

International Cosmic Day.

An Astroparticle Physics Outreach Event for High-School Students



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Contact

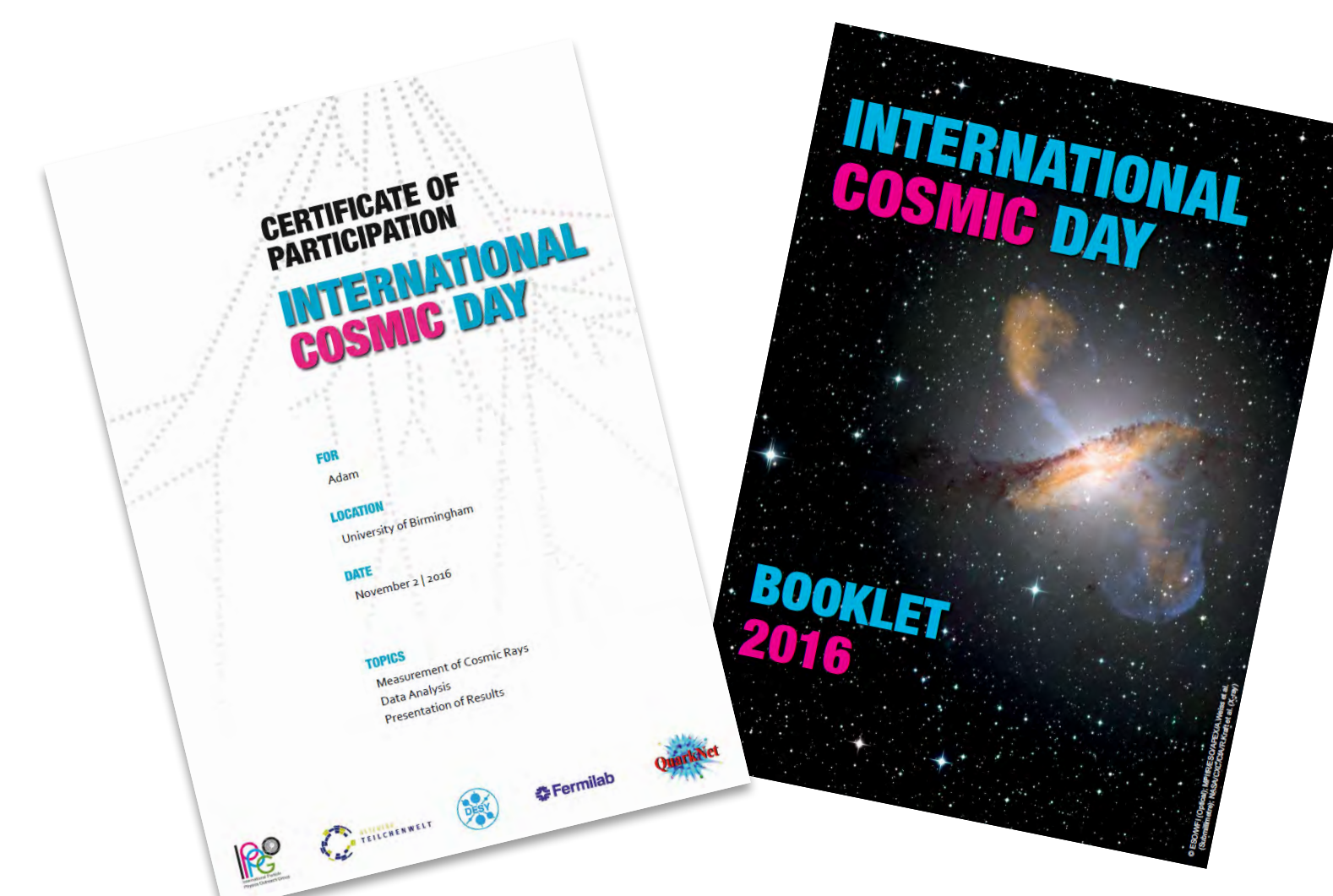
Participation is possible with any detector sensitive to atmospheric muons.

Website and Registration:

<https://icd.desy.de>

Social Networking Service:

www.facebook.com/InternationalCosmicDay



After the event, participants receive a personal e-mail with their certificate and proceedings booklet.

About the Event

- What?** brings together students and different physics outreach projects
Why? students learn about cosmic rays and scientific methods, perform an experiment and work like in an international collaboration
Where? all over the world
When? one day event, once a year
Who? groups of students, teachers and scientists

Students:

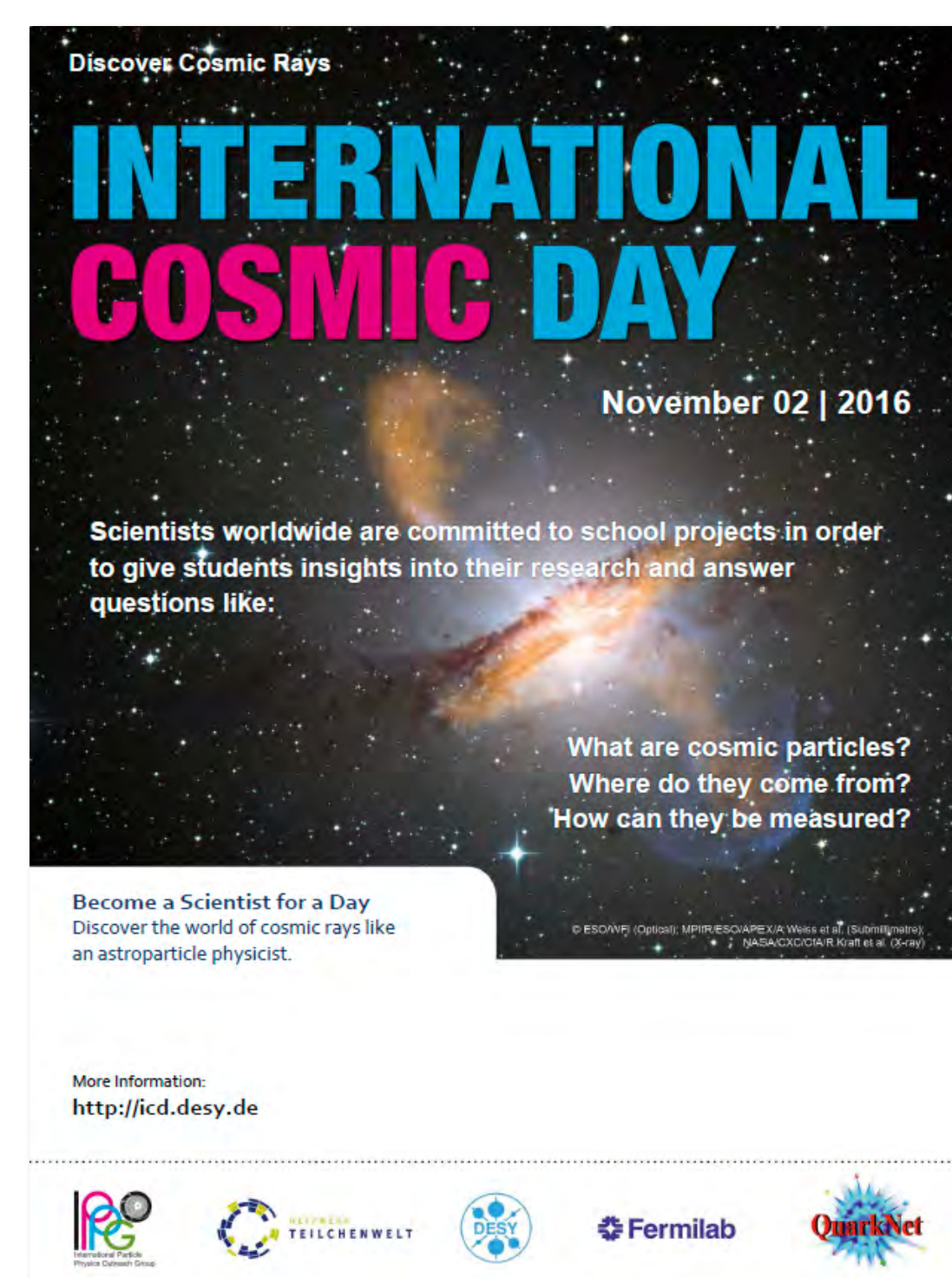
- > carry out an experiment, interpret data, compare results of the same physical quantity measured with different detector types
- > get a glimpse of how professional scientific research works
- > get insight into young research field and contact to scientific institutions and fellow pupils worldwide

Teachers:

- > good possibility for knowledge transfer outside of the standard curriculum
- > add topics of particle and astroparticle physics, cosmology and special relativity to their curriculum
- > establish contact to scientific institutions and other teachers with similar interests

Scientists:

- > share their fascination with astroparticle physics with a wide range of students
- > networking between projects developing and providing cosmic ray experiments for schools
- > outreach platform for experiments to reach a wide audience



Announcement poster of the ICD in 2016.

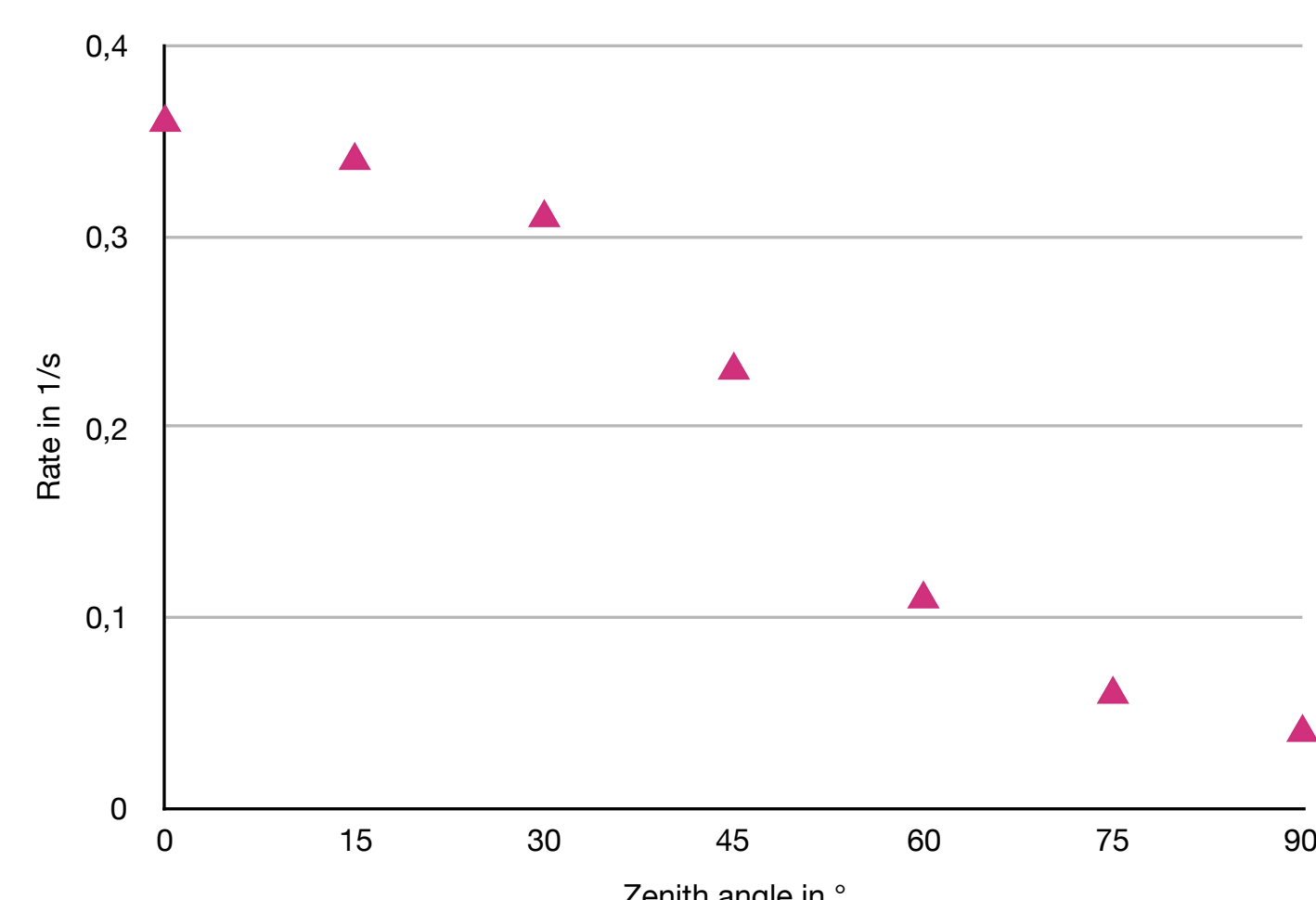
The ICD is organized by DESY in cooperation with Netzwerk Teilchenwelt, IPPOG, QuarkNet, Fermilab, and many national partners.

Educational Content

The focus is on one question:

Is the number of air shower particles arriving from the horizon the same as from the zenith?

With two coincident counters it can be explored within one day:



Zenith angle distribution of atmospheric muons measured by students with the CosMO detector during the 2016 ICD.

The measurement result leads to the question:

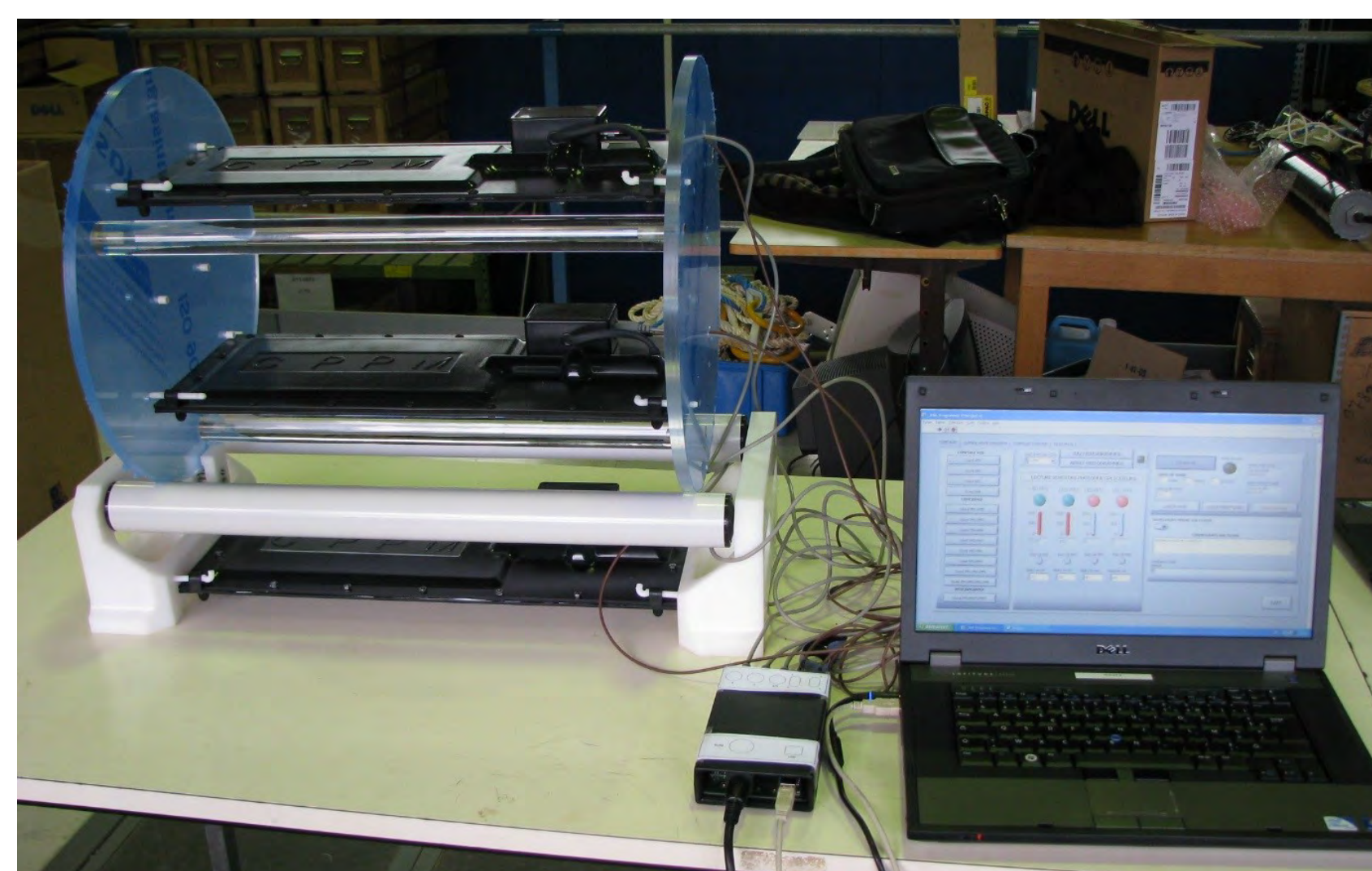
Why has the muon rate its minimum if the detectors are oriented horizontally?

This leads to the lifetime of muons and their decay. Muon interactions and parent particles can be discussed.

Experiments

Experiments for Students:

- > apply similar techniques as large-scale scientific experiments
- > mostly based on scintillation counters
- > data acquisition (DAQ) board and software specifically developed for the students' needs
- > DAQ board supports coincidence triggers between multiple counters
- > operated as muon hodoscopes enabling direction-dependent muon flux measurements



Cosmic ray detector called "Cosmodétecteur" of the French project „Cosmos à l'École" [3].

Large-Scale Experiments:

A novelty in 2016: PhD students from ATLAS [1] and IceCube [2] analyzed their atmospheric muon data tailored to the questions addressed by the students and presented the results on equal terms with the students.

Participating student groups get an impression of:

- > the idea behind these large experiments,
- > what the most important detector components are,
- > how big data analyses work, in comparison to the students' experiment.



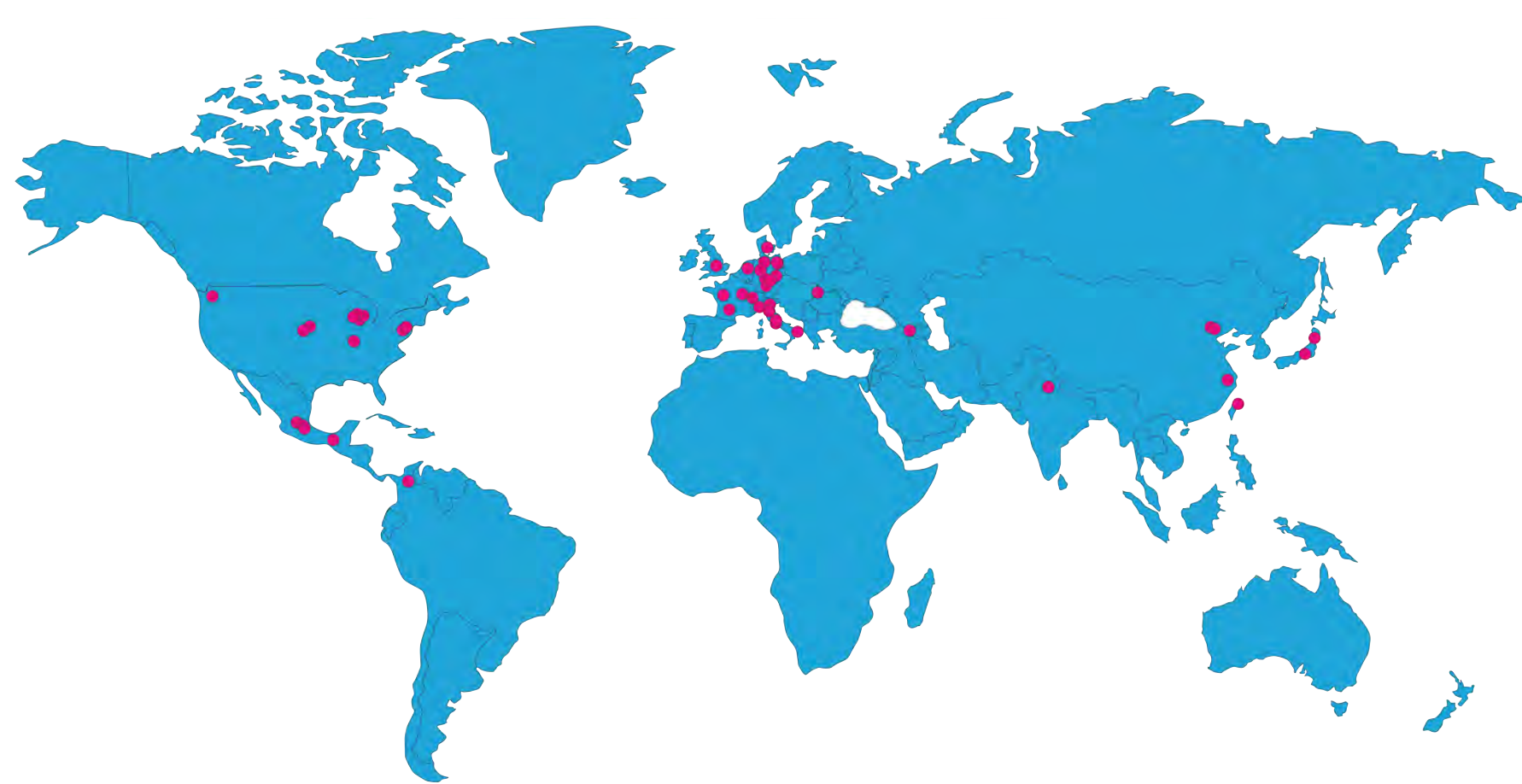
Students at the ICD in 2015 performing a measurement of the zenith distribution of atmospheric muons using the CosMO detector [4].

The ICD Agenda

Typical schedule of the ICD:

- > introduction to cosmic rays
- > measuring cosmic particles, analyzing data
- > discussing results within the group and with other groups worldwide
- > preparing the results for publication in a conference booklet

To foster the international exchange, several video calls are organized for the different time zones. The calls are held in English.



Locations of all groups participating at the ICD in 2016.

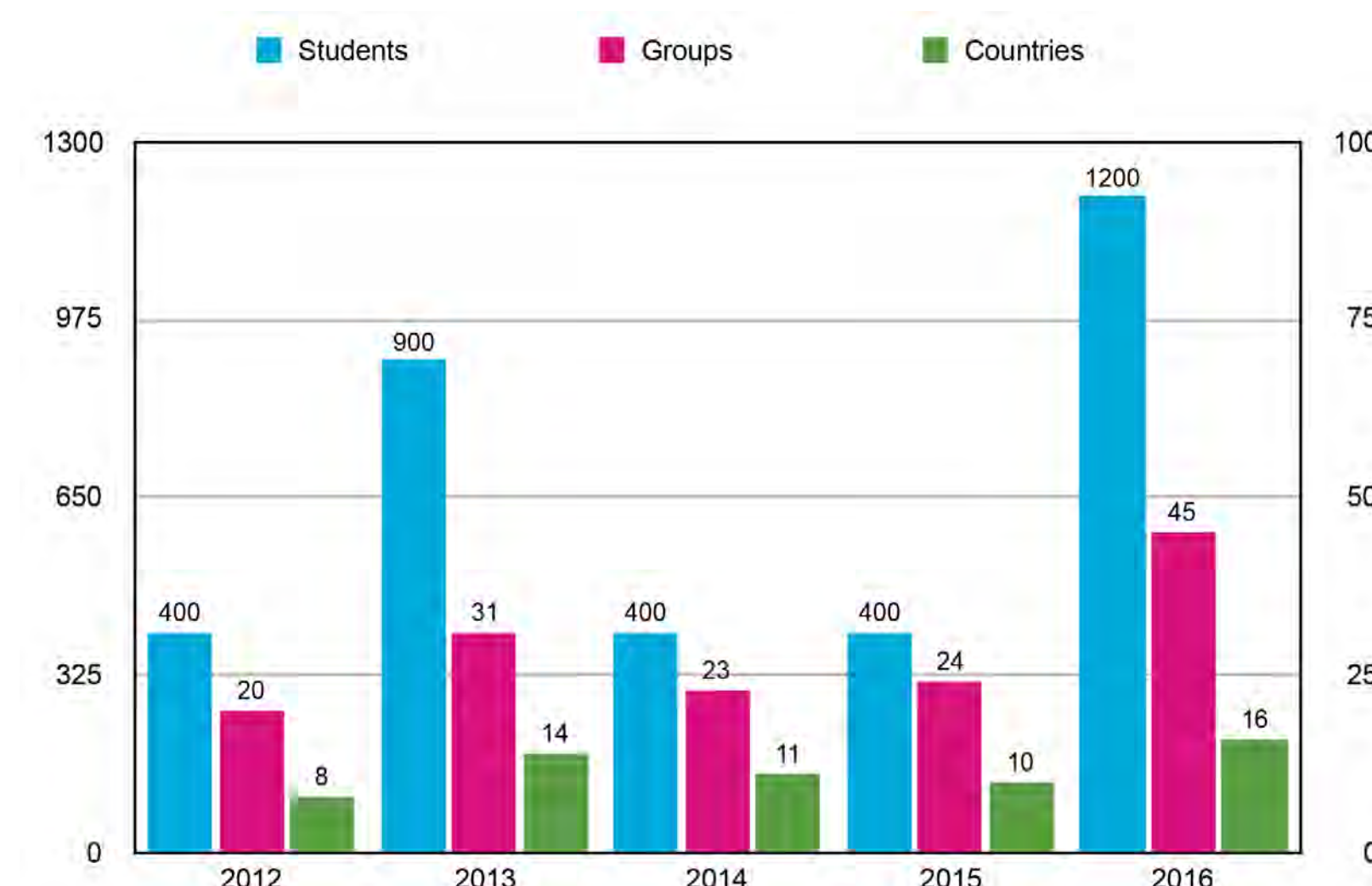
A Growing Event

Facts and Figures:

- > at five ICDs, about 3300 students from 26 countries have participated
- > average of 20 to 30 students per group
- > ideally, two to six students per detector set for autonomous experimentation
- > in larger groups experiments should be demonstrated by the teacher

Outlook:

- > cost per set is relatively high for typical public school budget
- > plan to provide data in a suitable format to be analyzed by students without access to experiments
- > data set should be large enough to leave room to realize own analysis ideas and make "discoveries"
- > but: larger data sets need more documentation and tools which are usually not utilized in a high school environment
- > threshold to start an analysis increases quickly to the point where working with this data becomes unattractive
- > tools are needed to allow students accessing large and unfiltered data in an intuitive way: first experience e.g. within the International Masterclass project [5] and within Cosmic@Web [6]



Number of students, groups, and countries participating in the ICD since its establishment in 2012.

References

- [1] ATLAS Collaboration, JINST 3 (2008) S08003.
[2] M. G. Aartsen et al. (IceCube Collaboration), JINST 12 (2017) P03012.
[3] <http://www.sciencesalecole.org/plan-cosmos-a-lecole-materiel>

- [4] R. Franke et al., CosMO – A Cosmic Muon Observer Experiment for Students, 33rd ICRC, arXiv:1309.3391 [astro-ph.IM]
[5] <http://www.physicsmasterclasses.org>
[6] <http://cosmicatweb.desy.de/ctplot>



ICRC2017