

INTERNATIONAL COSMIC DAY

Discover Cosmic Rays

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Life Lab Foundation QuarkNet-India | Oktober 8, 2021

About me

Where is my workplace?

DESY, GERMANY, ZEUTHEN

What is my task?

CONCEPTION OF
EDUCATION PROJECTS FOCUSED ON
ASTROPARTICLE PHYSICS

What I do when I'm not online?

WORK WITH STUDENTS AND TEACHERS
IN OUR COSMICLAB.
DEVELOPMENT OF EXPERIMENTS WITH
COSMIC RAYS FOR STUDENTS.



International Cosmic Day

About

- one day event, once a year (usually in November)
 - this year: November 10, 2021
- focuses on cosmic rays
- students, teachers and scientists come together to talk and learn about cosmic rays
- <https://icd.desy.de>
- Facebook and Instagram:
[#InternationalCosmicDay](https://www.facebook.com/InternationalCosmicDay)



Discover Cosmic Rays

INTERNATIONAL COSMIC DAY

10 YEARS International Cosmic Day

November 10 | 2021

Cosmic particles, these unnoticed particles that surround us all the time, are the focus of this day. Students, teachers and scientists get together to talk and learn about Cosmic Rays and answer questions like:

What are cosmic particles?
Where do they come from?
How can they be measured?
And what can we learn from them?

If you want to know more about the secrets they bring with and to be part of this collaboration, get here more information:

<https://icd.desy.de>
<https://www.facebook.com/InternationalCosmicDay>

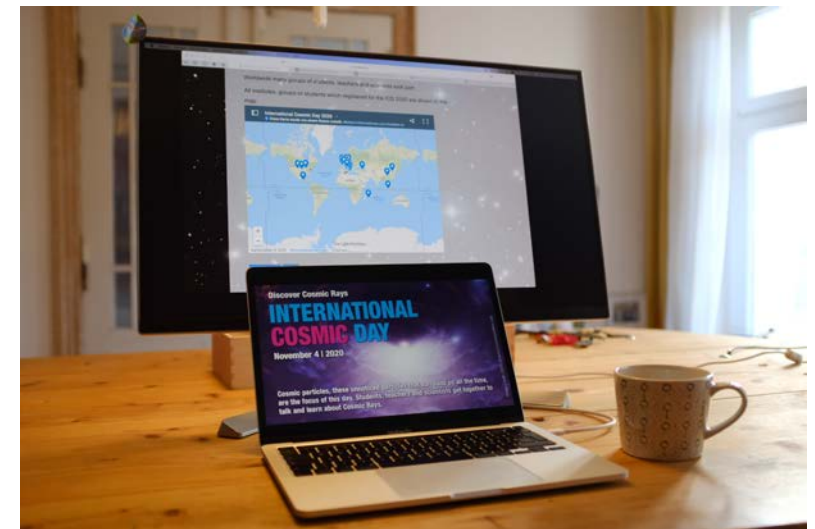
Image Credit: DESY, Science Communication Lab

Logos: IPhG (International Particle Physics Outreach Group), Netzwerk Teilchenwelt, DESY, Fermilab, QuarkNet

Idea of the ICD

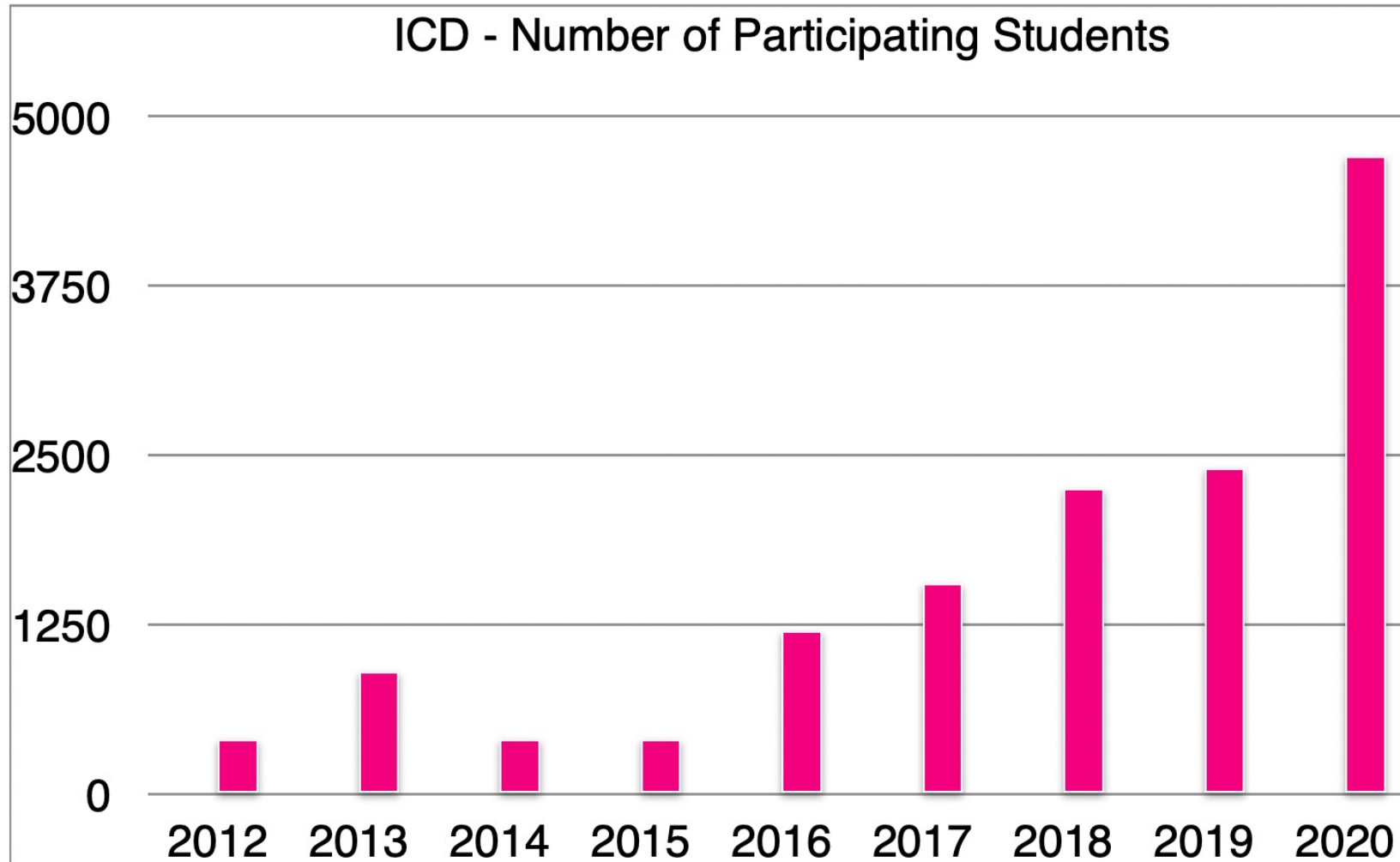
How it works?

- once a year, at one day, work on the same topic worldwide
- this offers young people:
 - opportunity for exchange in videocalls
 - participate in a common framework, as in an international collaboration
- teachers and scientists are asked to design a program for a group of young people (local activities)
- ICD team provide the common framework, provide materials, connect the different groups with each other



Number of Participating Students

Growing Event



Participating Groups Worldwide

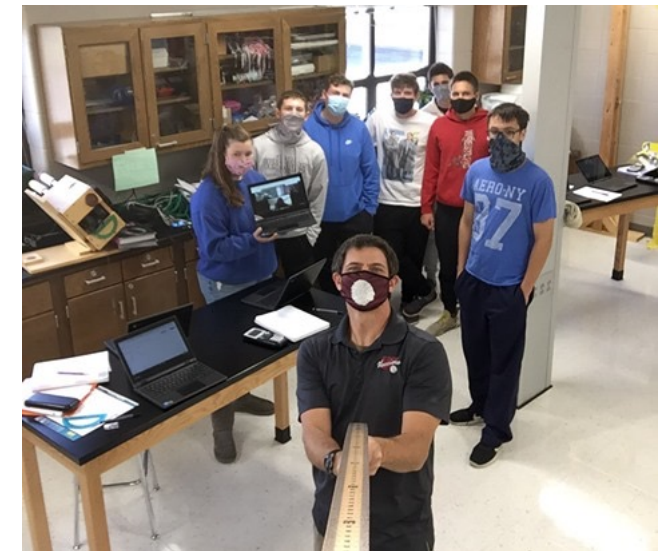
2020



Activities for the ICD

What to do?

- each group plan its own event
- activities:
 - discussions on cosmic particles
 - news about the latest research
 - direct measurement of cosmic particles
 - data analysis of cosmic particles
- formats:
 - Lectures
 - Masterclasses or Masterclasses@home
 - video transmissions to the classroom
 - tasks that the students can do in school or at home



 **The EEE Project @ ICD 2018** 



Offers centrally organized

- Material: poster, press release
- Welcome call at 9 UTC
- Organization of video calls for about 4 participating groups
- Organization of a Booklet to present the results of every participating group

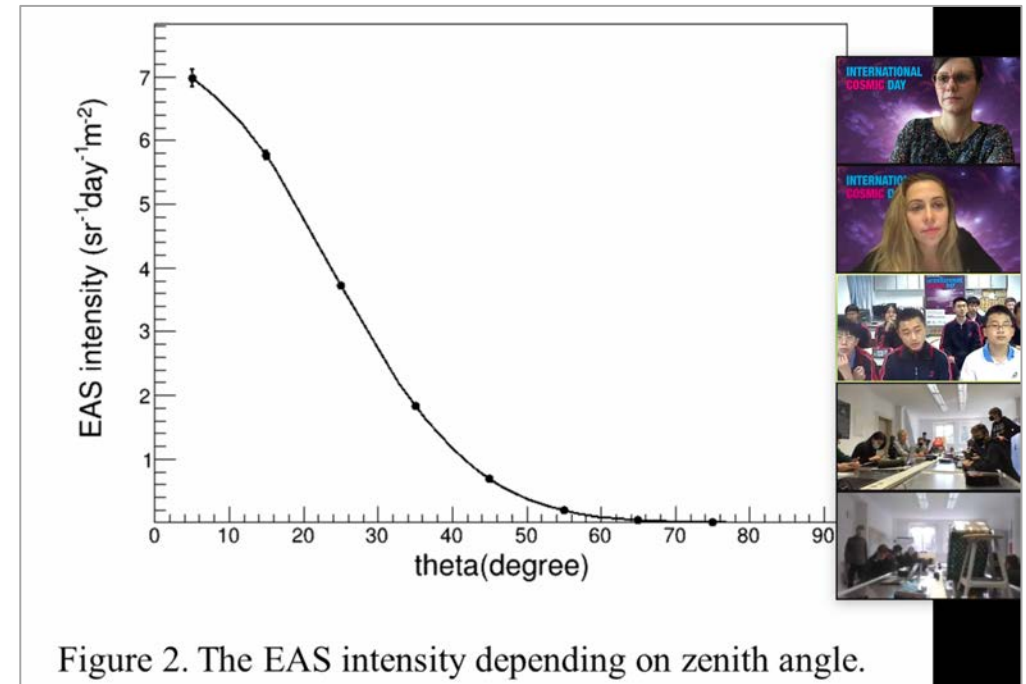
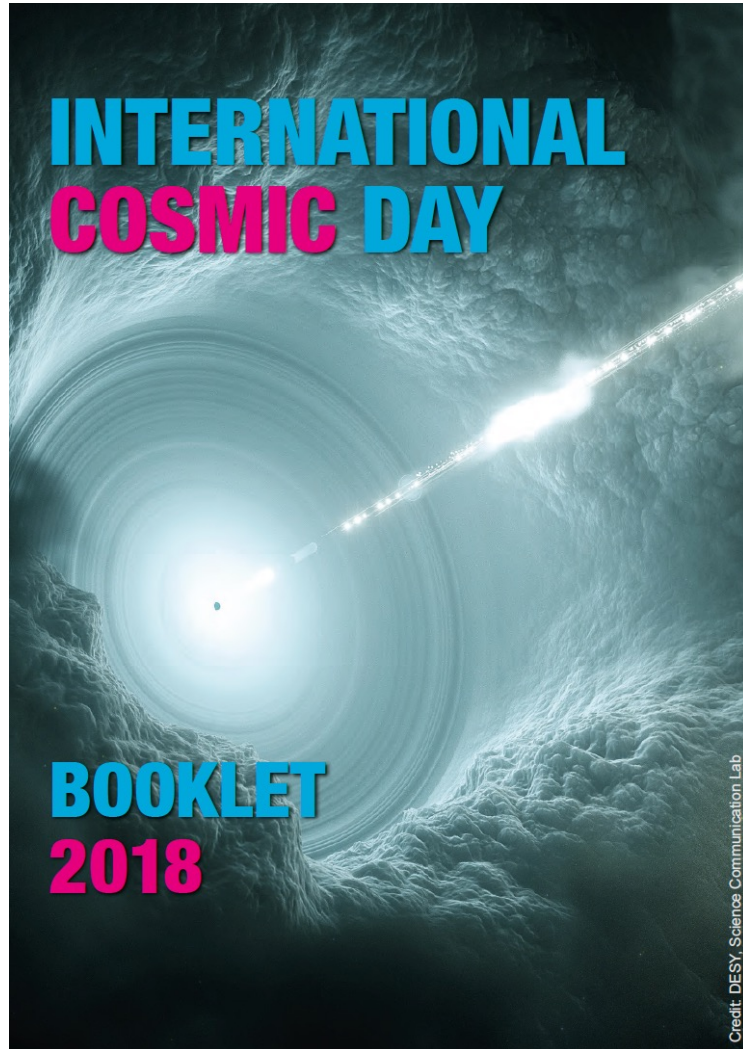


Figure 2. The EAS intensity depending on zenith angle.

The Publication of the Research Work at ICD

Booklet with all Contributions of the Participating Groups



INTERNATIONAL COSMIC DAY

Dear Young ICD-Researchers,

Thank you for your participation and contribution to the 7th International Cosmic Day!

Over 2250 students, 200 teachers and 120 scientists from 16 countries have made this day possible.

Various cosmic particles constantly reach the Earth – particles that can provide insights into events happening in the depths of the universe. You – the ICD young researchers – studied cosmic rays for one day. For 24 hours around the globe, cosmic particles were at the center of interest. All over the world, we discussed questions like:

What are cosmic particles?

Where do they come from?

How can they be measured?

You all have done your measurements very well. It is great to see all the results, which show only small differences but many agreements.

We hope the International Cosmic Day gave you an insight into astroparticle physics – a young research field located at the interface between astrophysics, particle physics, astronomy and cosmology.

Maybe you have become interested and it opens a new window for you to explore the universe.

In this booklet you can find information about all participating groups, the results of your measurements and web links to more information about astroparticle physics.

USA

ITALY

SPAIN

CHINA

SERBIA

MEXICO

FRANCE

SWEDEN

RÉUNION

GERMANY

DENMARK

AUSTRALIA

ARGENTINA

PHILIPPINES

UNITED KINGDOM

UNITED ARAB EMIRATES

INTERNATIONAL COSMIC DAY 2018

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Offers centrally organized

- Material: poster, press release
- Welcome call at 9 UTC
- Organization of video calls for about 4 participating groups
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- social media: Facebook and Instagram
- Kahoot quiz
- Selfie and Drawing contest

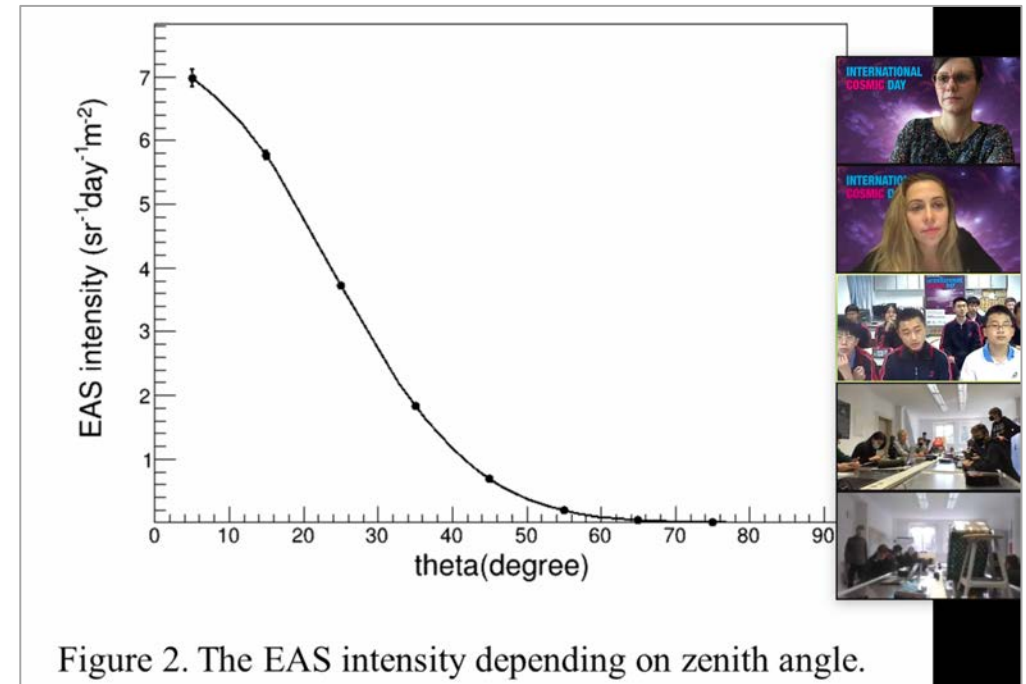


Figure 2. The EAS intensity depending on zenith angle.

Winner of the COSMIC SELFIE 2019 is:
INFN Laboratori Nazionali Del Gran Sasso
Italy, L'Aquila



COSMIC SELFIE's 2019

INFN - Sezione di L'Aquila



INFN - Sezione di Bari



IIS Giulio Casiraghi - Cinisello Balsamo



Drawing Contest

This year new



Draw your favorite cosmic particle.
Post it on Facebook or Instagram
and use the hashtag
#InternationalCosmicDay.
The best one will get a prize!

Neutrino © Nora Feigl | DESY

Offers centrally organized

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- Organization of a Booklet to present the results of every participating group
- social media: Facebook and Instagram
- Kahoot quiz
- Selfie and Drawing contest
- Links to recordings/online presentations
- Links to data provided online

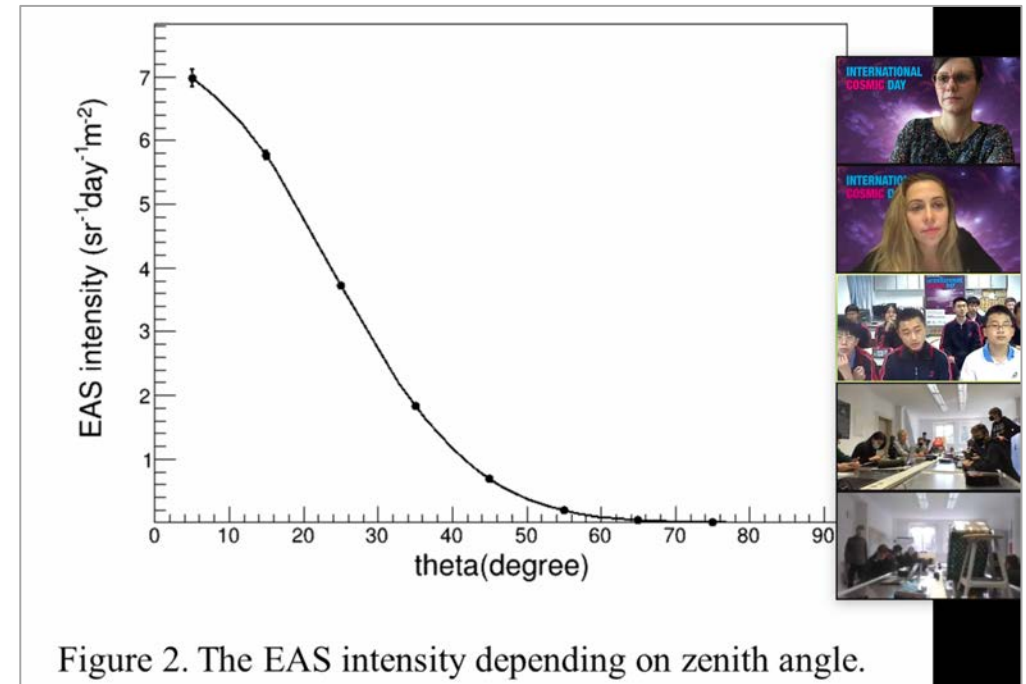
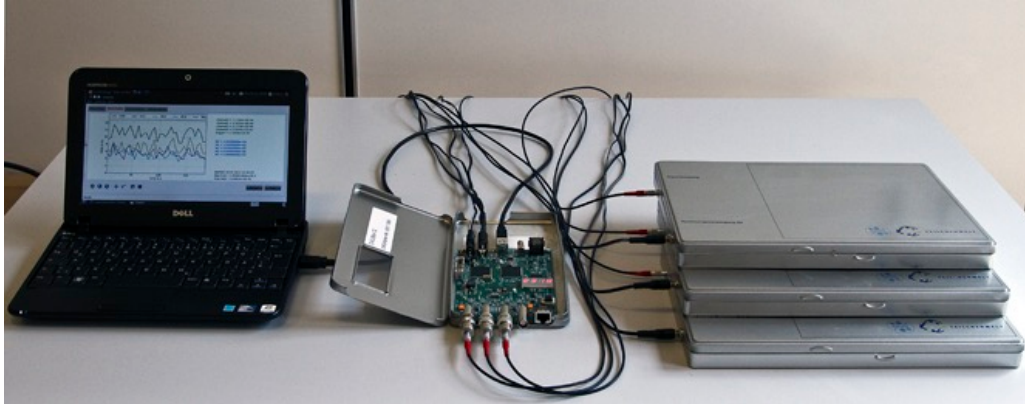


Figure 2. The EAS intensity depending on zenith angle.

Direct Measurement of Cosmic Particles

Use your Own Detector - Examples



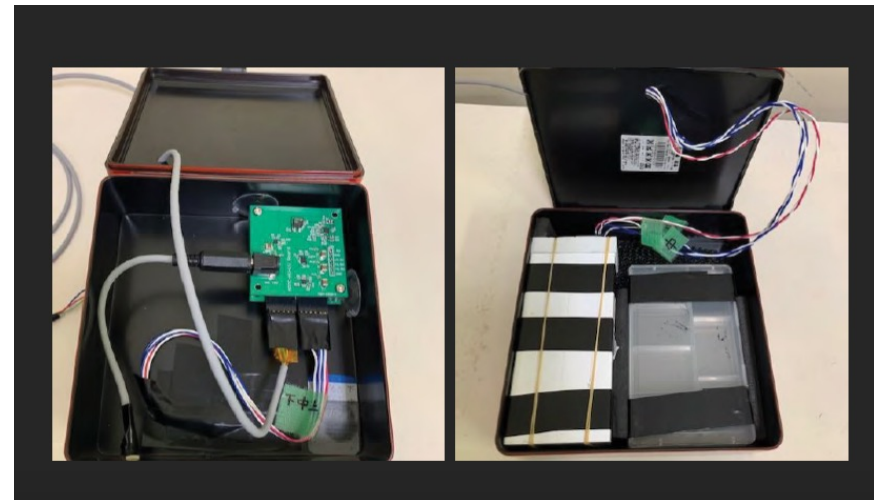
CosMO, GERMANY



Cosmos à l'École, FRANCE



OCRA, ITALY

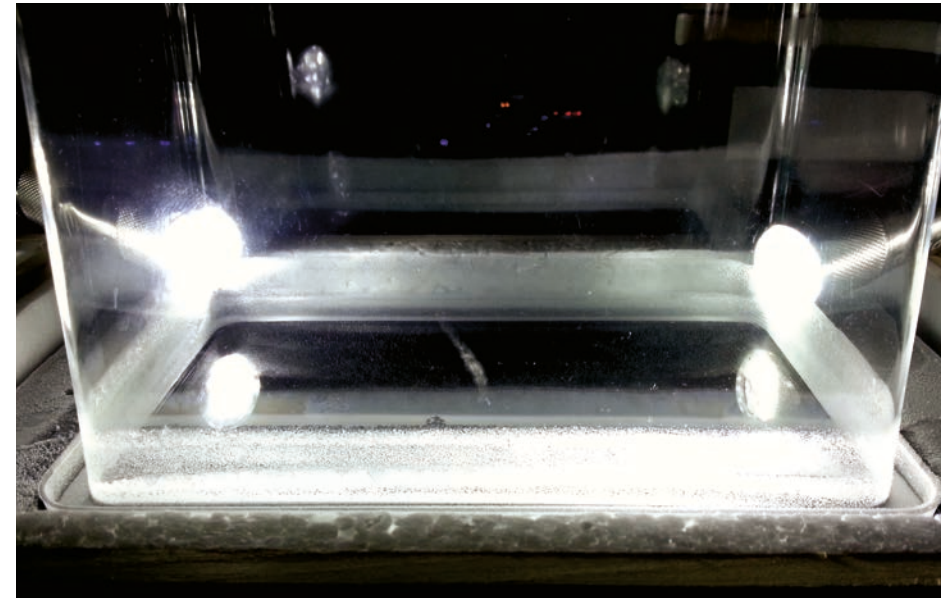
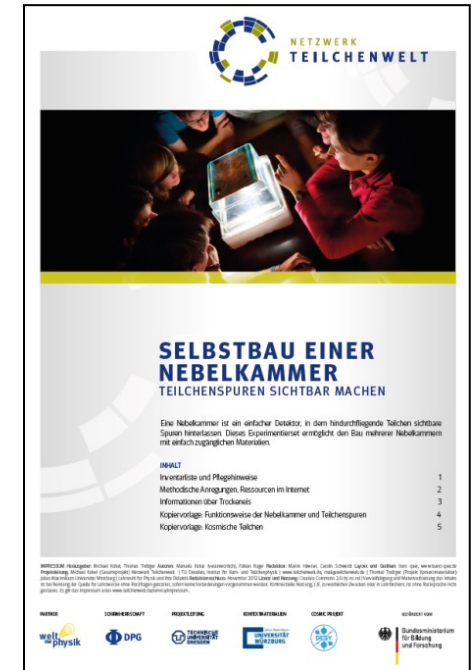


tan-Q, JAPAN

Build your own Cloud Chamber

For Example: Cloud chamber set from Netzwerk Teilchenwelt

- similar to CERN chambers (a little bit smaller)
- handout for teachers with notes and copy templates (in German)
- for workshop in institute or school, teachers can borrow set for free
- https://www.teilchenwelt.de/fileadmin/user_upload/Redaktion/Netzwerk_Teilchenwelt/Material_Lehrkraefte/Selbstbau_einer_Nebelkammer.pdf



Cosmic@Web

Analysis of Data from Cosmic Particles

- online learning platform
- evaluation of data from experiments that measure cosmic particles 24|7
- students can work like scientists and do their own astroparticle physics research
- <http://cosmicatweb.desy.de>

PHYSIK.BEGREIFEN

School lab in Zeuthen

HOME / Offers / Cosmic Particles / Cosmic@Web

OFFERS

- Vacuum Lab
- Cosmic Particles**
- Basics
- Student Experiments
- Cosmic@Web**
- Trigger Hodoscope
- CosMO Mill
- CosMO-muv
- LiDO
- Polarstern Project
- Neumayer Station III
- SEVAN
- Weather Data Zeuthen
- How To
- Glossary
- Links

PHOTOS

CONTACT

MORE SCHOOL LABS

LINKS

PARTNER

SCHOOL LAB HAMBURG

Cosmic@Web

- » plotting tool
- » manual
- contact

Further Offers

- » visit DESY



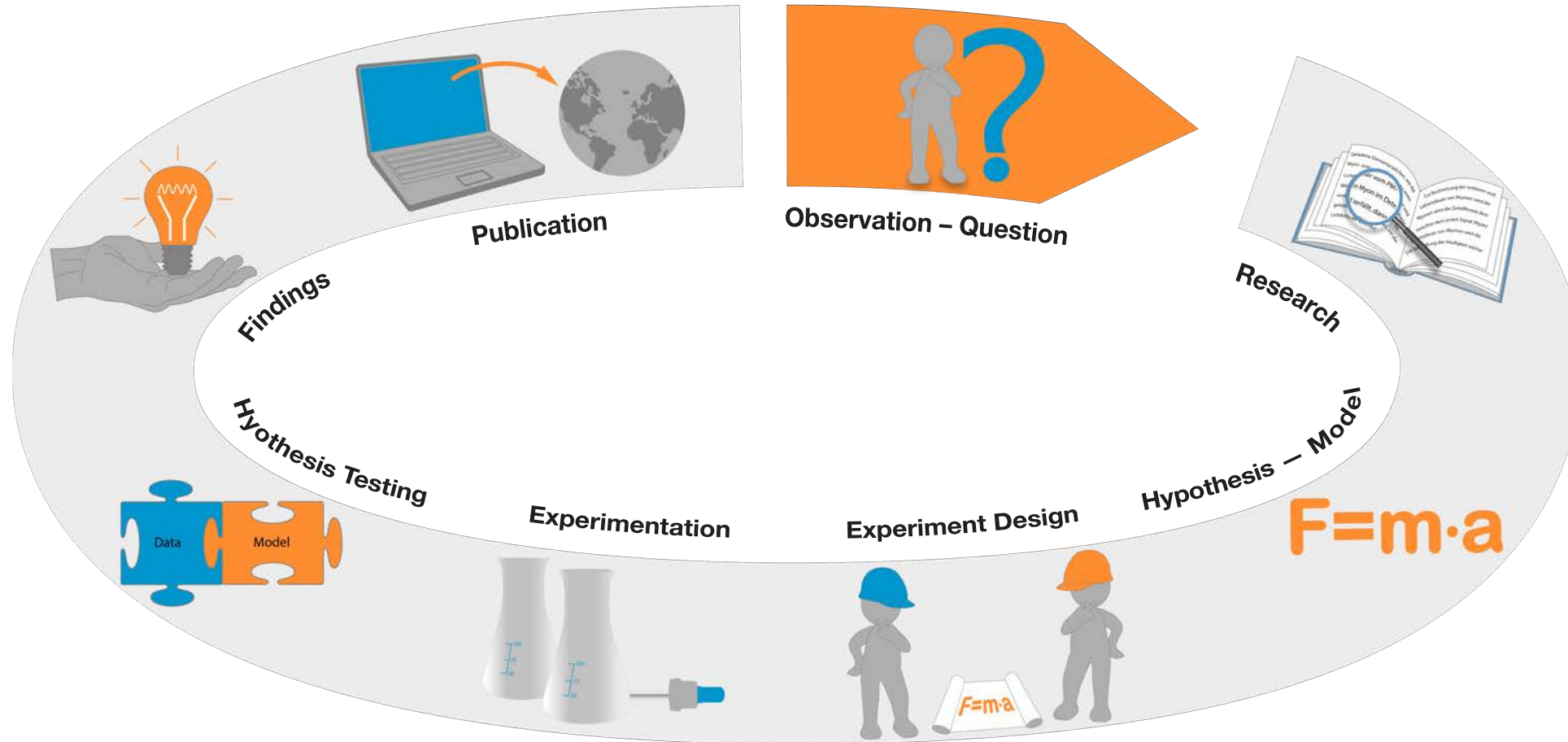
When working in scientific research it is not always possible to have the experiment on-site. Especially the large-scale experiments researching particle and astroparticle physics are so complex and expensive, they are made only once in coordination of all involved science facilities. Examples of DESY's 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 the location and available infrastructure play a significant role. Since scientific data from these experiments is available via internet it can be analysed from home. The scientists and technicians that travel to the locations of the experiment, mainly do so for maintenance and upgrade of the experimental facilities.

It is almost impossible for schools and teachers to arrange lessons about particle and astroparticle physics with the appropriate experiments. As can be seen in [Student Experiments](#), DESY has developed and produced a large number of CosMO and Kamiokannen experiments which were made available by DESY and other astroparticle physics institutes in Germany for student and school projects with cosmic particles.

To expand the possibility of investigations with cosmic particles in the classroom and to reach a broader audience, the use of experimental data by students via the internet was introduced. DESY provides the internet portal [Cosmic@Web](#) which allows to analyse a large amount of data taken by different cosmic particle experiments running continuously at DESY, on the research

Work like a Scientist

From the Question to the Publication



https://www.desy.de/school/school_lab/zeuthen_site/cosmic_particles/scientific_work

Provides:

- introduction pages
- experiment descriptions
- data descriptions
- selection of interesting problems to solve
- How to and glossary
- plotting tool



PHYSIK.BEGREIFEN

School lab in Zeuthen

Home / Offers / Cosmic Particles / Cosmic@Web / CosMO Mill

OFFERS

- Vacuum Lab
- Cosmic Particles
 - Basics
 - Student Experiments
- Cosmic@Web
 - Trigger Hodoscope
 - CosMO Mill**
 - CosMO-muv
 - LIDO
 - Polarstern Project
 - Neumayer Station III
 - SEVAN
 - Weather Data Zeuthen
 - How To
 - Glossary
 - Links

PHOTOS

CONTACT

MORE SCHOOL LABS

LINKS

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SCHOOL LAB HAMBURG

Cosmic@Web

- » plotting tool
- » manual
- contact

Further Offers

CosMO Mill

As seen on the photo, the CosMO Mill consists of two **CosMO detectors** mounted on a wing arm. The particle rate is measured with a coincidence requirement; a signal must appear in both detectors. Starting at the 90 degree position, data is taken for one hour. Then, a step motor moves the arm by 15 degrees into the new position. This allows the continuous measurement of the dependence of cosmic particle rate on the Zenith angle at an interval of 90 to -90 degrees. **Zenith angle** dependence of the cosmic particle rate in the angle interval of 90 to -90 degrees.

Setup

The CosMO Mill consists of:

- > two CosMO detectors
- > a **DAQ card**,
- > a wing arm with the two detectors mounted at 97 cm distance,
- > a step motor and the electronic components to steer the arm,
- > a notebook to control the angle position and for the accumulation of data with the program **muonic**.



Data Structure

The datasets available via Cosmic@Web contain: time, air pressure, temperature, angle position, particle rate. More detailed information can be found in the description of the **Dataset**.

Possible Student Exercises

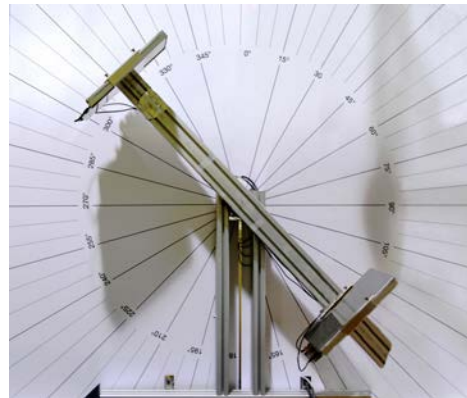
- > Investigate the particle rate in dependence of the zenith angle.
- > Investigate the influence of weather conditions on the rates.
- > Compare the measurements from different years.
- > Compare the mill's rates with those of the Trigger Hodoscope.
- > Compare with own measurements performed with the CosMO or Kamiokannen experiments.

Cosmic@Web

Investigate Atmospheric Muons

9 experiments:

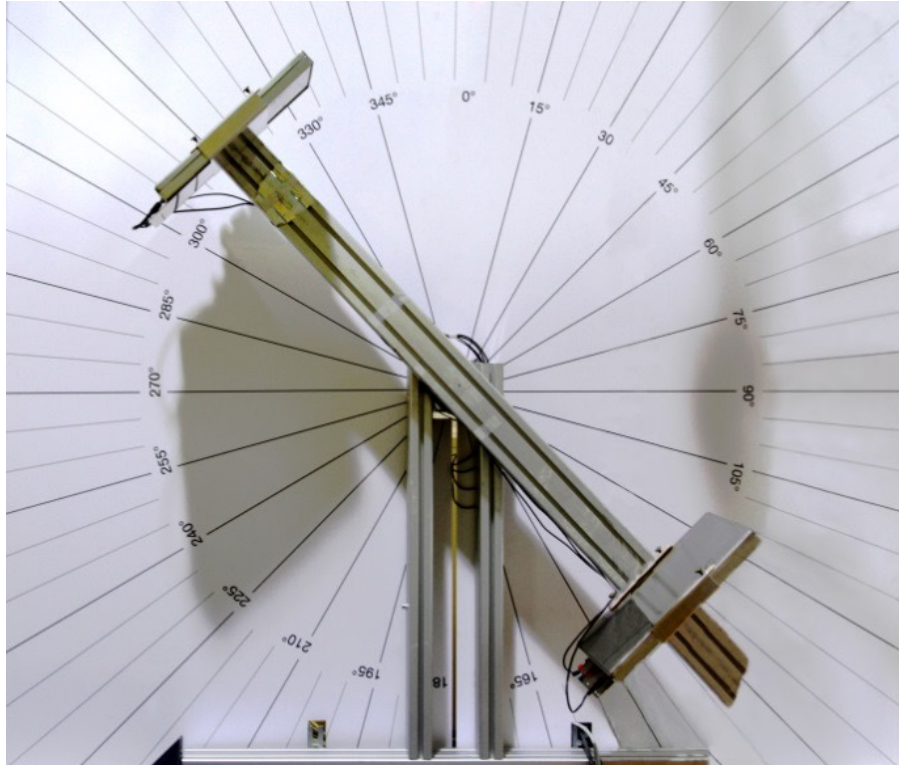
- lifetime of muons
- geomagnetic effect
- zenith angle dependence
- rate in Germany, Armenia and Antarktis
- rate depending on weather conditions




CosMO-Mill

Investigation of zenith angle dependence

- possibility to participate in ICD without own experiment on site
- instruction: <https://icd.desy.de/e35439/>




**Zenith Angle Dependence
of the Cosmic Muon Rate**




Measurement and Analysis with Cosmic@Web

Status: October 2020
Contact: cosmicatweb@desy.de

Carolin Schwerdt
Wissenschaftliche Koordinatorin Cosmic-Projekte | DESY
carolin.schwerdt@desy.de
Platanenallee 6 | 15738 Zeuthen | Germany



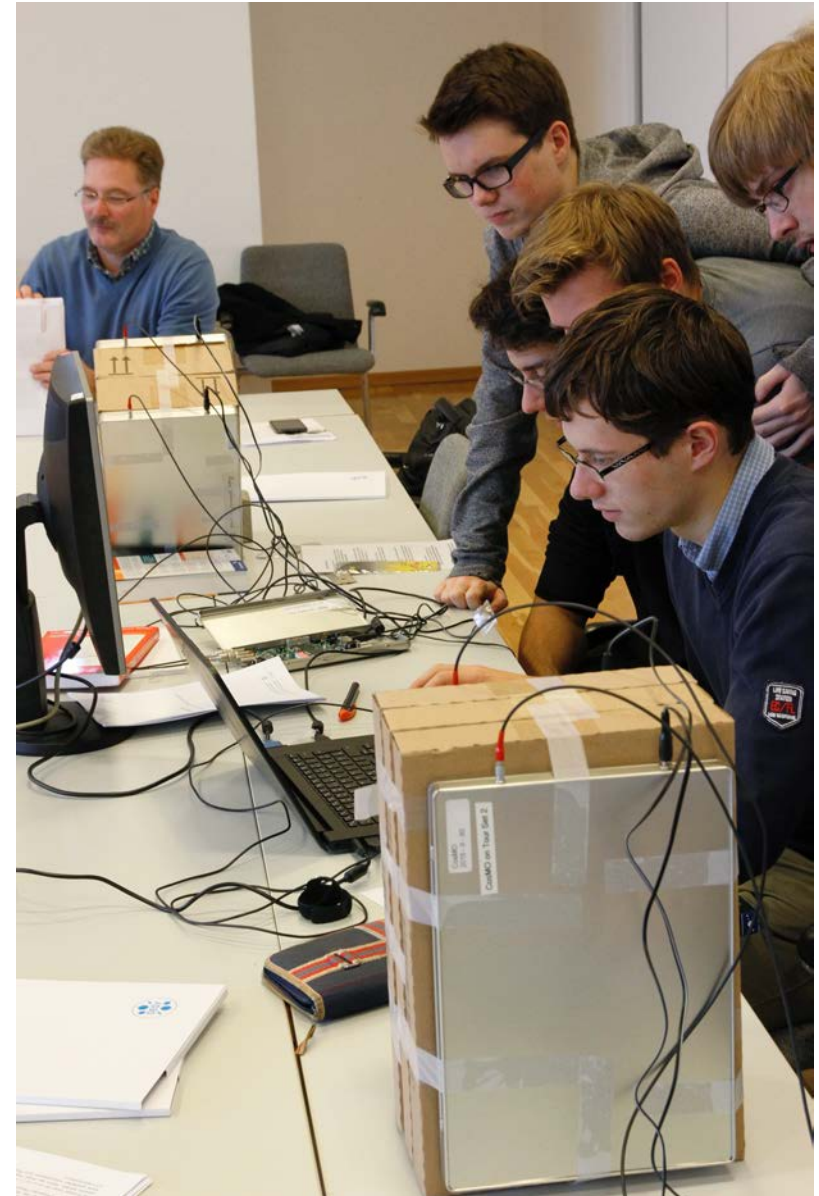
NETZWERK
TEILCHENWELT



Participate

How to be part?

- Register: <https://icd.desy.de/e12688/>
- Plan your day
- Join the Welcom Call or a video call
- Contribute to the booklet
- Point the students to Kahoot, selfie or drawing contest
- Use the poster, press release, videos and material we provide

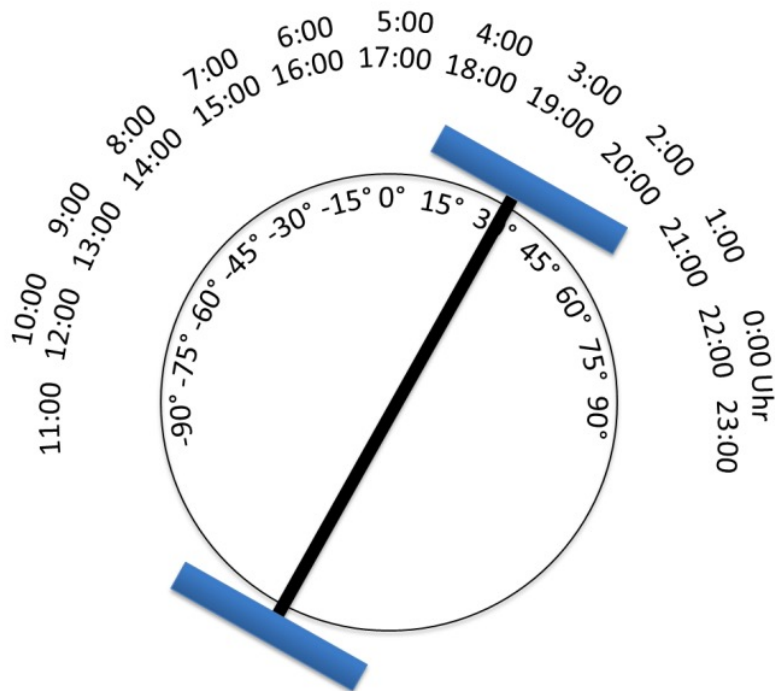


CosMO-Mill

Investigation of zenith angle dependence

Location: Zeuthen

Mill changes its position every hour by 15°



SETTINGS DIAGRAMS SAVED DIAGRAMS

Language: **English** / German

- » More information about Cosmic@Web
- » Cosmic@Web manual (still in German)
- » Start Tutorial, (still in German)

Diagram Creation

Setting of detail level

Standard

1. Data Array

Choose Data Set

Experiment: CosMO-Muehle

Data Set: 2017_M - rate per angle

Diagram Type: xy-Diagram

Choose Variables

x-Variable: time [s]

y-Variable: mu_rate [1/h]

z-Variable: optional

Diagram Option

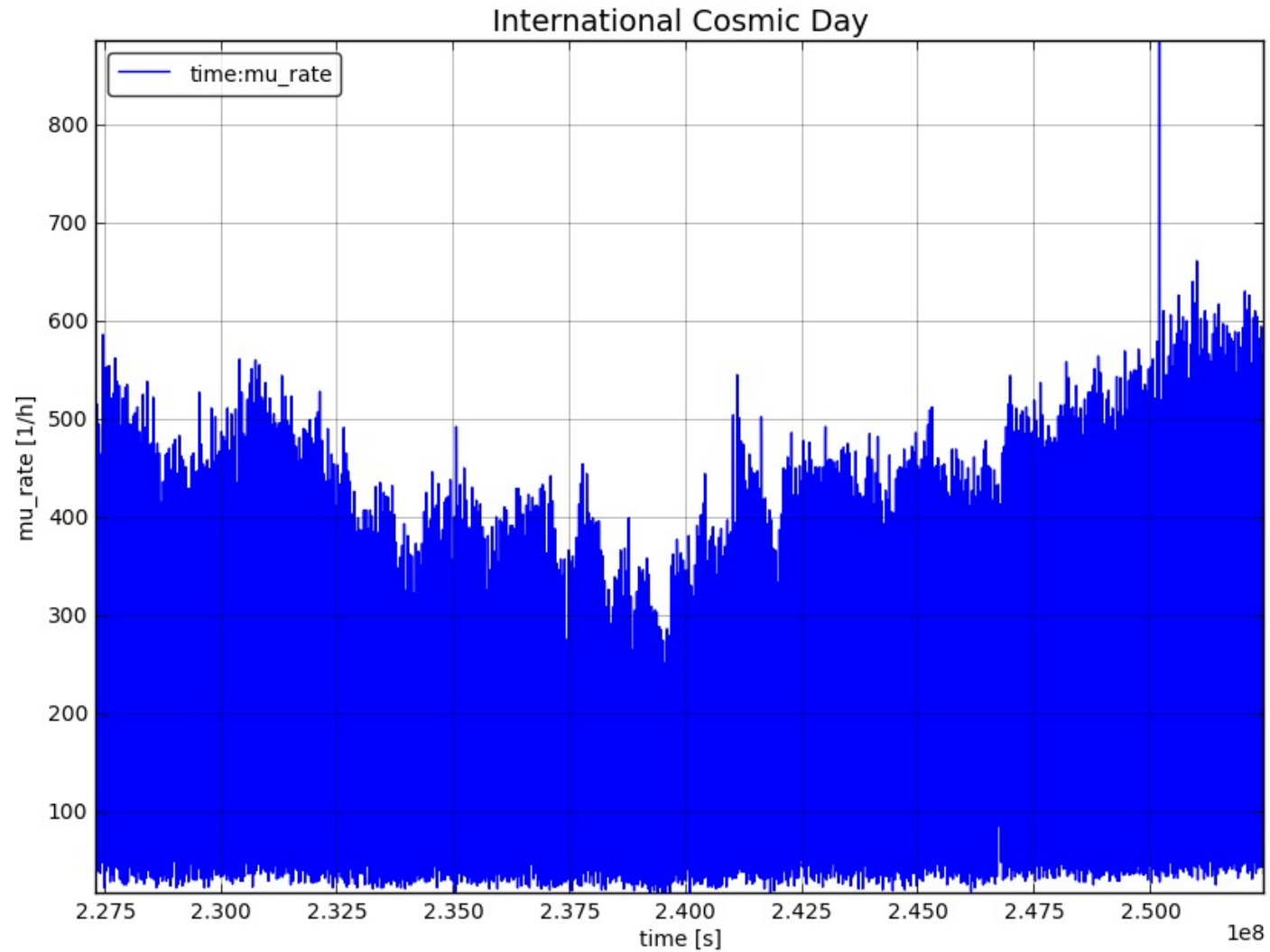
Title: International Cosmic Day

Legend

Position: automatically

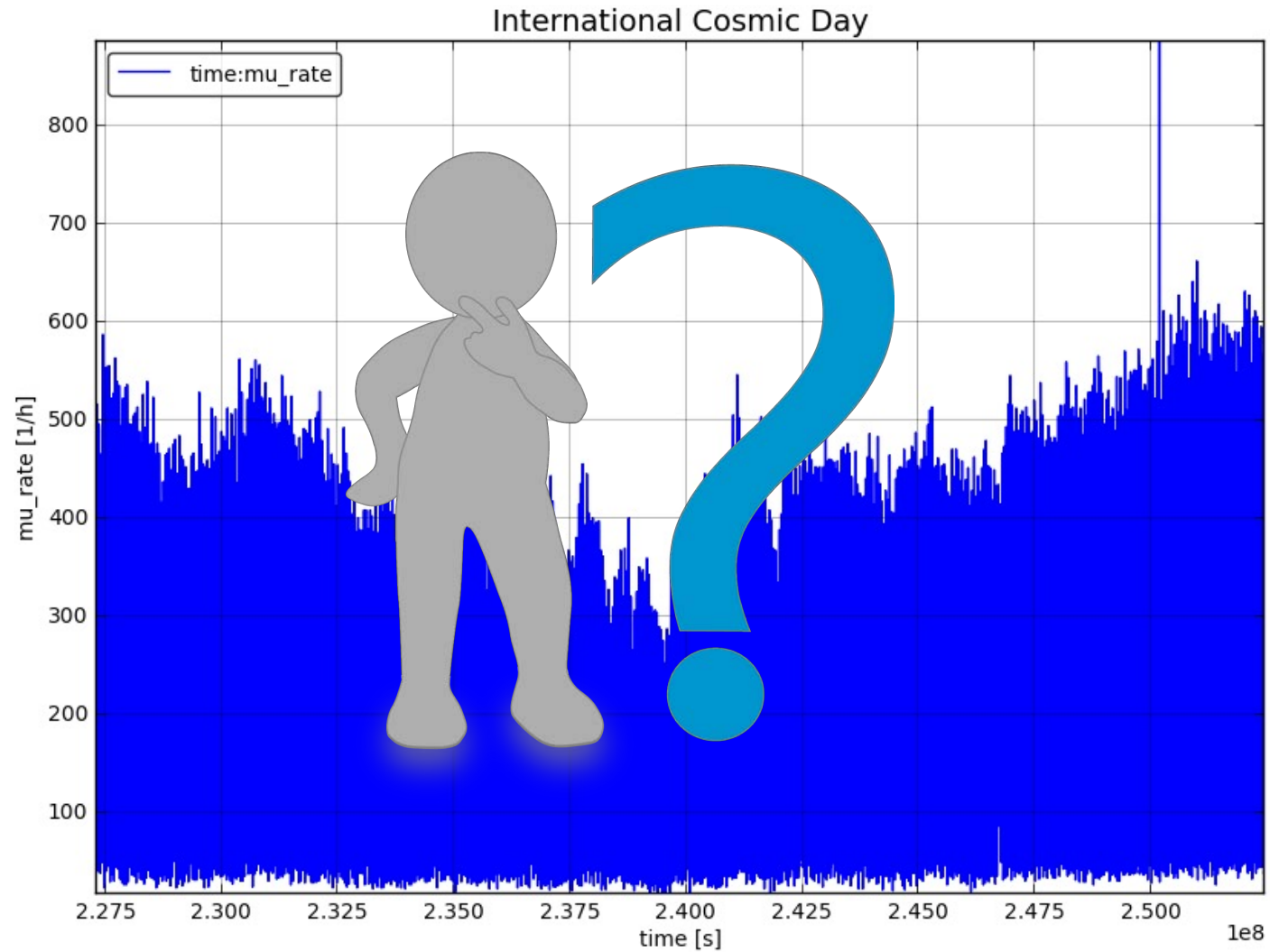
CosMO-Mill

Investigation of zenith angle dependence



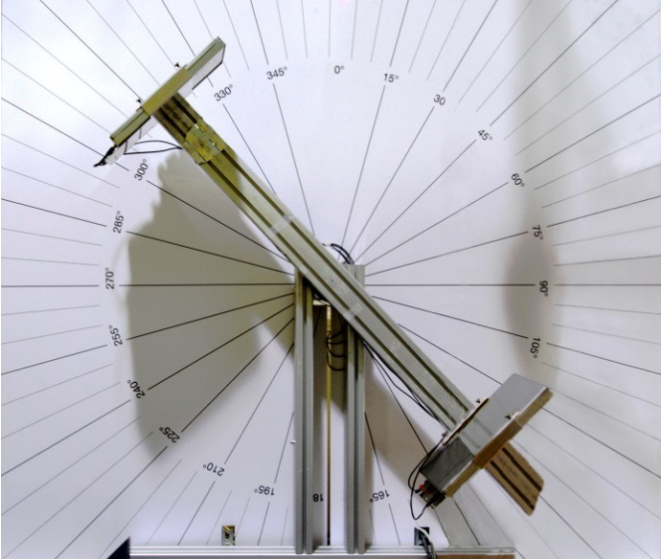
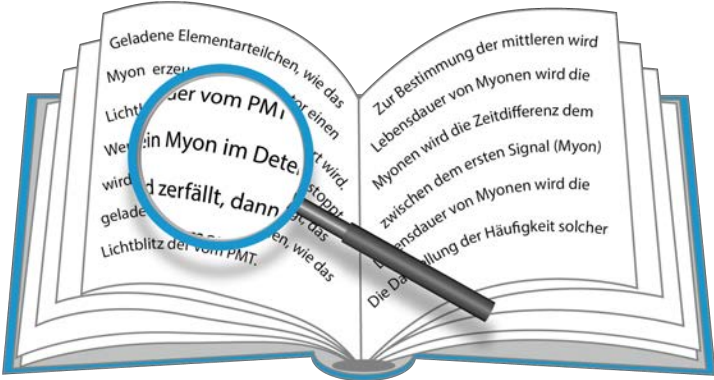
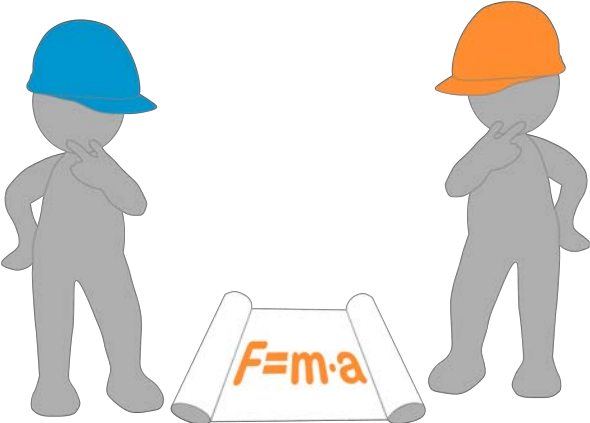
CosMO-Mill

Investigation of zenith angle dependence



CosMO-Mill

Investigation of zenith angle dependence



Dataset CosMO Mill

Parameter	Definition	SI-Unit	Example
time	UTC time since 1.1.2010 00:00:00	seconds	165500000
p	Air Pressure	hPa	1013.7
T	Temperature	Grad Celsius	17.0
angle	Zenith Angle	Grad	0.0
mu-rate	Muon Rate, number of muons per hour	1/h	9331

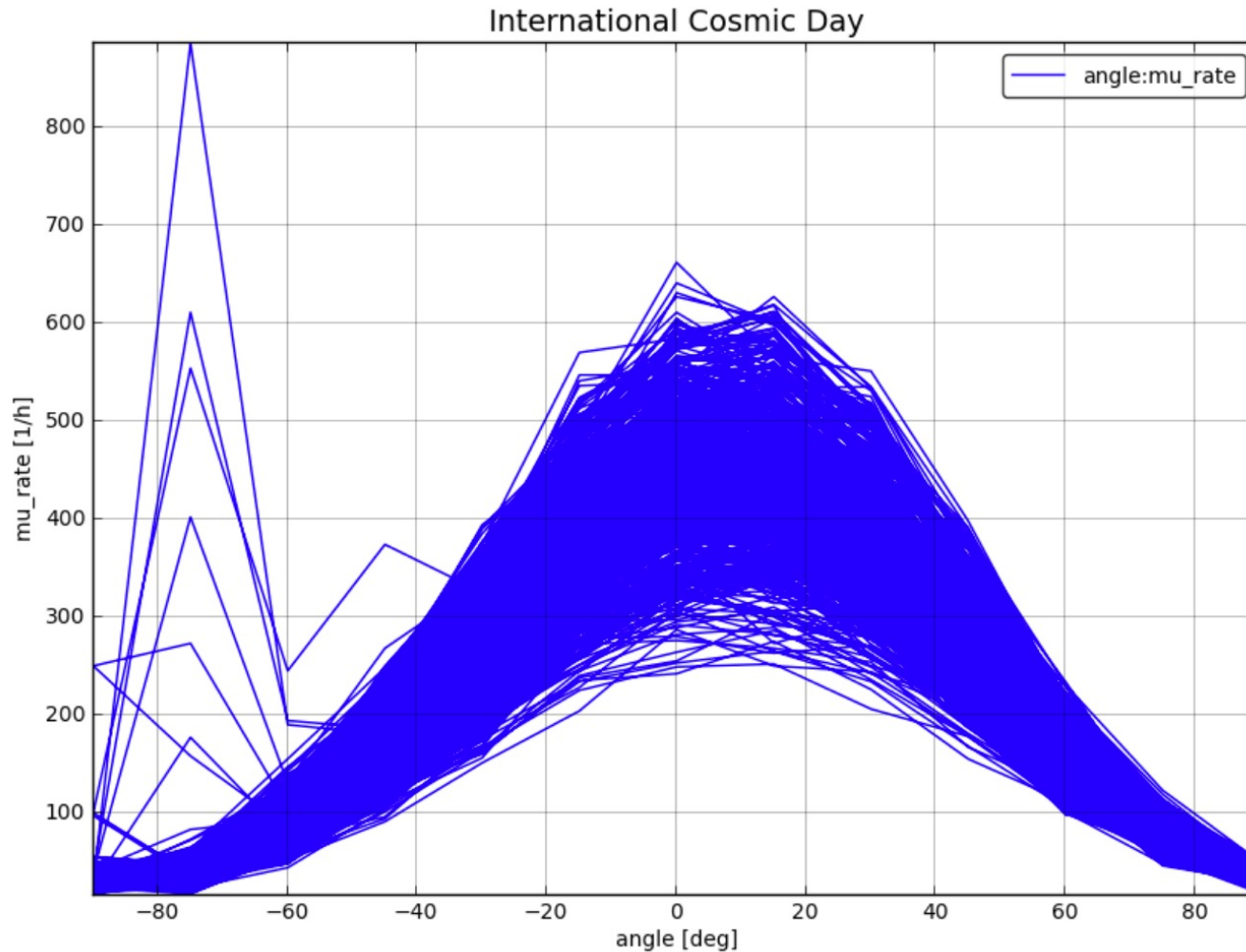
CosMO-Mill

Investigation of zenith angle dependence

SETTINGS	DIAGRAMS	SAVED DIAGRAMS
		Language: English / German
<ul style="list-style-type: none">More information about Cosmic@WebCosmic@Web manual (still in German)Start Tutorial, (still in German)		
Diagram Creation		
Setting of detail level		
Standard		
1. Data Array ✖ + Add Data Array		
Choose Data Set		
Experiment		
CosMO-Muehle		
Data Set		
2017_M - rate per angle		
Diagram Type		
xy-Diagram		
Choose Variables		
x-Variable		
angle [deg]		
y-Variable		
mu_rate [1/h]		
z-Variable		
optional		
Diagram Option		
Title		
International Cosmic Day		
Legend		
Position		
automatically		
↺ Reset Diagram Creation		

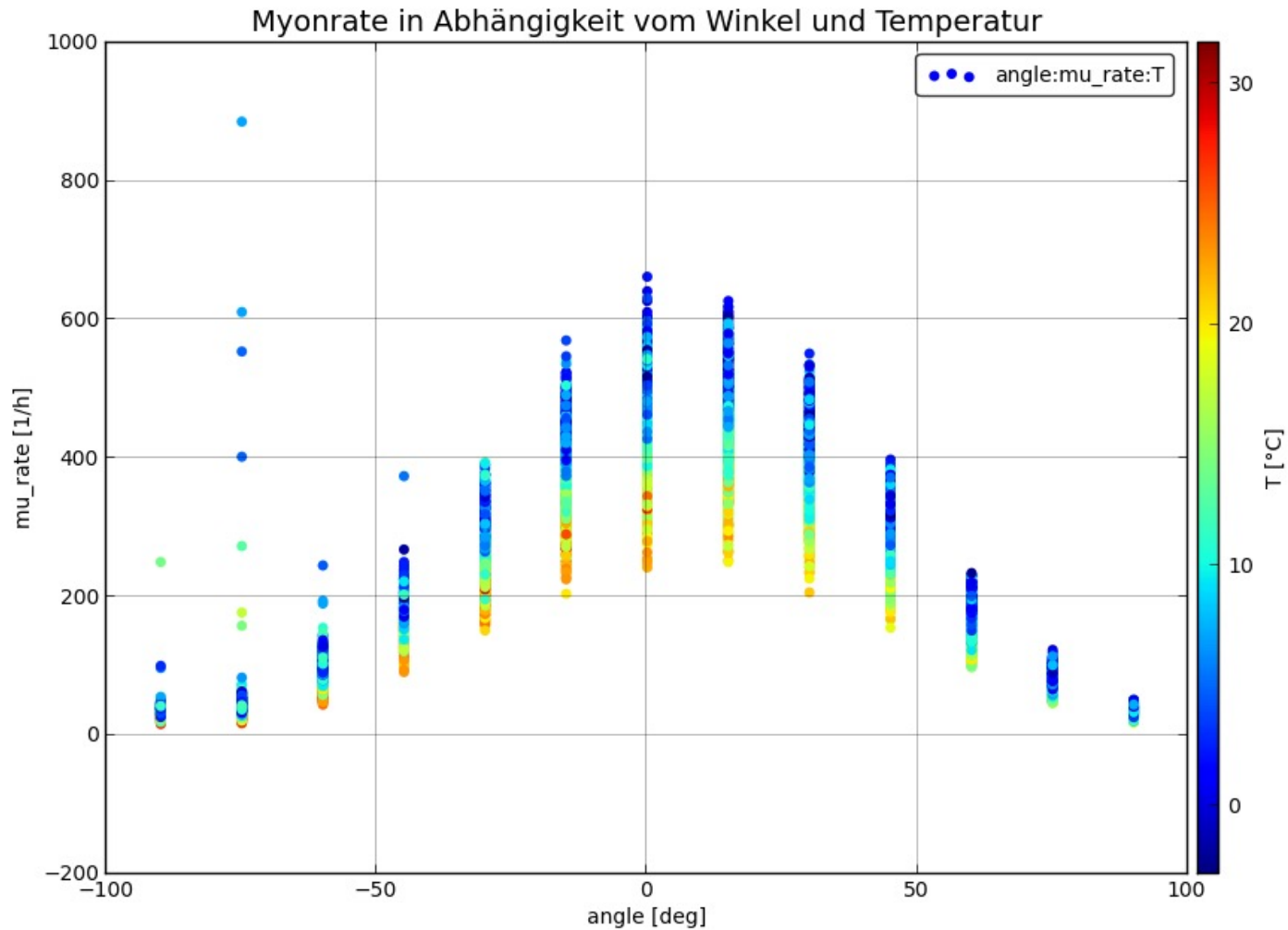
CosMO-Mill

Investigation of zenith angle dependence



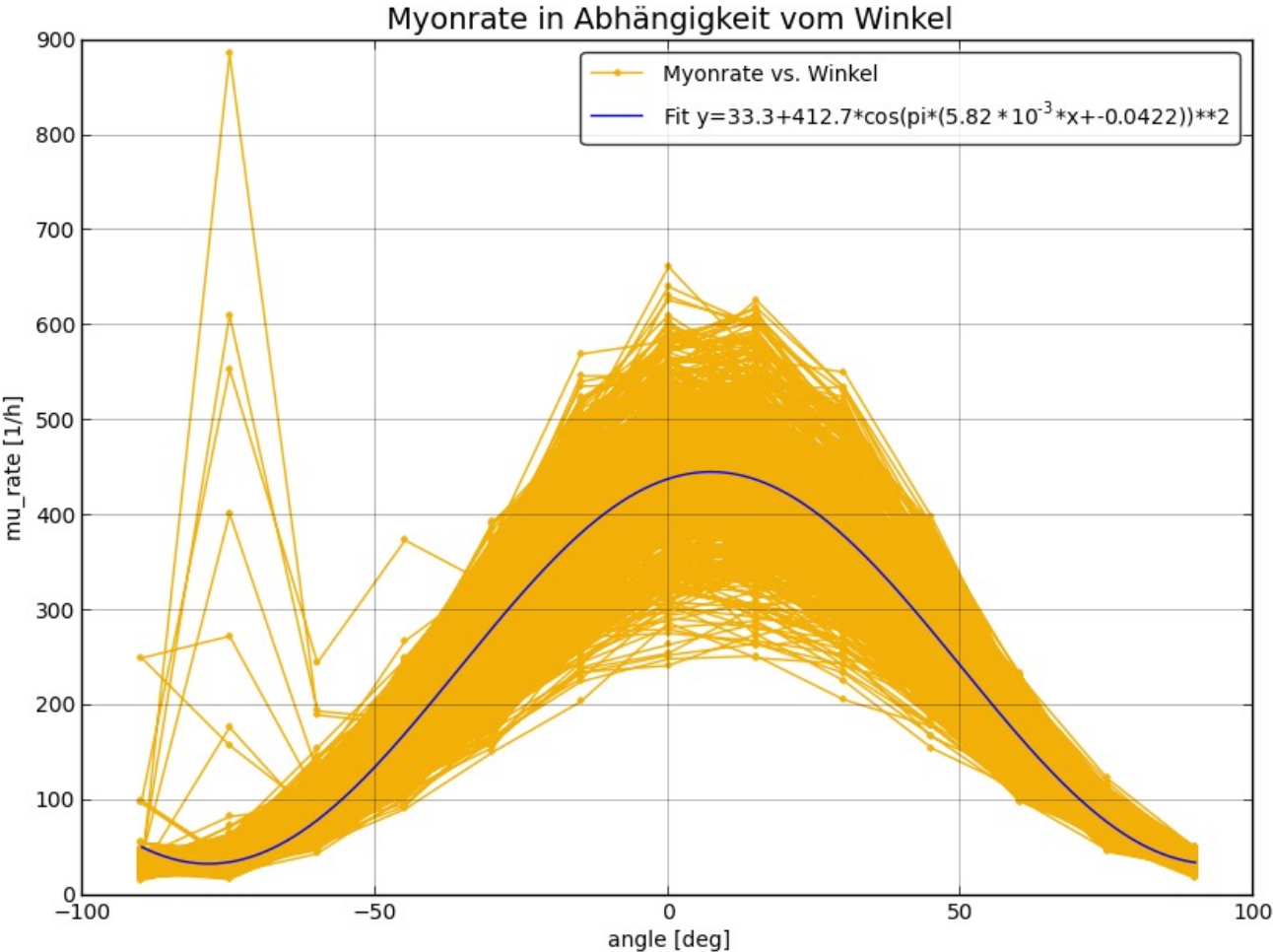
CosMO-Mill

Investigation of zenith angle dependence



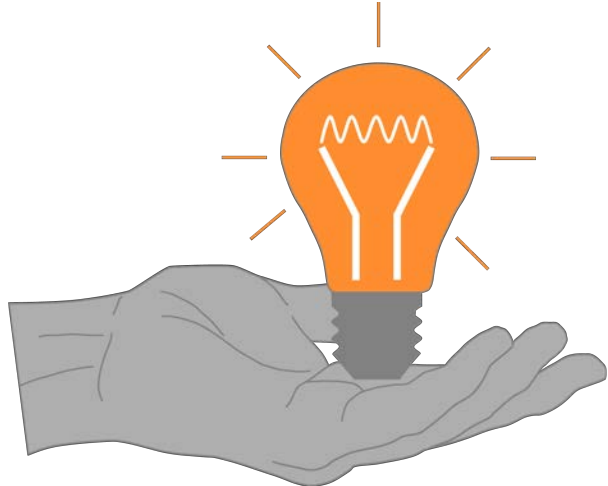
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Investigation of zenith angle dependence

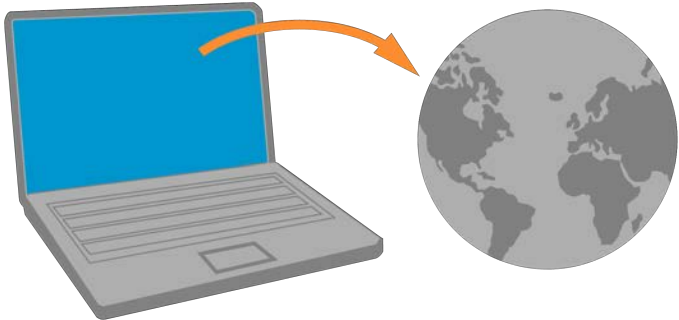


$$y=p[0]+p[1]*\cos(\pi*(p[2]*x+p[3]))^{**2}$$

$N/N = 1.713 * 10^7 / 6991$
 $p[0] = 33.31 \% 1.315$
 $p[1] = 412.7 \% 1.697$
 $p[2] = 5.824 * 10^{-3} \% 2.174 * 10^{-5}$
 $p[3] = -0.04221 \% 6.668 * 10^{-4}$



Rate of measured muons depends on temperature and zenith angle



Many Thanks



NETZWERK
TEILCHENWELT

Kontakt

DESY. Deutsches
Elektronen-Synchrotron

www.desy.de

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Telefon: +49 33762 7-7264

PROJEKTLEITUNG



PARTNER



SCHIRMHERRSCHAFT



FÖRDERER

GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung



DR. HANS RIEGEL-STIFTUNG