# Students work like Astroparticle Scientists

## International Cosmic Day and Cosmic@Web

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FAIR-GSI, Darmstadt, 23. Mai 2019

HELMHOLTZ SPITZENFORSCHUNG FÜR GROSSE HERAUSFORDERUNGEN

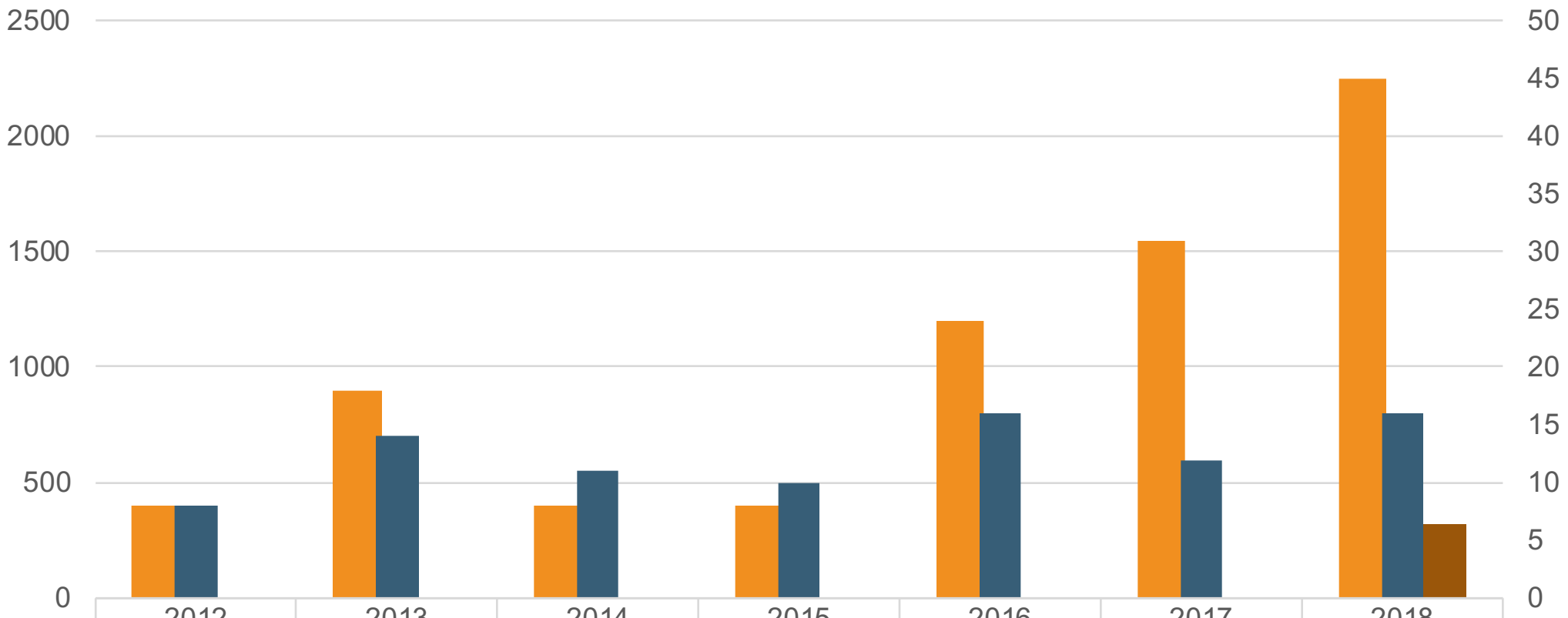
DESY.

# International Cosmic Day

- brings together different astroparticle-physics outreach and education projects from all over the world
- one day event, once a year (usually in November)
- goal: Students work like a scientist in a international collaboration
- each group performs measurements with own detectors or analyse data
- topic: zenith angle dependence of athmosperic muons
- http://icd.desy.de

# Participants ICD

## Growing Event




| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|
| Students | 400 | 900 | 400 | 400 | 1200 | 1550 | 2250 |
| Teachers and Scientist | | | | | | | 324 |
| Countries | 8 | 14 | 11 | 10 | 16 | 12 | 16 |

# Video Conference at the ICD

## Innovations 2018

- more video conferences with fewer participants per session offered
  - in each session was a chair and a scientist
  - the scientist presents the results of a scientific experiment (analyze data regarding the same question of zenith angle dependence like the student groups)
  - represented scientific experiment were: ATLAS, IceCube, Fermi
- If you know of any scientific experiments that would like to contribute to this, let me know

# Video Conference at the ICD

## Innovations 2018

- more video conferences with fewer participants per session offered
- joint session at the beginning of the (european) day
  - everyone could dial in
  - welcoming words to everyone
  - explanation of the tasks of the day
  - live stream to Polarstern
- if you have an idea for a live stream this year, let me know

# Video Conference at the ICD

## Innovations 2018

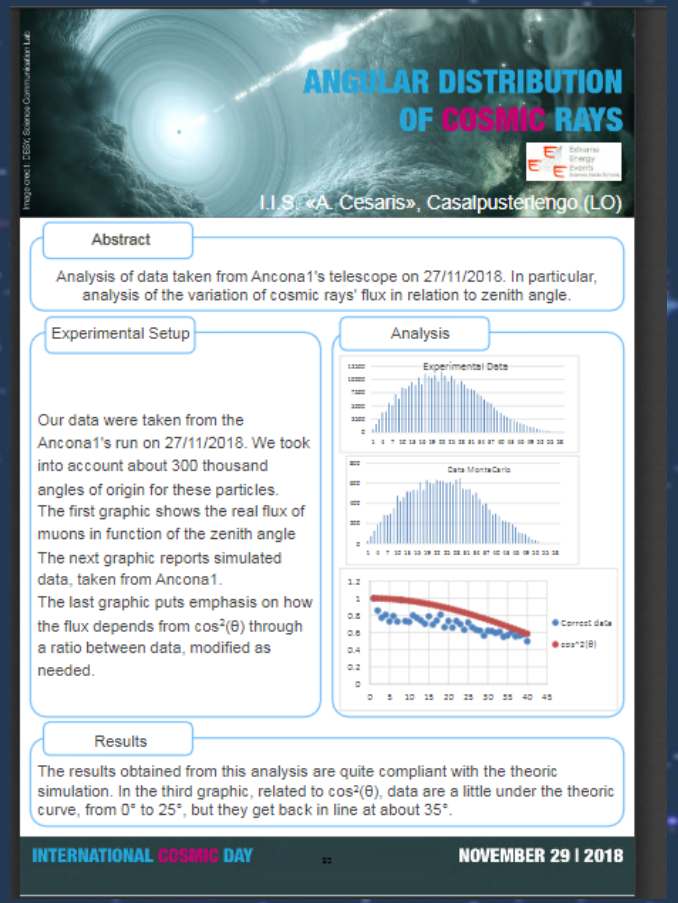
- more video conferences with fewer participants per session offered
- joint session at the beginning of the (european) day

- we want to keep both for the next ICD


Example of advertising poster with the agenda of the event, similar for all EEE schools and with a central common part

# The EEE Project @ ICD 2018

- **58 Italian High School,** 17 Local Researchers, 71 teachers and 680 students, distributed in 11 local sites:
  - Dipartimento di Fisica di Torino
  - Dipartimento di Fisica di Salerno
  - Dipartimento di Fisica di Bari
  - Dipartimento di Fisica di Catania
  - Liceo Volta, Lodi
  - Liceo Fermi, Bologna
  - Liceo Grassi, Savona
  - Liceo Banzi Bazoli, Lecce
  - IIS Levi, Quartu S.Elena
  - Liceo Quadri, Vicenza
  - Liceo Volta, Reggio Calabria
- **Data from EEE telescopes**



# The EEE Project @ ICD 2018

# Cosmic@Web

## http://cosmicatweb.desy.de

- 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

# Work like a Scientist

## From the Question to the Publication

- show students all aspects of scientific work, not only focus on the experiment

# Cosmic@Web

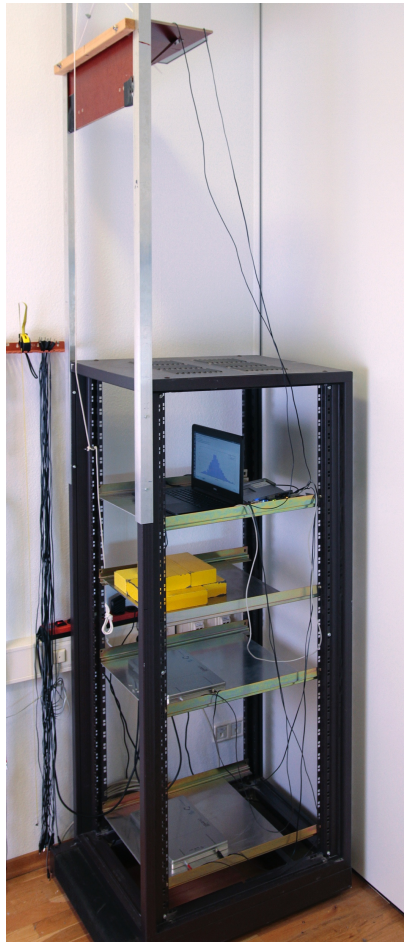
## Learning Platform for Students

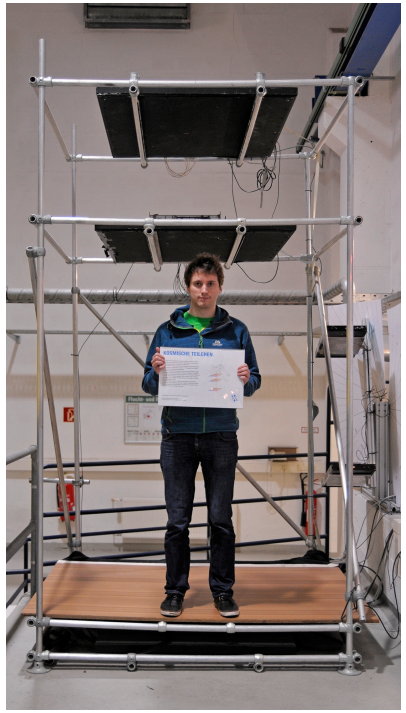
Provides:

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

# Cosmic@Web

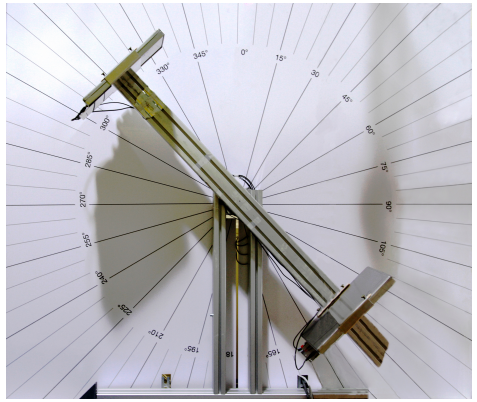
## Investigate Athmospheric Muons





9 experiments:

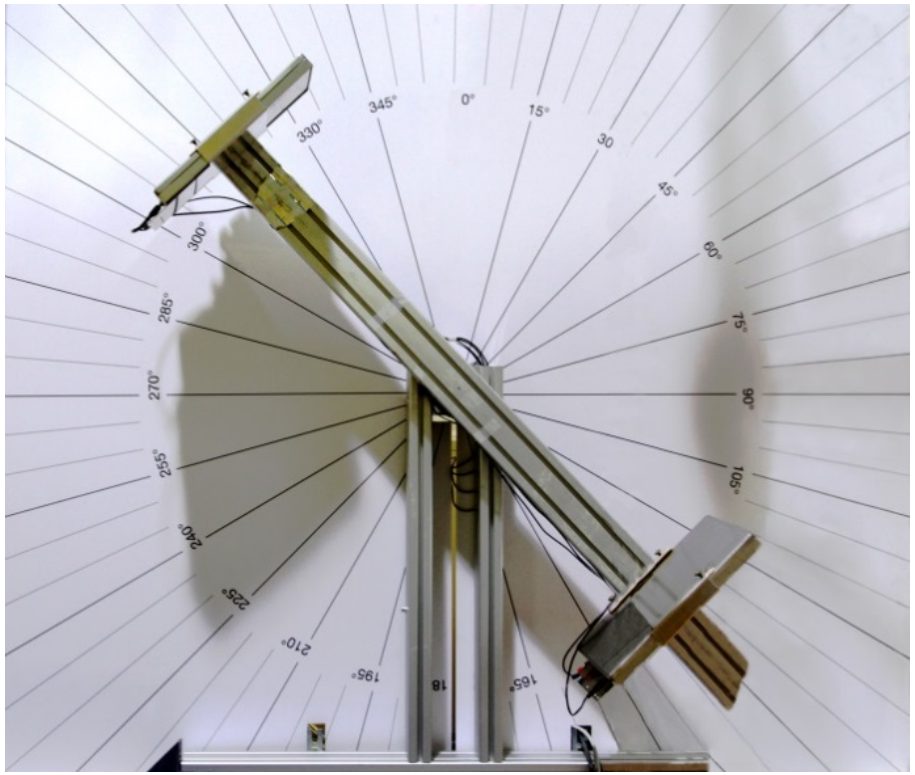
- lifetime and velocity
- geomagnetic effect
- zenith angle dependence
- rate in Germany, Armenia and Antarktis
- rate depending on weather conditions

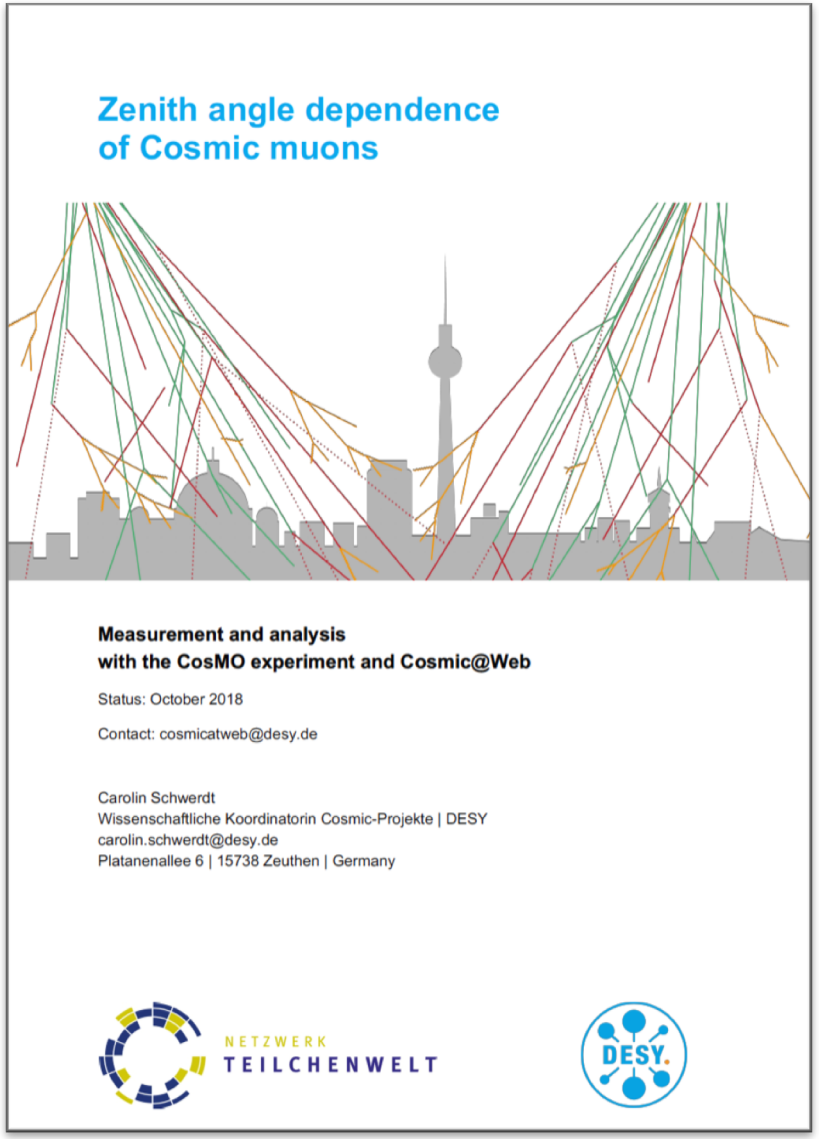


# CosMO-Mill

## Investigation of zenith angle dependence

- possibility to participate in ICD without own experiment on site
- instruction: https://icd.desy.de/e12688/



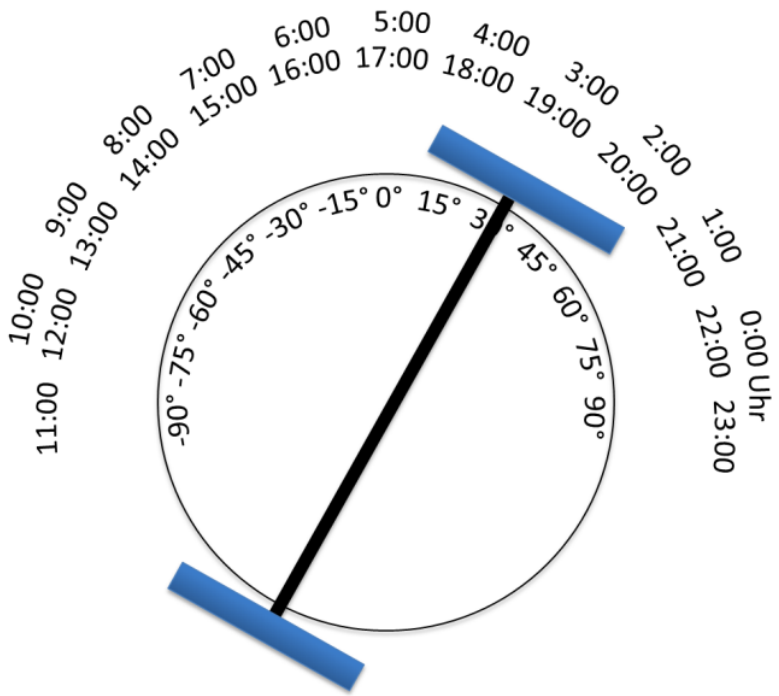



# CosMO-Mill

## 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

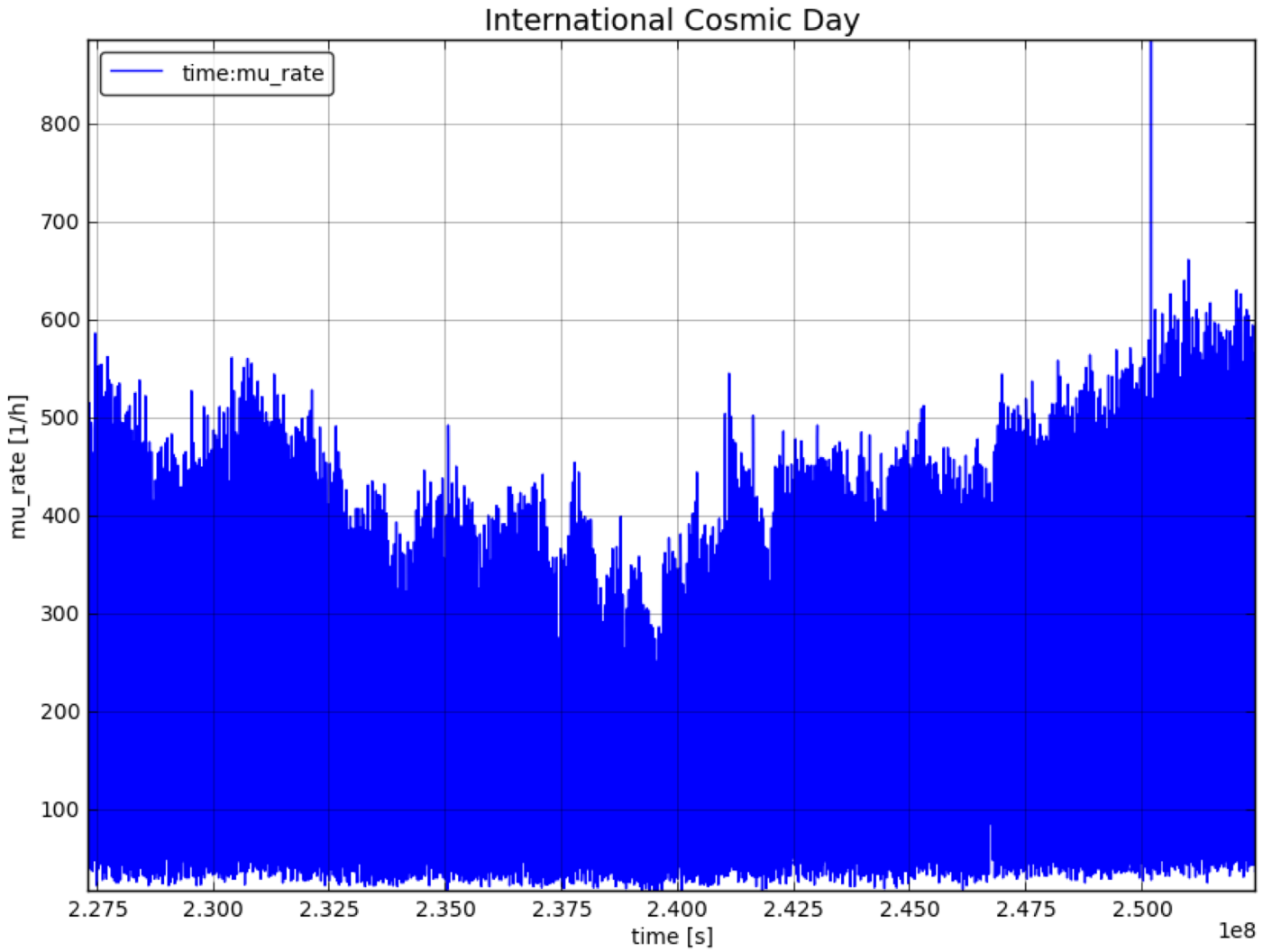
Legend

Position: automatically

Reset | Diagram Creation

# CosMO-Mill

## Investigation of zenith angle dependence



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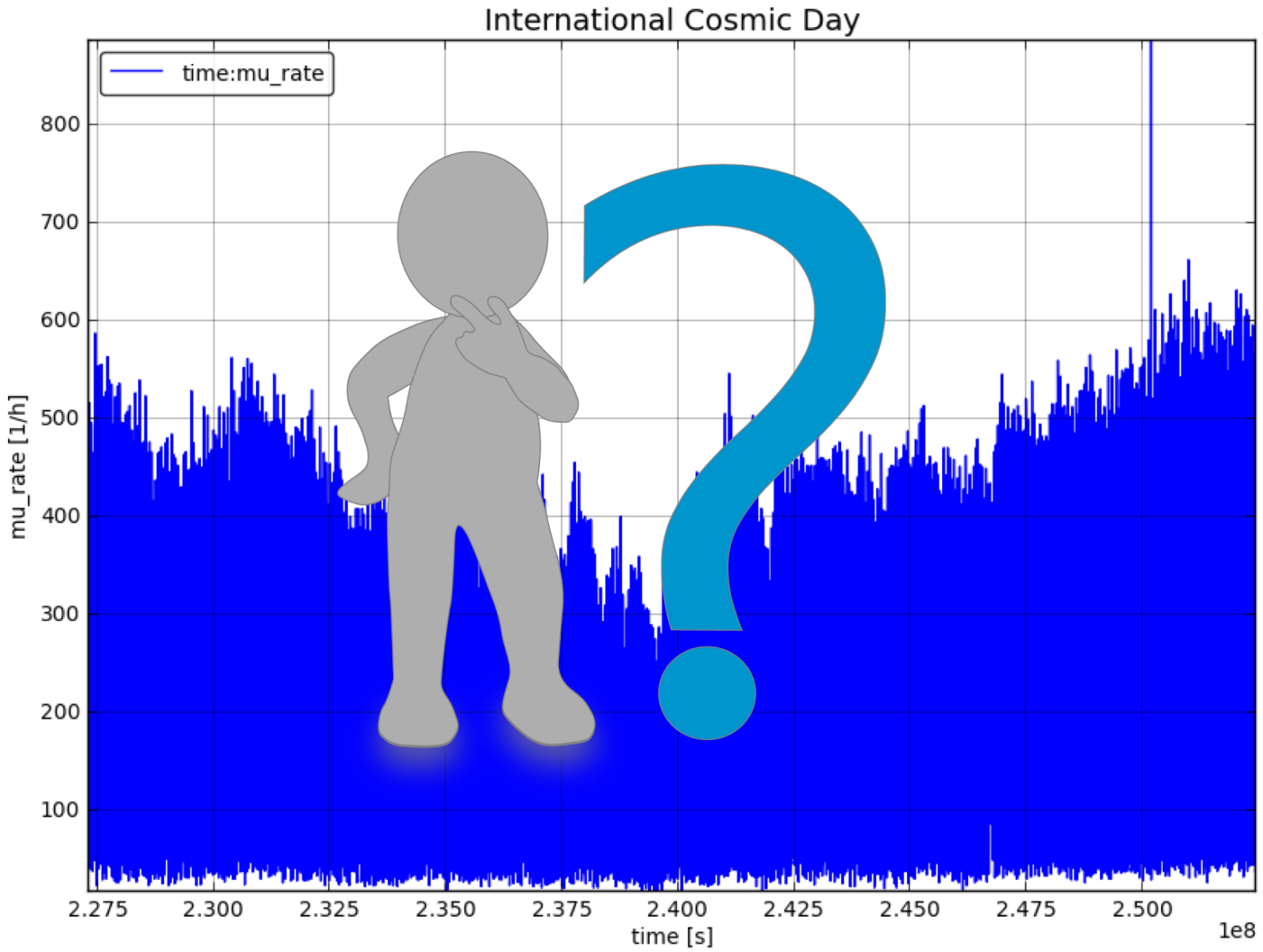

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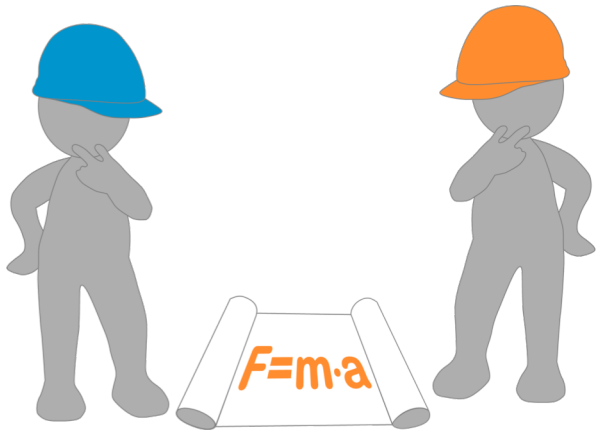
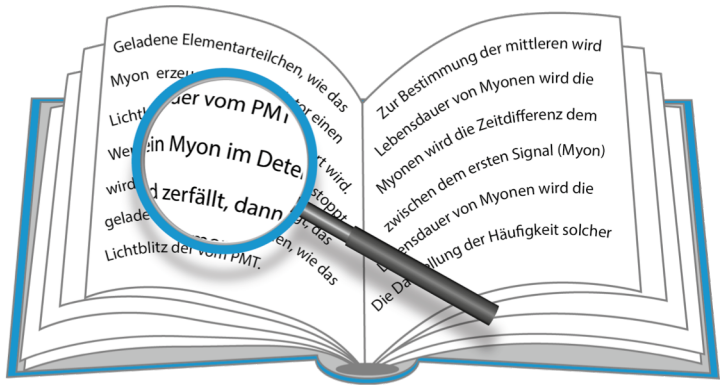
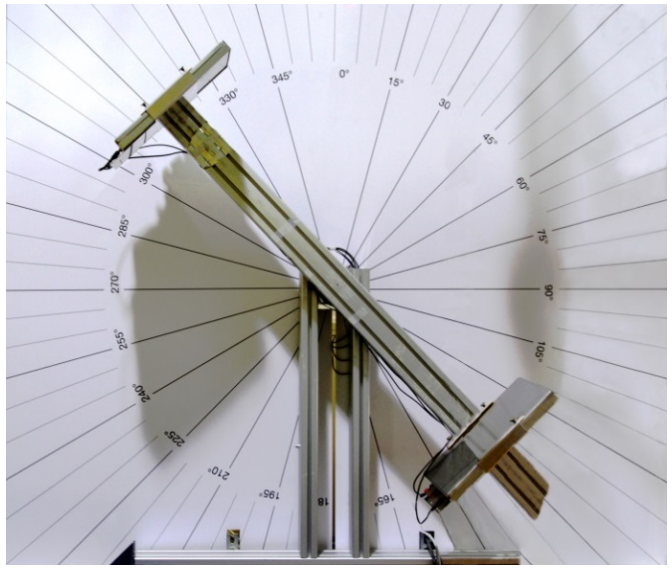


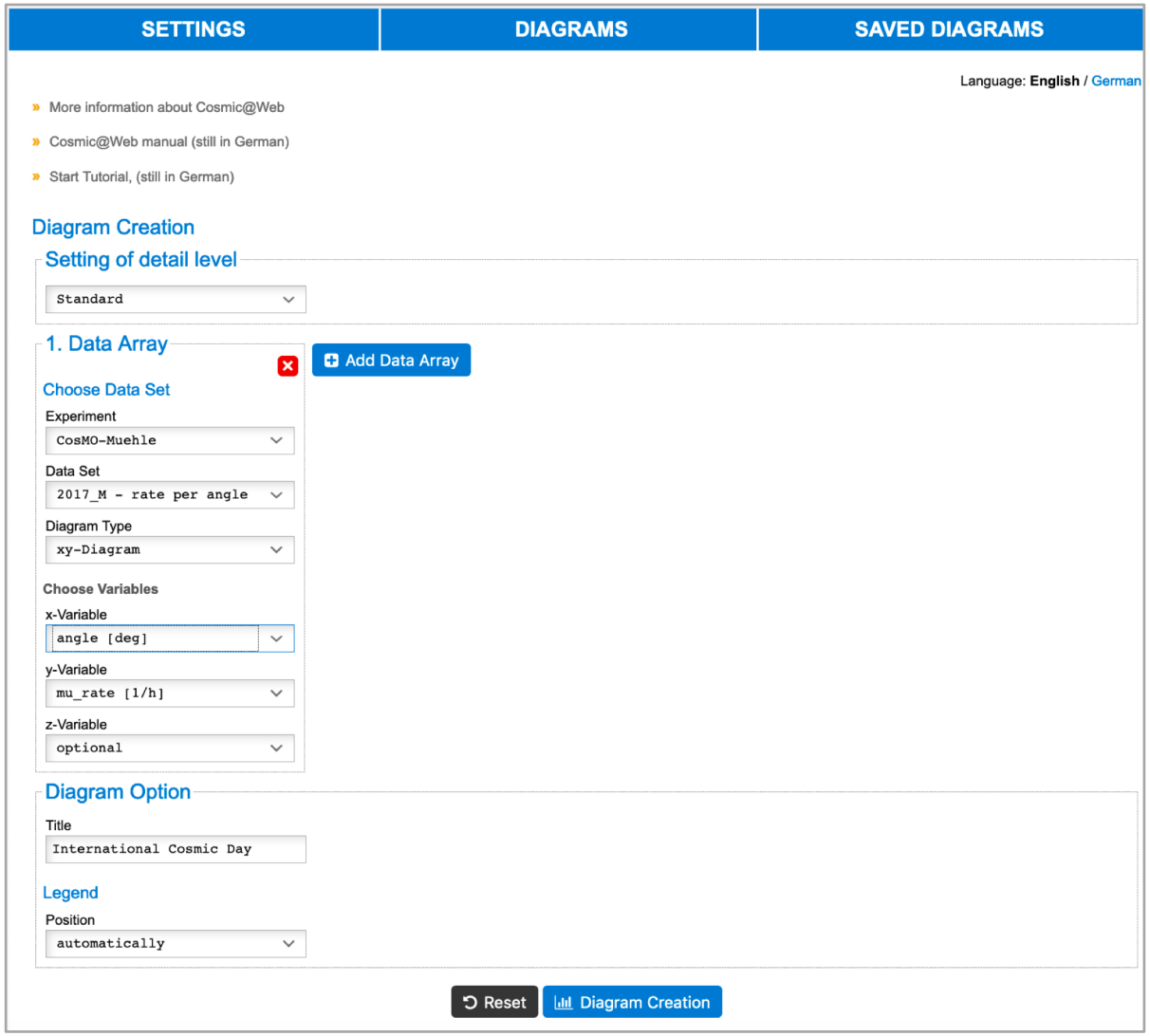



### Dataset CosMO Mill

| 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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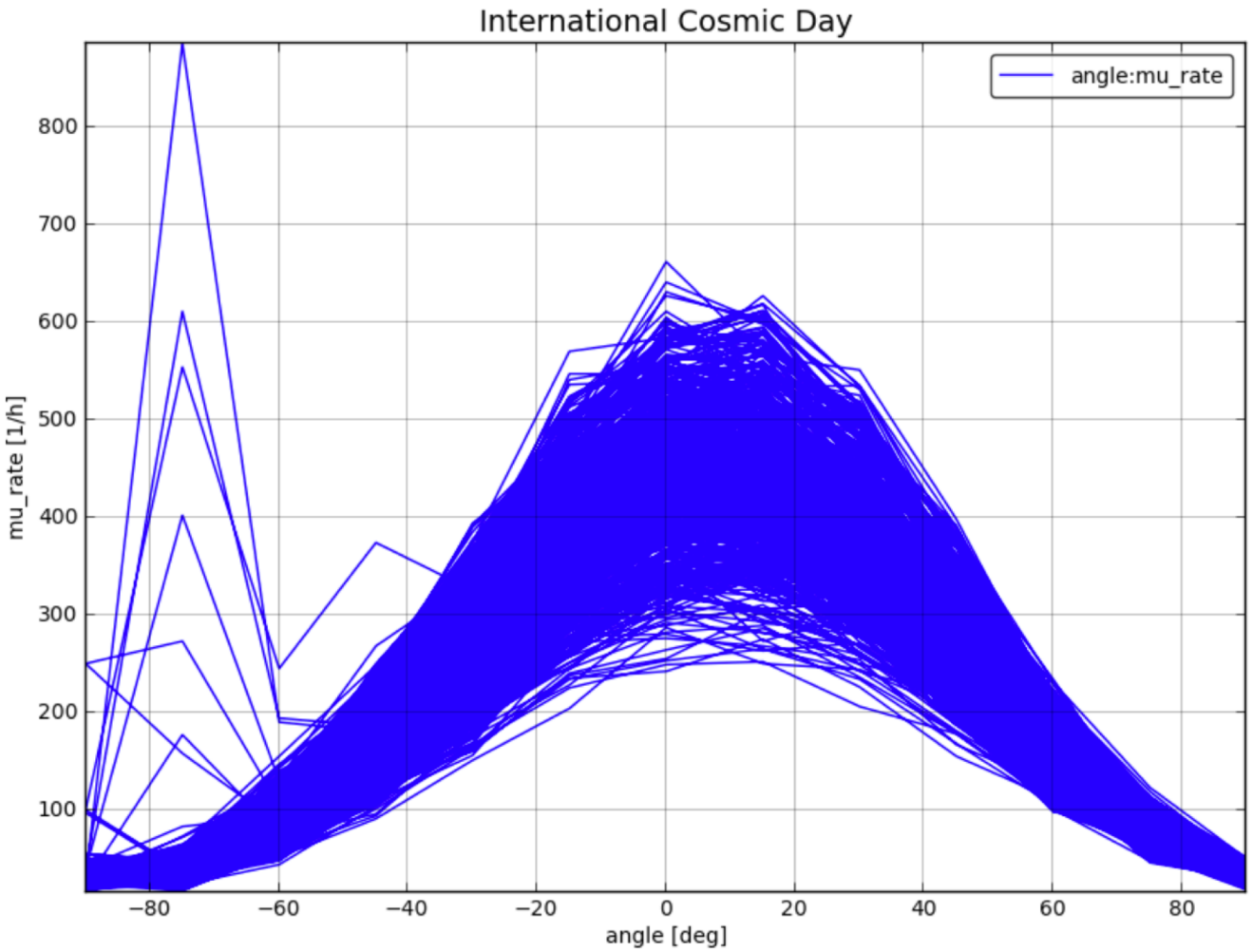

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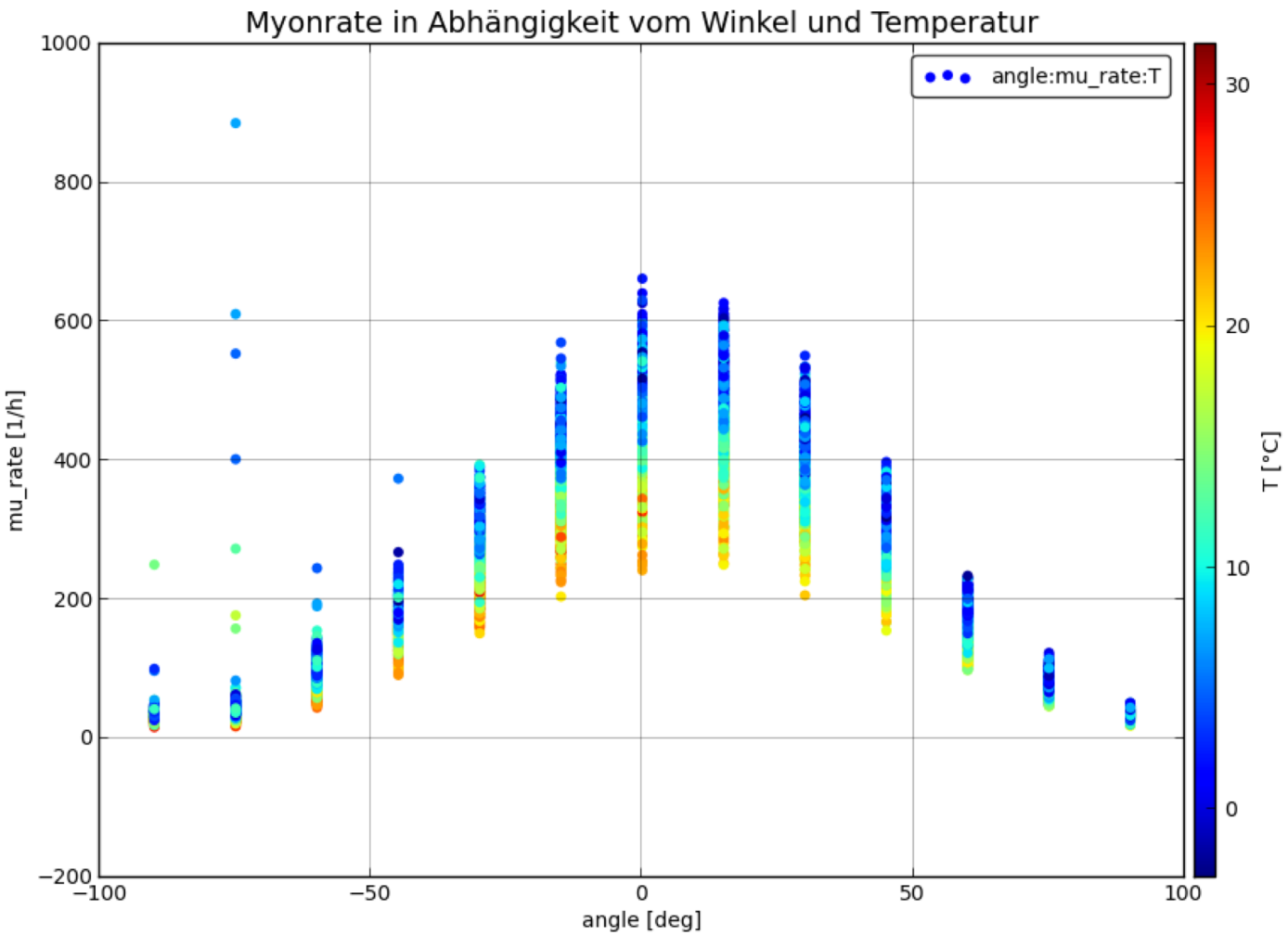

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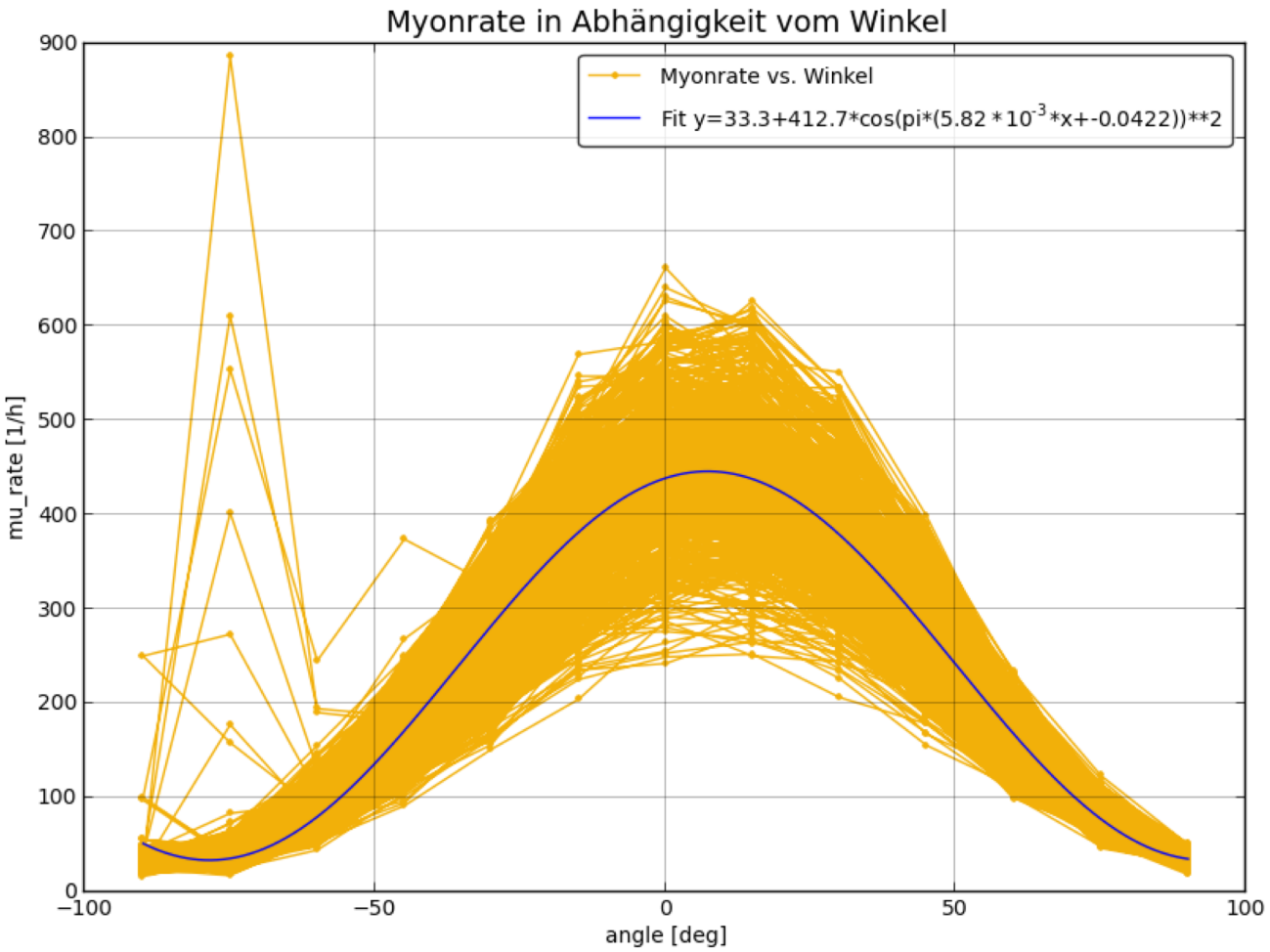
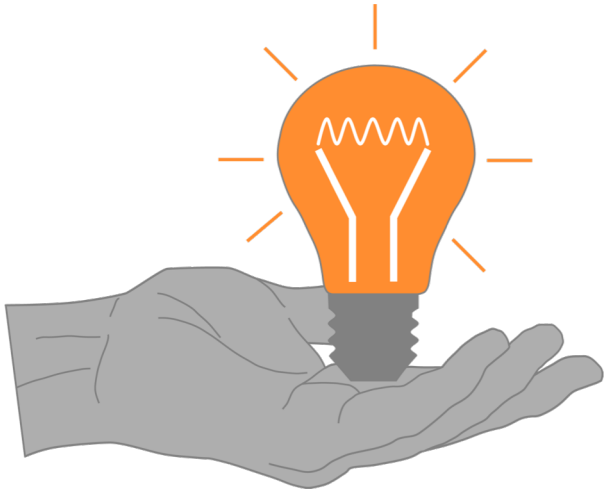
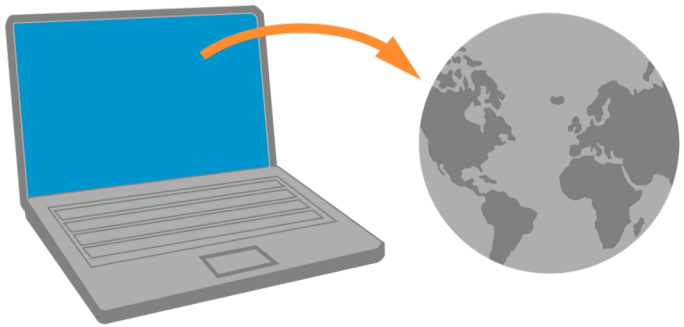



y=p[0]+p[1]*cos(pi*(p[2]*x+p[3]))**2
$\chi^2/N = 1.713 * 10^7/6991$
p[0] = 33.31 %1.315
p[1] = 412.7 %1.697
p[2] = $5.824 * 10^{-3}$ %$2.174 * 10^{-5}$
p[3] = -0.04221 %$6.668 * 10^{-4}$

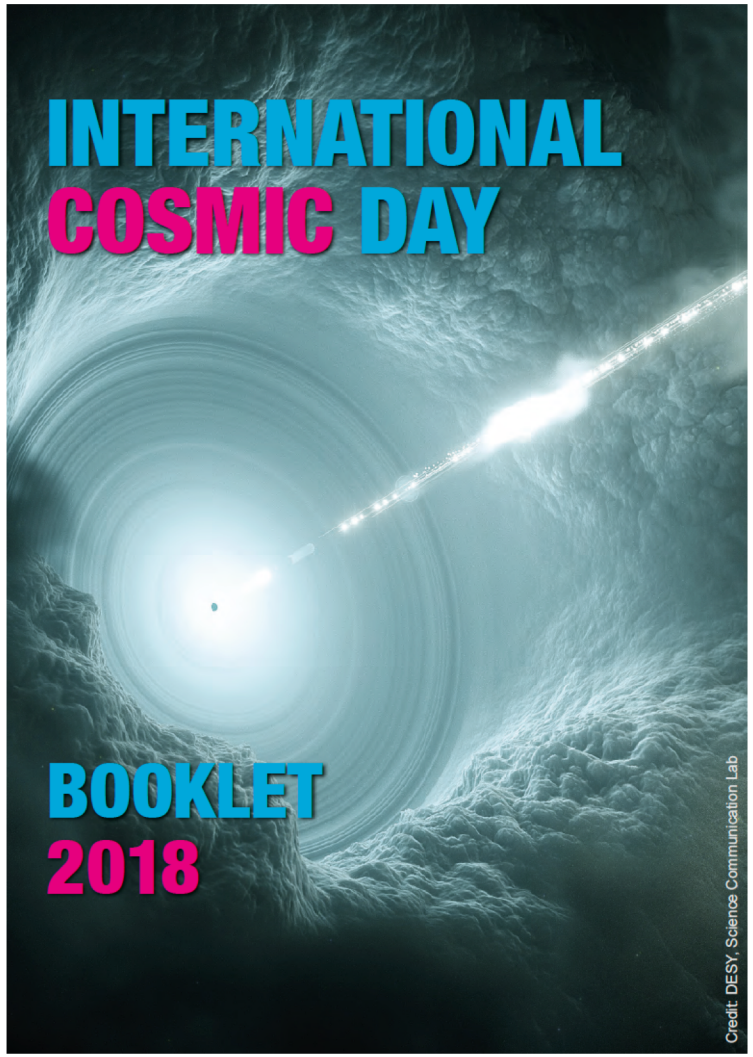


Rate of measured muons depends on temperature and zenith angle



# 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



**TABLE OF CONTENTS**

# 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

**Kontakt**


DESY. Deutsches Elektronen-Synchrotron

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