KHUK Coordinated Outreach Activities

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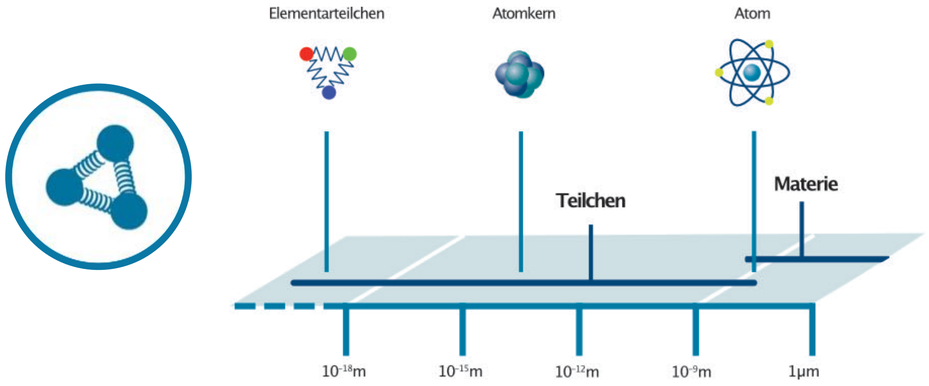
NETZWERK TEILCHENWELT

BMBF: Fields Of Action

- Topic **particles**
  - "… Elementarteilchen, Hadronen und Kerne …"

- 4 Fields of action
  - Large Scale Facilities
  - **Networking**
  - **STEM young scientists**
  - **Transfer & participation**

- Explicitly supported e.g. in **KONTAKT project**
  - **KO**mmunikation, **N**achwuchsgewinnung und **T**eilhabe der **A**llgemeinheit an Erkenntnissen auf dem Gebiet der **K**leinsten **T**eilchen
  - Next: **Kle**inste **T**eilchen, **T**eilhabe und **T**alente: KleT^3
  - 2018 – 2021: KONTAKT, 2021 – 2024: KONTAKT2
    - Established topical and regional hubs (Knotenpunkte) in 2019: Bonn, Mainz, Münster**: Explicit focus on HUK**
- Also support via FSP organisation: LHC office @ DESY, experimental FSPs (and other sources of funding: Graduate schools, Research centres, …)



Vernetzung
- Kompetenzen von Hochschulen und Forschungseinrichtungen bündeln
- Forschung international vernetzen

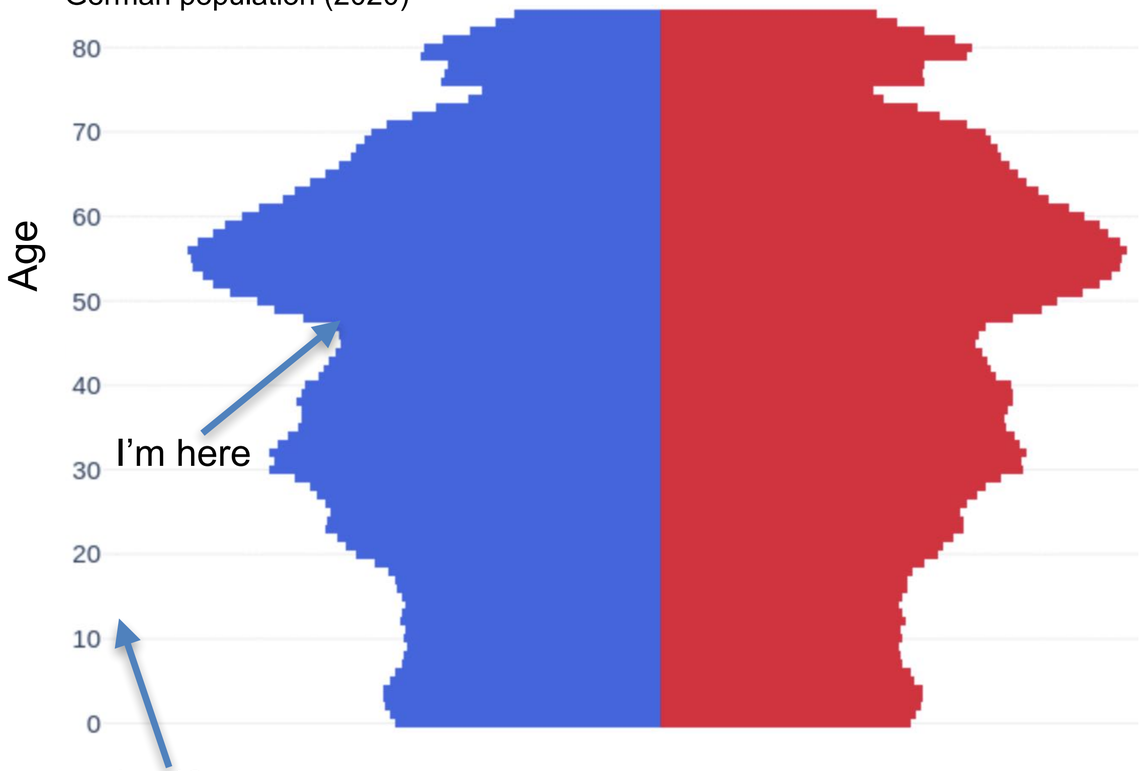
MINT Nachwuchs
- Nachwuchs für MINT Fächer faszinieren
- Wissenschaftlichen Nachwuchs qualifizieren
- Karriereperspektiven schaffen

Transfer und Partizipation
- Wissenschaftstransfer von Forschung in Wirtschaft und Gesellschaft anregen
- Dialog zwischen Forschung und Bürgerinnen und Bürgern intensivieren

ErUM Rahmenplan

The General Public

Relative parts of
German population (2020)



Age 12y
m/f gap opens in self confidence for STEM (ypulse)
Girls underestimate systematically their ability in math (DIW)

wiki

The general public / our society is very diverse

STEM young talents

– Diversity is not represented at all levels of the educational system / in STEM … and our field

Physik BSc 2021

– e.g. m/f gap in STEM develops early

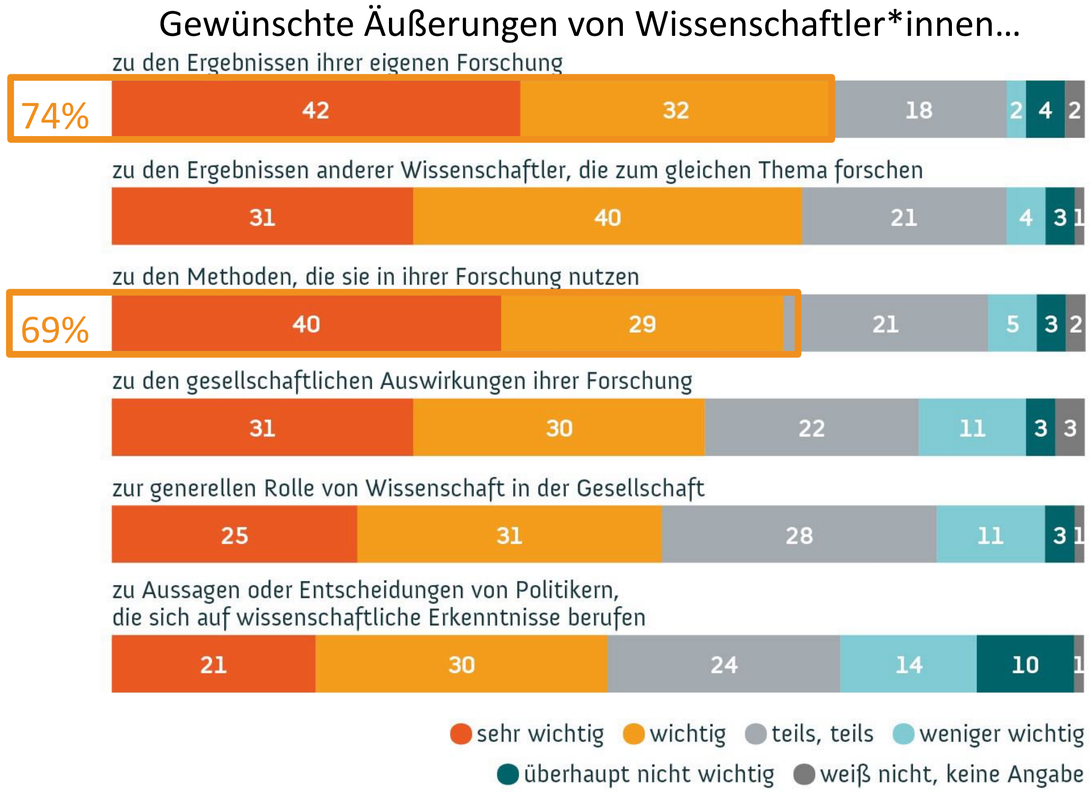
Participation

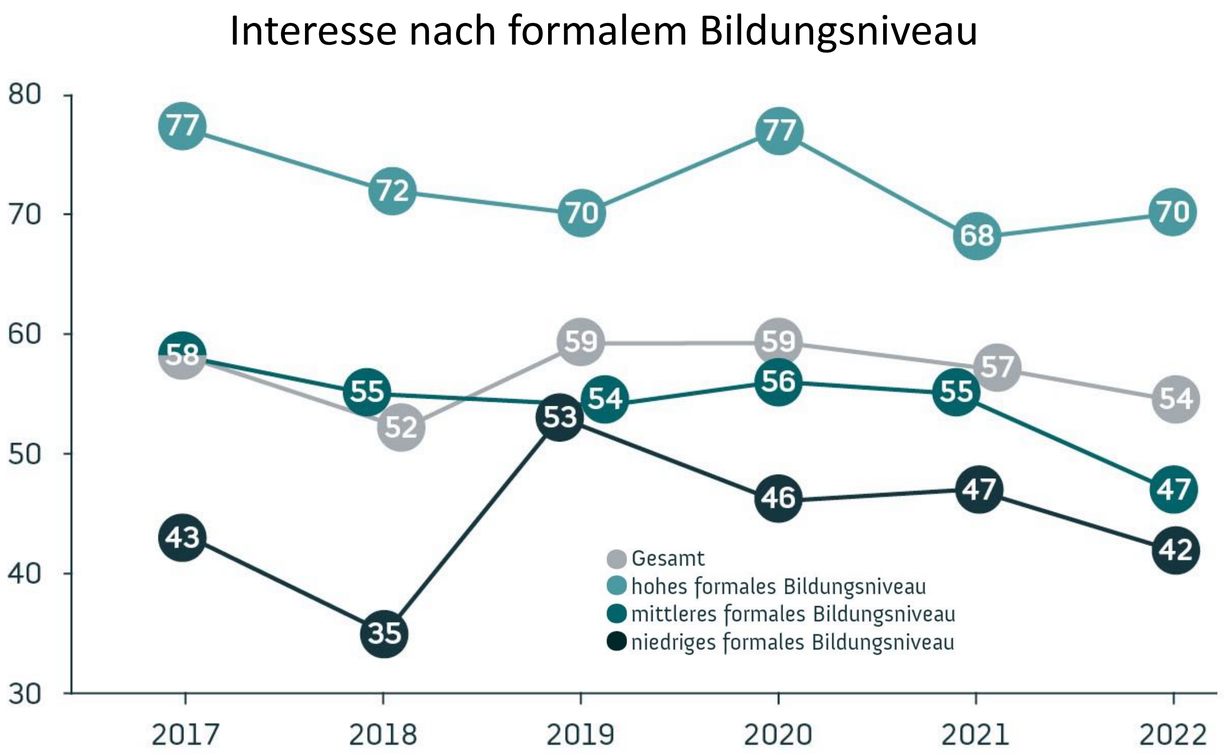
– Different approaches to target specific audience (age, gender, education, …)
  – Broad public, under 15 years, young scientists, girls …
– Be aware of selection biases and sensitive ages
  – Audience at science shows is not typical for society

Our actions today will have an impact …
Of course this is not our key expertise … isn't it?

Public Interest in Science

Wissenschaftsbarometer 2022





Communication of own research and methods highly requested

Young scientists are authentic communicators and role models

Interest in science not homgenous

Exploit potential via broad and targeted approaches

Public Outreach

“Reach out” to the people with our research topics, methods, technologies and science in general to

- **Satisfy existing curiosity** for fundamental research and spark interest
- **Promote appreciation** for fundamental research
- **Educate** on scientific methods and nature of science
- **Stimulate** to study STEM / gaining **new talents**

Some personal benefits

- Self effectiveness as a scientist
- Active role in shaping society
- Communication training
- New networks and interdisciplinary projects

Koalitionsvertrag “Mehr Fortschritt wagen”:

“Wissenschaft … lebt vom Austausch und der Kommunikation mit der Gesellschaft. Wir wollen Wissenschaftskommunikation systematisch auf allen wissenschaftlichen Karrierestufen und bei der Bewilligung von Fördermitteln verankern.”

Taking science into the society and leave a personal impact is a strong motivation for many

Coordinated Outreach since 2010

NETZWERK TEILCHENWELT

- **Network** of **34 universities/research labs** (Standorte) + CERN
  - Bundle existing activities
  - Share structure and programs
  - High visibility and impact
  - **136 groups recently signed LOI (31 new)**
- **Established brand**, high school students and teachers education
- Connected to astroparticle physics (Zeuthen), Weltmaschine/LHC (incl. ALICE), ErUM FSPs, FAIR Outreach Office …
- Since 2019 **explicit inclusion of nuclear and hadron physics**
  - Knotenpunkte/Hubs: **Mainz and Münster**
- Win for school, BSc, MSc, PhD students, group leaders

4 new since 2022
Uni Bielefeld
ALICE (theory)

Forschungszentrum Jülich
Nuclear and hadron physics (theory)

Helmholtz-Zentrum Dresden-Rossendorf
Nuclear astrophysics, accelerators

Helmholtz-Institut Jena
Nuclear spectroscopie, APPA/ SPARC, Laser acceleration, QFT

Project team:
TU Dresden, CERN, DESY-Zeuthen

Knotenpunkte:
Bonn, Mainz, Münster
mainz@teilchenwelt.de
muenster@teilchenwelt.de

Almost all HuK locations already present in the network. Approach your local contacts or hubs (standort@teilchenwelt.de), check with collaborations (FSPs, LHC Office, FAIR Outreach Office).

Masterclasses HUK

Concepts, Applications and QGP

NETZWERK TEILCHENWELT

Scattering boards

- Mechanical analogue to scattering fixed target experiments
- With electronic read out / DAQ
- Suitable also for younger students

Particle therapy

- Cancer treatment with X-Ray, protons, carbon ions
- Therapy planning / irradiation profiles

Nuclear Astrophysics *A Journey Through the Elements*

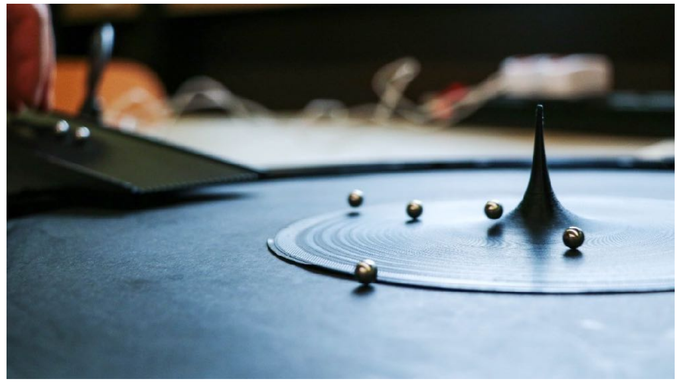
- Stellar evolution and nucleosynthesis

ALICE

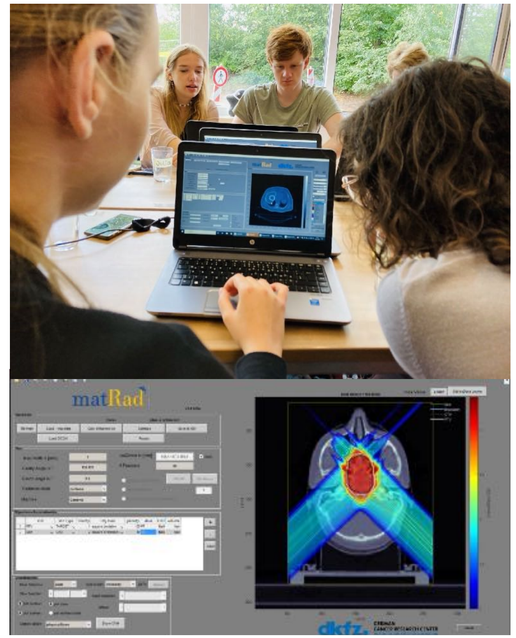
- Nuclear Modification Factor Masterclass
  - jupyter notebooks + binder
- Looking for Strange Particles Masterclass
- J/ψ Masterclass

Developments on theory, cross-sectional methods and Nature of Science.

With topical diversity in HUK a broad audience can be reached.



Scattering boards (Mainz)

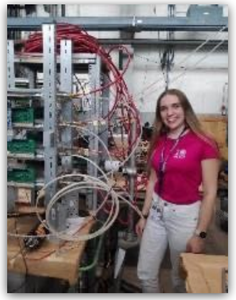


Particle therapy (GSI)

Nuclear astrophysics (Dresden)

Multi-Step Program

From Participation to Young Talent's Own Research

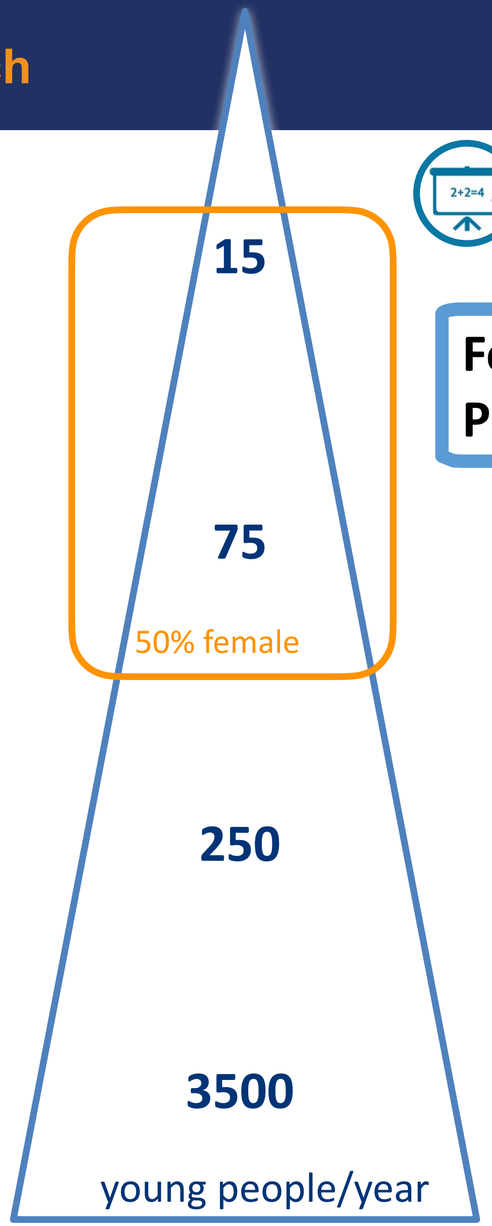


CERN project weeks
Own research project
(BeLL, Jugend forscht,…)
List of 131 essays, incl. 37 awards

CERN-Workshop (4 days)
Teilchenphysik-Akademie Mainz (1 week)

Own engagement
Detector project, tutoring
work with Cosmic@Web

Masterclasses in schools, labs or online
- (Astro)Particle physics
- Nuclear (Astro)physics
- Hadron physics



Fellow-Program

University/
Research Groups

Physics diploma 2022 (women)
- 22% Bachelor (out 2800)
- 23% Master
- 21% PhD

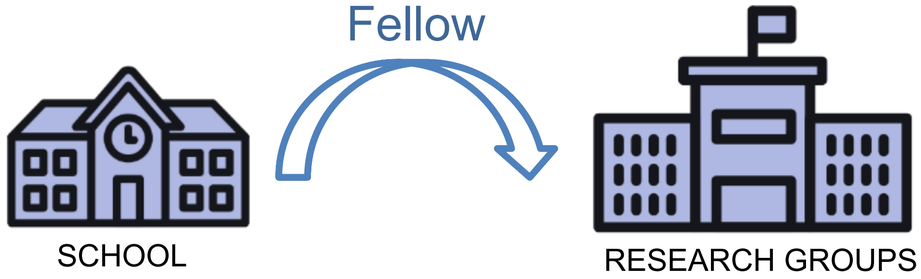
Fellow Program

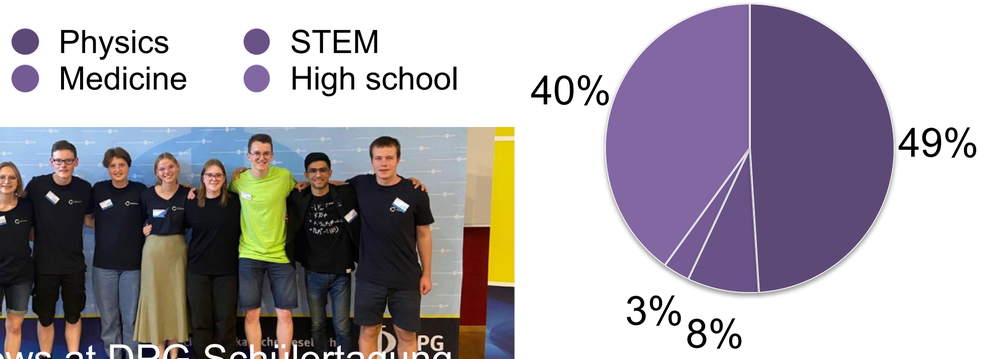
Keeping Young Talents Attached

- 160 people, **50% female** (program launched in 2017)
- Mainly alumni of CERN workshops
- Opening to engaged young physics students
- Now often studying physics or shortly before
- Local offers: Internships, excursions, invitation to outreach events, colloquia, regulars´ table etc.
- Central offers:
  - Yearly meetings 2022, 2023
  - Fellow physics and detector schools 2021, 2023, 2024
  - national physics conference / FSP attendance,
  - Online talks, mentoring, “Ask the expert”, etc.

Win for fellows: Close and early connection to research, extra training, networking

Win for Groups: Close connection to highly motivated, well trained students, possible support in science and outreach





Fellows at DPG Schülertagung Bad Honnef


Fellow Meeting Münster 2023

Facilitators / Vermittler*innen

Young Researchers as Science Communicators

NETZWERK TEILCHENWELT

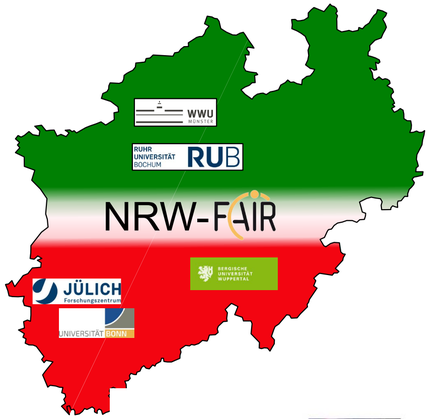
- **150 PhD and master students** engaged in Netzwerk Teilchenwelt
- **Guide Masterclasses** and supervise students´ research projects
- Get reimbursement of expenses and travel cost
- Communication and outreach training (2.5 days) in German or English:
  - Englisch: 14.-17.04.2024 im Physikzentrum Bad Honnef
  - German: Fall 2024
  - Alle Termine auf indico
- Regular onboarding events (1 - 2h) for new PhD students
  - Next: 05.02.2024 / 04.06.2024 / 28.8.2024 / 29.11.2024
- Learn to pitch your research to non-experts
- Build additional **networks** outside own collaboration (broaden for future career)
- As **role models**, they influence students´ career-related aspirations and choices.
- It‘s a win-win situation

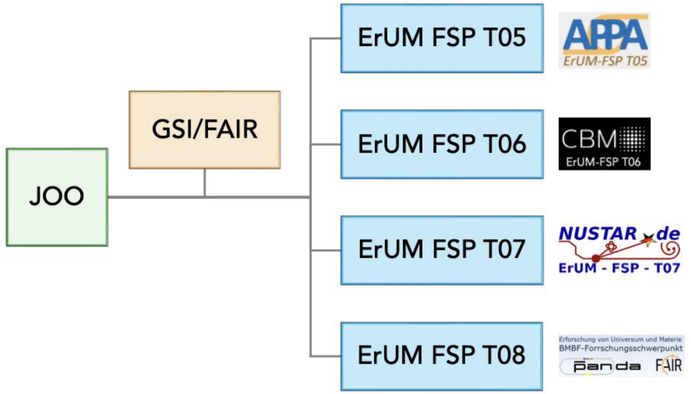
@Supervisors: **Please support this important task!**

Stay up to date
Newsletter

Networks on all Scales

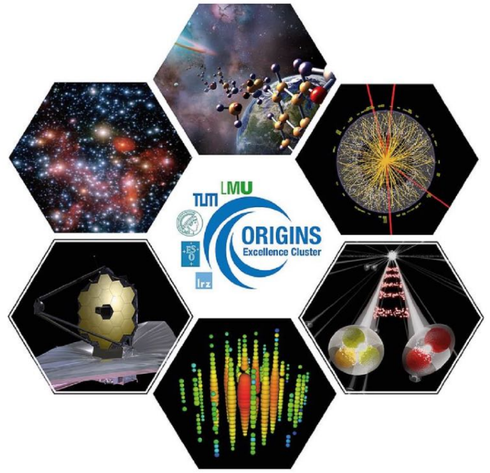
- Outreach organised and coordinated on various levels:
  - funding lines, interest, experiments, country, state, institutes, companies, foundations…
  - CRC, University, City, museums, NRW-FAIR,
  - FSPs, LHC-ErUM-FSP-Office, FAIR JOO…

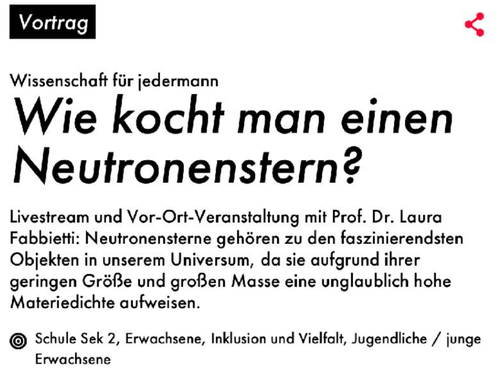




Schülerakademie Bonn/Jülich:
strong focus on theory: future Masterclass

CRC 110: Symmetries and the emergence of Structure in QCD





ORIGINS: Cluster of Excellence

**Activities often by same set of persons,
Partners outside research very beneficial**

Targeted Outreach – Ages 8 and Up

NETZWERK TEILCHENWELT

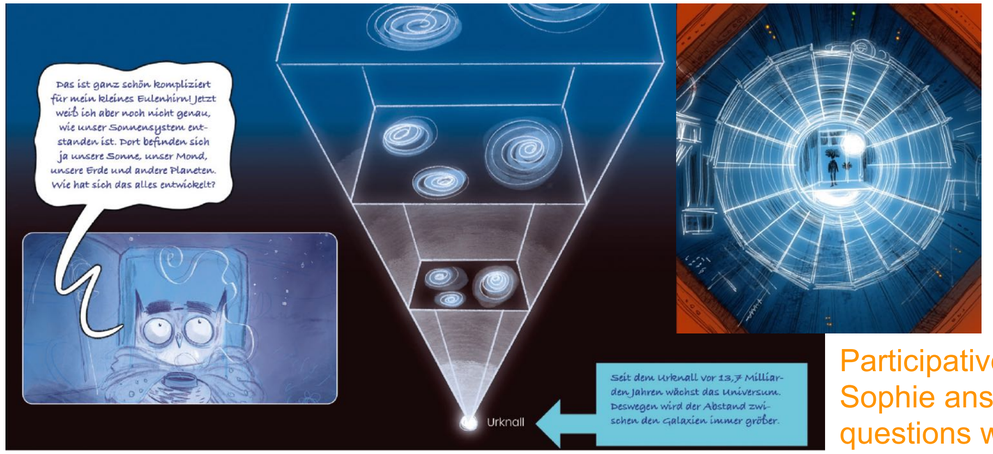
Talent Tage Ruhr

LEGO and Build your own particle detector science camp

Forscher*innen im sogenannten ALICE-Experiment (A Large Ion Collider Experiment) gelingt es für Bruchteile von Sekunden die Materie zu erzeugen, ...

Was war vor dem Urknall?

... wie sie eine millionstel Sekunde nach dem Urknall existierte. Wir nähern uns also wissenschaftlich immer weiter dem Zeitpunkt des Urknalls an und damit neuen und spannenden Erkenntnissen!



frag-sophie.de

Participative project: Sophie answers public questions with scientists.

Events for children often with local partners

Eye-catchers: LEGO, cloud chamber, VR

Topics: Big Bang, stars, big machines

Targeted Outreach – Sek. 1

- Cloud Chamber Workshops
  - Very well suited for school visits **≥ 7th grade**
  - 2 – 4h with young scientists
  - Detector technology und radioactivity
    - New DIY detectors under development (Bonn)
- Stand alone Program
  - Little effort for schools
  - Since 01/2022 more than 500 students
- Connection to other topics: Oppenheimer, Scientific collaboration and responsibility

Dry ice always eye catcher on school grounds

Workshop with Ukrainian children and Tetyana Galatyuk (CBM/Darmstadt)

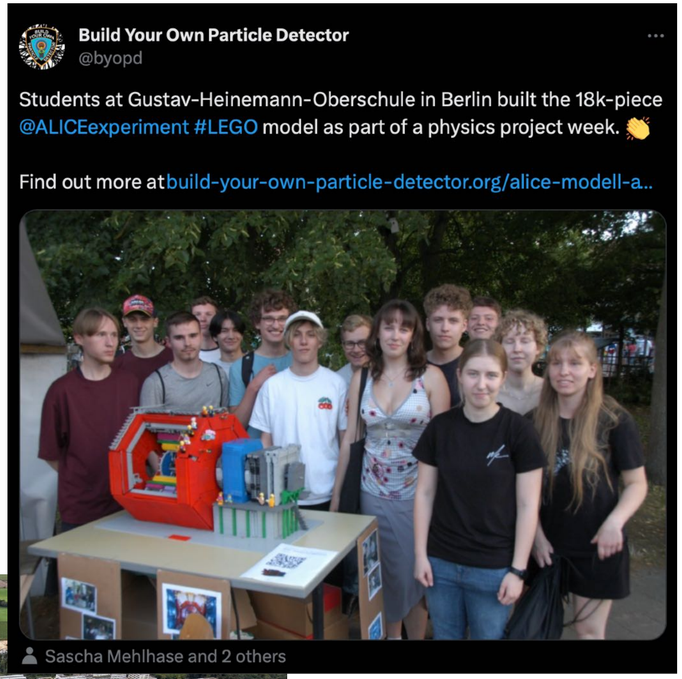
Cloud chambers are ideal starting points for HUK and detector physics.

Becoming standard program, similar to Masterclasses

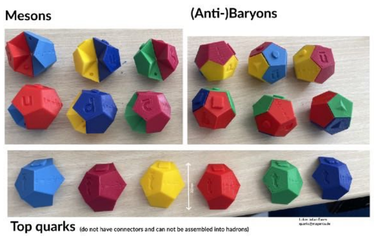
Covering the HuK Spectrum … with different means

VR applications

Classical books and posters springer



LEGO models BYOPD



New 3D printed quark puzzle (thingiverse)

FAIR site (movie 11/23)

Experimental facilities and theoretical concepts equally appealing.
With topical diversity a broader audience is reached.

HUK @ Events und Exhibitions

28.04.23, Zukunftstag NRW Landtag (ZDI.NRW)

Nov. 22, World Robot Olympiad, Dortmund, 365 teams, 73 countries

Eine Initiative des Bundesministeriums für Bildung und Forschung

Wissenschaftsjahr 2023

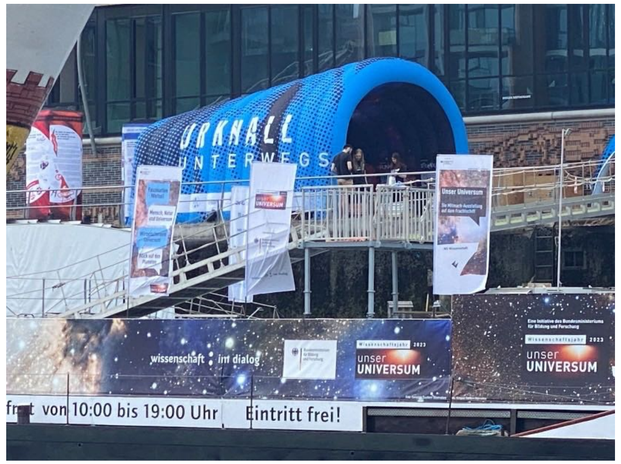
unser UNIVERSUM

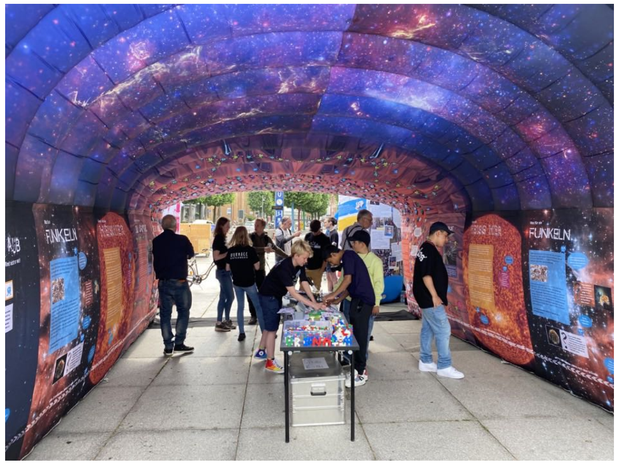
Dec. 22, Urban Science Store (Uni, FH, Stadt Münster)

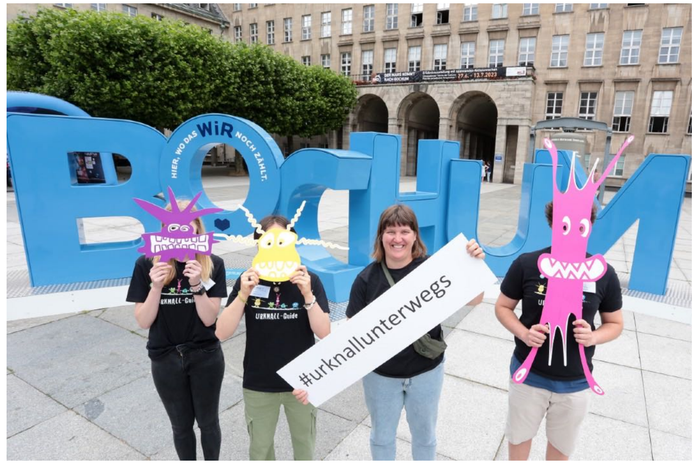
MS Wissenschaft

General Public – Urknall unterwegs

- Pop-up exhibition on Big Bang, nuclear and particle physics
- Tunnel: time travel through the history of the universe
- 2 Elements: Interactions and particles, Research methods, spin-offs
- Target audience: general public, families, people with less affinity for science
- Go to public places, shopping malls, Science Festivals…
- Tour with 13 Stops in 2023: Witzenhausen, Frankfurt, Hamburg, Ilmenau, Bochum, Karlsruhe, Hamburg, Berlin, Münster, Aachen, Aschaffenburg, Dresden, Hamburg, Partially with MS Wissenschaft







Booking now open for 2024 urknall@teilchenwelt.de

Woche der Teilchenwelt

One week of concentrated outreach efforts

- 30 events at 16 places
  - About 1000 persons reached in-person and und online
  - Masterclasses, Cloud-Chamber and other Workshops, MINT-EC Camp
  - (Virtual) Visits in Labs and at accelerators
  - Talks, Meet-a-Scientist, Talks in pubs
  - Movie screening with panel discussion
    - Particle Fever
    - 3sat Film-Preview: Elementarteilchen – Wie sie unsere Welt durchdringen
- Central coordination
  - Organisation of open virtual visits for all LHC experiments and Belle II
  - Central landing page wochederteilchenwelt.de
  - Templates for unified marketing (Print and social media)
  - Press releases

High impact via common activities, large fraction of HUK
Repetition likely attached to CERN70 in September

Summary and Outlook

- **Central structure: Netzwerk Teilchenwelt** for the field of smallest particles
  - Significant expansion in HUK,
  - Synergetic collaboration between **KONTAKT, LHC-Office and FSPs** for special events, promotion of young talents and broader target group

- **Investment into the future:**
  - **Young talents for Scientific and technical personell** at FAIR, LHC, FCC and for STEM in general
  - Need to address kids at young age and broader, also other paths of education
  - Research fundin, acceptance and support from society

- **Keys to success**
  - **Diversity:** Topics, offers, age groups and people
    - Big machines, engineering and computing challenges
    - Scientific concepts accessible at an early age
  - **Authenticity**: Real data, methods and applications
    - Meeting young scientists
    - Stars, Universe, Big Bang
  - Formal and informal **networks**

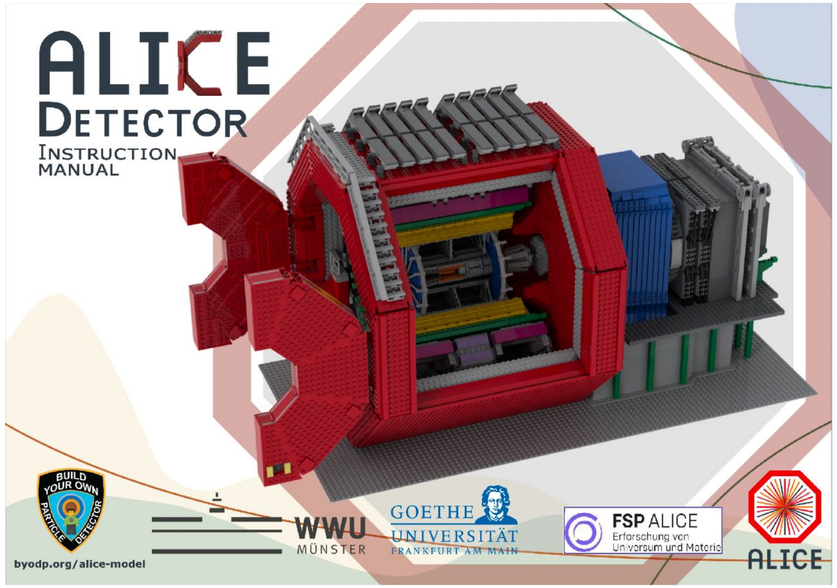
Authenticity is based in own research and biography.
Please foster outreach talents in your group!

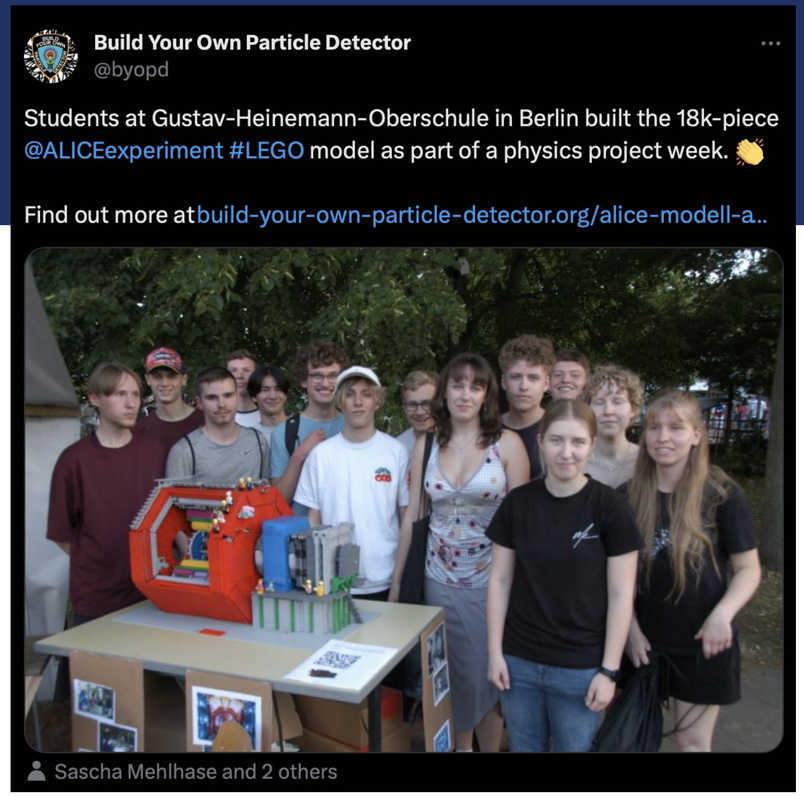
Urknall unterwegs


Kinderuni: Vom Regenbogen zum Urknall

Big Machines:
ALICE LEGO is spreading

V2.0
> 18 000 parts, 18 kg
Stabilised from prototype design refinements
Full step-wise instruction, Sub modelling, detector info

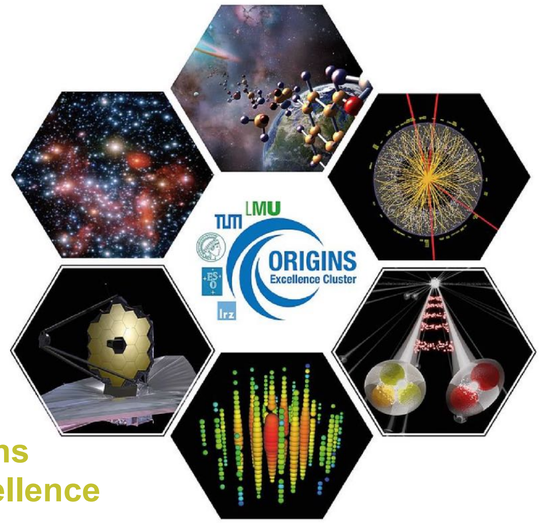




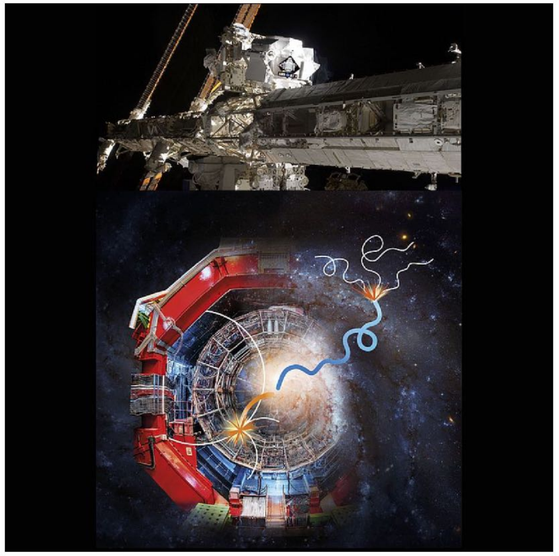
Now 5 full scale models worldwide
Berlin, CERN, Münster (2), Frankfurt
Instructions BYOPD

Learning about ALICE with Web 3D (link)

Universe and Stars: Public Talks / Museums



TUM and Origins
Cluster of Excellence



Vortrag

Wissenschaft für jedermann

Wie kocht man einen Neutronenstern?

Livestream und Vor-Ort-Veranstaltung mit Prof. Dr. Laura Fabbietti: Neutronensterne gehören zu den faszinierendsten Objekten in unserem Universum, da sie aufgrund ihrer geringen Größe und großen Masse eine unglaublich hohe Materiedichte aufweisen.

Schule Sek 2, Erwachsene, Inklusion und Vielfalt, Jugendliche / junge Erwachsene

Deutsches Museum

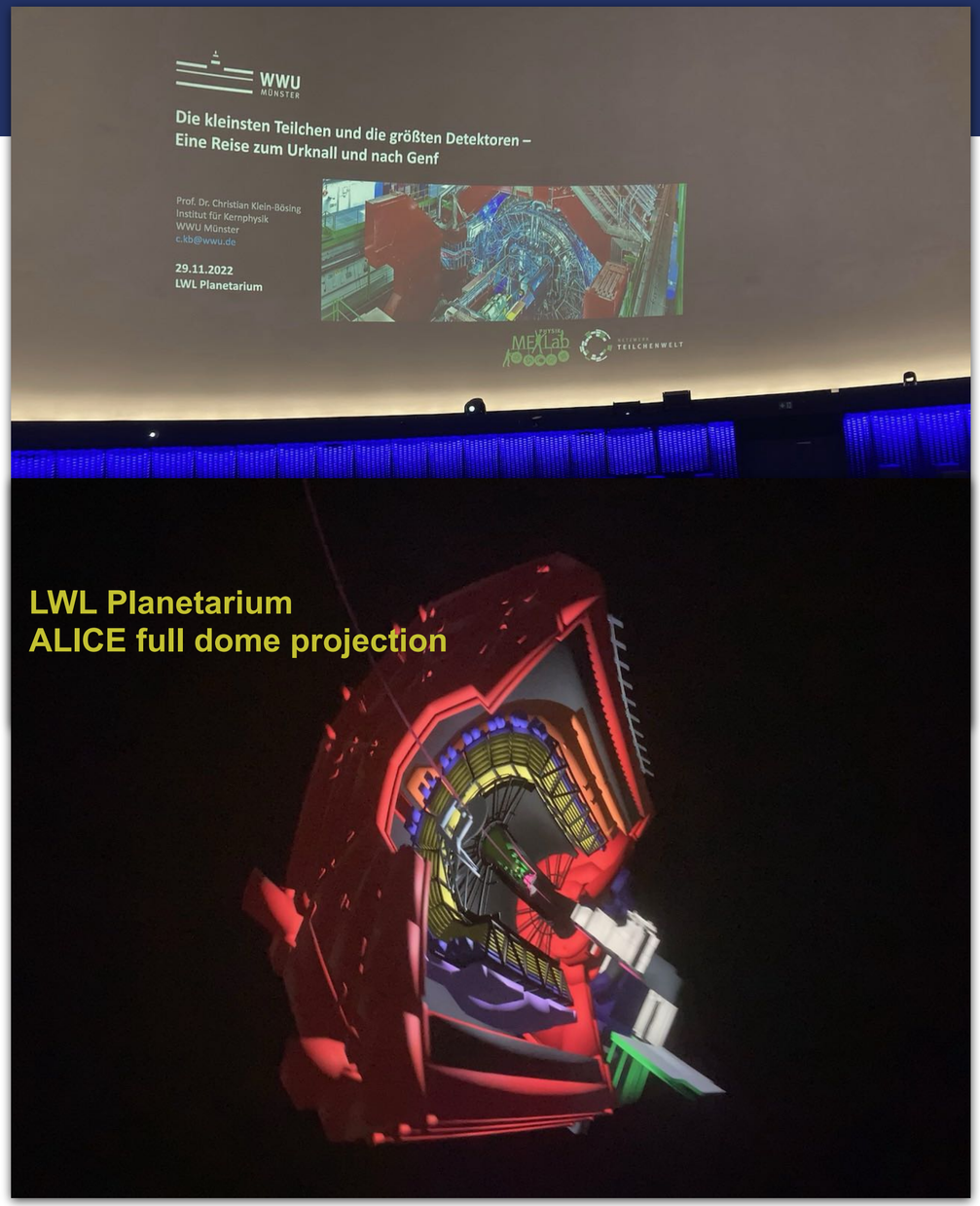
Vortrag

Wissenschaft für jedermann

Die Lange Reise der Antikerne

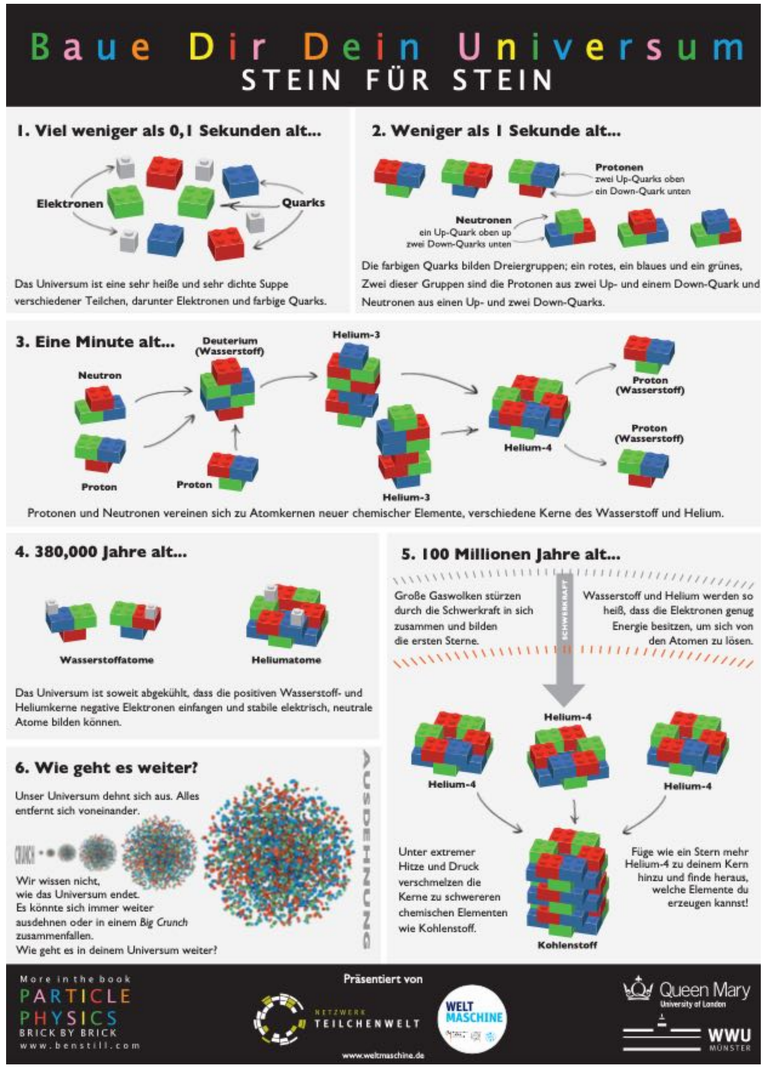
Livestream und Vor-Ort-Veranstaltung – Antikerne sind Spiegelbilder von normalen Atomkernen, mit der gleichen Masse, aber entgegengesetzter Ladung.

Schule Sek 2, Erwachsene, Inklusion und Vielfalt, Jugendliche / junge Erwachsene



LWL Planetarium
ALICE full dome projection

Nukleosynthesis with LEGO

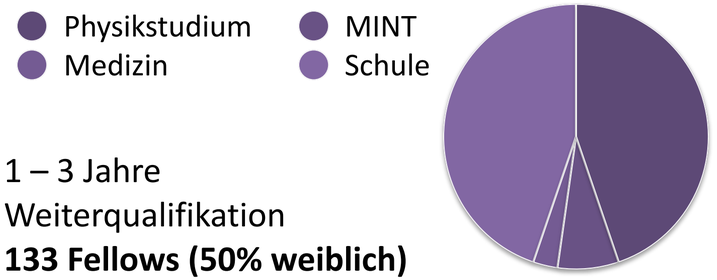


Primordiale Nukleosynthese: Vom QGP zum n/p Verhältnis und heutigem H/He Massenverhältnis

Wirksamkeit von Outreach?

Masterclasses,
U15-Aktivitäten,
Urknall Unterwegs,
Aktionstage,
Newsletter,
Fortbildungen…

3620 Adressen
40% eindeutige Öffnungen
5,4% eindeutige Klicks

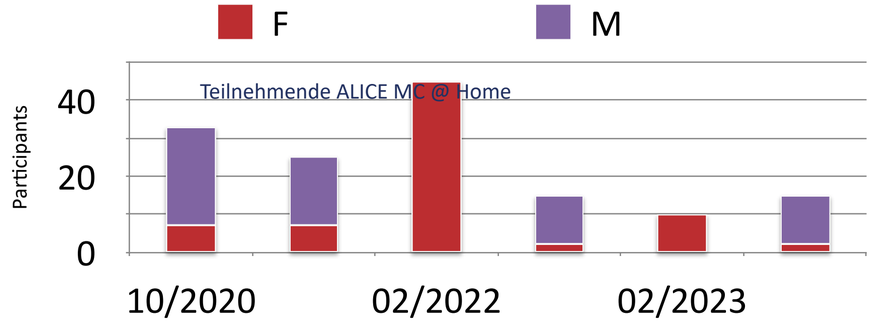


1 – 3 Jahre
Weiterqualifikation
133 Fellows (50% weiblich)
Übergang ins Studium

INPUTS → ACTIVITIES → OUTPUT → OUTCOME → IMPACT

Synergien/Ressourcen
Netzwerk Teilchenwelt, FSPs,
Lokale Akteur*innen,
BMBF Förderung
Persönlicher Einsatz

Interesse an Grundlagenforschung
mehr 200 Events/Jahr
ca. 3500 SuS/Jahr in Masterclasses
131 Arbeiten, 37 Preisträger*innen



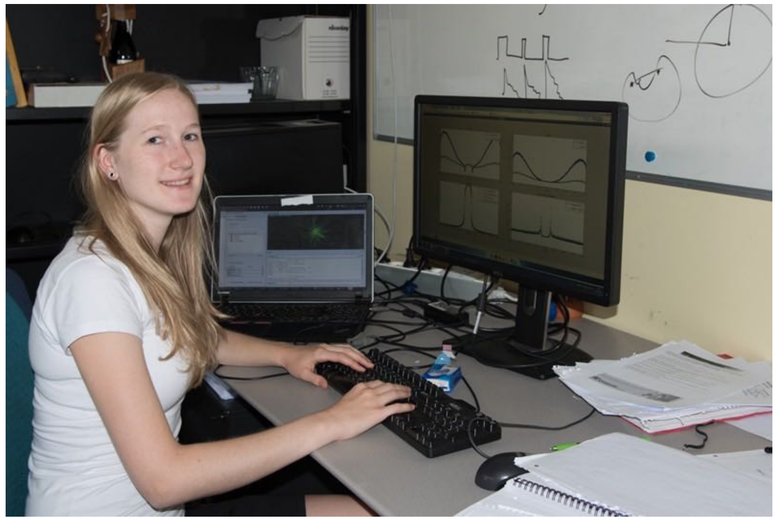
> 3 Jahre, gesellschaftliche Wirkung:
Modernes Bild von Wissenschaftler*innen,
Methoden und Nature-of-Science
Nachwuchs in Wissenschaft/Technik

Lindau 2021, mit Genzel, Gross, Perlmutter, Weiss
und Doktorandin Saskia Plura (AG Denig, Mainz; MC 2013, CERN Programm 2015, Fellow…)

Interdisziplinäre Arbeiten nötig
(Medien, Kommunikations- und Sozialwissenschaften)

Long Term Impact
(survey among graduates of CERN workshops 2010-2014)

- Maria M.: “Netzwerk Teilchenwelt has **changed my study plans** in particular and given me the opportunity to get to know modern day-to-day research." *Physics Bachelor University of Göttingen, Master Imperial College London, PhD University of Oxford, now PostDoc at Berkeley Lab*



- Lara B.: "[...] really **encouraged my interest in physics**. As I didn't have any teachers in secondary school who encouraged my interest (rather the opposite), there were **people in Netzwerk Teilchenwelt who motivated me and gave me great experiences.** These experiences are certainly one of the reasons why I will be starting my physics degree in the fall." *Physics Bachelor University of Göttingen, Master University of British Columbia in Vancouver, now PhD student at University of British Columbia*