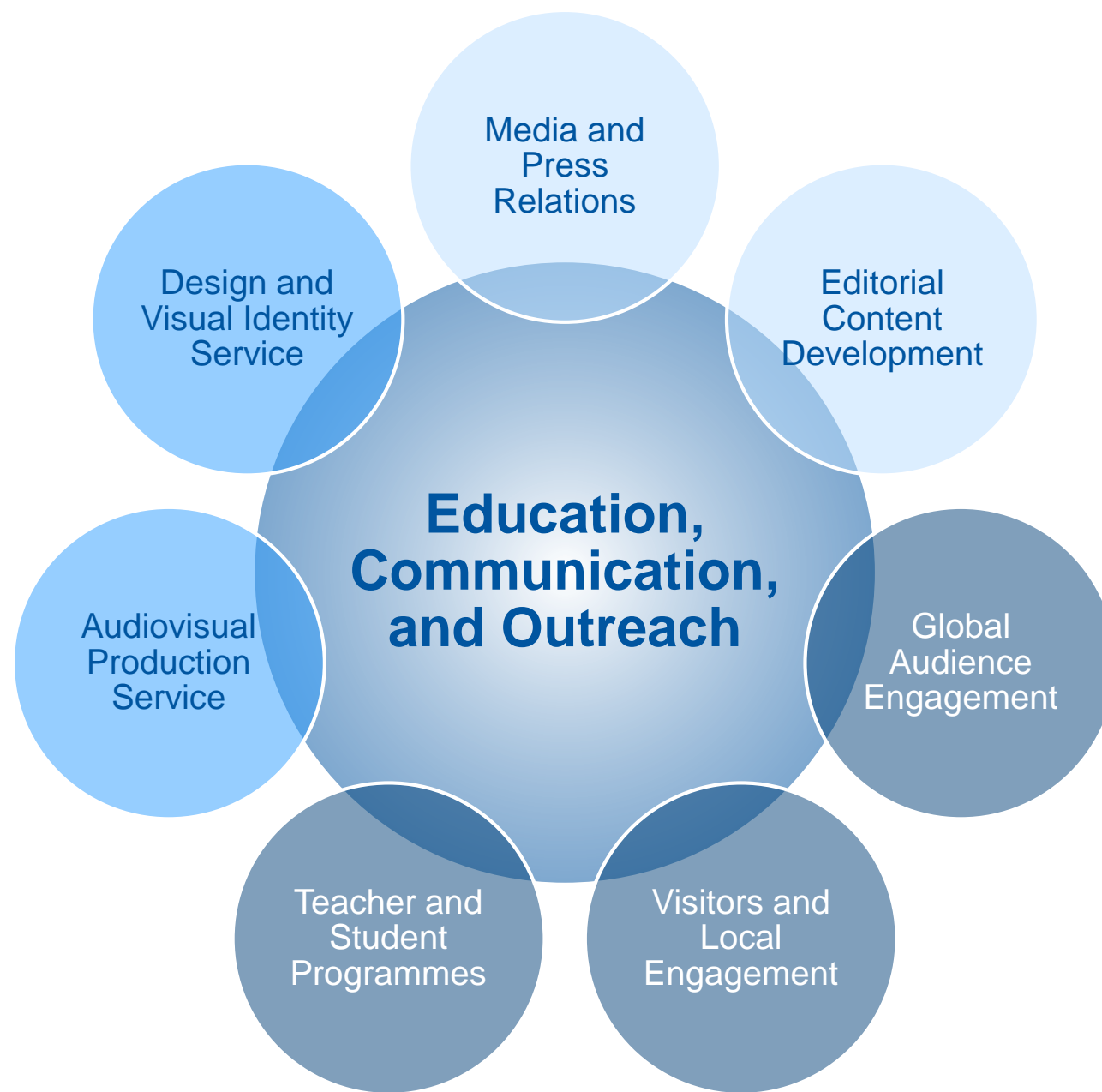


Opportunities for Science Teachers

in
Physics Education
&
Physics Education Research
at
CERN

Dr. Sascha Schmeling
Head of Teacher and Student Programmes



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.

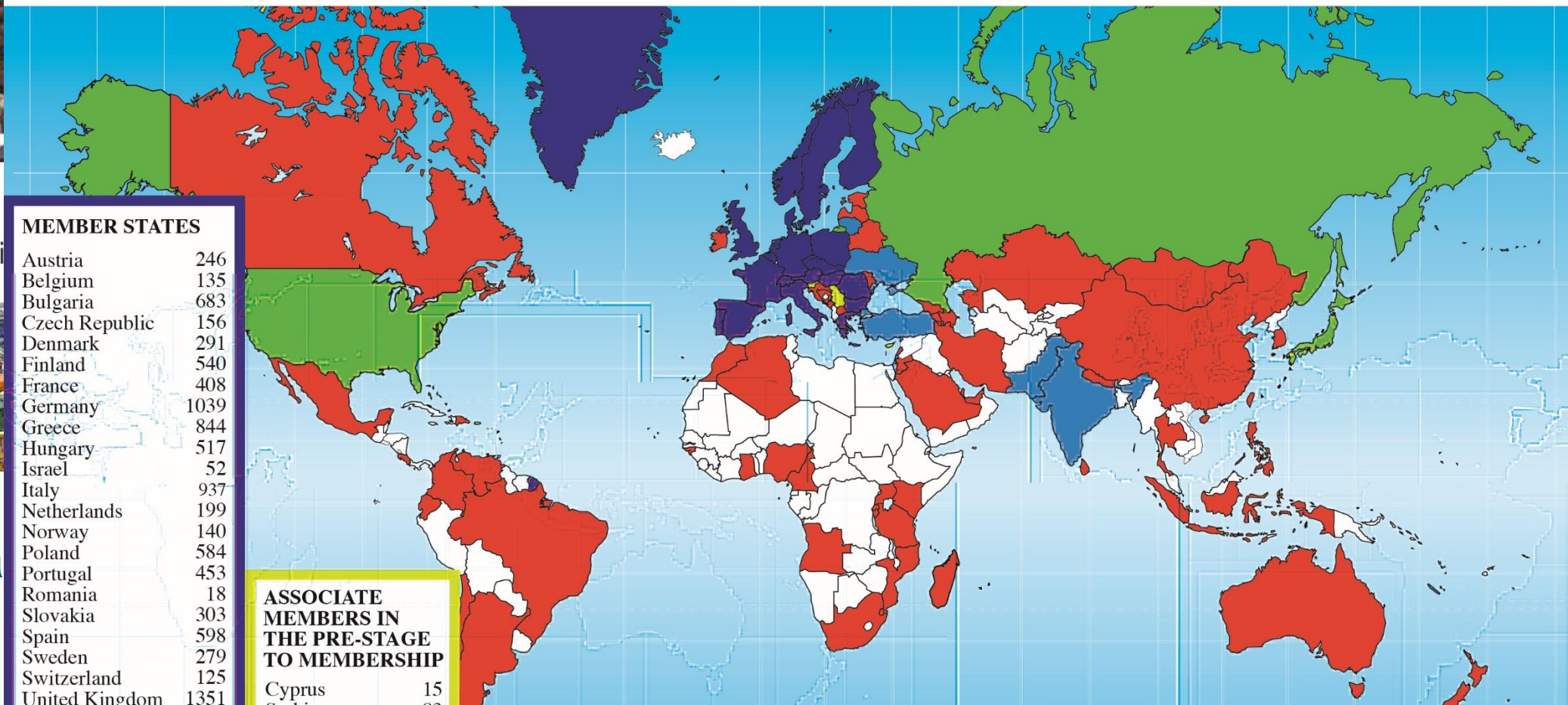
Furthermore, CERN's teacher programmes enable you to meet with teaching colleagues from your country or from all around the World. We offer teacher programmes in English or in one of the national languages of CERN Member States, lasting between 3 days and 3 weeks. Take part!

[National Teacher Programmes](#) & [International Teacher Programmes](#)



Teacher Programmes

Teacher Programme Participants 1998 - 2018 (Total: 12320)



MEMBER STATES

Austria	246
Belgium	135
Bulgaria	683
Czech Republic	156
Denmark	291
Finland	540
France	408
Germany	1039
Greece	844
Hungary	517
Israel	52
Italy	937
Netherlands	199
Norway	140
Poland	584
Portugal	453
Romania	18
Slovakia	303
Spain	598
Sweden	279
Switzerland	125
United Kingdom	1351

9898

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP

Cyprus	15
Serbia	83
Slovenia	21

119

ASSOCIATE MEMBERS

India	10
Lithuania	54
Pakistan	7
Turkey	327
Ukraine	179

577

OBSERVERS

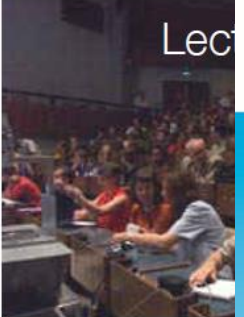
Japan	12
Russia	408
USA	116

536

OTHERS

Algeria	10	Burundi	2	Estonia	92	Lebanon	21	Palestine	5	T.F.Y.R.O.M.	13
Angola	7	Cameroon	9	Georgia	154	Madagascar	2	Philippines	2	Thailand	19
Argentina	2	Canada	14	Ghana	7	Malta	37	Qatar	1	Timor-Leste	9
Armenia	3	Cape Verde	4	Guinea Bissau	1	Mexico	83	Rwanda	20	Uganda	3
Australia	9	Chile	3	Indonesia	3	Moldova	4	Sao Tome	7	U.A.E.	1
Azerbaijan	2	China	2	Iran	12	Mongolia	1	Saudi Arabia	1	Venezuela	1
Bahrain	2	Colombia	2	Ireland	9	Montenegro	16	Singapore	2		
Belarus	8	Costa Rica	4	Jordan	13	Morocco	2	South Africa	8		
Bosnia and Herzegovina	6	Croatia	81	Kazakhstan	14	Mozambique	22	Sri Lanka	2		
Brazil	231	Dominican Rep.	72	Kenya	4	Nepal	3	Swaziland	1		
		Ecuador	2	Korea	49	New Zealand	4	Taiwan	1		
		Egypt	2	Latvia	62	Nigeria	1	Tanzania	1		

1190



0th

ays

National and Multinational Teacher Programmes are organized with

- specific contacts
 - at CERN
 - and in the country/region

At least 9 months in advance

Announce preferred week(s)

- Number of participants
- Funding
- Number of hotel rooms
- Number of external lecturers

Provided the preferred week is available we will reserve rooms at the CERN hotel. Once the reservation is confirmed we will set up the indico website, update the information on the TP website, and enter the preliminary programme into CERN's visit agenda. We will also book lecture rooms.

Please wait for confirmation before publicising the programme!

At least 3 months in advance

Send programme proposal

- Lectures
- Visits
- Social events

We will update the indico agenda accordingly and arrange the visits itinerary with the visits service. Furthermore, we will take care of booking the welcome reception and the official dinner.

Please inform us about any special requests (e.g. visa requirements) as soon as possible!

At least 2 months in advance

Inform external lecturers to contact Maureen for their travel arrangements

We will take care of all travel arrangements and reservations at the CERN hotel for external lecturers. We will also provide them with meal vouchers to be used at CERN's restaurants.

All travel arrangements and hotel reservations have to be made by Maureen!

At least 1 month in advance

Provide final list of participants

- TP spreadsheet
- Fine-tune programme
- Lecturers
- Guides

We will update our reservation at the CERN hotel in accordance with the final list of participants. **Please note: this list needs to be final.** Furthermore, we will prepare the welcome envelopes for the teachers and send the list to the guards to ensure that all teachers can enter the CERN site when they arrive.

Please use the excel template for the list of participants!

During the programme

- Accompany the group
- Facilitate the programme
- Send translations if needed
- Communicate with lecturers & guides

We will prepare the welcome reception, provide the treasure hunt documents (+ treasures), and try to partake in the official dinner. Based on the participants list we will also prepare the official certificates and provide CERN goodie bags for all teachers.

Please let us know if we can help in any way to ensure a smooth running of the programme!

TP Calendar 2019

January	February	March	April	May	June	July	August	September	October	November	December
1 Tu	1 Fr	1 Fr	1 Mo	1 We	1 Sa	1 Mo	1 Th	1 Su Portuguese LTP	1 Tu	1 Fr	1 Su Serbian TP
2 We	2 Sa	2 Sa	2 Tu	2 Th	2 Su Finnish TP	2 Tu	2 Fr	2 Mo	2 We	2 Sa	2 Mo
3 Th	3 Su	3 Su	3 We	3 Fr	3 Mo	3 We	3 Sa	3 Tu	3 Th	3 Su Russian LTP	3 Tu
4 Fr	4 Mo	4 Mo	4 Th	4 Sa	4 Tu	4 Th	4 Su ITW2018	4 We	4 Fr	4 Mo	4 We
5 Sa	5 Tu	Slovenian TP	5 Tu Baltic TP	5 Fr	5 Su	5 We	5 Mo	5 Th	5 Sa	5 Tu	5 Th
6 Su	6 We	6 We	6 Sa	6 Mo	6 Th	6 Tu	6 Fr	6 Fr	6 Su Italian TP	6 We	6 Fr
7 Mo	7 Th	7 Th	7 Su Ukrainian TP	7 Tu	7 Fr	7 Tu	7 Sa HST2018	7 Mo	7 Sa	7 Th	7 Sa
8 Tu	8 Fr	8 Fr	8 Mo	8 We	8 Sa	8 Mo	8 Th	8 Tu	8 Sa	8 Fr	8 Su
9 We	9 Sa	9 Sa	9 Tu	9 Th	9 Su	9 Tu	9 Fr	9 Mo	9 Sa	9 Tu	9 Mo
10 Th	10 Su	10 Su	10 We	10 Fr	10 Mo	10 We	10 Sa	10 Tu	10 Th	10 Sa Swiss TP	10 Tu UK TP
11 Fr	11 Mo	Maltese TP	11 Th	11 Sa	11 Tu	11 Th	11 Su	11 We	11 Fr	11 Mo	11 We
12 Sa	12 Tu	12 Tu	12 Fr	12 Mo	12 We	12 Fr	12 Mo	12 Th	12 Sa	12 Tu	12 Th
13 Su	13 We	13 We	13 Sa	13 Mo	13 Th	13 Th	13 Su	13 Tu	13 Fr	13 We	13 Fr
14 Mo	14 Th	14 Th	14 Su	14 Tu	14 Fr	14 Fr	14 Sa	14 We	14 Mo	14 Th	14 Sa
15 Tu	15 Fr	15 Fr	15 Mo	15 We	15 Sa	15 Mo	15 Th	15 Su	15 Tu	15 Fr	15 Sa
16 We	16 Sa	16 Sa	16 Tu	16 Th	16 Su	16 Tu	16 Fr	16 Mo	16 We	16 Sa	16 Mo
17 Th	17 Su	17 Su	17 We	17 Fr	17 Mo	17 We	17 Sa	17 Tu	17 Th	17 Su	17 Tu Italian TP
18 Fr	18 Mo	18 Mo	18 Th	18 Sa	18 Tu	18 Th	18 Su	18 We	18 Fr	18 Mo	18 We
19 Sa	19 Tu	UK TP	19 Tu	19 Fr	19 Su	19 We	19 Mo	19 Th	19 Sa	19 Tu	19 Th
20 Su	20 We	20 We	20 Sa	20 Tu	20 Fr	20 Th	20 Sa	20 Tu	20 Fr	20 We	20 Fr
21 Mo	21 Th	21 Th	21 Mo	21 We	21 Fr	21 Th	21 Su	21 We	21 Sa	21 Mo	21 Sa
22 Tu	22 Fr	22 Fr	22 Tu	22 Th	22 Sa	22 Mo	22 Th	22 Tu	22 Fr	22 Th	22 Su
23 We	23 Sa	23 Sa	23 We	23 Fr	23 Su	23 Tu	23 Fr	23 Mo	23 We	23 Sa	23 Mo
24 Th	24 Su	24 Su	24 We	24 Fr	24 Mo	24 We	24 Sa	24 Tu	24 Th	24 Su	24 Tu
25 Fr	25 Mo	25 Mo	25 Th	25 Sa	25 Tu	25 Th	25 Su	25 We	25 Fr	25 Mo	25 We
26 Sa	26 Tu	26 Tu	26 Fr	26 Mo	26 We	26 Fr	26 Mo	26 Th	26 Sa	26 Tu	26 Th
27 Su	27 We	27 We	27 Sa	27 Tu	27 Th	27 Tu	27 Fr	27 Tu	27 Fr	27 Su	27 Fr
28 Mo	28 Th	28 Th	28 Mo	28 We	28 Fr	28 Th	28 We	28 Tu	28 Sa	28 Th	28 Sa
29 Tu	29 Fr	29 Fr	29 Tu	29 Th	29 Su	29 Tu	29 Fr	29 Mo	29 Tu	29 Fr	29 Su
30 We	30 Sa	30 Sa	30 We	30 Fr	30 Mo	30 We	30 Tu	30 We	30 Th	30 Mo	30 Mo
31 Th	31 Su	Georgian TP	31 Tu	31 Th	31 Fr	31 We	31 Sa	31 Mo	31 Th	31 Tu	31 Tu

S'Cool
LAB

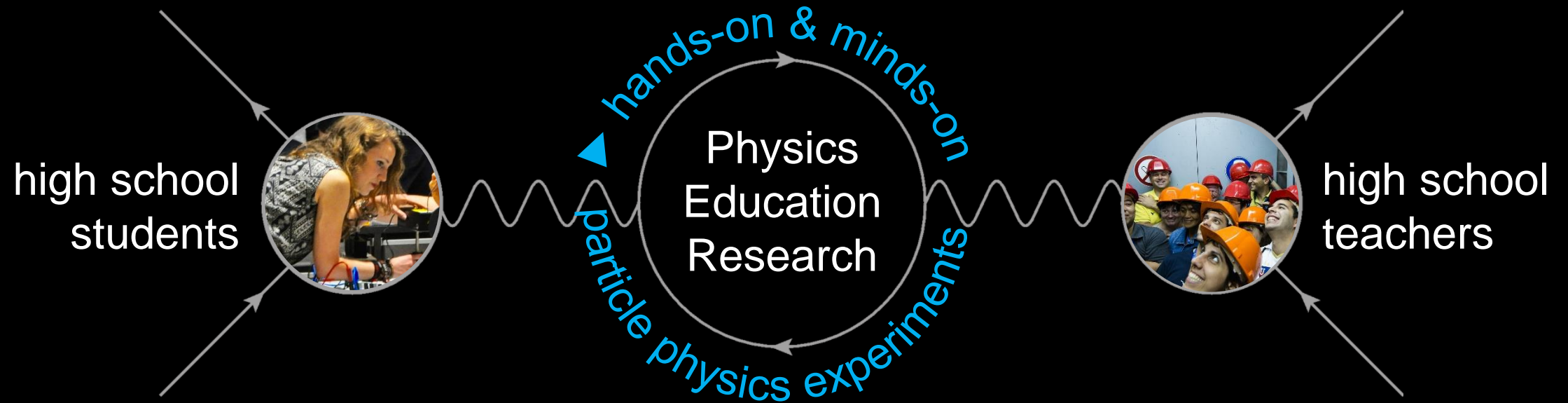
Welcome

There is always a way to do it
better... find it!

If you can't explain it simply,
you don't understand it well enough



What is S'Cool LAB?



TEST BED FOR PHYSICS EDUCATION RESEARCH

Impact of S'Cool LAB workshops, students' conceptions in particle physics, teachers' motivations for field trips, new (low-cost) experiments for classrooms



INTERNATIONAL PARTICLE PHYSICS LEARNING LABORATORY

More than 7000 high-school students and teachers per year from more than 30 countries learning about physics and technologies at CERN









HANDS-ON EDUCATION FOR STUDENTS & SCIENTISTS

Independent experimentation in small groups
guided by diverse CERN volunteers,
Q&A with inspirational role models


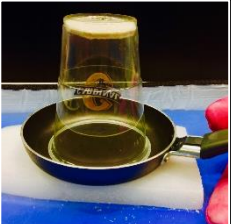

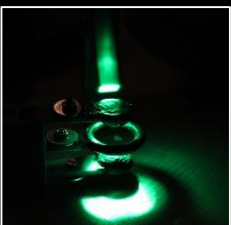

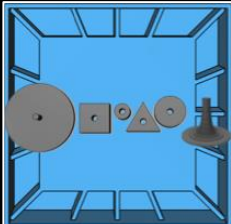


Experiments: High-Tech vs. Low-Cost

In S'Cool LAB: High-Tech

	electrons in magnetic fields		cloud chambers
super- conductivity		pixel detectors	
PET			X-ray machines

For the Classroom: Low-Cost

3D printable magnet models		DIY cloud chambers	
	Bragg peak model		3D printable particle traps
3D compass			Rutherford scattering model

... and many more to come

Aims of S'Cool LAB



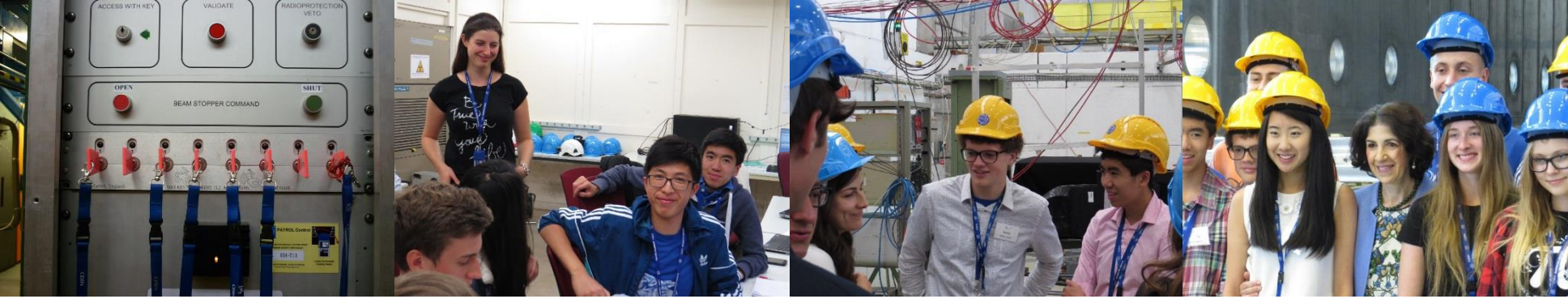
Give insights into the working methods, technologies and research of the world's largest particle physics laboratory



Spread CERN's spirit of science curiosity, foster physics interest and self-concept



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



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)



Winners 2018:
R.N. Podar School, Mumbai, India
International School Manila, Philippines

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



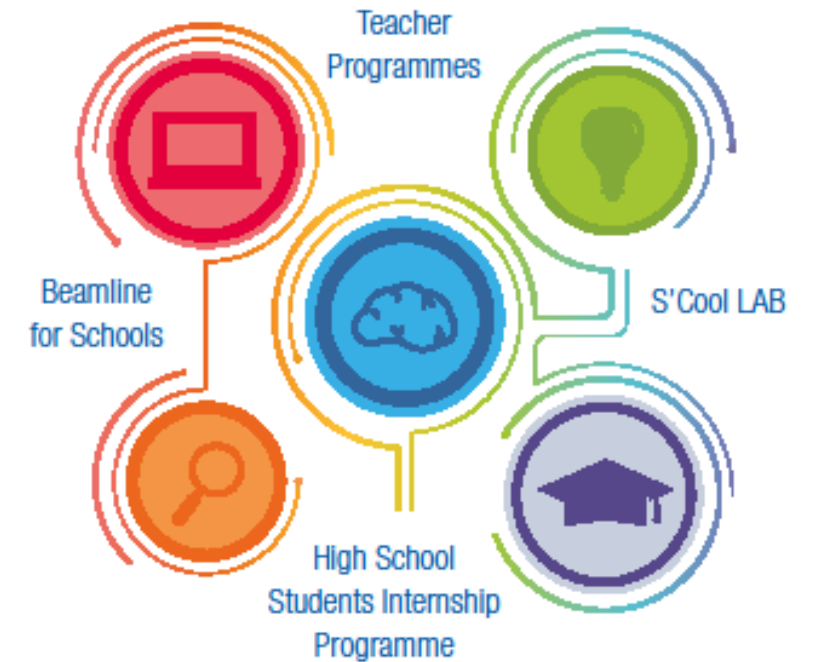
Did you know that CERN offers more than just tours of its premises? Check-out our educational programmes and get inspired to join one!

- Content

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

- Target Audience

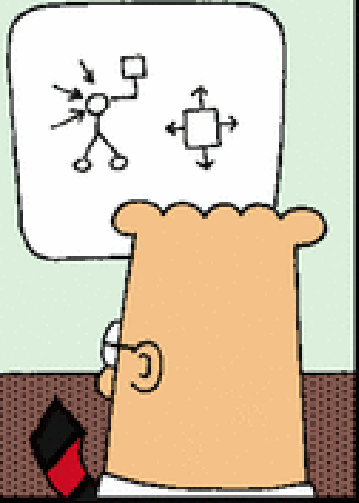
- visitor groups
- teacher programme participants
- member state representatives



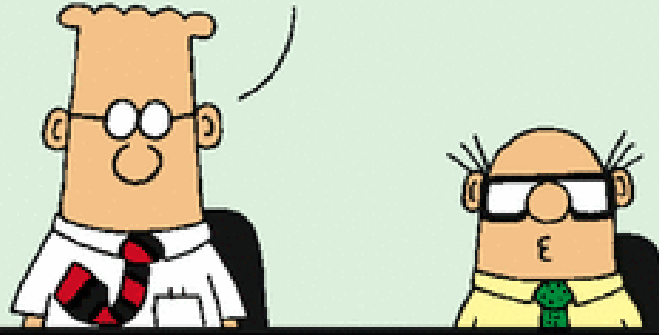
Physics Education Research

- Possibilities for interested students and teachers to research topics around the teaching of science exist at CERN
 - doctoral thesis
 - teacher in residence
- Research topics include
 - S'Cool LAB, its impact, development, ...
 - Cosmology in the Classroom
 - K-12 Particle Physics
 - Silicon Detectors for School Use
 - Low-cost Experiments
 - ...

THAT CONCLUDES MY
TWO-HOUR PRESENTA-
TION. ANY QUESTIONS?



DID YOU INTEND THE
PRESENTATION TO BE
INCOMPREHENSIBLE,
OR DO YOU HAVE SOME
SORT OF RARE "POWER-
POINT" DISABILITY?



ARE THERE
ANY QUESTIONS
ABOUT THE
CONTENT?



THERE WAS
CONTENT?

www.dilbert.com scottadams@aol.com

8/9/03

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Your Time, Your Questions!

... maybe my answers ...



International Relations Sector
Secteur Relations Internationales

Research Topics



DEVELOPMENT AND EVALUATION OF THE HANDS-ON PARTICLE PHYSICS LEARNING LABORATORY S'COOL LAB AT CERN

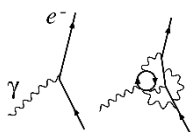
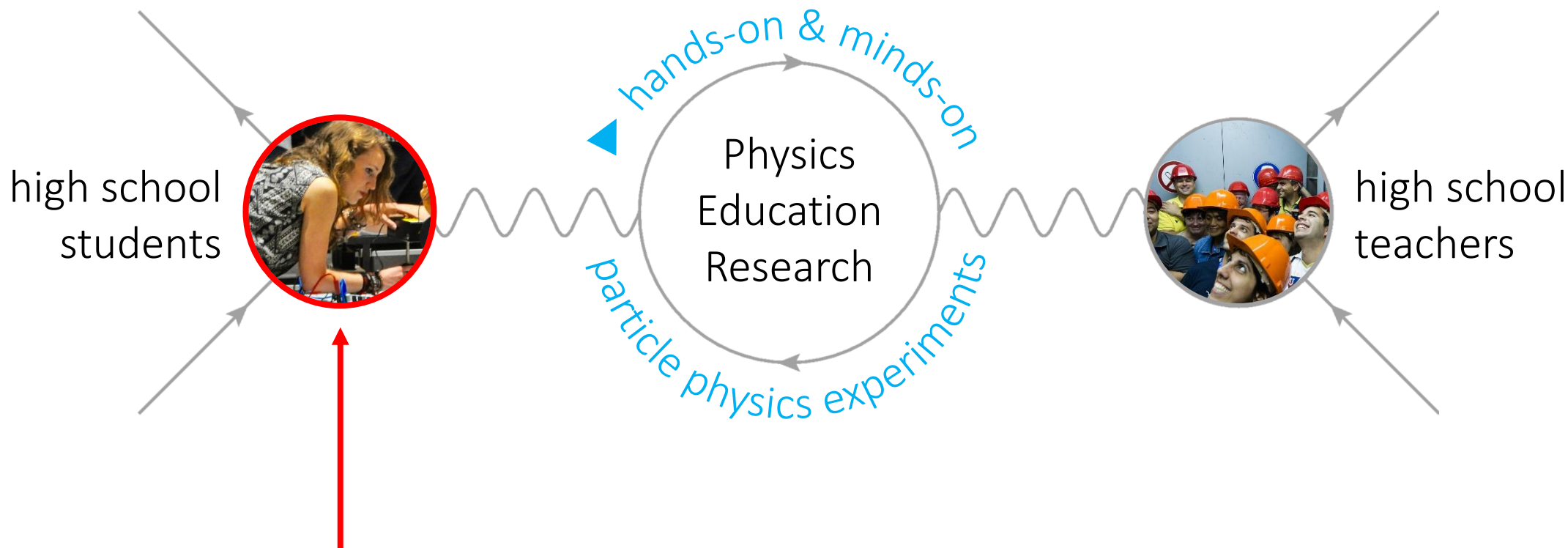
Effects of Student and Laboratory Characteristics on
Cognitive and Affective Outcomes

Julia.woithe@cern.ch




Problem

Understanding the impact of S’Cool LAB Days on students



Coupling „constant“ student \sim oslep effect as function of properties_student & properties_lab



Elementary particle physics in early physics education

Dr. Jeff Wiener

Development of a learning unit

on the subatomic structure of matter

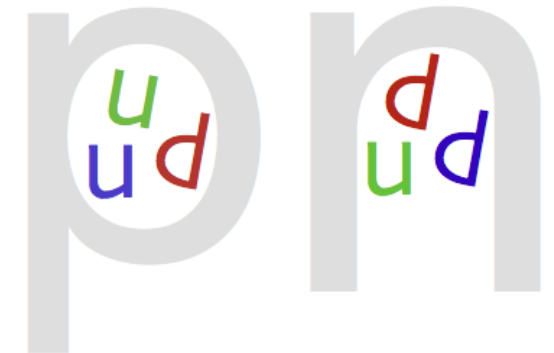
Model aspect of physics


“With the model of particle physics, we describe...”

Linguistic accuracy

particle vs. particle system

Typographic illustrations





DEVELOPMENT OF A TEACHING CONCEPT ON LEARNING ABOUT RADIOACTIVITY

Teaching of Physics Phenomena based on
Randomness and the Benefits of New Devices

Alexandra.Jansky@cern.ch



Design and Methods

Literatur

Develop Hypothesis

Interviews 1

Adapt Hypothesis

previous knowledge

Interviews 2

Develop teaching concept

Design for User Interface

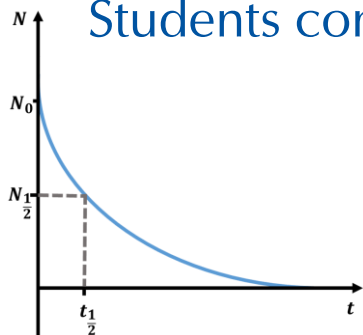
Adapt teaching concept

Adapt User Interface

Aim

Teaching concept

Students conceptions on randomness and chance in science



„Juffadeninterviews“
vorschlagsfrage:
Wie wirken sich dokumentierte SchülerInnenvorstellungen zu Zufall und Wahrscheinlichkeitsrechnung auf das physikalische Verständnis von SchülerInnen und -lehrern aus?

Frage	Ergebnis
Es gibt keine eindeutige Definition von Zufall. Was heißt Zufall für dich?	133
Wie fällt dir zu Zufall im Zusammenhang mit Physik auf?	133
Wie hast du im Unterricht schon über Radioaktivität gelernt? Gibt es andere Beispiele nach einer Zusammenhang zwischen Zufall und Radioaktivität?	133, 122
Ist der Zufall zufällig? Was ist beim Zufall zufällig?	133
Vergleiche den zufälligen Prozess beim Zufall mit dem Mischaufwurf?	133
Stell dir vor, du hast einen Kern, unter Aussendung eines α -Teilchens zerfällt. Ist es wahrscheinlicher, dass er in der ersten Sekunde zerfällt oder in den ersten 5 Sekunden?	125, 143
Wie groß ist die Wahrscheinlichkeit, dass ein Kern zu einem bestimmten Zeitpunkt aus zerfallen ausstrahlt?	133
Wie hast du schon festgestellt, dass ein Kern zu einem bestimmten Zeitpunkt zerfallen ist?	133

Pilot Interviews
N=10, aged 16-19
Main Interviews
N=23, aged 16-19



Benefit of Pixel Detectors





**Learning about radioactivity using pixel detectors:
Development and investigation
of new experimental tools**

Oliver Keller
CERN & Université de Genève

Visualising Radioactivity using AR

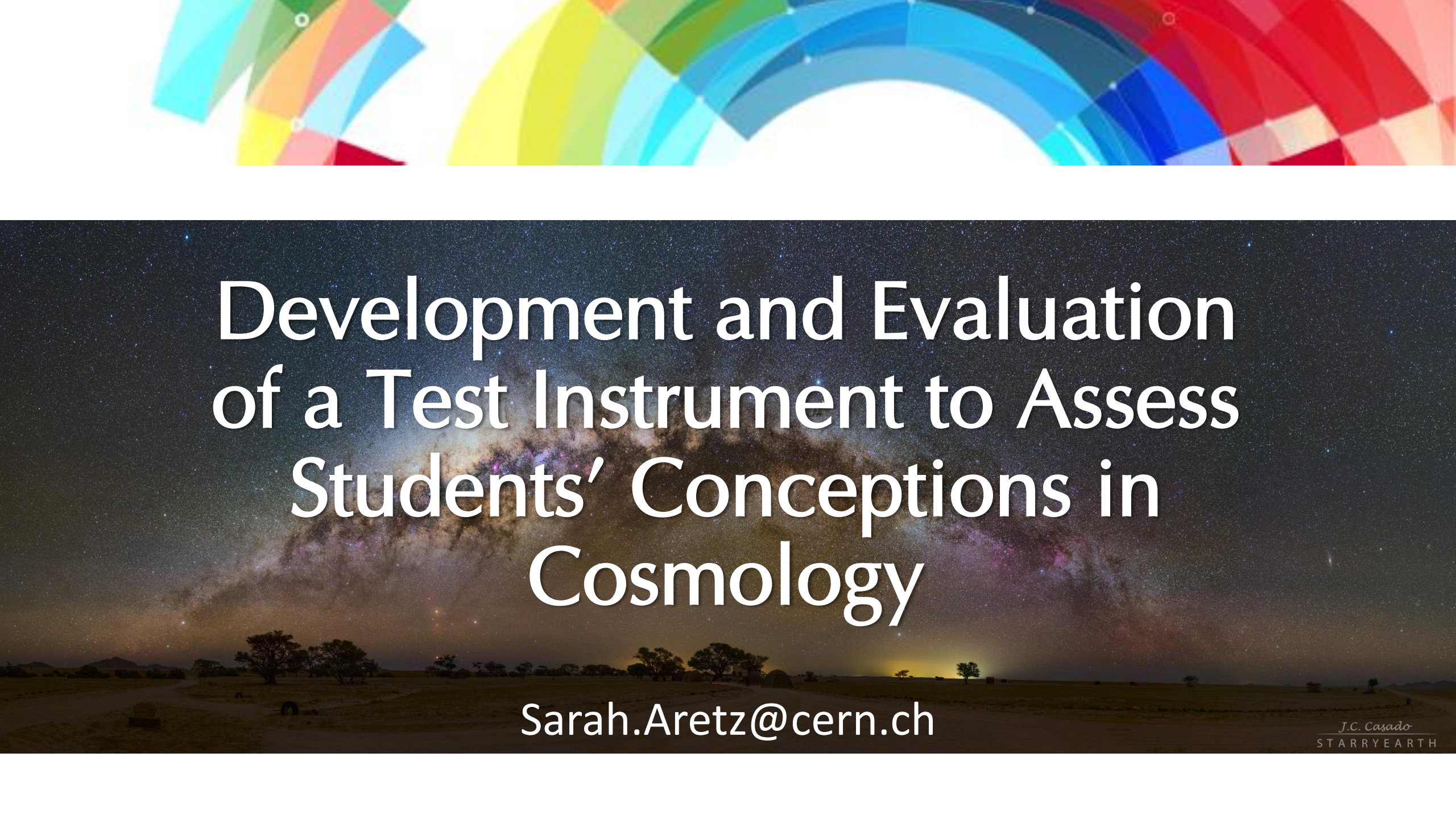
Idea: Create a visual instrument, inspired by cloud chambers, which is mobile and engaging to use

First prototype of its kind: iPadPix *

- Using augmented reality to discover particles on a live screen: Alphas, Betas/electrons, X-ray/gamma photons and cosmic rays
- Based on the Timepix pixel detector, developed within the Medipix Collaboration hosted at CERN
- Opportunities of Augmented Reality tools in education: gains in learning, motivation, interaction and collaboration (Bacca et al. 2014)

** iPadPix - A novel educational tool to visualise radioactivity measured by a hybrid pixel detector, O. Keller et al. 2016 JINST 11 C11032 (Presented at PIXEL 2016)*





Development and Evaluation of a Test Instrument to Assess Students' Conceptions in Cosmology

Sarah.Aretz@cern.ch



International Relations Sector
Secteur Relations Internationales

Evaluation of International Teacher Programmes



International Relations Sector
Secteur Relations Internationales

Low-Cost Experiments for the Classroom

... and far too many ideas ...