International Cosmic Day.
An Astroparticle Physics Outreach Event for High-School Students

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References

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](image)

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.

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.

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

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

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.

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]

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

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

Zenith angle in °

0 10 20 30 40 50 60

Rate in 1/s

0 0.1 0.2 0.3

Cosmic ray detector called “Cosmodétecteur” of the French project „Cosmos à l’École” [3].

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

Locations of all groups participating at the ICD in 2016.

Announcement poster of the ICD in 2016.

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