



Particle Physics Outreach with Netzwerk Teilchenwelt

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Workshop on communicating the physics of the smallest particles

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NETZWERK
TEILCHENWELT



UNIVERSITÄT **BONN**

Motivation for outreach

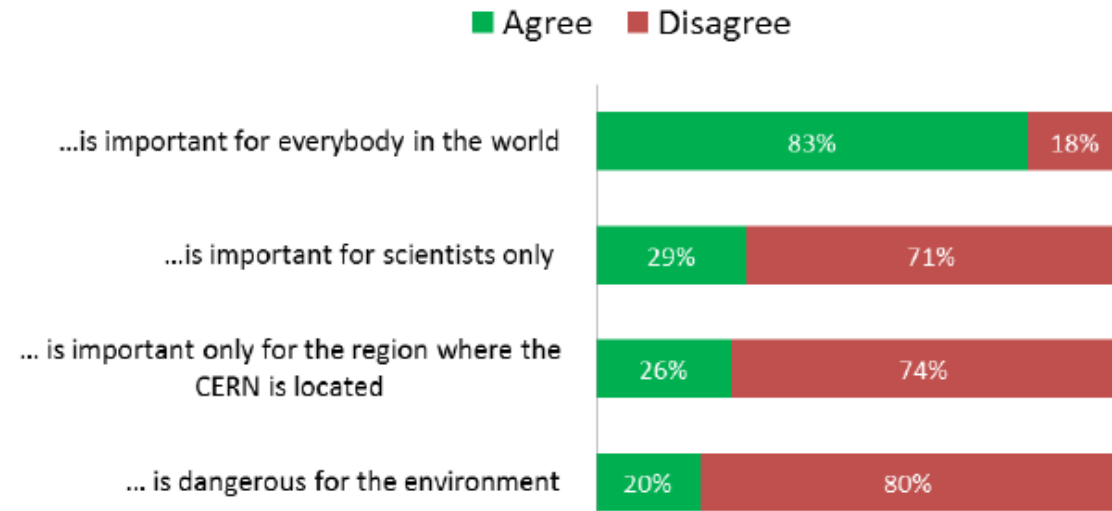


Recruitment of
future scientists

Motivation for outreach

- Secure funding for our projects (“1 coffee/year”)
- **A price worth paying** R. Heuer (2020) <https://cerncourier.com/a/a-price-worth-paying/>
- **Scientific Research at CERN as a Public Good: A Survey to French Citizens** M. Florio et al. (2018) <http://cds.cern.ch/record/2635861>

Figure 8. Scientific research at CERN ... (n=1,005)



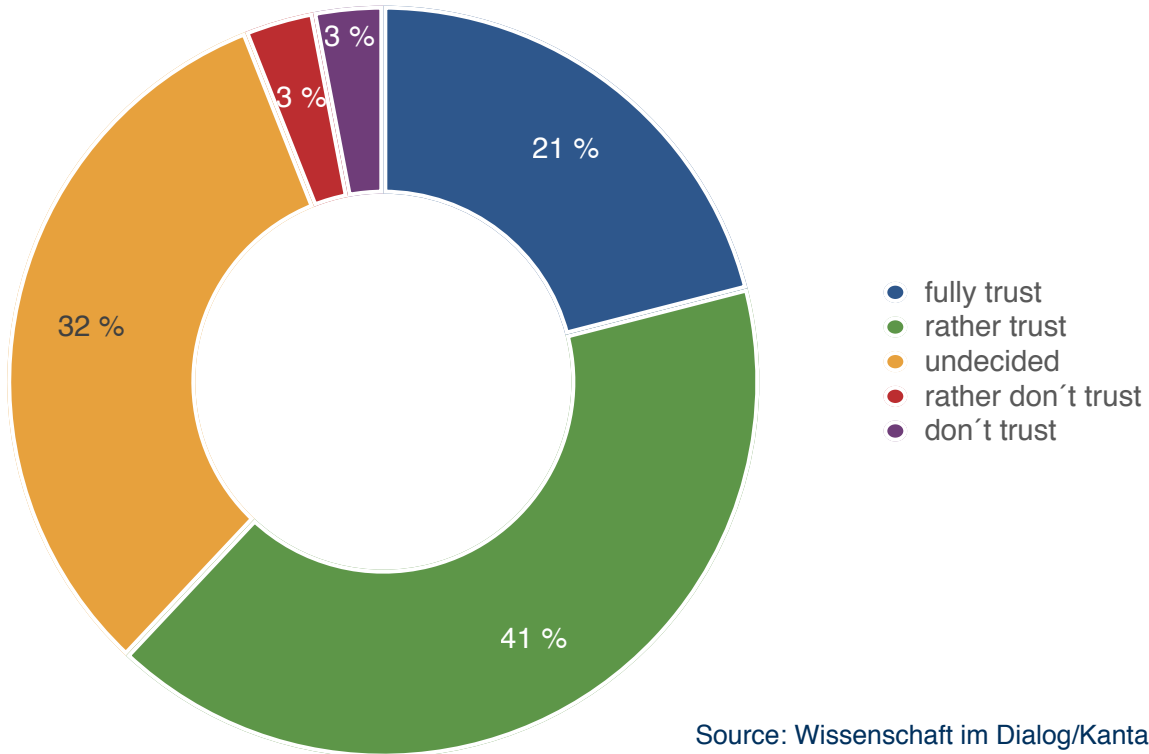
Recruitment of
future scientists

Explanation &
legitimation

Motivation for outreach

“How much do you trust science and research?”

Wissenschaftsbarometer 2021



Recruitment of future scientists

Explanation & legitimization

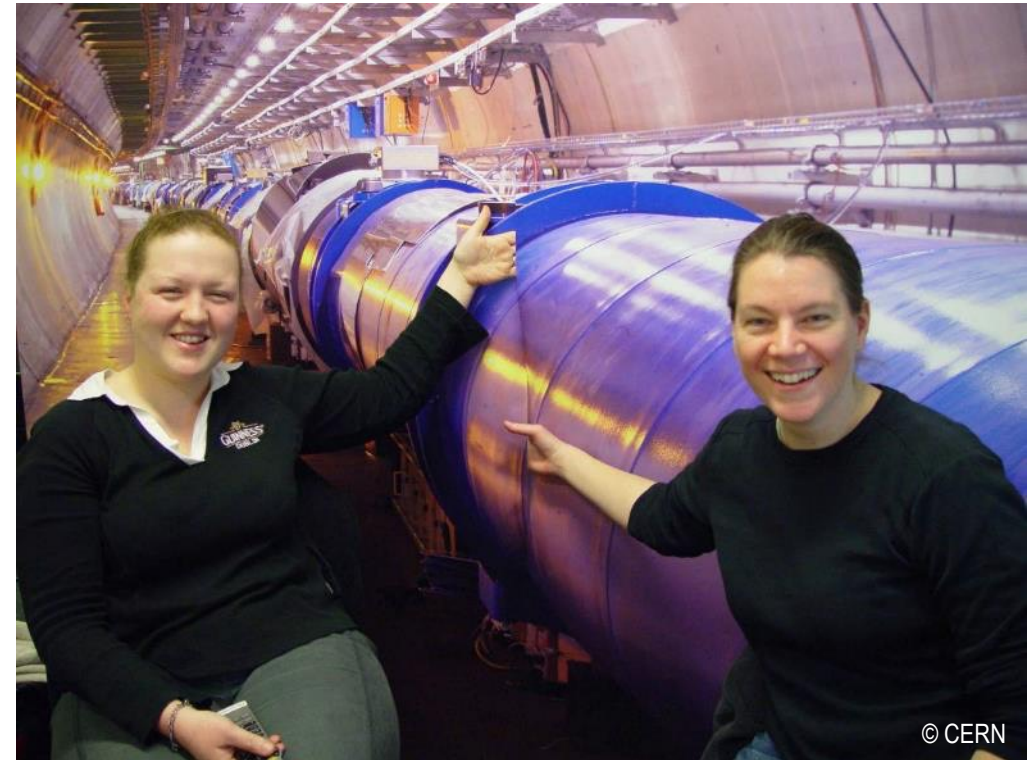
Create trust in science

Motivation for outreach

Quotes from Masterclasses moderators:

“The best thing is actually answering the questions and seeing how excited and how happy they are, waving at the camera. They're really excited to be talking to physicists based at CERN!”

“It is very satisfying, because we do many video conferences and rarely do people cheer on the other side if you say something. Here they do!”



Recruitment of
future scientists

Explanation &
legitimation

Create
trust in science

Intrinsic
motivation

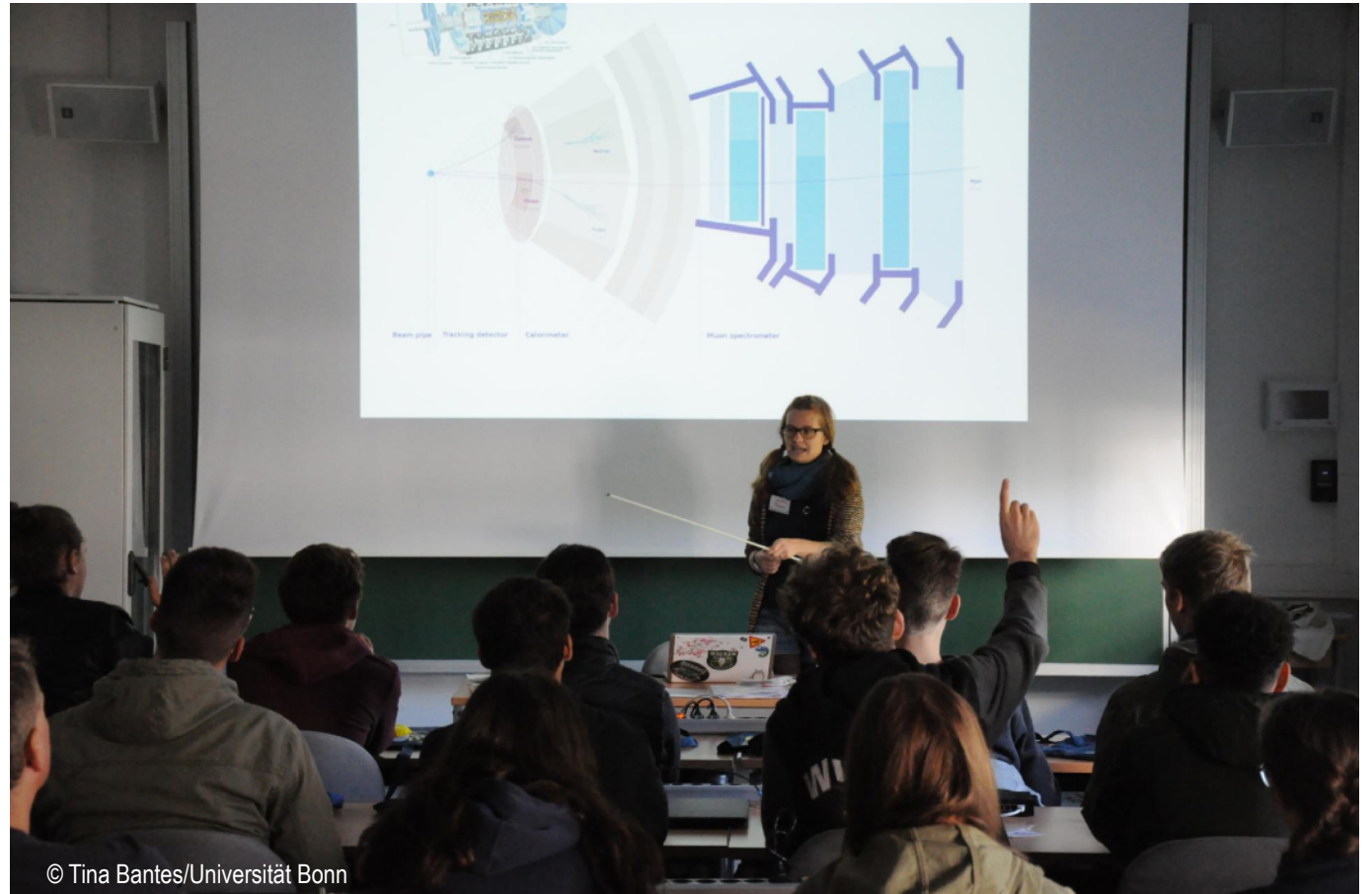
Motivation for outreach

What do you have to do?

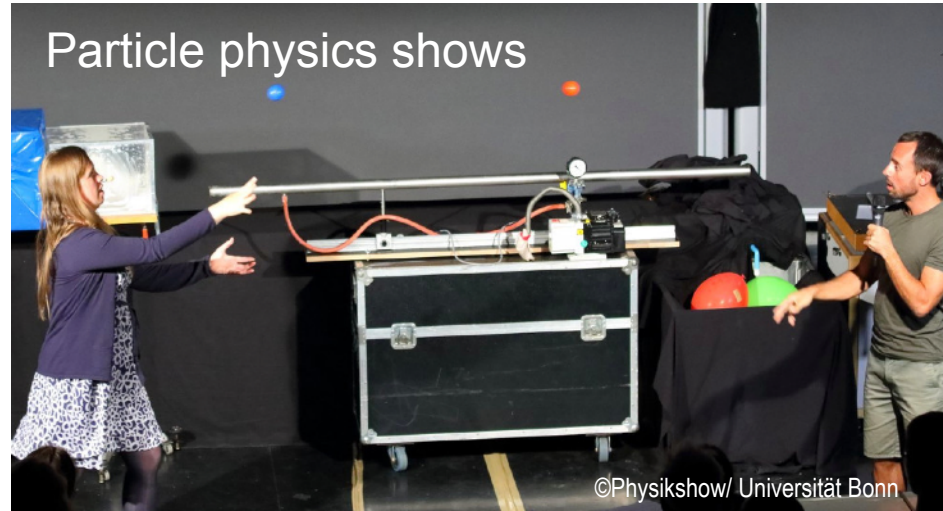
- Be a role model
- Talk about your research

What does it give to you?

- Experience interest in own research
- Acquire soft skills, for personal and professional development
- Increase general acceptance for fundamental research



Outreach - How to?



The Idea behind Masterclasses

Act as a "scientist for a day"

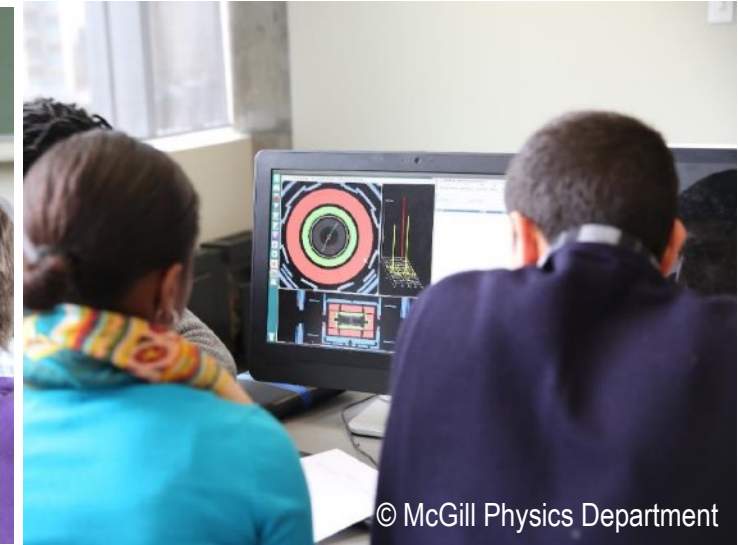
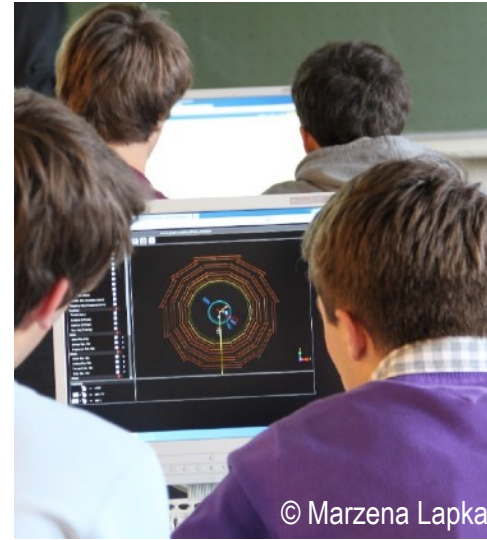
- Close to current research
- Own "hands-on" activities (listen = forget, see = remember, do = understand)

Get insight into the research process

- Use of relevant methods and tools
- Comparisons between experiment and theory

Authentic experiences

- Analysis of real scientific data
- Meeting and discussion with scientists



Why “Masterclass”?

As in a Masterclass in the arts, students work with an expert

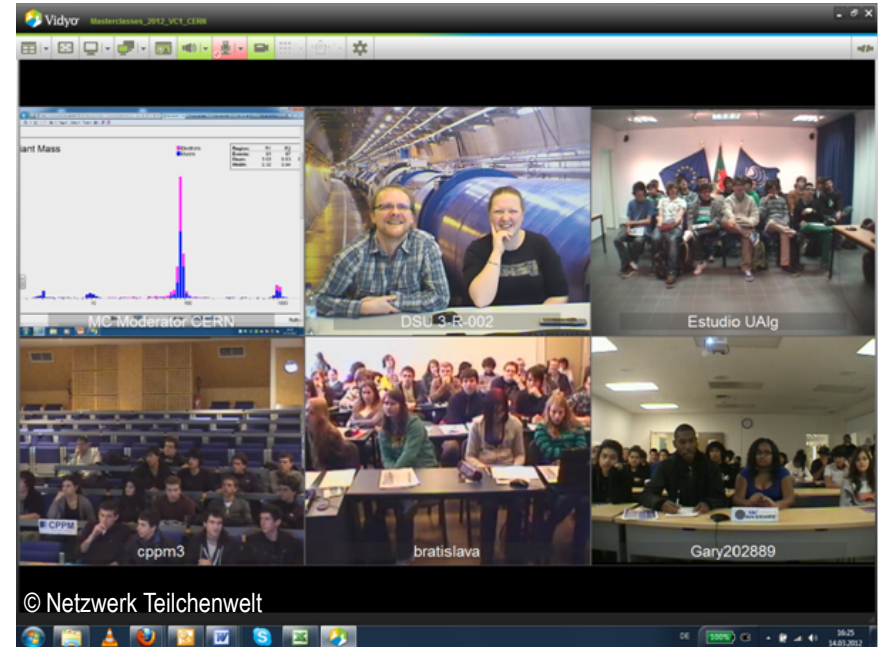
Expert = particle physicist

Violin = particle physics data analysis



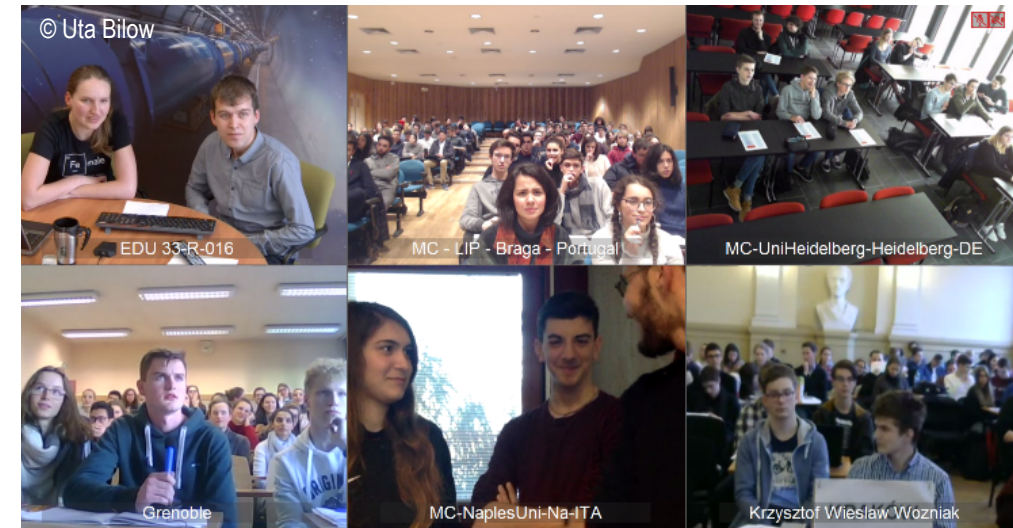
Concept of International Masterclasses

- High school students (15 – 19) are „scientists for one day“
- Get invited to a research institute or university
- Introductory talks (standard model, detectors, accelerators)
- Measurement with data
- International video conference (3 – 5 inst. + moderators)



Sample Agenda

Local time	Activity
8:30 - 9:00	Registration & Welcome
9:00 - 10:00	Introduction to Particle Physics
10:30 - 11:30	Second talk or tour
12:00 - 13:00	Lunch
13:00 - 15:00	Data analysis
15:00 - 16:00	Local combination + Discussion
16:00 - 17:00	International video conference

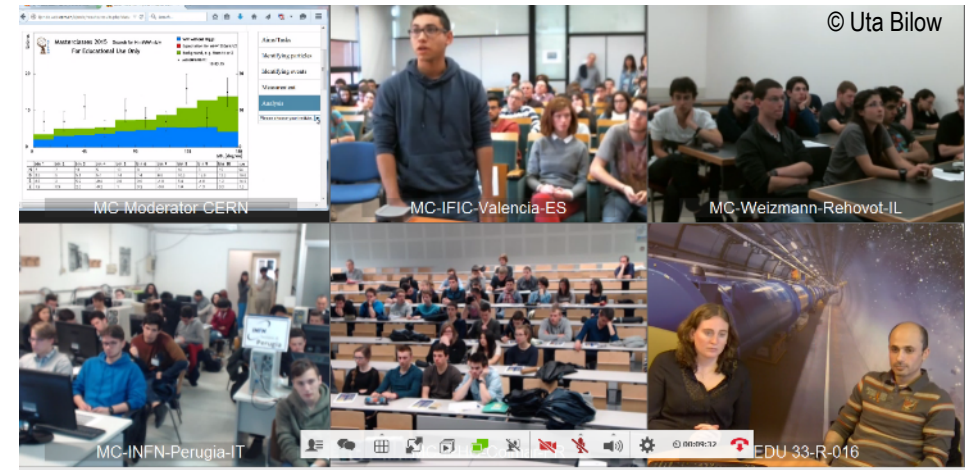


Video Conference

- 45-60 min
- 3-5 institutes, reflecting international collaboration
 - Same measurement, different data
- 2-3 Moderators (PhD students, Postdocs)
- Moderation centers: CERN, Fermilab, KEK, GSI, TRIUMF
- Agenda
 - Welcome
 - Combination and discussion of results
 - General Q & A
 - Quiz

You are welcome to join the community of moderators!

(see [list of CERN moderators for IMC 2022](#))



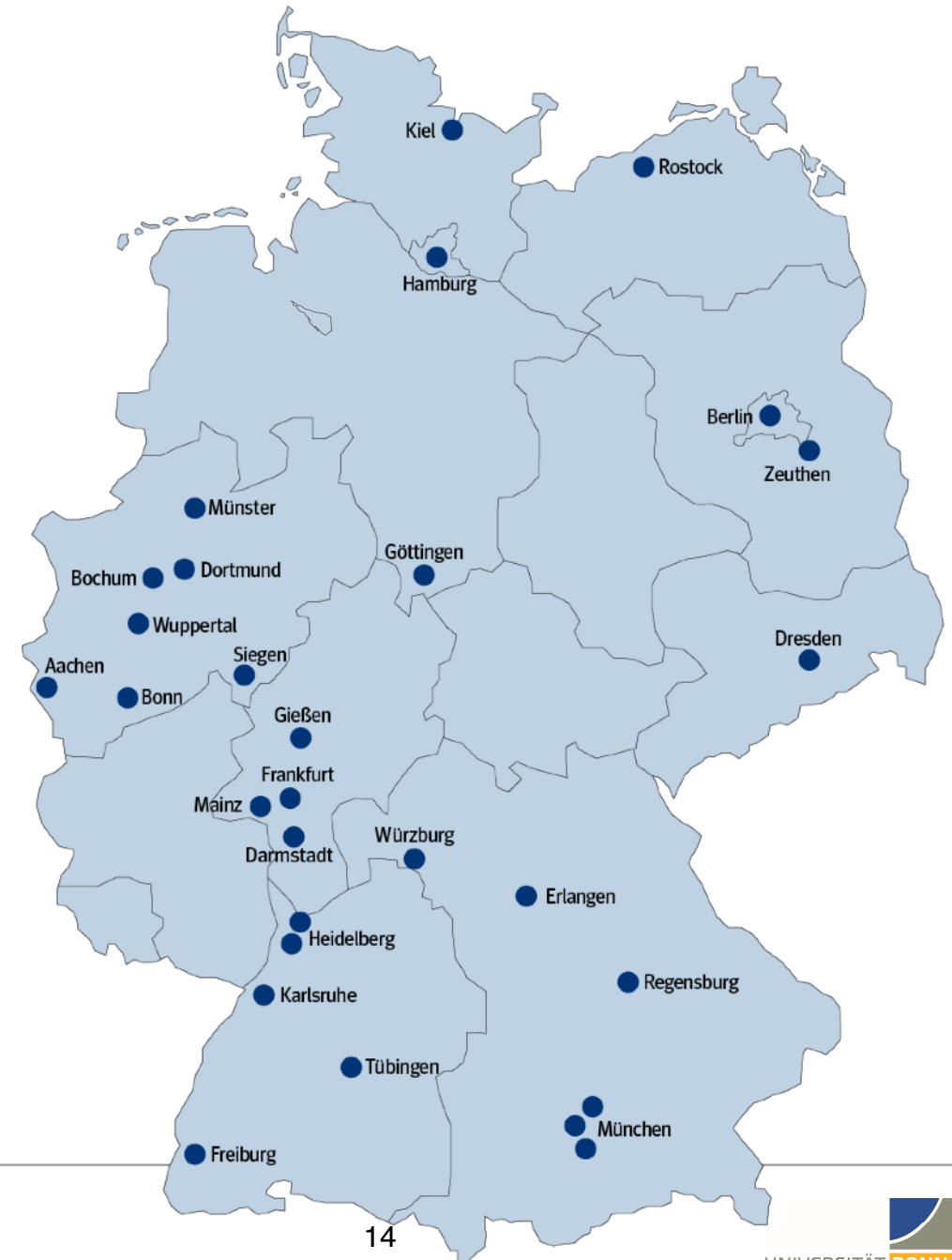
IPPOG Worldwide program

- Organized by IPPOG (International Particle Physics Outreach Group)
- 60 countries involved
- 220 research labs
- 2019: 15.000 high school students
- Coordination: Ken Cecire (QuarkNet) / TU Dresden



Netzwerk Teilchenwelt

- Funded as integral part of research by the German Ministry of Education and Research
 - KONTAKT¹ project funded since 2018, ErUM²=supporting program
 - **30 sites** (universities/research labs + CERN)
 - Joint outreach in particle, astroparticle and hadron (since 2018) physics
 - Bundle existing activities
 - Share structures and programs
- **High visibility and impact**



1) KONTAKT = Kommunikation, Nachwuchsgewinnung und Teilhabe der Allgemeinheit an Erkenntnissen auf dem Gebiet der Kleinsten Teilchen“
2) ERUM= Erforschung von Universum und Materie

Netzwerk Teilchenwelt

- Project team: TU Dresden / DESY / CERN
+ **3 hubs** in Bonn, Mainz & Münster

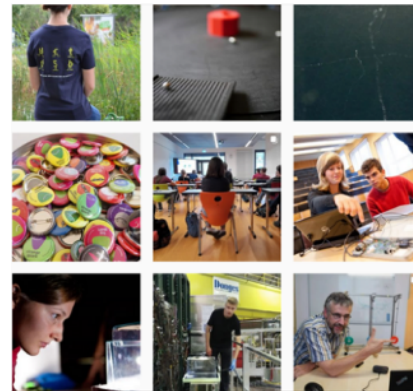


Netzwerk Teilchenwelt on social media



Newsletter
„Teilchenwelten“
3 x per year (Abo)

Webseite



Die Woche der Teilchenwelt findet statt vom 02. bis 08. November 2020.
Editorial
Liebe Teilchenphysik-Begeisterte,
kreativ in der Krise: Trotz der andauernden Corona-Pandemie findet im Netzwerk



Facebook

Instagram

YouTube-Videos „Netzwerk Teilchenwelt mit Moritz“

Core: Multi-step Program for High School Students



Masterclasses



Active engagement,
detector projects



4 days CERN



Own research
projects

Number of students
per year



Fellow program



SCHOOL



RESEARCH GROUPS

- 200 people, 50% female
- Mainly alumni of CERN workshops
 - Often studying physics or shortly before that
 - Close connection between highly motivated students and research groups

Central offers: Fellow physics schools (HEP, detectors), “Ask the expert” sessions (online), national physics conference attendance, etc.

Local offers: internships, excursions, invitation to outreach events, colloquia, regulars’ table, etc.



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Teachers as multipliers

- Development of material
 - [Teaching material for schools](#), 4 volumes (>20k printed, >35k downloaded)
 - [Portal Leifi Physik](#): Chapter on particle physics
 - [Particle profile cards](#)
 - [GeoGebra Analysis of Bubble Chamber images](#)
 - [Context material](#)
- [Teacher training „Forschung trifft Schule“](#), funded by:
 - 2-day training: Introduction to particle physics, 6 trainings p.a.
 - Summer School at CERN: 6 days, once per year



Student experiments on Astroparticle physics

- Experiments can be used in Masterclasses or workshops
- Teachers can borrow experiments for school



Big Bang on the Road (Urknall Unterwegs)

- Interactive mobile exhibition modul on particle physics
 - Tunnel: time travel through the history of the universe
 - Columns: Interactions and particles, Research methods, spin-offs
 - Pavilion with games (Particle Twister, Particle Yenga)
- Target audience: general public, people with less affinity for science
- On the road since the end of July 2021



Science Communicators

- ~ 150 PhD and Master students
- Guide Masterclasses, supervise students' research projects
- Influence students' career-related aspirations and choices
- Reimbursement of expenses and travel cost
- Get training courses on communication, didactics, and presentation techniques



Activities related to Netzwerk Teilchenwelt

- International Masterclasses at site
- Masterclasses in museums & schools in surrounding area
- Student experiments related to astroparticle physics (e.g. cloud chamber workshops)
- Teacher Trainings on (astro-)particle physics
- Research projects for students
- Supervision of Bachelor-/Master theses in didactics related to particle physics outreach
- Exhibitions



Your role as facilitator

You do "The show" i.e.

- you give the talks
- interact with your audience
- supervise the exercises and measurements

You get

- Experience in communication and supervision of students
- Experience strong interest in your personal work/research
- 50-100 Euro fee per day (+compensation for travel costs)
- Usually all materials incl. slides available at your site, in the Wiki([Materials for Masterclasses](#), [Collection of slides](#) both german though, english materials available [here](#))

You don't have to care about

- organising the Masterclass
 - coordination with the teachers/schools (fixing the date, installing software etc.)
- usually done by the site contact

Materials for Masterclasses

- Slides for the presentation
- Exercise sheets for the different measurements
- [Preparation course on particle physics \(german\)](#) that the students do in advance

- German material available in the Wiki: [Materials for Masterclasses](#), [Collection of slides](#)
- English material on ATLAS and BELLE II Masterclass [here](#)

- Link to [international Masterclass page e.g. for ATLAS](#) include lots of Information on the measurements (for other measurements → Lauras Backup Slides)

- Online games (→Lauras Backup Slides)
- Particle Zoo (if available), card games etc.
- (Astroparticle) experiments