
## Discover Cosmic Rays

Carolin Schwerdt
Life Lab Foundation QuarkNet-India | Oktober 8, 2021

HELMHOLTZ SPITZENFORSCHUNG FÜR GROSSE HERAUSFORDERUNGEN

DESY.

# 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

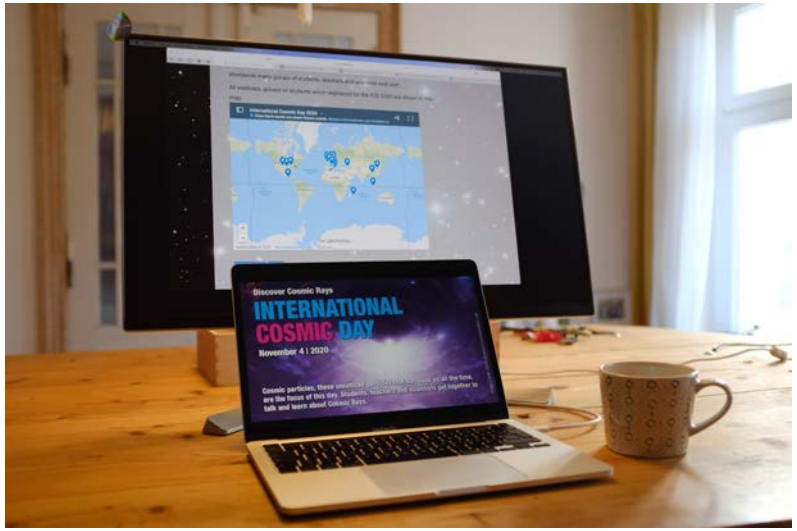
## About

- 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

# Idea of the ICD

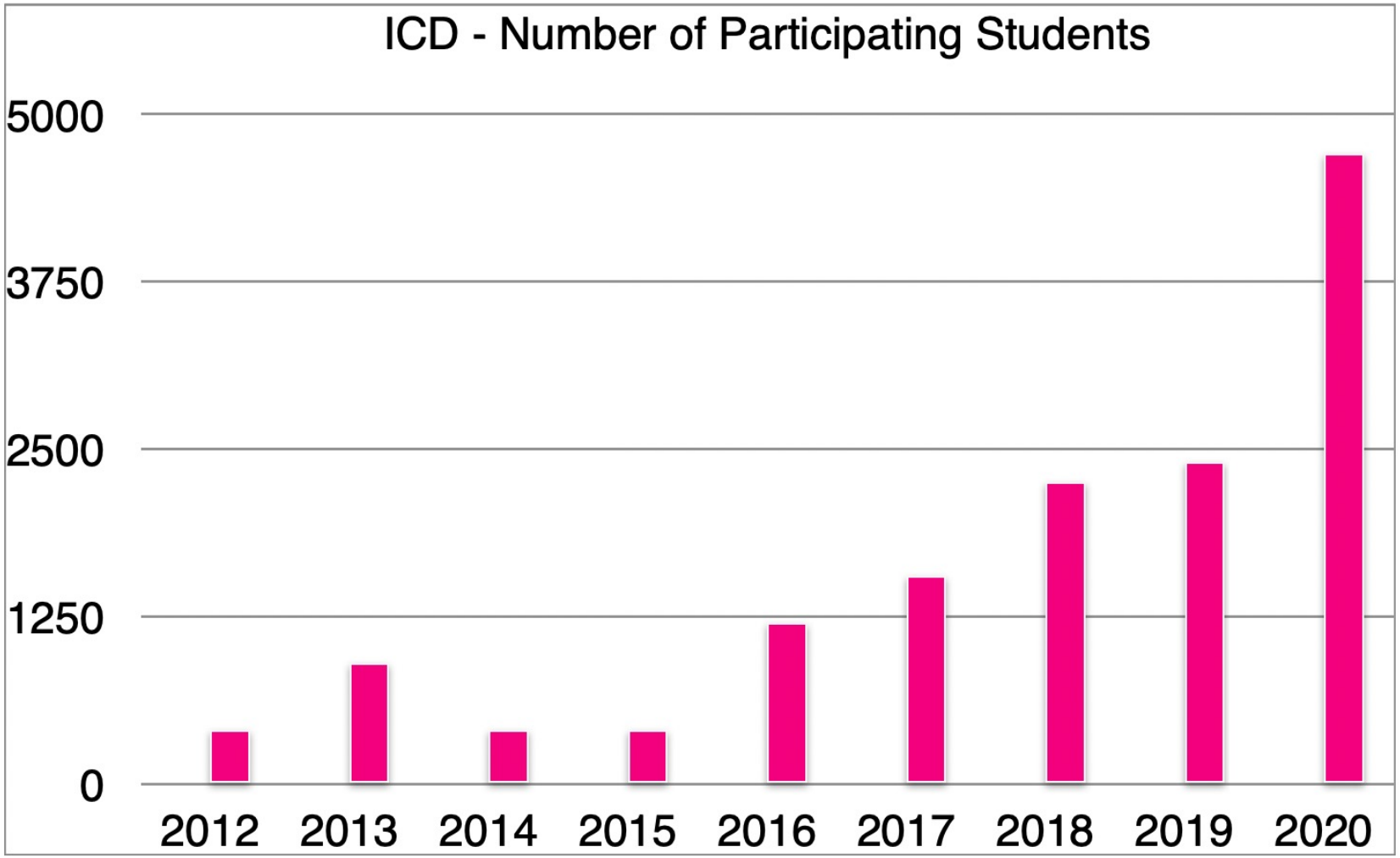
## How it works?

- 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



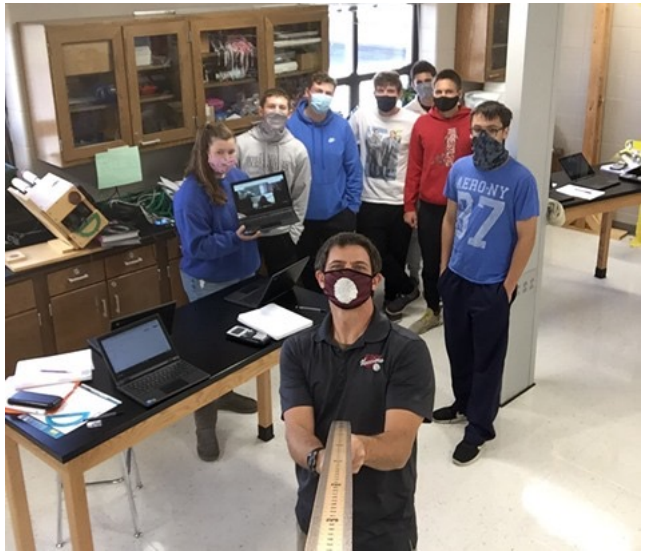
# Participating Groups Worldwide

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



# 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

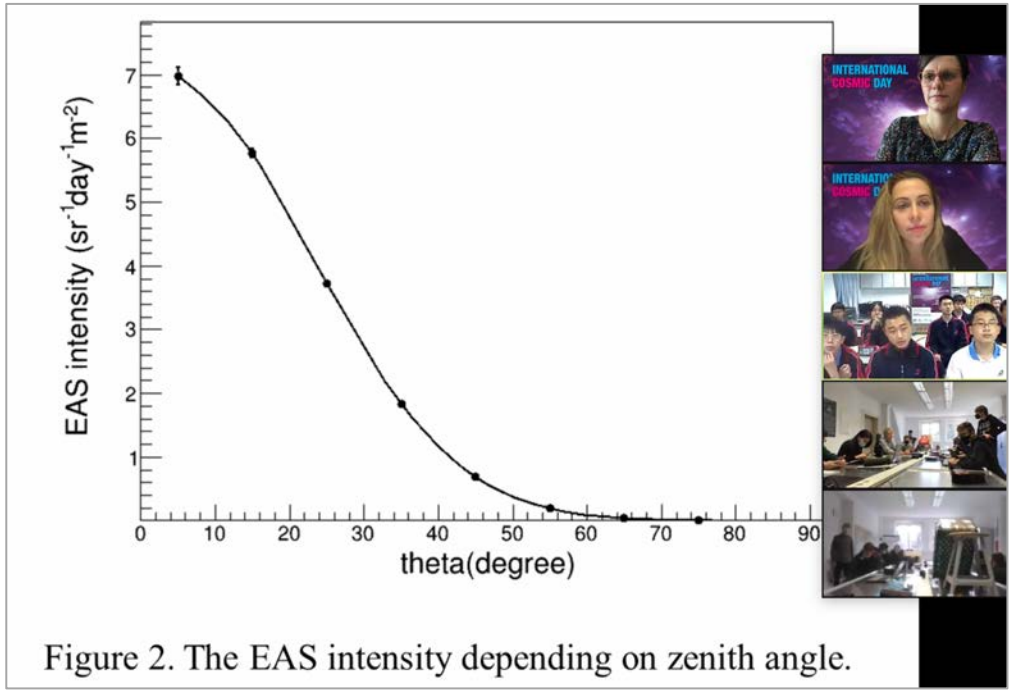
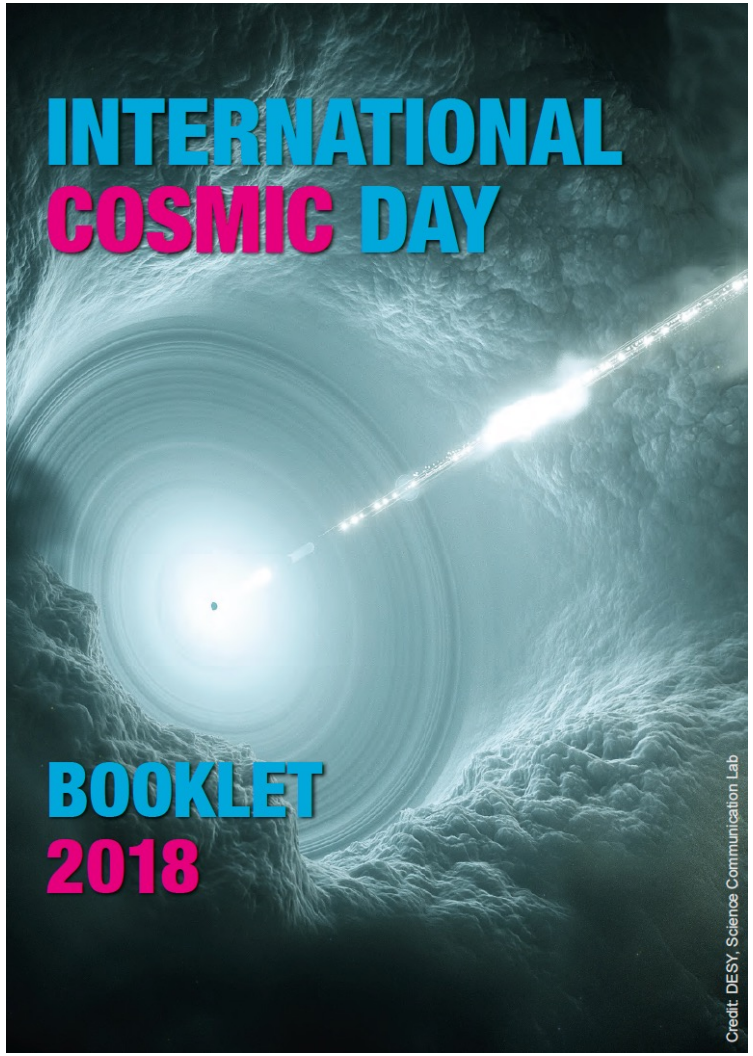




Figure 2. The EAS intensity depending on zenith angle.

# 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



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- social media: Facebook and Instagram
- Kahoot quiz
- Selfie and Drawing contest


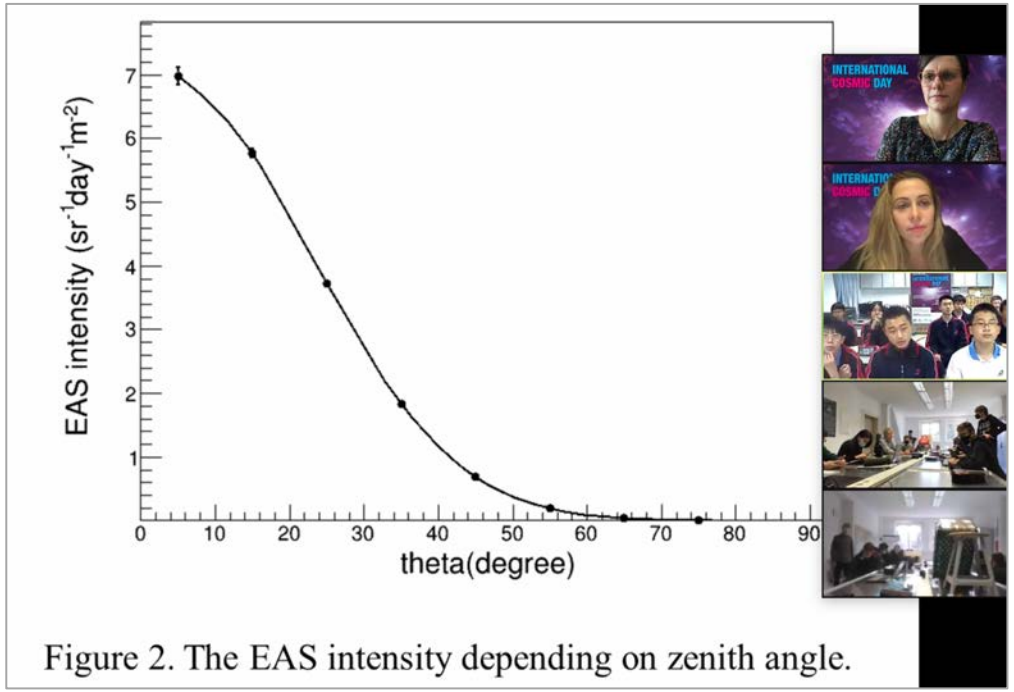

Figure 2. The EAS intensity depending on zenith angle.

# COSMIC SELFIE‘s 2019

## Winner of the COSMIC SELFIE 2019 is:

## INFN Laboratori Nazionali Del Gran Sasso
## Italy, L’Aquila

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

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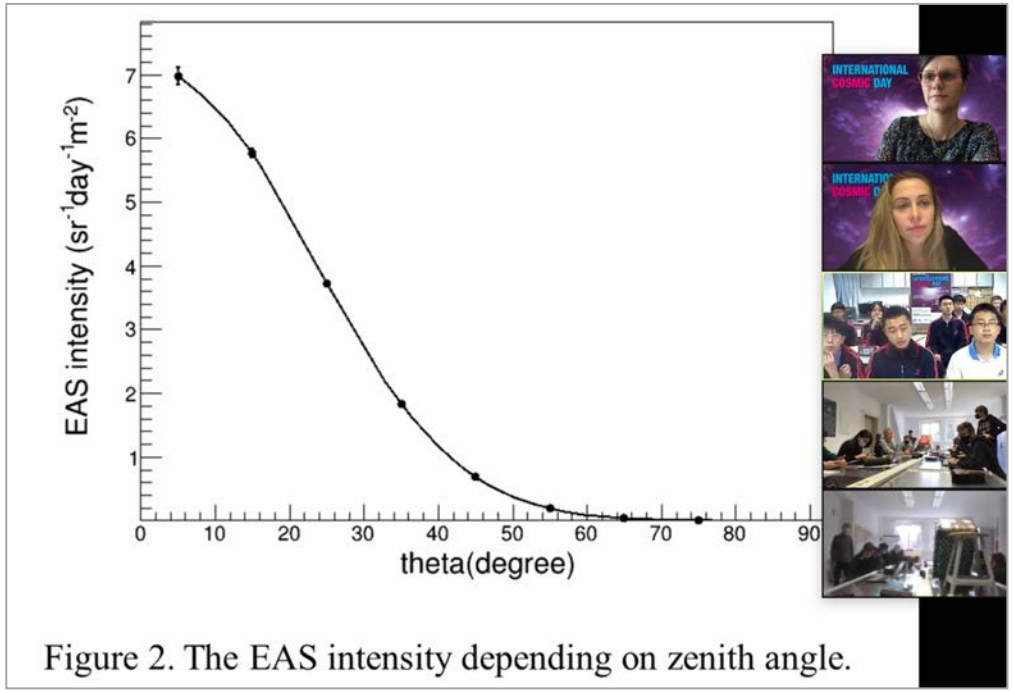
- Selfie and Drawing contest
- Links to recordings/online presentations
- Links to data provided online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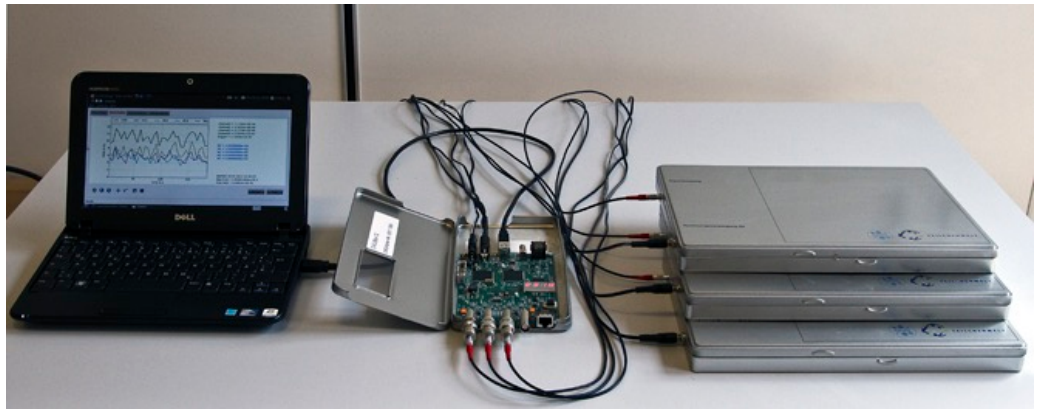
# Direct Measurement of Cosmic Particles

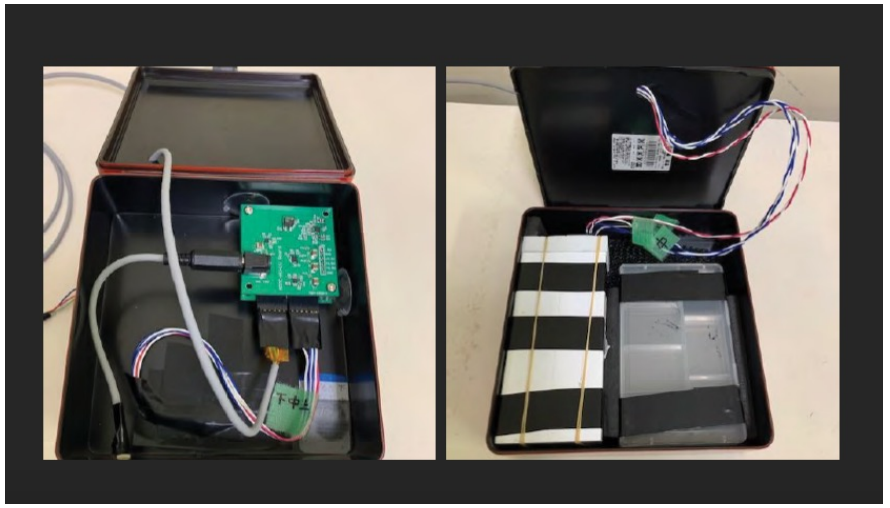
## Use your Own Detector - Examples



CosMO, GERMANY

Cosmos à l'École, FRANCE

OCRA, ITALY

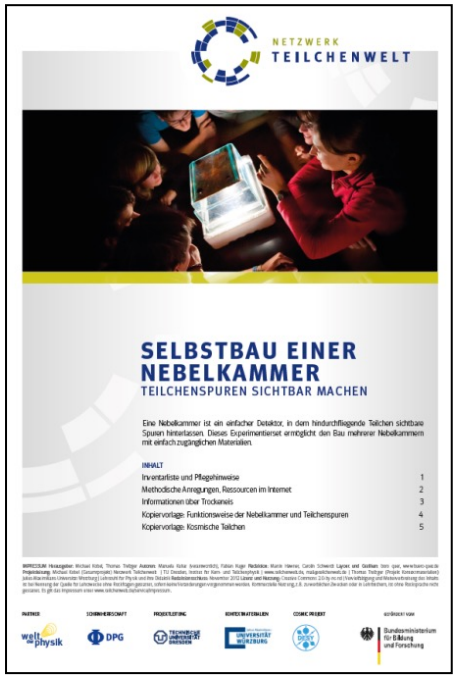


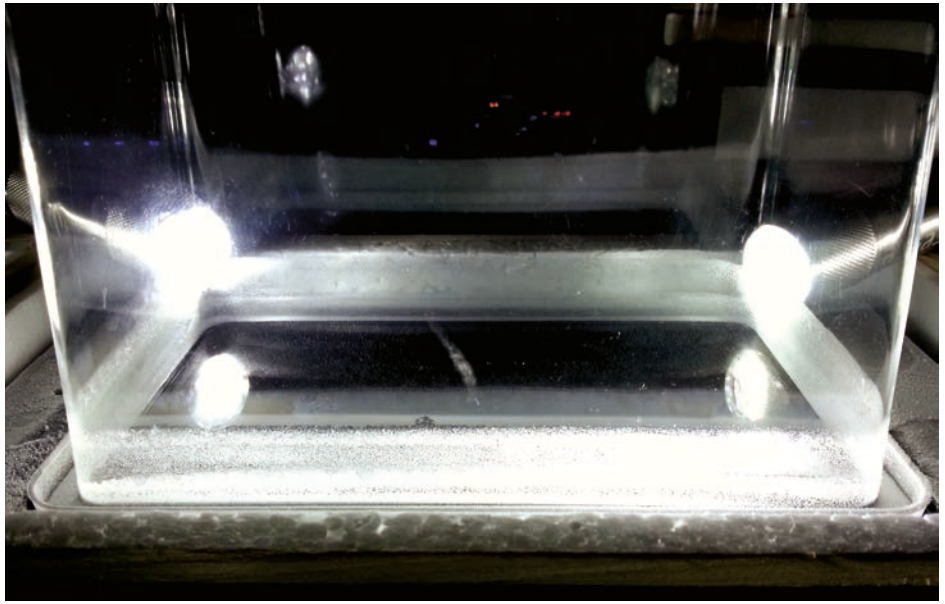
tan-Q, JAPAN

# 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



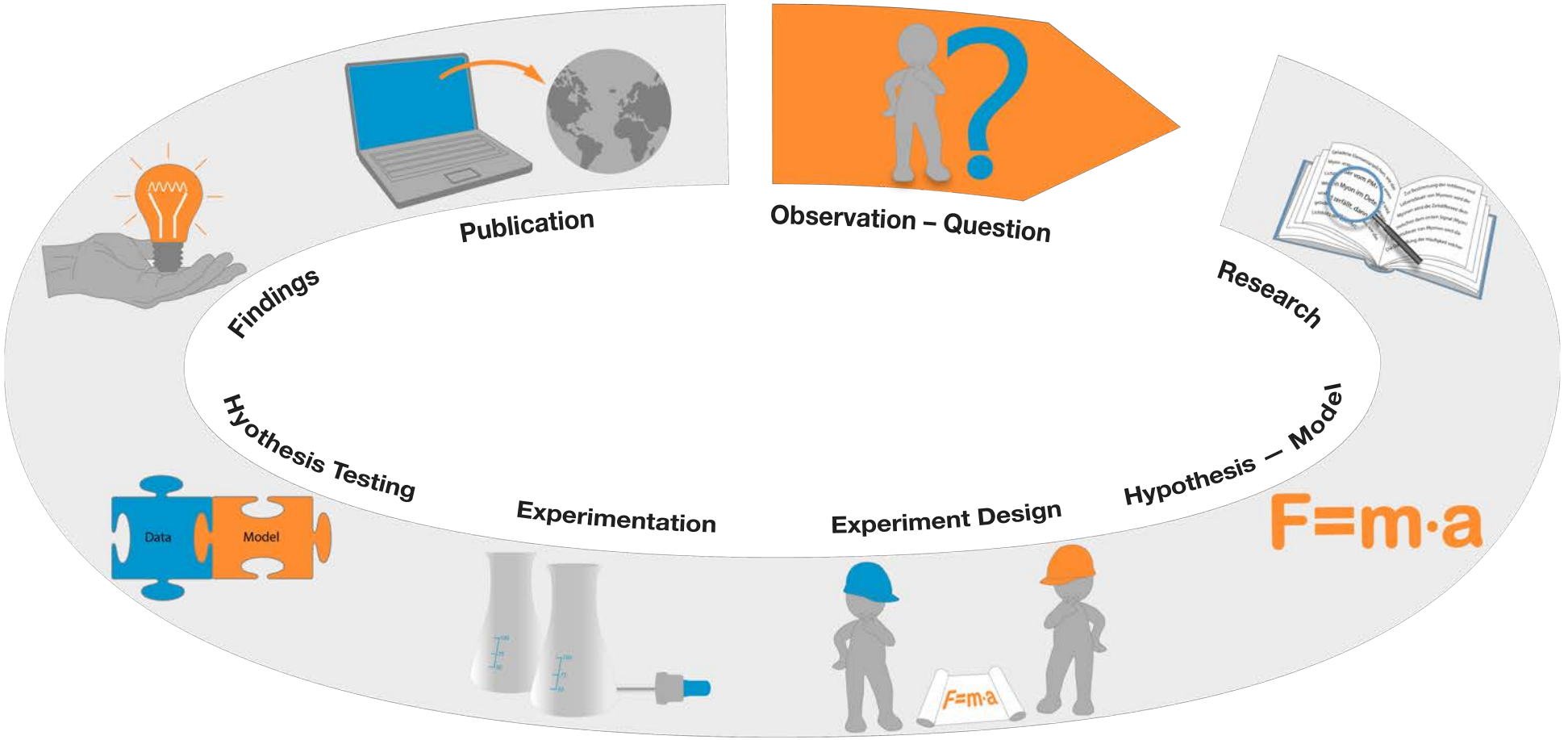
# Cosmic@Web

## 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

# Work like a Scientist

## From the Question to the Publication




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

# Cosmic@Web

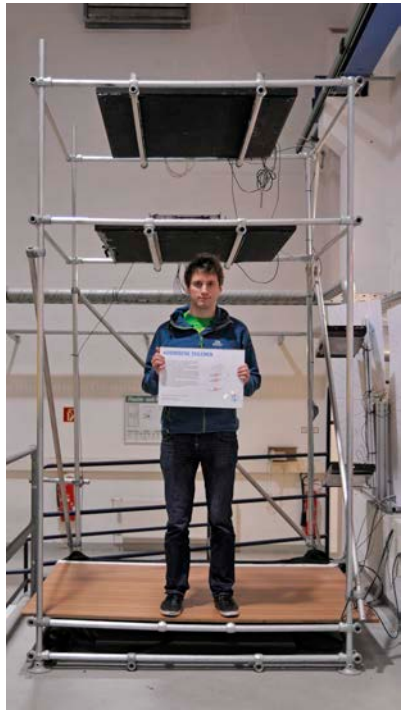
## Learning Platform for Students

Provides:

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

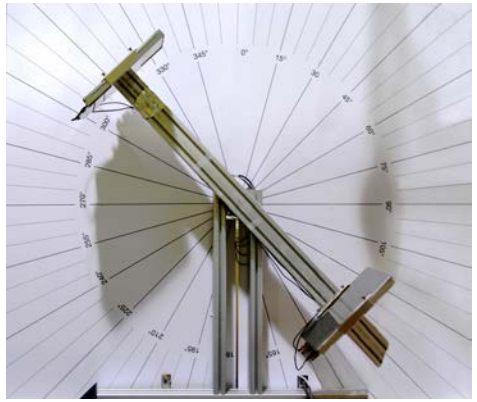
# Cosmic@Web

## Investigate Athmospheric Muons



9 experiments:

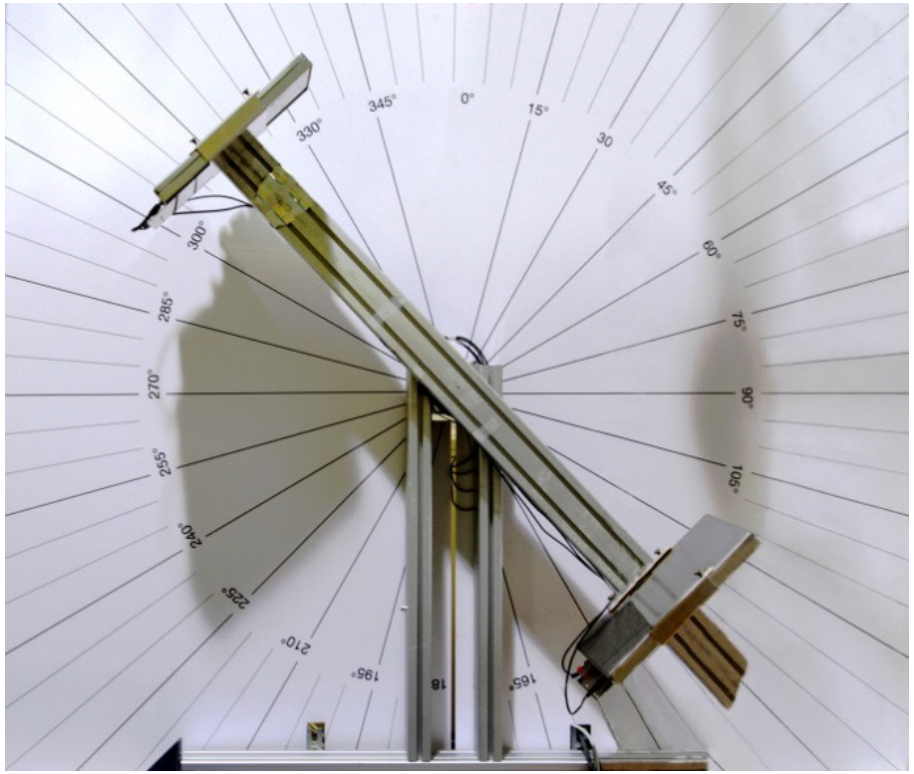
- lifetime of muons
- geomagnetic effect
- zenith angle dependence
- rate in Germany, Armenia and Antarktis
- rate depending on weather conditions



# CosMO-Mill

## Investigation of zenith angle dependence

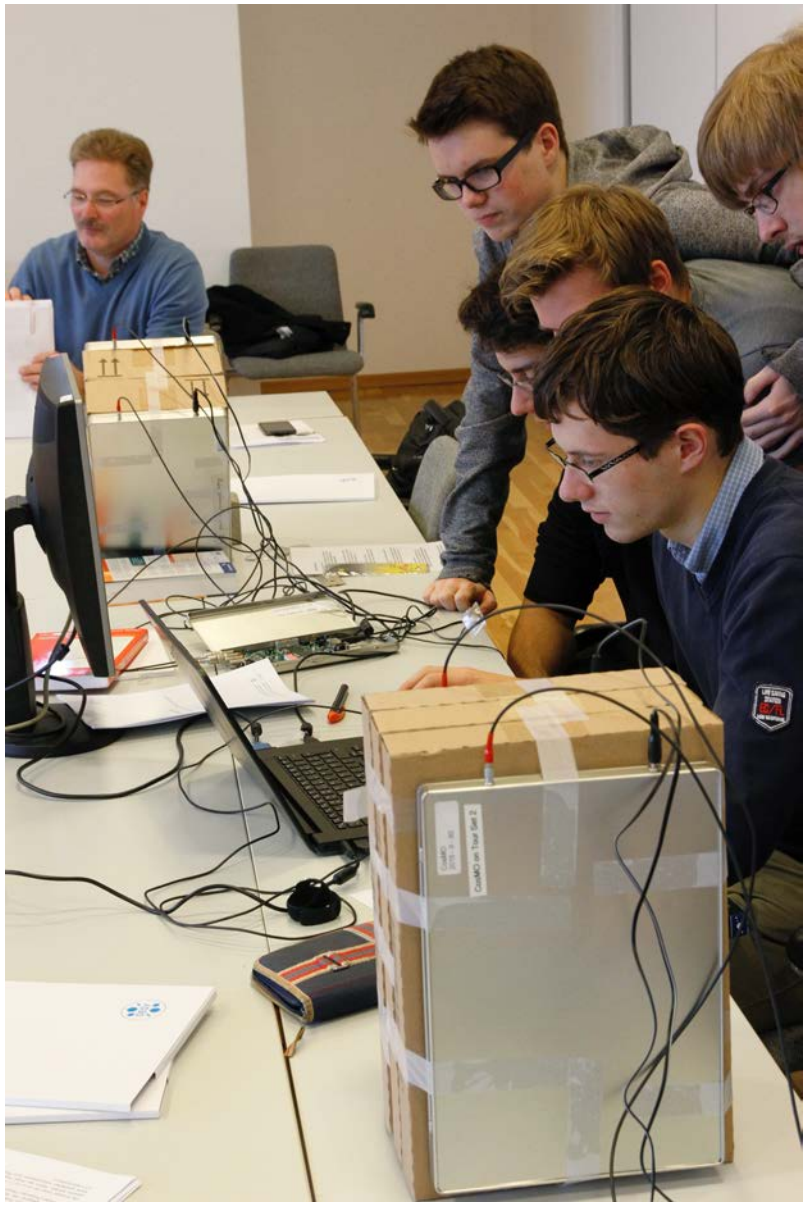
- possibility to participate in ICD without own experiment on site
- instruction: https://icd.desy.de/e35439/




# 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

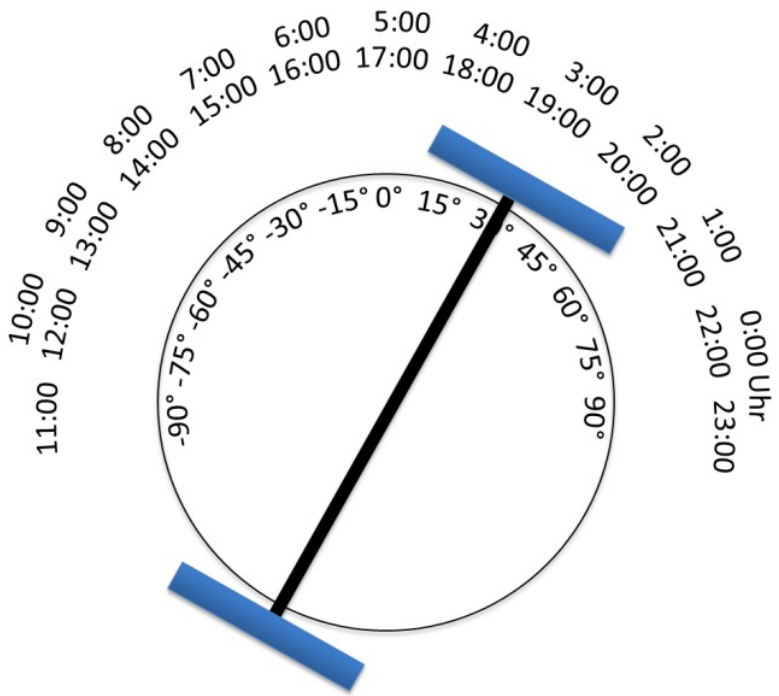


# CosMO-Mill

## 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

Add 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

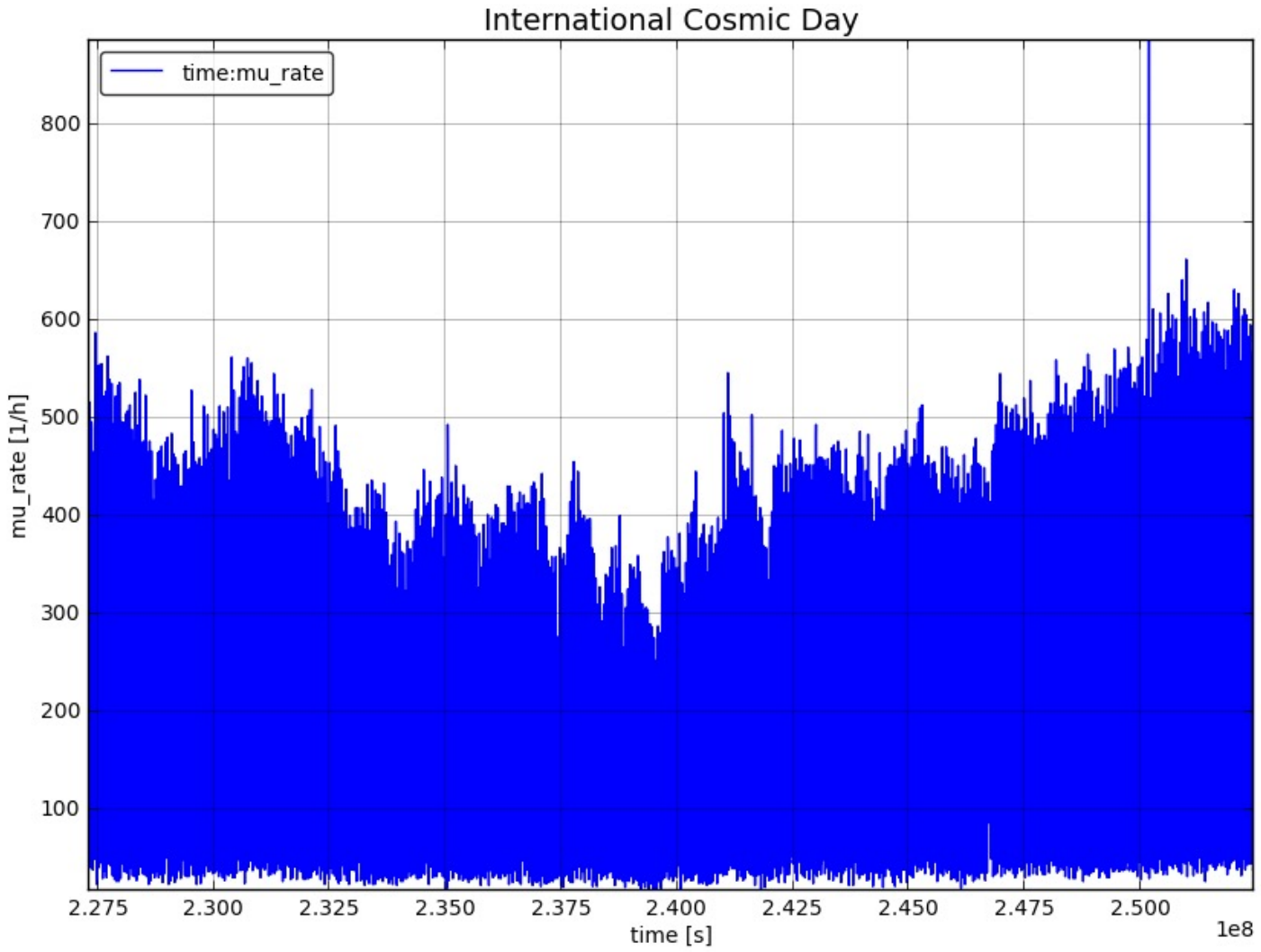
Legend

Position: automatically

Reset | Diagram Creation

# CosMO-Mill

## Investigation of zenith angle dependence



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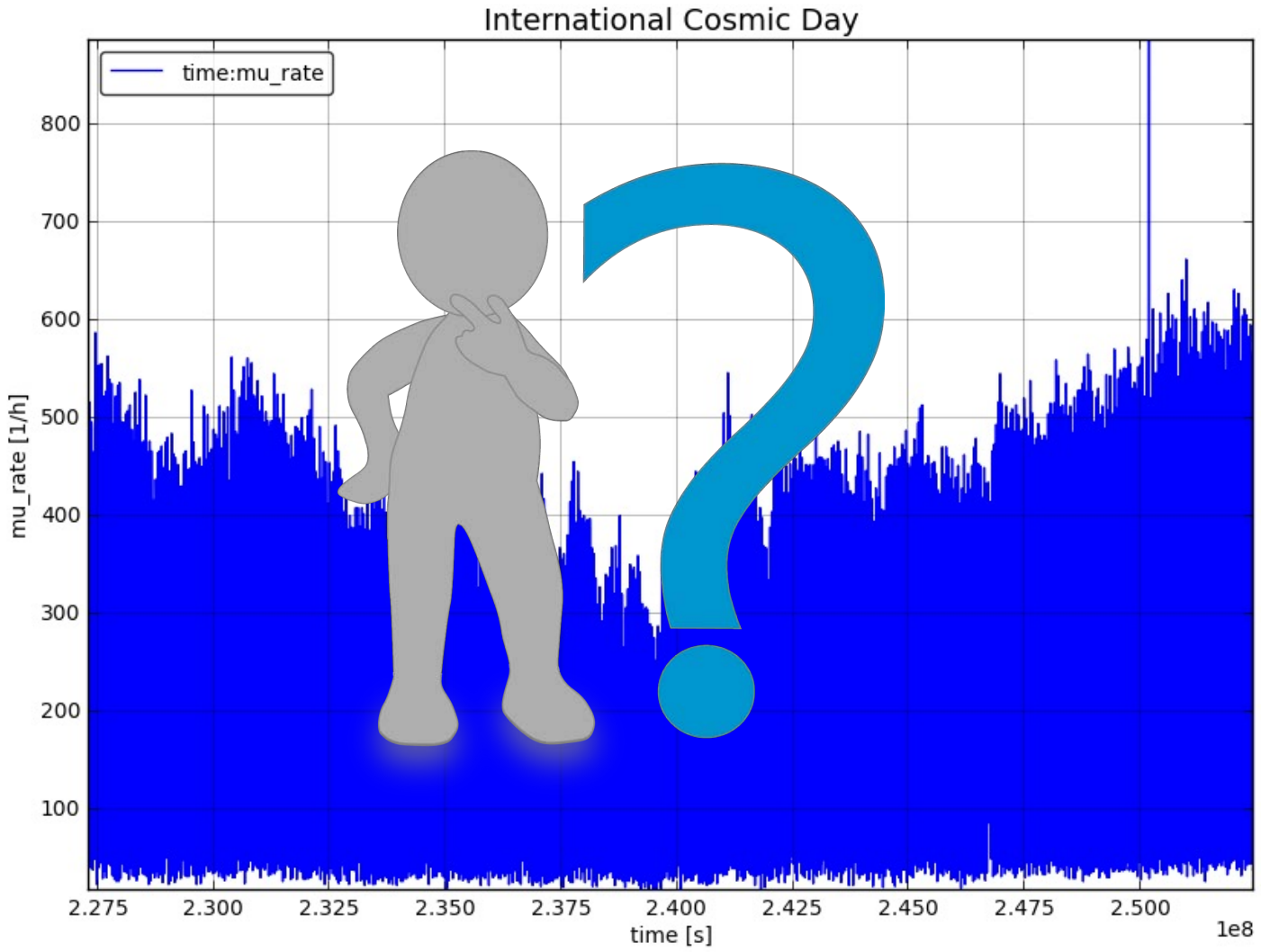

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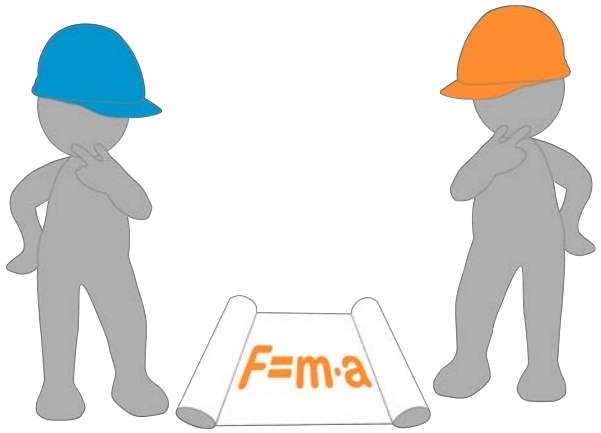
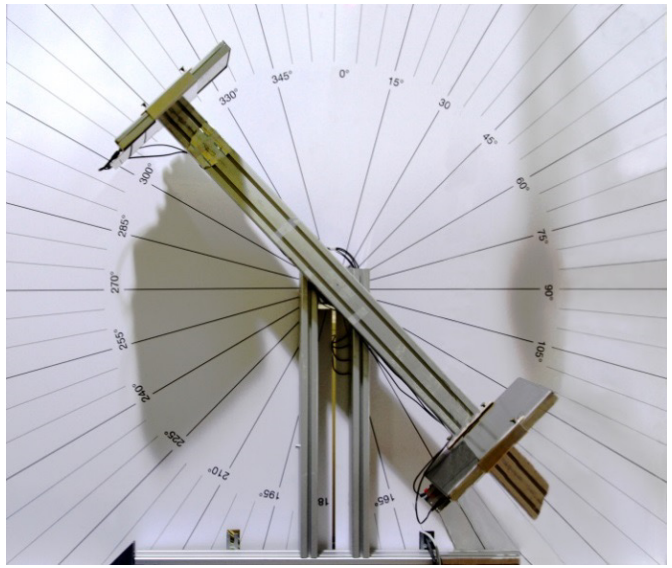




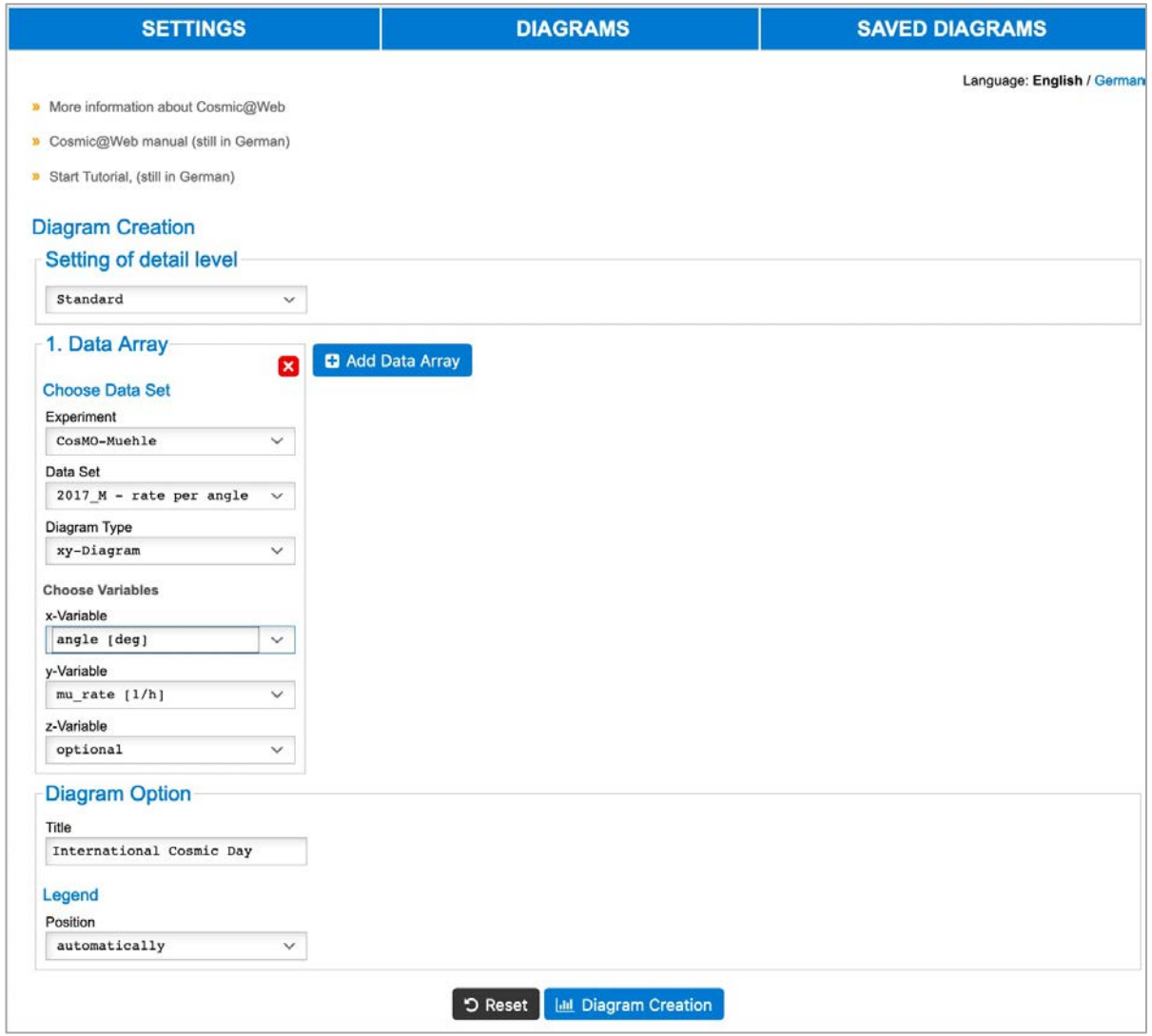


### Dataset CosMO Mill

| Parameter Webinterface | 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



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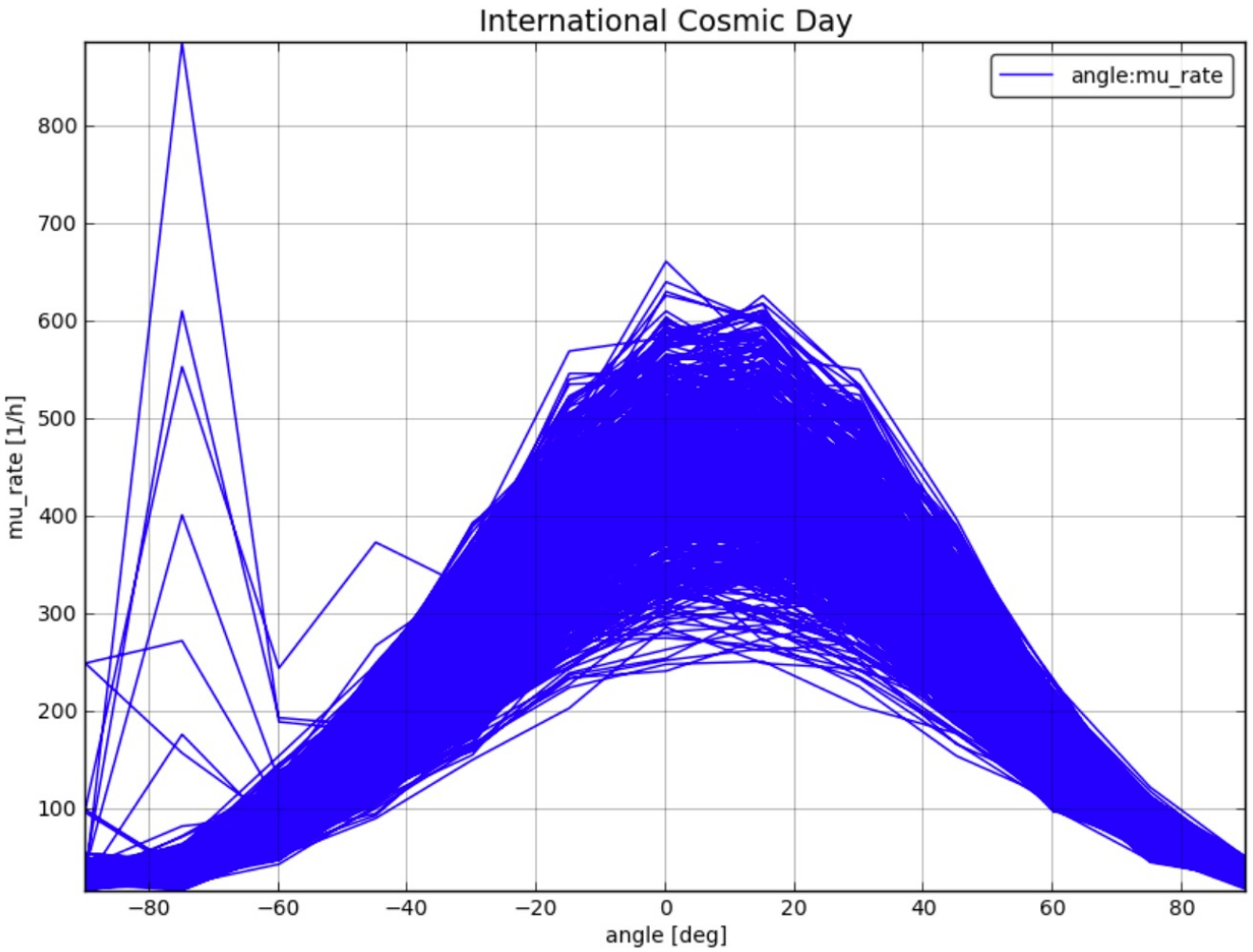

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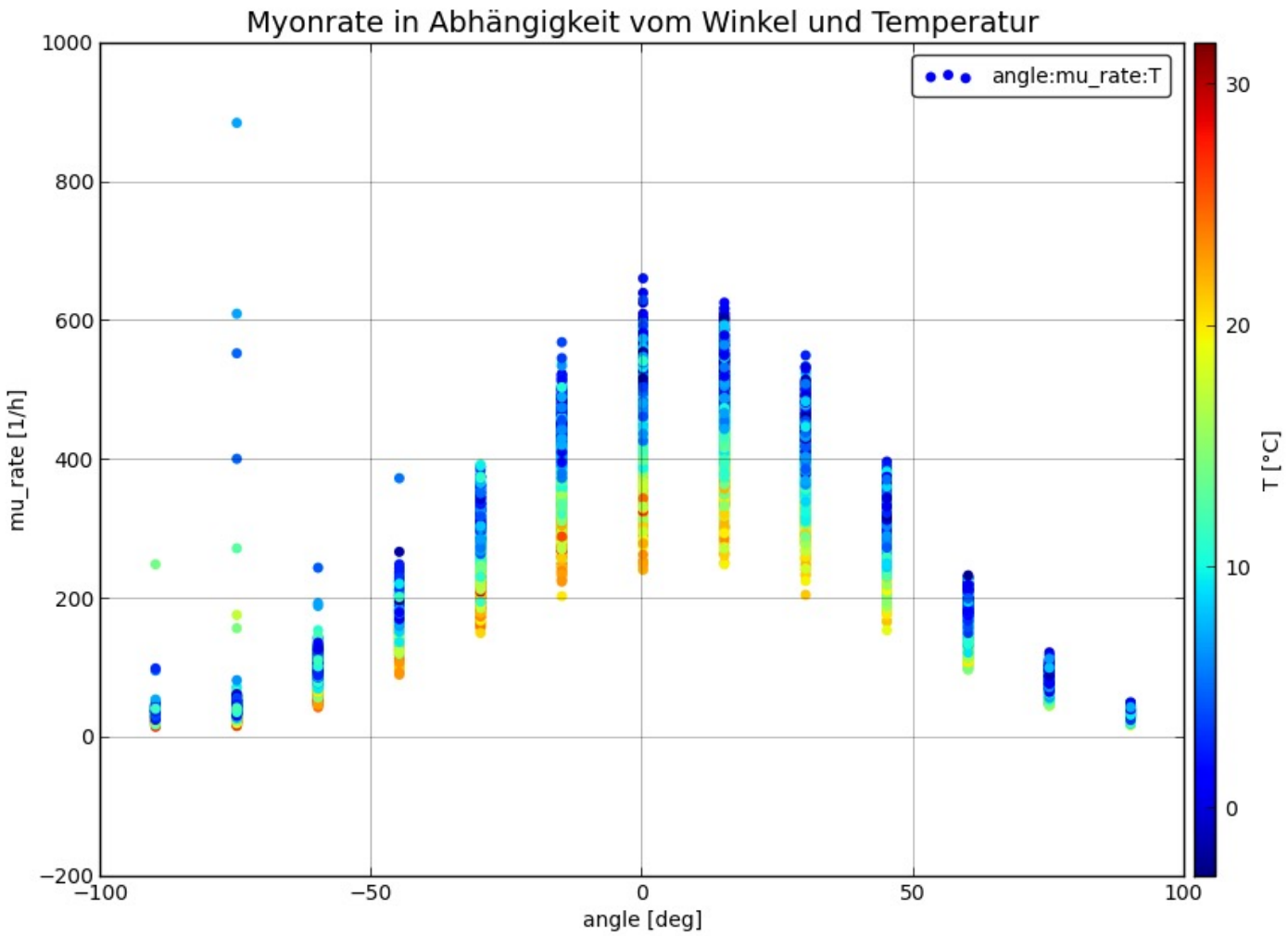

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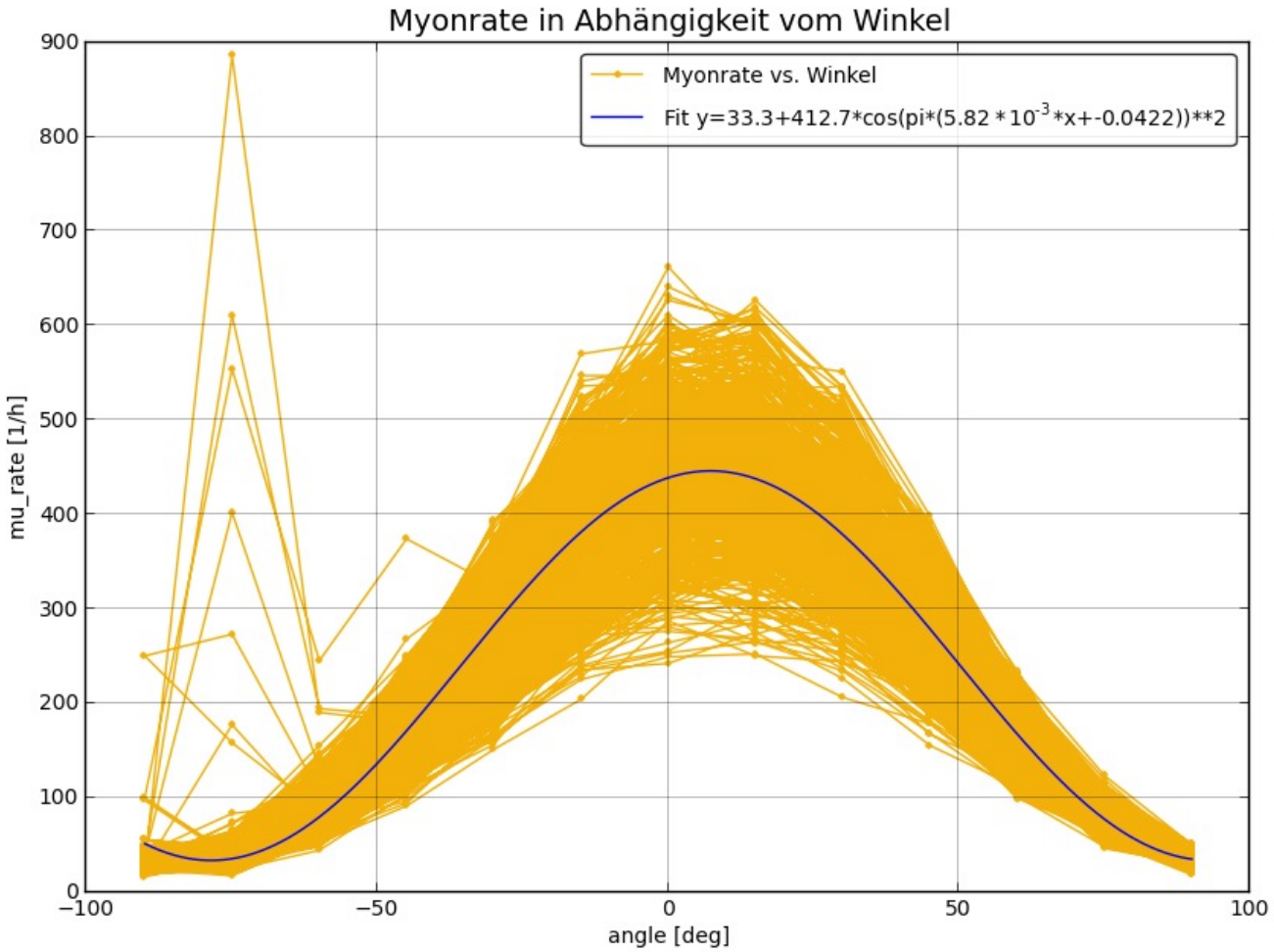
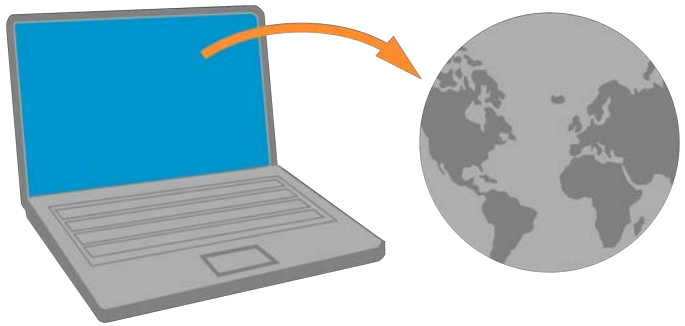



y=p[0]+p[1]*cos(pi*(p[2]*x+p[3]))**2
$\chi^2$/N = $1.713 * 10^7$/6991
p[0] = 33.31 %1.315
p[1] = 412.7 %1.697
p[2] = $5.824 * 10^{-3}$ %$2.174 * 10^{-5}$
p[3] = -0.04221 %$6.668 * 10^{-4}$

Rate of measured muons depends on temperature and zenith angle



# Many Thanks

NETZWERK TEILCHENWELT

PROJEKTLEITUNG

TECHNISCHE UNIVERSITÄT DRESDEN

PARTNER

CERN DESY

SCHIRMHERRSCHAFT

DPG

FÖRDERER

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

Dr. Hans Riegel-Stiftung

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DESY. Deutsches Elektronen-Synchrotron

www.desy.de

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