

# Netzwerk Teilchenwelt

Where High School Students Participate in HEP  
Research and Young Talents are Promoted



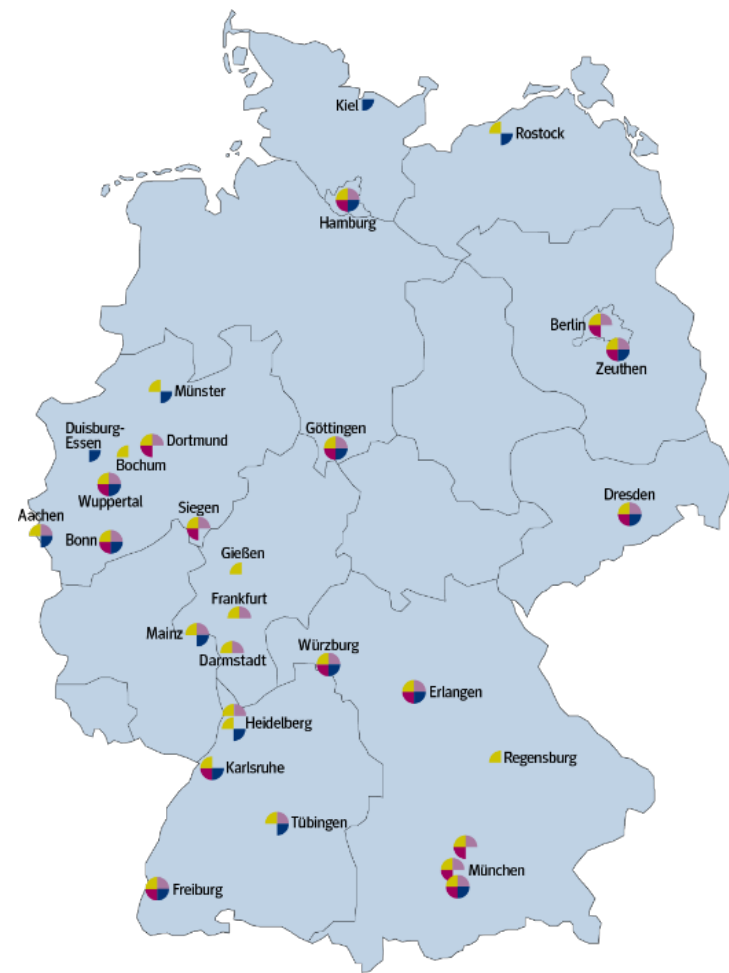
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© Anne Rockstroh

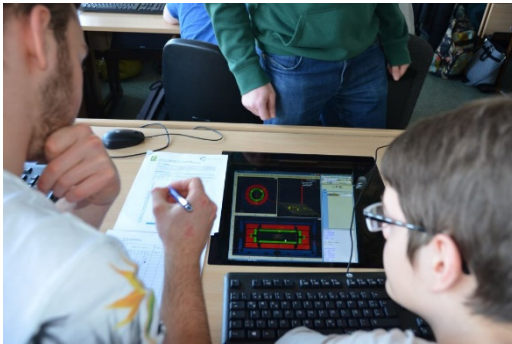
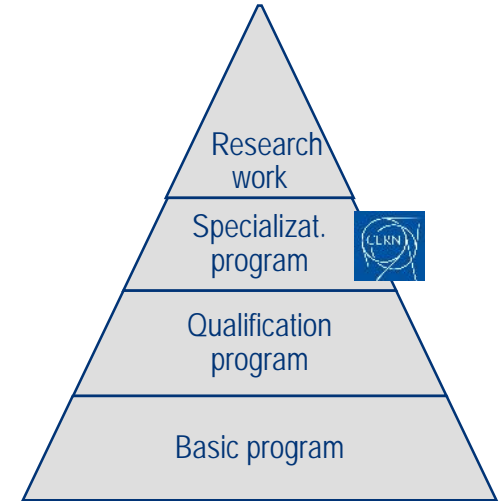
# Netzwerk Teilchenwelt

- ▶ High school students (15-19 y.)
  - experience HEP research
  - participate in HEP research
- ▶ 30 universities/research labs + CERN
- ▶ Project team
  - TU Dresden
  - DESY at Zeuthen
  - CERN
- ▶ started in 2010



# Netzwerk Teilchenwelt

- ▶ Multi-stage program
- ▶ per year working with original HEP data and/or particle detectors
  - 3600 high school students
  - 350 in advanced levels
  - 60 at CERN workshops
  - 15 research projects at CERN or research labs

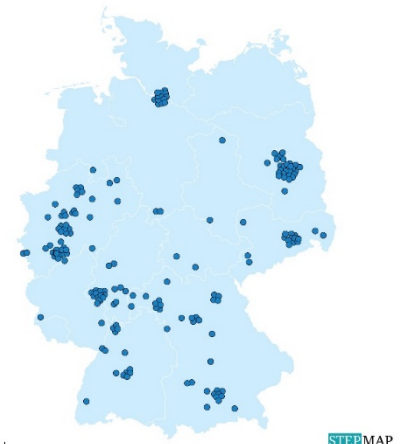


# Offers for High School Students

[www.teilchenwelt.de/mitmachen/jugendliche](http://www.teilchenwelt.de/mitmachen/jugendliche)

## Basic program: Masterclasses

- ▶ 1-day-activities, concept:
  - High school students are „scientists for one day“
  - Introductory talks (standard model, detectors, accelerators)
  - Hands-on: measurement with real data
  - Tasks: identify events, create histograms
  - Optional: video conference
- ▶ Particle and Astroparticle Physics
- ▶ at schools, school labs, museums etc.
- ▶ ~ 140 Masterclasses per year



Masterclasses 2018

# Offers for High School Students

[www.teilchenwelt.de/mitmachen/jugendliche](http://www.teilchenwelt.de/mitmachen/jugendliche)

## Basic program

- ▶ LHC Masterclasses ATLAS, CMS, LHCb, ALICE, ALICE
- ▶ Pierre-Auger Masterclass
- ▶ IceCube Masterclass
- ▶ NEW: Hadron Therapy Masterclass
  - From GSI and DKFZ
- ▶ Each research lab/university focuses on their experiments and activities



### ATLAS

- W path ( $W^+/W^- + H \rightarrow WW$ )
- Z path ( $Z, Z', \dots$ )



### CMS

- $J/\psi$  data quality
- W, Z, H analysis



ALICE

### ALICE

- Strange Particles
- Modification Factor  $R_{AA}$



### LHCb

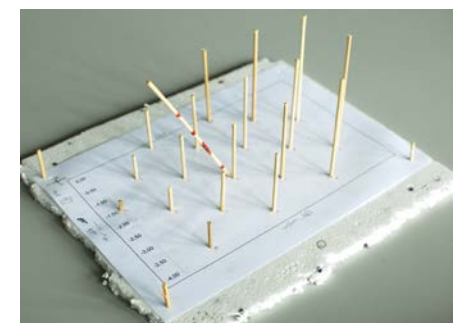
- Charm lifetime



15.10.2019



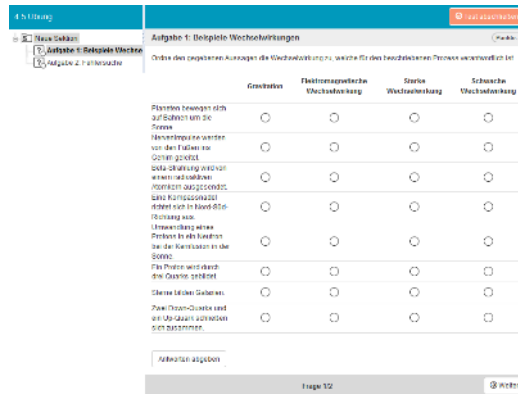
Uta Bilow, TU Dresden



6

# NEW: Online Preparatory Course for LHC Masterclasses

- ▶ Introduction to charges, interactions and particles
- ▶ Info texts, animations, exercises
- ▶ requires 60-90 min
- ▶ Teacher theses from Carolin Diesel, TU Dresden 2018
- ▶ Evaluation: very good results



#### 4 Die vier fundamentalen Wechselwirkungen

|   |   |  |   |
|---|---|--|---|
| <p>Warum bewegt sich der Mond um die Erde und fliegt nicht einfach davon?</p>  | <p>Warum ist es möglich, dass ein Atomkern aus mehreren sich elektrisch abstoßenden Protonen besteht?</p>  | <p>Warum halten Elektronen und der Atomkern als Atom zusammen?</p>  | <p>Wie ist die Umwandlung eines Neutrons in ein Proton erklärbar?</p>  |
|---|---|--|---|

Verantwortlich für die beschriebenen Phänomene sind die sogenannten vier fundamentalen Wechselwirkungen der Natur. Sie heißen Gravitation, elektromagnetische Wechselwirkung, starke Wechselwirkung und schwache Wechselwirkung. Alle ablaufenden Prozesse können durch mindestens eine dieser Wechselwirkungen erklärt werden. Beispielsweise beschreiben die vier Wechselwirkungen die Kräfte, mit denen Objekte aufeinander einwirken oder begründen, wie Umwandlungen von Teilchen in andere Teilchen ablaufen. Die vier Wechselwirkungen sollen in diesem Abschnitt des Vorbereitungskurses vorgestellt werden.

Ziel des Abschnitts ist es, dass du den Wechselwirkungen Beispielprozesse zuordnen kannst. Du lernst auch die Ursachen der Wechselwirkung kennen.

# Cosmic@Web

<http://cosmicatweb.desy.de>

- ▶ web platform
- ▶ Data sets from 9 experiments, incl. From research vessel Polarstern and Neumayer Station
- ▶ Free scientific work
- ▶ Learning at various stages
  - Basic knowledge, experiment description, operating instructions, glossary, literature
- ▶ 2 working modes: standard and extended



Deutsches Elektronen-Synchrotron DESY  
A Research Centre of the Helmholtz Association

DESY HOME | RESEARCH | NEWS | **ABOUT DESY** | CAREER | CONTACT

## PHYSIK.BEGREIFEN

School lab in Zeuthen

HOME / Offers / Cosmic Particles / Cosmic@Web

**OFFERS**

- Vacuum Lab
- Cosmic Particles
- Basics
- Experiments
- Cosmic@Web**
- Online Analysis Tools
- Documentation
- Scientific Work
- Glossary
- Links

**PHOTOS**

**CONTACT**

**MORE SCHOOL LABS**

**LINKS**

**PARTNER**

**SCHOOL LAB HAMBURG**

**Cosmic@Web**

- ▶ Plotting Tool
- ▶ Documentation
- Contact

**Further Offers**

- ▶ visit DESY
- ▶ International Cosmic Day
- ▶ IceCube Masterclass
- ▶ QuarkNet

**Cosmic@Web - Online Analysis Tools**

Without any programming knowledge and comfortably from a home laptop, pupils can now also work like an astroparticle physicist. Data from simplified cosmic rays experiments, most of which are carried out at DESY in Zeuthen, are integrated into Cosmic@Web and thus offer easy access to real long-term measurements.

When working in scientific research it is not always possible to have the experiment on-site. Especially the large-scale experiments researching particle and astroparticle physics are so complex and expensive, they are made only once in coordination of all involved science facilities. Examples of DESY's participations in such projects are the IceCube experiment in the Antarctica, the experiments at the Large Hadron Collider (LHC) at CERN and the planned Cherenkov Telescope Array (CTA). For astroparticle experiments additional aspects infringe the ability to build an experiment as space requirements, available infrastructure, annual weather conditions and scattered light play a significant role. Often several hours flight and travel time lie between the office and the research station. However, it is not always necessary to have your workplace next to the experiment. For the observation and investigation of cosmic particles, long-term measurements are particularly necessary in order to obtain suitable statistics and to derive significant statements. The measured data is therefore made available via the Internet so that it can be analyzed regardless of location. The

# More Offers

[www.teilchenwelt.de/mitmachen/jugendliche](http://www.teilchenwelt.de/mitmachen/jugendliche)

## Basic program

- ▶ Own measurements with particle detectors
  - Scintillation counter (CosMO)
  - Cherenkov counter (Kamiokannen)
  - Various research tasks: Detector understanding, investigation of physical phenomena
- ▶ Cloud chamber sets for classrooms



# Advanced program: CERN and research work

- ▶ High school students are brought into contact with research at qualification levels
- ▶ 60 students in two annual workshops (4 days) <https://indico.cern.ch/event/762375/>
- ▶ 10 students in project weeks (2 weeks) <https://indico.cern.ch/event/775569/>
  - own research projects, e.g. Medipix detector, CLOUD, ATLAS trigger system, lifetime of the B-meson, search for supersymmetry and dark matter, NA62, CP violation, beam simulation...
  - Often prize-winning



# Young Scientists as Key Players

- ▶ ~ 180 Facilitators (Vermittler/innen)
- ▶ PhD and Master students
- ▶ Guiding Masterclasses
- ▶ Supervision of student research projects
- ▶ Reimbursement of expenses + travel costs
- ▶ 2-day advanced training in science communication, didactics, and presentation techniques
- ▶ Practice in communication techniques as a "soft skill" for own career



# Promoting Young Talents through the Fellow Program

- ▶ Alumni of NTW, mainly alumni of CERN workshops
  - Now often studying physics or shortly before that
  - Interested in particle and astroparticle physics
- ▶ Fellow program launched in 2017
- ▶ Currently about 160 people
- ▶ Aim: increase connection with local research groups



Fellow Meeting 2017 Hamburg



Fellow Meeting 2018 Dresden

# Offers for Fellows

## Local offers

- Invitation to lectures, seminars, excursions etc.
- Internships
- Regulars table (Stammtisch)
- Participation in scientific and outreach activities
- Mentoring
- ...

## Central coordinated offers

- Fellow Meeting
- Fellow/Bachelor Physics School (March 2019)
- Soft Skill Workshops (Science Communication, Didactics)
- Participation in conferences, FSP meetings...



Fellow Meeting 2019 Mainz



Outreach activity 2019 Berlin



Fellow Meeting 2019 Mainz





# Win-win-Situation

## ► Research labs

- Highly motivated students interested in particle physics as future members of the research groups
- Support for scientific activities (SHK, conferences)
- Support for outreach activities (Long Night of Science, exhibitions, Open Day, Masterclasses, etc.)

## ► Fellows

- Close connection to research groups
- Further technical training, e.g. Fellow Physics School in March 2019
- Networking beyond local university



TeVPA Conference 2018 Berlin



Dark Matter Day 2017 RWTH Aachen



FCC Week 2017 Berlin

# Teachers as multipliers

## ► Development of material

- Teaching material for schools (4 volumes)

[www.teilchenwelt.de/tp](http://www.teilchenwelt.de/tp)

- Portal Leifi Physik: Chapter on particle physics

[www.leifiphysik.de/themenbereiche/teilchenphysik](http://www.leifiphysik.de/themenbereiche/teilchenphysik)

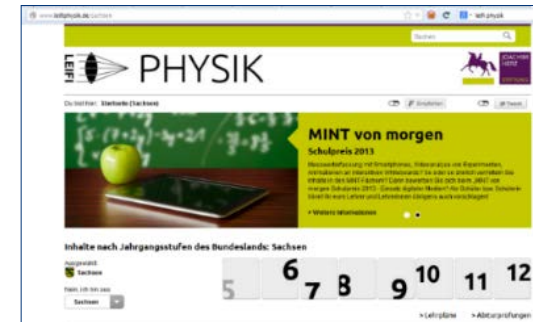
- Particle profile cards

- Context material

- > 100 detectors for Cosmic Ray measurements

- DIY Cloud Chamber sets

- GeoGebra Analysis of Bubble Chamber images



# Teacher Training

Teacher training at universities and research labs, e.g. KIT, DESY ...

Forschung trifft Schule  
funded by:



DR. HANS RIEGEL-STIFTUNG

- ▶ 2-day training for teachers
  - Introduction to particle physics, 6 trainings p.a.
- ▶ Summer School at CERN
  - 6 days, once per year

[www.teilchenwelt.de/angebote/lehrerfortbildungen-forschung-trifft-schule/](http://www.teilchenwelt.de/angebote/lehrerfortbildungen-forschung-trifft-schule/)



# KONTAKT

KOmmunikation, Nachwuchsgewinnung und Teilhabe der Allgemeinheit an Erkenntnissen auf dem Gebiet der Kleinsten Teilchen (2019 – 2021)

- ▶ Build on existing structures **Netzwerk Teilchenwelt + Weltmaschine**
- ▶ Extend frameworks and programs
- ▶ Intensify cooperation with other professional players in the areas of communication, participation, recruitment of new talents
- ▶ Reach out to other target groups
- ▶ More topics/contents from other fields of physics of the smallest particles
- ▶ Funded as **integral part of research** within the German research framework program ErUM: Exploration of the Universe and Matter



# Weltmaschine

[www.weltmaschine.de](http://www.weltmaschine.de)

- ▶ Central 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



# KONTAKT Work Packages 1 - 3

## → General Public

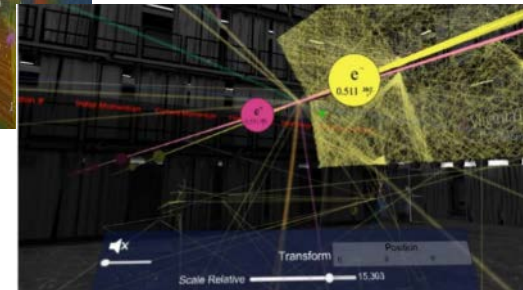
- Long Night of Science, Open Days, Highlights der Physik usw.
- Mobile exhibition module **NEW**
- Virtual Reality Systems **NEW**

## → High school students

- Data analysis and detectors (Masterclasses, CERN programs, research projects)
- Nuclear and hadron physics **NEW**

## → Students/Fellows

- Internships, SHK, hospitations, regulars' tables, Fellow meeting
- Fellow School **NEW**



Hierholzer Alliance  
**PHYSICS AT THE TERASCALE**  
 Introduction to the Terascale  
 18 - 22 March 2019  
 DESY, Hamburg

18 - 22 March 2019  
 DESY, Hamburg

<http://belle2.ijs.si/masterclass/>

Belle II Masterclass: Describe process → Run analysis → Fit results → Save/load process locally

Run Analysis | Select | Save Diagram | Load Diagram

Particles  
 Analysis  
 Variables

Belle II Masterclass  
 Number of events: 10000  
 First event: 0  
 Data Source: hadron-1  
 Print particle list? No  
 Particle List

# KONTAKT Work Packages 4 - 6

## → Scientists

- Training in science communication (Workshop z. Vermittlung von HEP)
- Portraits „Teilchenjäger“
- Media training

NEW

## → Journalists

- Support for press offices of the institutes
- Expanding media work
- Journalist trip to CERN

NEW

## → Project team and institutes

- Wiki, data base, materials
- Internal and external communication
- Integration of new groups / sites

Home / Startseite / Die Teilchenjäger

### Die Teilchenjäger

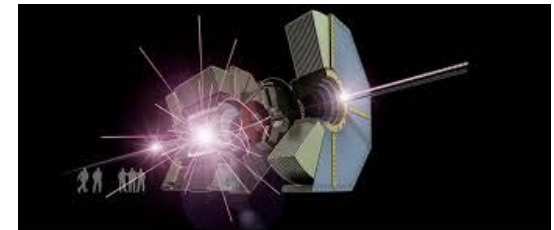
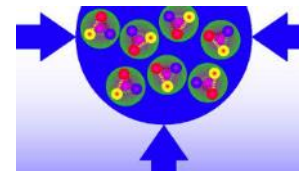
„Die Teilchenjäger“ sind los! In unserer Teilchenjäger-Serie gibt Ihnen Weltmaschine einen Einblick in das Leben einiger unserer Wissenschaftler, was sie beschäftigt und was sie an der Physik fasziniert. Bleiben Sie dran!



**Auf der Jagd nach b-Teilchen**  
28 März 2017

Carlos Marinus von der Uni Bonn ist Teilchenjäger an einem Experiment, das sich gerade noch im Bau befindet. Am japanischen Forschungszentrum KEK wird nächstes Jahr ein runderneuerter Teilchenbeschleuniger mit einem massiv umgebauten Teilchendetektor in Betrieb gehen: Belle II am Beschleuniger SuperKEKB.

[Ganze Nachricht lesen](#)



# Thank you for your interest!

 [mail@teilchenwelt.de](mailto:mail@teilchenwelt.de)

 [www.instagram.com/netzwerk\\_teilchenwelt/](https://www.instagram.com/netzwerk_teilchenwelt/)

 [www.facebook.com/teilchenwelt/](https://www.facebook.com/teilchenwelt/)

PROJEKTLEITUNG



PARTNER



SCHIRMHERRSCHAFT



FÖRDERER

GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung



DR. HANS RIEGEL-STIFTUNG

