

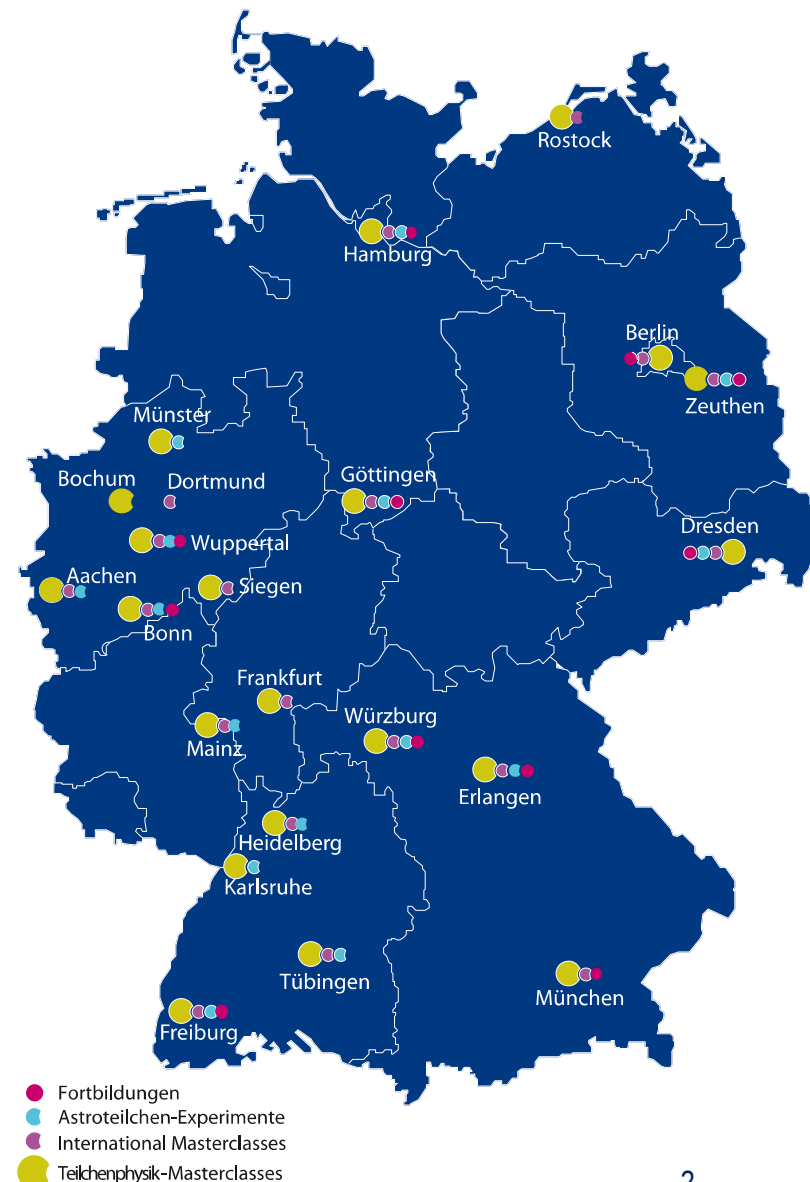
Netzwerk Teilchenwelt Education & Outreach in Astroparticle Physics

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Netzwerk Teilchenwelt

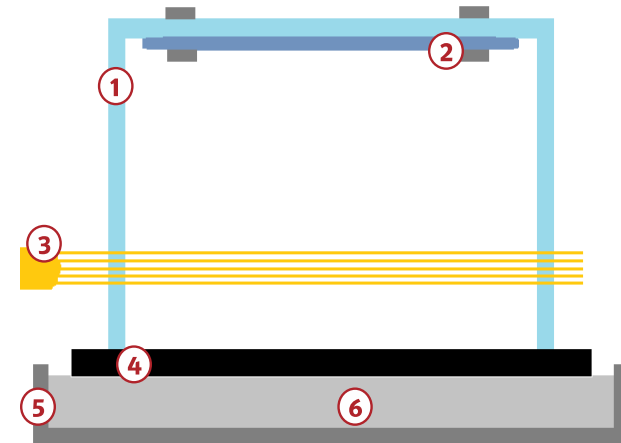
- ▶ Connects students, scientists and teachers
- ▶ 22 locations in Germany
- ▶ Engages students in astroparticle and high energy physics and lets them
 - ...participate,
 - ...teach,
 - ...research.



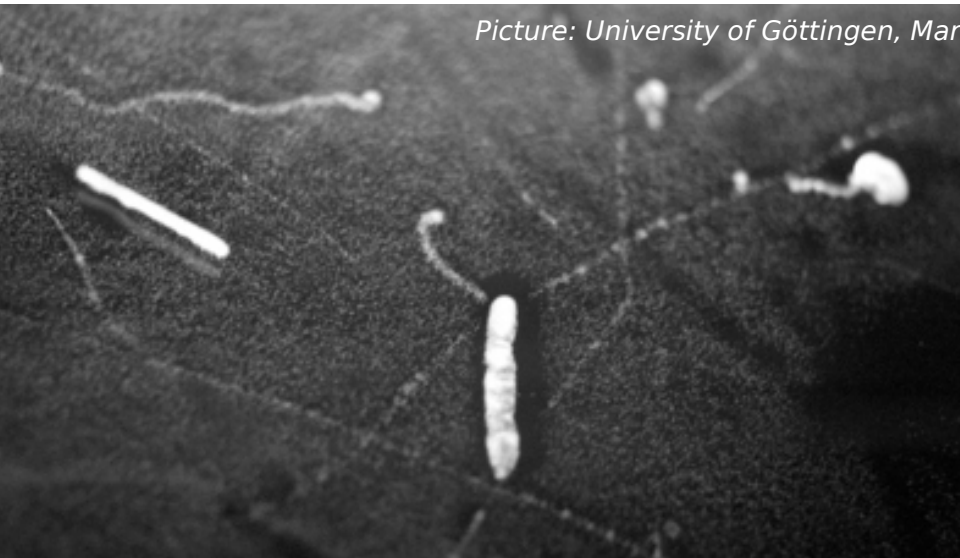
DIY Cloud Chambers

- ▶ Visualizing particle tracks
- ▶ From age 12, duration about 2 hours
- ▶ Sets available for schools to borrow or build themselves.

- ① Transparent plastic box
- ② Felt and magnets
- ③ Flashlight
- ④ Black metal plate
- ⑤ Styrofoam box
- ⑥ Dry ice



Picture: University of Göttingen, Markus Osterhoff



Pierre Auger Observatory

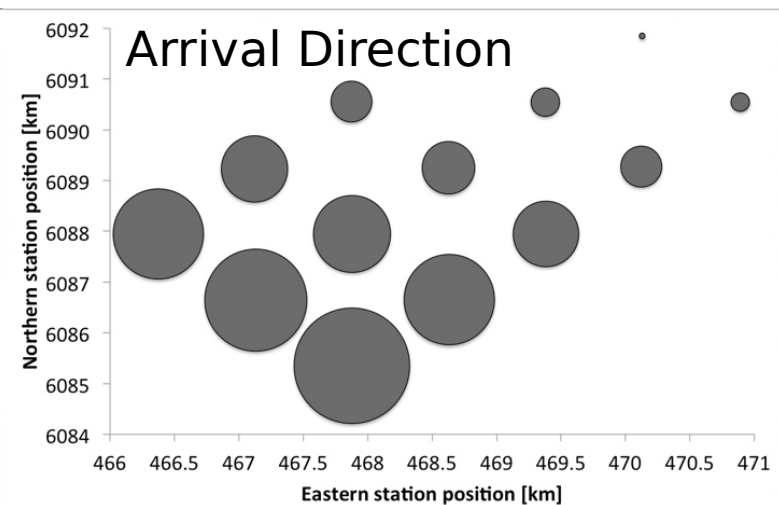
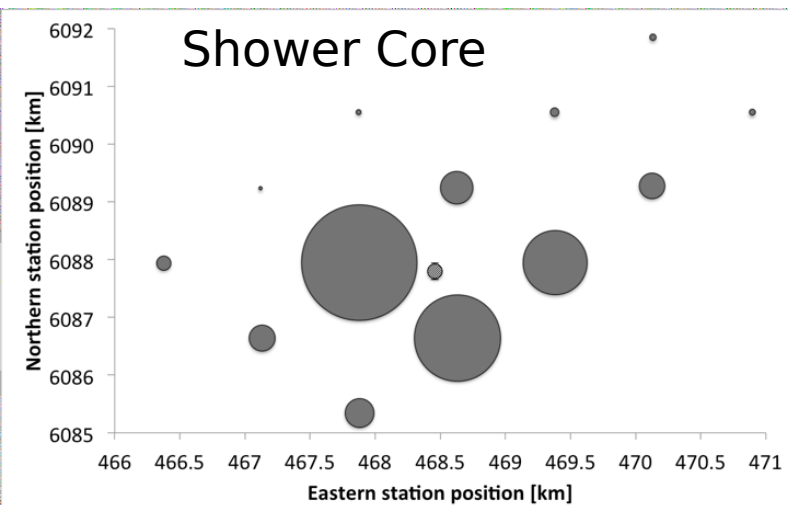
- ▶ 1600 water Cherenkov detectors on 3000km²
- ▶ 27 fluorescence detector telescopes at four sites
- ▶ 1% of the surface detector data is made available publicly

<http://auger.colostate.edu/ED/>



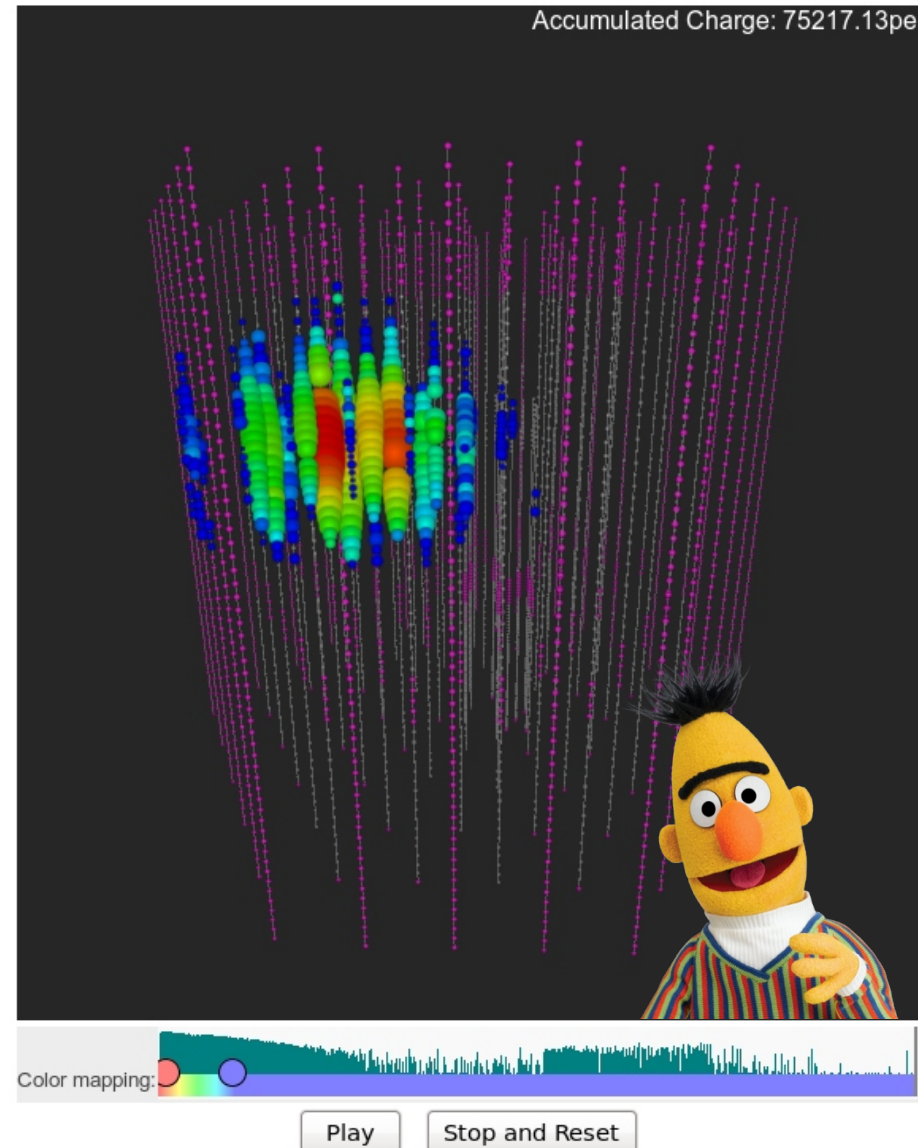
Auger Masterclass

- ▶ Typically at school with students of age 14 and higher
- ▶ Analysis of public data using spreadsheet software
- ▶ More at PoS(ICRC2015)304, Krause et al.



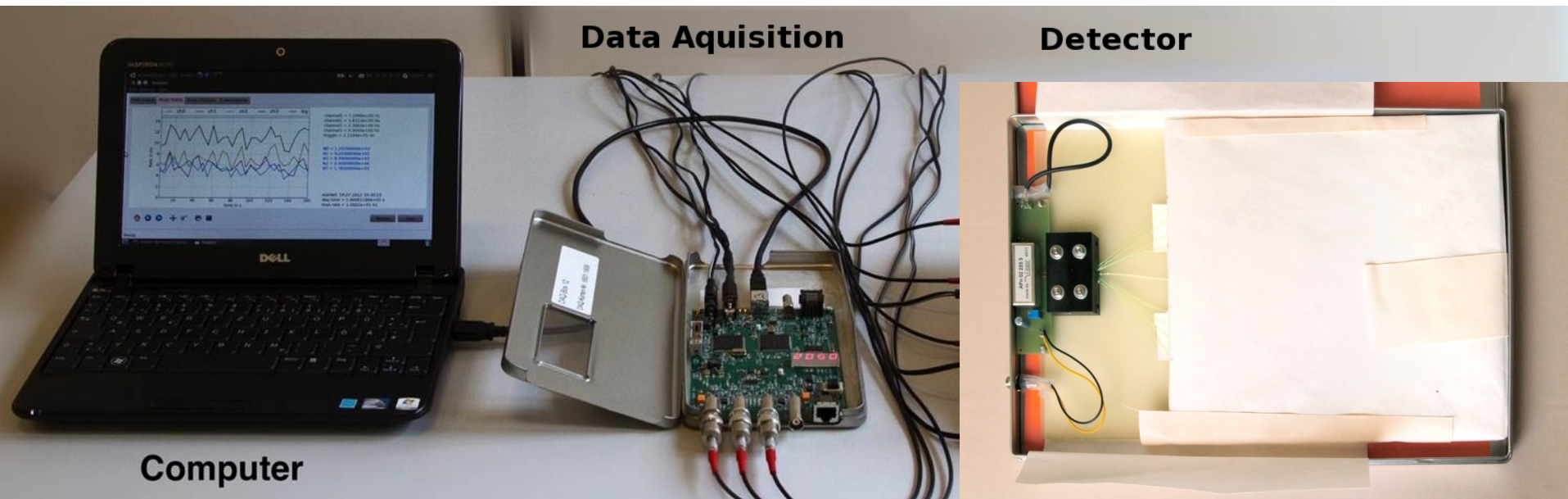
IceCube Masterclass

- ▶ Created and organized by IceCube collaboration
- ▶ Several NTW locations with IceCube group participated
- ▶ IceCube analysis using [web interface](#)
- ▶ Live chat with IceCube winter overs at south pole



CosMO-Experiment

- ▶ Plastic Szintillator (EJ 200), optical fibers and MPPC
- ▶ Can measure myons from cosmic ray induced air showers
- ▶ QuarkNet DAQ card allows measurements with up to four scintillators



International Cosmic Day 2015

- ▶ Students perform cosmic ray experiments in worldwide coordinated effort
- ▶ 400 participants in 23 groups in 2014
- ▶ Live online discussion during the event
- ▶ Students can present their results in common booklet
- ▶ Participate at <http://icd.desy.de>

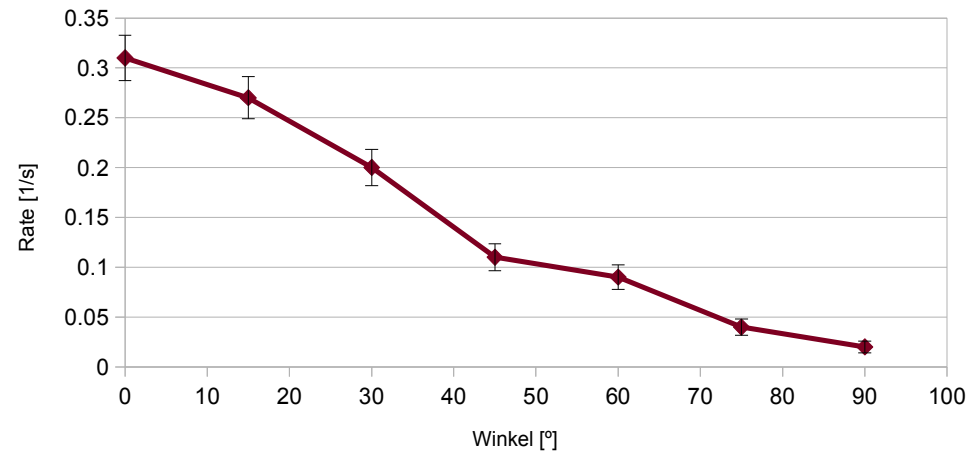
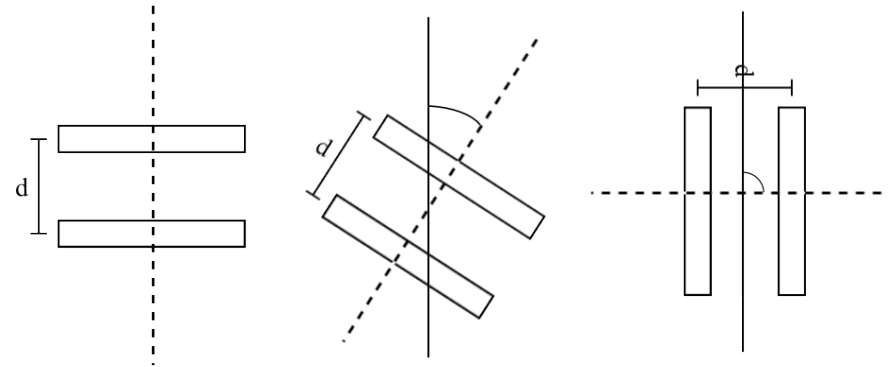


ICD Experiments: Zenith Angle

- ▶ Muon rate vs. zenith angle

Students learn:

- ▶ Geometrical detector acceptance
- ▶ Physical interpretation of results
- ▶ Statistical Uncertainties



ICD Experiments

- ▶ Understand physics of cosmic ray induced air showers
- ▶ Spatially distributed CosMO detectors at different distances
- ▶ “Kamiokannen” as small water Cherenkov detectors





INTERNATIONAL COSMIC DAY

Summary

- ▶ Students can participate at schools:
 - Build experiments like cloud chambers
 - Auger masterclasses
- ▶ Research:
 - Experiments with CosMO detectors
 - IceCube Masterclass
 - International Cosmic Day
- ▶ Teach:
 - Students can help in masterclasses after having participated
- ▶ Sign up for the ICD 2015 at <http://icd.desy.de/>



Backup: CosMO and Muonic

- ▶ More information about the hardware of the CosMO experiment can be found at http://physik-begreifen-zeuthen.desy.de/offers/cosmic_particles/students_experiments/cosmo_experiment/index_eng.html
- ▶ The detector software Muonic is an open source project developed at DESY and is available at <https://github.com/achim1/muonic/>
- ▶ ICRC Proceeding 2013 <http://arxiv.org/abs/1309.3391>