

Netzwerk Teilchenwelt

An outreach network in Germany

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High School Students and the Large Hadron Collider

- ▶ Students get in contact e.g. via CERN visits or International Masterclasses.
- ▶ They meet physicists and learn about topics of current research and the organization and process of research.
- ▶ Most students at least enjoy these events, some might even want to become (particle) physicists.
- ▶ How can we continue to motivate the interested students, after the one-off event?



Multi-talented student



Future HEP scientist



?

Multi-step program for high school students



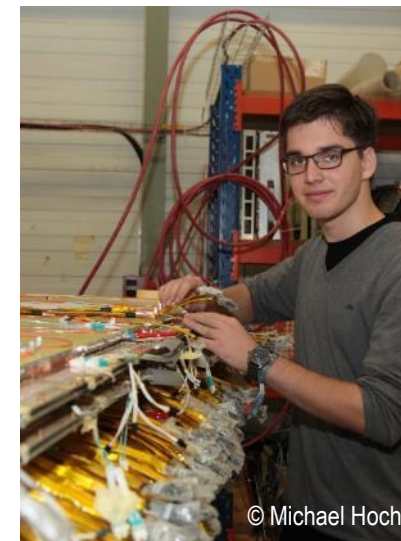
Masterclasses
(@schools, real data from ATLAS,
CMS, LHCb, ALICE, ALICE)



**Active engagement,
detector project**



**4d CERN
workshops**



**own research
projects**

Number of students/y



3500



250



60

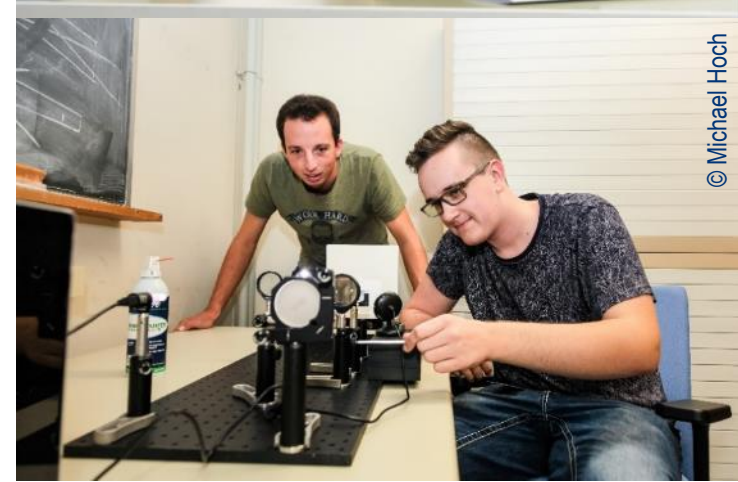


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Own research projects: examples

- ▶ Deep Learning Models for Energy Estimation in CMS HGCAL L1 Trigger (Felix Hansen)
- ▶ First data classification at the InGrid detector at the CAST experiment using deep learning (Caroline Kohl)
- ▶ The AWAKE experiment (Björn Dörschel)
- ▶ The effects of radiation on the CMS pixel detector (Katharina Ploog)
- ▶ Machine-learning based identification of highly collimated electron pairs from boosted Z boson decays (Sophia Veneris)

jugend  forscht





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Facilitators

- ▶ 150 PhD and Master students are engaged in Netzwerk Teilchenwelt. They guide Masterclasses and supervise students' research projects.
- ▶ Facilitators get reimbursement of expenses and travel cost.
- ▶ Netzwerk Teilchenwelt offers a 2d training course on communication, didactics, and presentation techniques (important skills also for own career!).
- ▶ As role models, they influence students' career-related aspirations and choices.

Fellow program to promote young talents



- ▶ 180 people, 50% female (program launched in 2017)
- ▶ Mainly alumni of CERN workshops
 - Now often studying physics or shortly before that
 - Interested in particle and astroparticle physics
- ▶ **Local** offers: Internships, excursions, invitation to outreach events, colloquia, regulars' table etc.
- ▶ **Central** offers: Fellow physics school (pwd „intro“), Fellow meeting, national physics conference attendance



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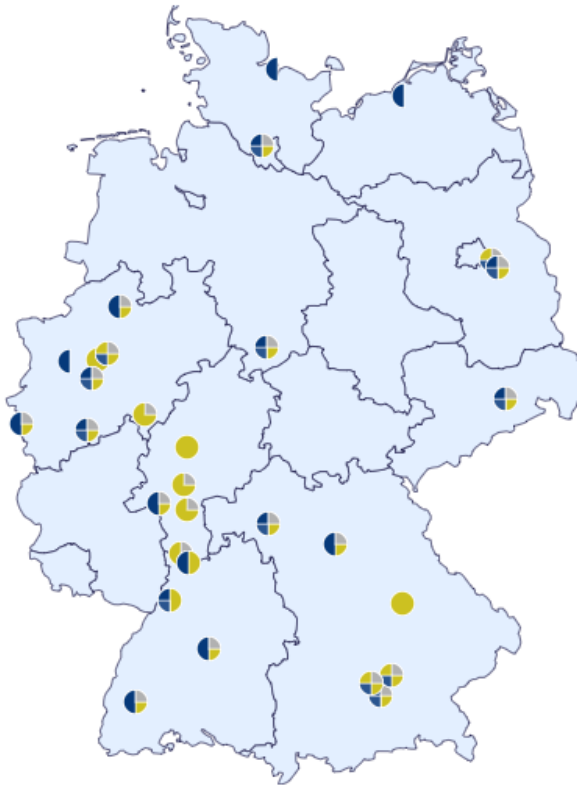


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German landscape of experimental (Astro) Particle Physics



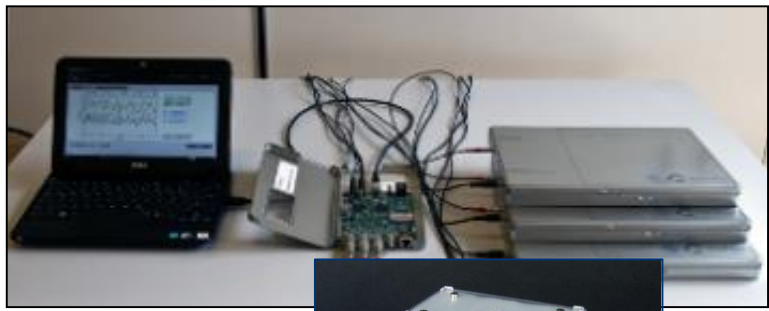
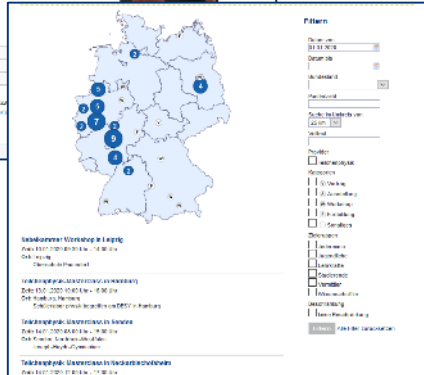
- ▶ Netzwerk Teilchenwelt founded in 2010
- ▶ 30 research labs / universities
- ▶ Each research lab focuses on its experiments and activities
- ▶ Project team:
TU Dresden / DESY@Zeuthen / CERN
- ▶ hubs at:
Univ. Bonn / Univ. Mainz / Univ. Münster



Central Coordination @ TU Dresden provides:

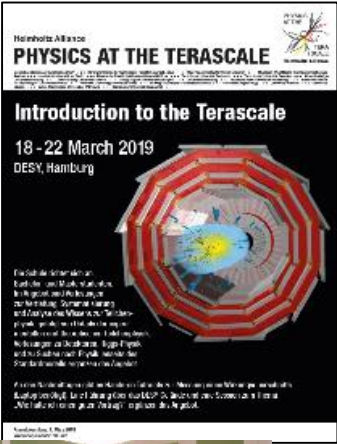
Structure

- Data base (people, schools, events)
- Event calendar
- Wiki



Central Coordination @ TU Dresden provides:

- ## Organisation
- Fellow physics school
 - Fellow meeting
 - Training for facilitators



- ## Communication
- Website
 - Social Media
 - Newsletter
 - Mailings



Teachers as multipliers

- ▶ Development of material
 - Teaching material for schools (4 volumes) www.teilchenwelt.de/tp
 - Portal Leifi Physik: Chapter on particle physics www.leifiphysik.de/themenbereiche/teilchenphysik
 - Particle profile cards
 - Context material
- ▶ Teacher training „Forschung trifft Schule“, funded by: www.teilchenwelt.de/angebote/lehrerfortbildungen-forschung-trifft-schule/
- ▶ 2-day training for teachers
 - Introduction to particle physics, 6 trainings p.a.
- ▶ Summer School at CERN
 - 6 days, once per year



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Activities in the current funding period

- ▶ Continue and consolidate existing programs
- ▶ Reach out to more target groups
 - General public
 - Journalists
- ▶ More topics from other fields of physics of the smallest particles
 - Hadron and nuclear physics
- ▶ **KONTAKT: KO**mmunikation, **N**achwuchsgewinnung und **T**eilhabe der **A**llgemeinheit an Erkenntnissen auf dem Gebiet der **K**leinsten **T**eilchen
- ▶ Funded as integral part of research within the German research framework program ErUM
- ▶ **Netzwerk Teilchenwelt + Weltmaschine** have joined forces



Weltmaschine

www.weltmaschine.de

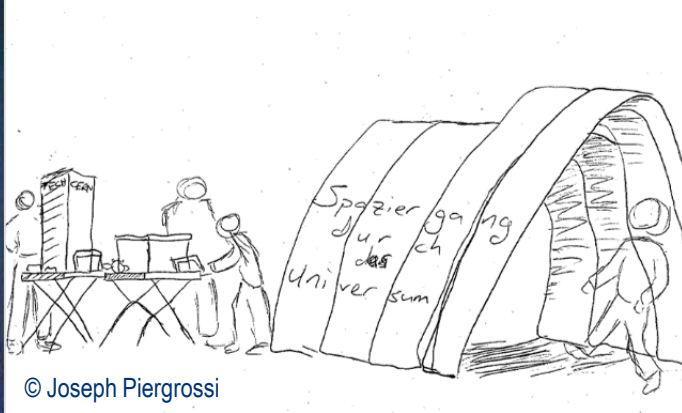
- ▶ German LHC information point for the public and media since 2008
- ▶ Excellent contact to the press
 - Press material, media library
 - Facts and figures
- ▶ Central event organization
 - Journalist Days, Press Spokesperson Day
 - Tag der Weltmaschine
 - Media training for scientists
- ▶ Mobile exhibition
 - Shown in 43 research labs



© Weltmaschine



© Weltmaschine



New target groups: the „uninterested“ general public and journalists

► VR headsets

- Apps from various experiments (LHC, also Belle II, IceCube)
- loan to Netzwerk Teilchenwelt research labs, central maintenance

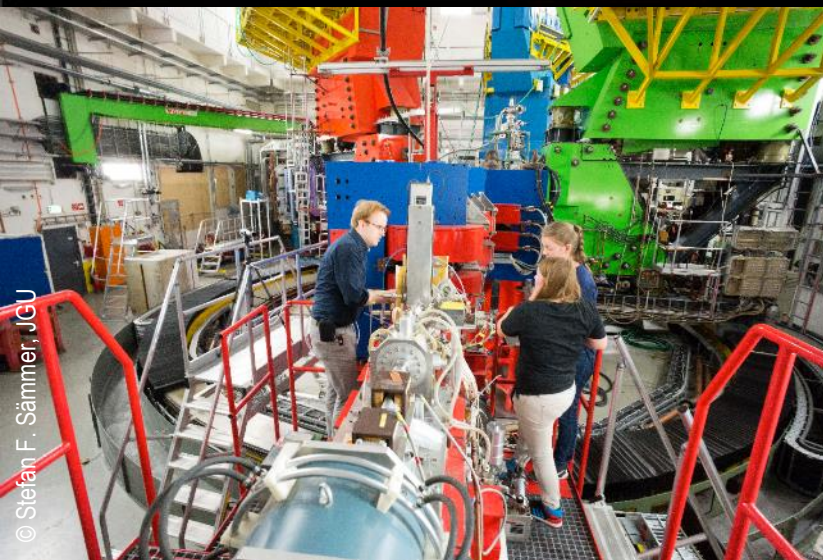
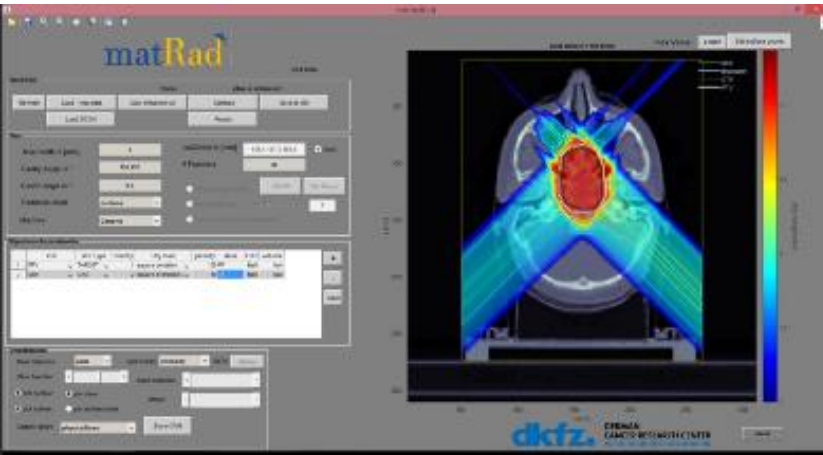
► Mobile exhibition modul

- Setup in <1h
- Tour stops planned in shopping malls and railway stations
- reaches groups that are less likely to access science

► Journalist trip to CERN

- + media training for scientists...

More topics from other fields of physics of the smallest particles



- ▶ Hadron and nuclear physics
 - Hadron therapy Masterclass
 - Belle II Masterclass
 - PANDA Masterclass
 - Scattering experiments Masterclass
 - exhibits
 - 1 week Summer course for high school students
 - Fellow detector school

Summary

- ▶ Germany has a nationwide network for outreach and promotion of young talent, which comprises 30 research labs and universities.
- ▶ High school students can engage in a wide range of activities, from Masterclasses and detector projects to programs at CERN and own research projects.
- ▶ A Fellow program bridges the gap between high school and research groups.
- ▶ The central project coordination provides structures, material, organisation and communication for all research labs.
- ▶ Regional hubs foster the integration of further research topics from hadron and nuclear physics and provide regional support.
- ▶ Netzwerk Teilchenwelt is funded as integral part of research.

Any questions?

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 www.facebook.com/teilchenwelt/

PROJEKTLEITUNG



PARTNER



SCHIRMHERRSCHAFT



FÖRDERER

GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung



DR. HANS RIEGEL-STIFTUNG



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