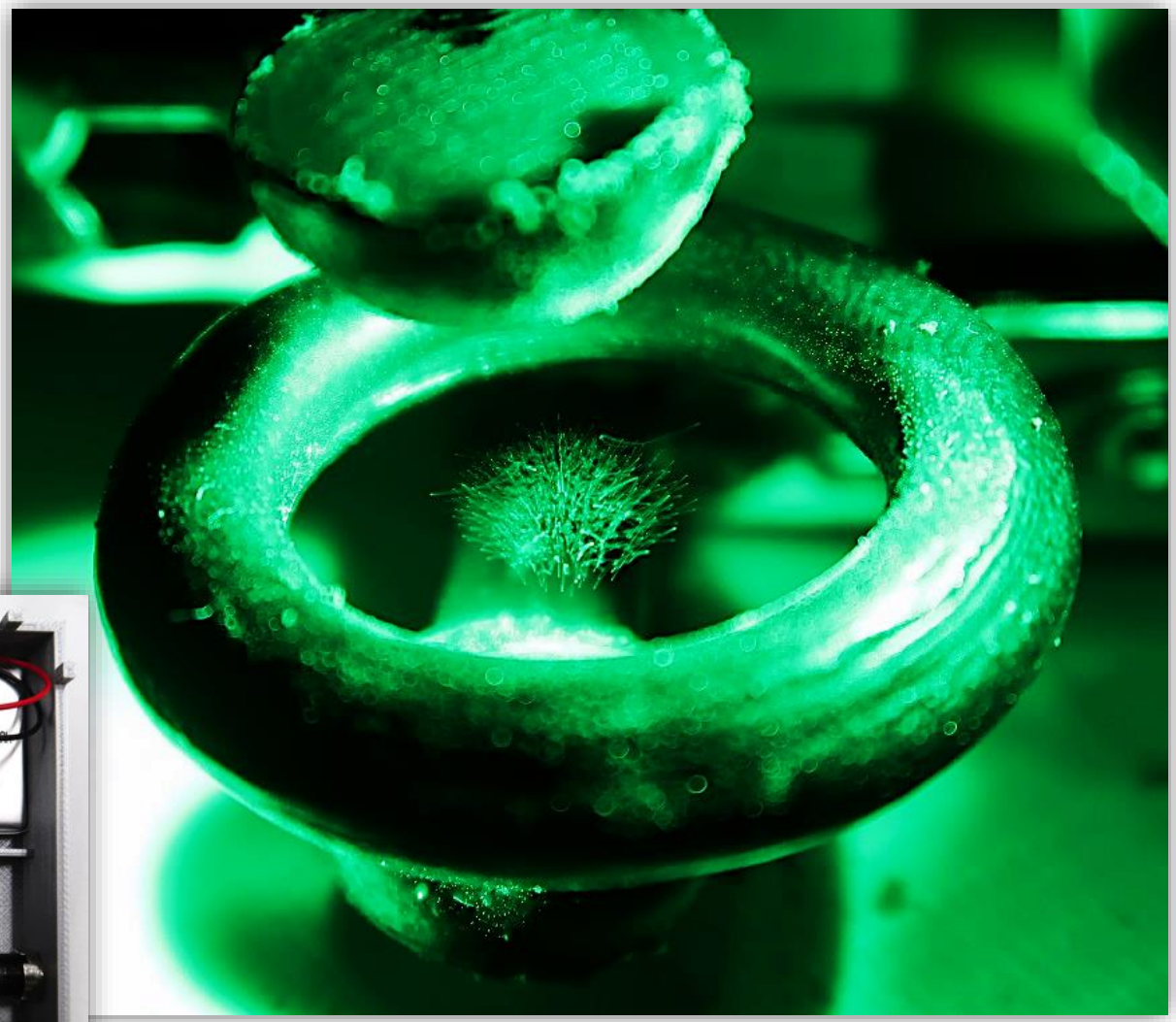


- apart from the public opportunities
  - development of new hands-on experiments
  - research possibilities for master and doctoral students
  - development of 3D-printables

3D-printed Paul Trap







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High-School Students Internship Programme

- Idea
  - give high school students the possibility to experience work at an international research laboratory
    - work shadowing
    - own projects
    - own insights
    - frame programme to show the laboratory and International Geneva
  - up to 24 high school students from one country come for a two week internship
    - lodged in the CERN Hotel
  - five pilot countries for 2017

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Information

- Content
  - special offers for teachers and students
    - Teacher Programmes
    - S'Cool LAB
    - High School Students Internship Programme
    - Beamline for Schools

- Target Audience
  - visitor groups
  - teacher programme participants
  - member state representatives

http://cern.ch/go/N9cn

Did you know that CERN offers more than just tours of its premises? Check out our educational programmes and get inspired to join one!

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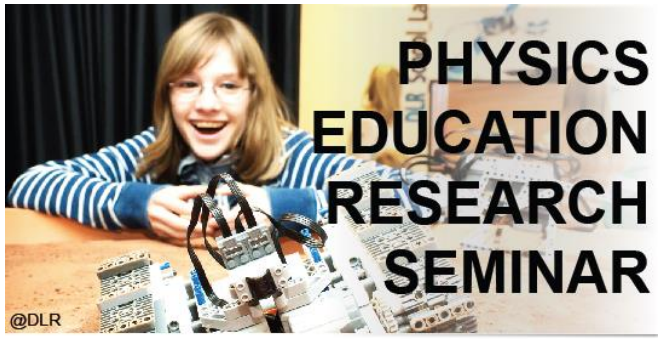
Physics Education Research

- Current and *Upcoming* Research Subjects/Thesis
  - Elementary Particle Physics in Early Physics Education
  - Affective and Cognitive Outcomes of OSLePs
  - Cosmology in the Classroom
  - eLearning as Preparation for OSLeP Experience
  - Development of a Radiation Detector for School Use
  - Radiation as Topic in High School Education
  - *Evaluation of International Teacher Programmes*
  - *Low-cost Modern Physics Experiments*
  - *Table-top Accelerators*
  - *Gamification of Modern Physics*

- Research Seminar



DLR_School_Labs

Out-of-school Learning Labs operated by the German Aerospace Center DLR

by **Tobias Bohnhardt** (DLR_School_Lab Berlin) &
Tobias Schüttler (DLR_School_Lab Oberpfaffenhofen)

Thursday 9 Feb 2017
16:00 → 17:30

503-1-001
Council Chamber

This seminar will give an insight into the out-of-school learning labs in Oberpfaffenhofen and Berlin (**DLR_School_Labs**) operated by the **German Aerospace Center (DLR)**. In the second part of the colloquium we will focus on the research of out-of-school learning places, including the impact on student's attitude towards natural sciences.

indico.cern.ch/e/dlr_school_labs

organised by the Teacher & Student Programmes Section (P-E-R@cern.ch)

- Publications
  - currently (and in the future) papers are published in various journals
  - from this year onwards, we are co-publishing a multilingual scientific journal on physics education as an open access journal at CERN – **PriSE**

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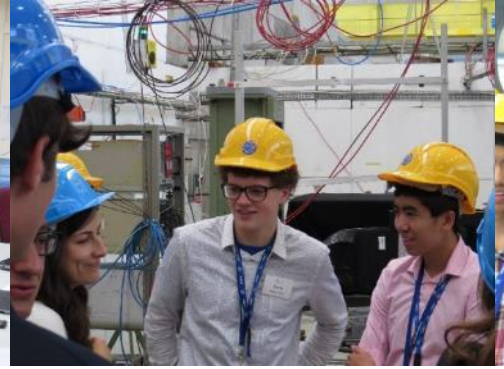
Teacher and Student Forum

- CERN management together with Council wants to strengthen the ties between CERN activities and activities in the Member States
- Forums with thematic focus have/are being created

- 1st meeting of the Teacher and Student Forum
  - December 2016 Council Week
  - most member states have sent members
  - CERN Educational Activities presented
  - selected countries presented

- further meetings March+September Council Weeks


beamline for schools
cern.ch/bl4s
powered by CERN

BL4S is a worldwide competition for teams of high school students, aged at least 16 years and guided by a teacher, to use a fully equipped beam line at CERN's Proton Synchrotron

Teams have to design an experiment which uses a particle beam. They have to submit a written proposal and a one-minute video

The main goal is to motivate the students to learn about physics by treating them as if they were professional scientists

Launch: summer, proposal submission: 31 March of the following year

Beamline for Schools

2014
Odysseus' Comrades (GR)
Dominicuscollege (NL)

2015
Leo4G (IT)
Accelerating Africa (ZA)

2016
Relatively Special (UK)
Pyramid Hunters (PL)

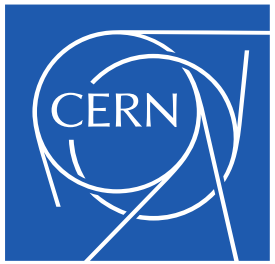
Team “TCO-ASA” from Italy:
Test at CERN a Cherenkov detector that they have build at their school

Team “Charging Cavaliers” from Canada:
Challenge the Standard Model by looking for particles with a fractional charge

Competition Winners 2017

“Magic is not happening at CERN,
magic is being explained at CERN.“

Tom Hanks



www.cern.ch

http://cern.ch/go/9N8Q