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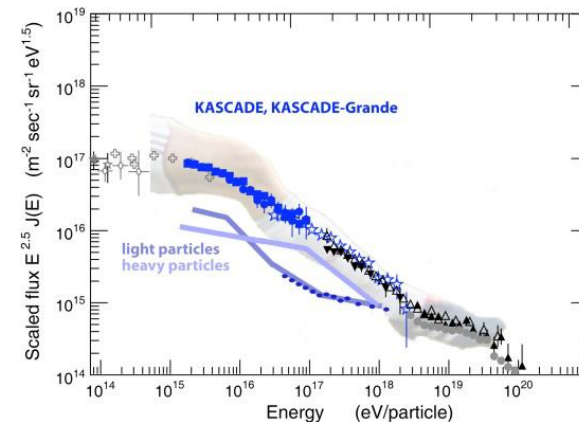
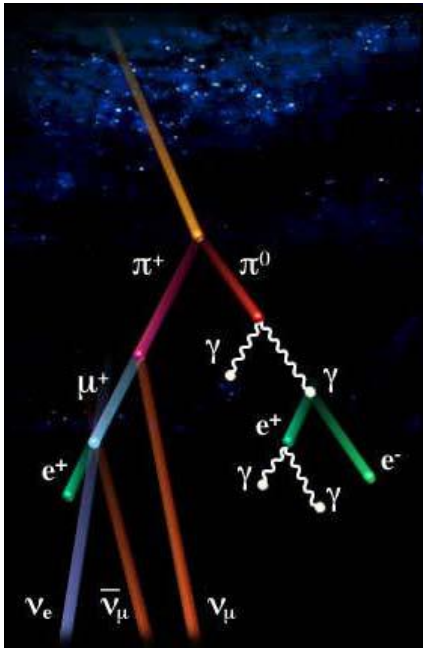
KASCADE

KARlsruhe Shower Core and Array DETector

High energy cosmic ray measurements
by detection of air showers

physics topics under investigation

- sources, acceleration mechanisms and propagation of cosmic rays
- knee structure of the energy spectrum
- search for anisotropy in the incident direction
- hadronic interactions in the atmosphere
- and more.....



KCDC in a nutshell

- providing open access to astroparticle physics research data as required by funding agencies
now: $1.6 \cdot 10^8$ EAS events of first data release are available

- **data provider**

- free, unlimited, open access to KASCADE cosmic ray data
- selection of fully calibrated quantities
- reliable data source
- guaranteed data quality

- **information platform**

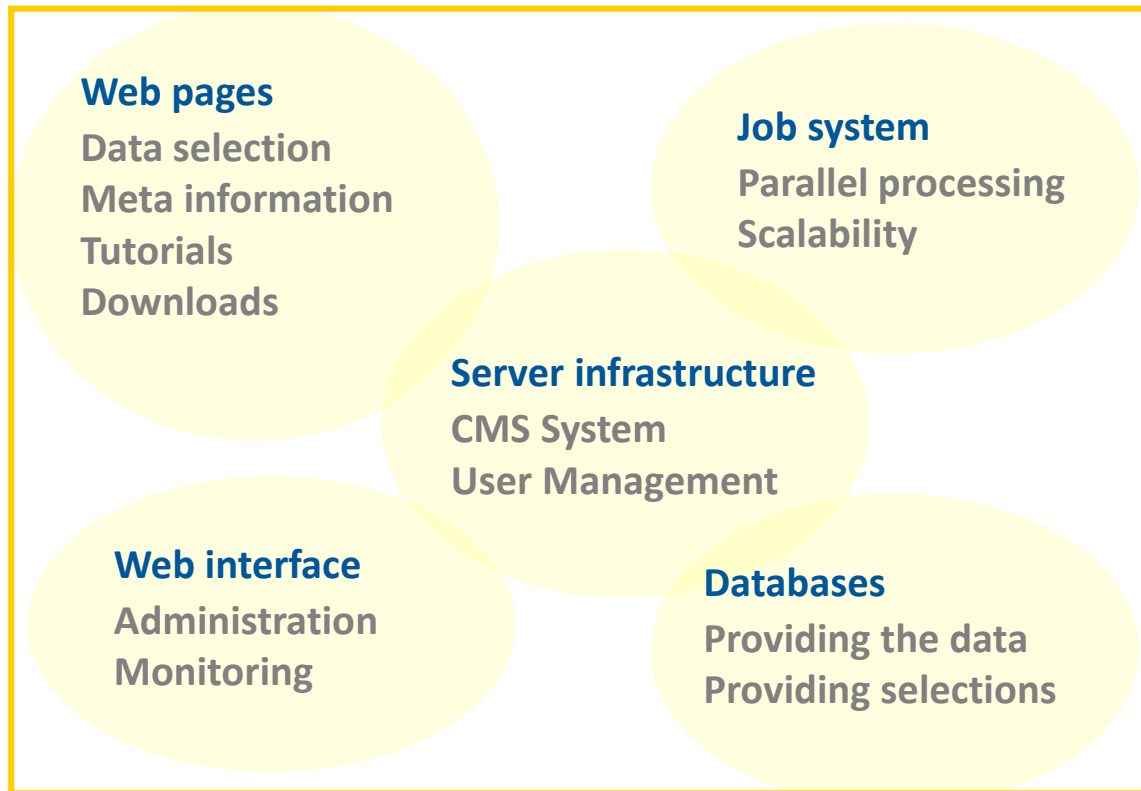
- experiment description
- meta information for data analysis
- physics background
- tutorials (focused on teachers and pupils)

- **as long-term digital data archive**

- archive of software and data
- for the collaboration
- for the public

The Web Portal

- **open data publication**
 - follows the “Berlin Declaration on Open Data and Open Access”
 - explicitly requests the use of web technologies
- **free unlimited access for everyone**
 - scientific and non-scientific audience in focus, requires extensive documentation
- **modern technologies**
 - internet access & interactive data selections



KCDC impressions



HOME | KIT | IKP | IMPRESSUM | ADMIN | LOGIN



KASCADE Cosmic Ray Data Centre (KCDC) / Open β

KCDC Homepage

KCDC Motivation

Regulations

Information

Announcements

FAQs

DATA Shop

User Page

Lehrmaterial

Report a Bug

Welcome to KCDC

The aim of the project **KCDC** (KASCADE Cosmic Ray Data Centre) is the installation and establishment of a public data centre for high-energy astroparticle physics based on the data of the KASCADE experiment. KASCADE was a very successful large detector array which recorded data during more than 20 years on site of the KIT-Campus North, Karlsruhe, Germany (formerly Forschungszentrum, Karlsruhe) at 49,1°N, 8,4°E; 110m a.s.l. KASCADE collected within its lifetime more than 1.7 billion events of which some 425.000.000 survived all quality cuts. Initially about 160 million events are available here for public usage.



KASCADE
Karlsruhe Shower Core
and Array Detector



Institute for Nuclear Physics (IKP)

KIT Campus North

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D-76344 Eggenstein-
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E-Mail:

[ikp-kcdc\[at\]lists.kit.edu](mailto:ikp-kcdc[at]lists.kit.edu)

Downloads

[KCDC Manual \(english\)](#)

OPEN BETA - VERSION : WOLF359.01

KCDC impressions

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KCDC Data Shop

Selection	Cuts	Submission
-----------	------	------------

Full Data

High Energy

Vertical Showers

"Full data selection"
Quantities selected for retrieval

Energy

Zenith angle

Electron Number

Air Temperature

Local Date (UTC)

Micro Time

Run Number

Core Position

Azimuth angle

Muon Number

Air Pressure

Global Time

Time of Day

Event Number

Shower Core Info



The shower core position of the reconstructed KASCADE showers is derived from the measured particle densities of the KASCADE Array Detectors. Available are all events with a core position within 91 m radius from the centre of the detector array with a total size of $200 \times 200 \text{ m}^2$ wide. The core positions are given in x- and y-directions where X denotes the west-east direction and Y the south-north direction respectively (rotated by $+15^\circ$ see azimuth).

[details-> [kcdc-manual](#)]


OPEN BETA - VERSION : WOLF359.01

KCDC impressions

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KASCADE Cosmic Ray Data Centre (KCDC) / Open β



KCDC Data Shop

Selection	Cuts	Submission
<p>"Full data selection" Define cuts on quantities selected for download</p>		
	<p>Cuts on Energy</p> <p>from <input type="text" value="1e16"/> to <input type="text" value="1e17"/> eV</p>	<input type="button" value="add cut"/>
	<p>Cuts on Core Position X</p>	<input type="button" value="add cut"/>
	<p>Cuts on Core Position Y</p>	<input type="button" value="add cut"/>
	<p>Cuts on Zenith angle</p>	<input type="button" value="add cut"/>
	<p>Cuts on Azimuth angle</p>	<input type="button" value="add cut"/>
	<p>Cuts on Electron Number</p>	<input type="button" value="add cut"/>
	<p>Cuts on Muon Number</p>	<input type="button" value="add cut"/>

Cuts on Energy


The available data sets are within the Energy range 10^{14} to 10^{17} eV. The values have to be provided in $\log_{10}(E)$ like 1.123e14 in [eV].

[\[details-> kcdc-manual \]](#)

Information


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KCDC impressions



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Karlsruhe Institute of Technology

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- Report a Bug

KCDC Data Shop

Selection	Cuts	Submission
-----------	------	------------

"Full data selection"
Check your order and submit request

Energy	range: 1.00e+16 to 1.00e+17 eV	
Core Position X	range: -91.0 to 91.0 m	No cuts applied
Core Position Y	range: -91.0 to 91.0 m	No cuts applied
Zenith angle	range: 0.0 to 60.0 °	No cuts applied
Azimuth angle	range: 0.0 to 360.0 °	No cuts applied
Electron Number	range: 1.00e+01 to 5.00e+08	No cuts applied
Muon Number	range: 1.00e+01 to 5.00e+06	No cuts applied
Micro Time	range: 0 to 99999999 μ s	No cuts applied
Time of Day	range: 0.0 to 235959.0 s	No cuts applied
Run Number	range: 282 to 4683	No cuts applied
Event Number	range: 1 to 3000000	No cuts applied

save as pre-selection

submit retrieval request

Request Submit Info

Overview on the parameters selected and their ranges after the user cuts were applied. To change the cuts or add deselected parameters go back to the 'Cuts' page or to the 'Selection' page respectively.

Note : Only 4 cuts per parameter are displayed, even though more cuts are selected and active.

[details-> [kcdc-manual](#)]

Information

OPEN BETA - VERSION : WOLF359.01

KCDC impressions

The screenshot shows the 'KCDC User Page' with a navigation menu on the left and a main content area. The navigation menu includes: KCDC Homepage, KCDC Motivation, Regulations, Information, Announcements, FAQs, DATA Shop, User Page (highlighted), Lehrmaterial, and Report a Bug. The main content area has a header with '[kdcadmin] | HOME | KIT | IKP | IMPRESSUM | ADMIN | LOGOUT' and a banner for 'KASCADE Cosmic Ray Data Centre (KCDC) / Open β '. Below the banner is the title 'KCDC User Page' and a sub-header 'MY JOBS | PROFILE | CHANGE PASSWORD | CLOSE ACCOUNT'. The main content is titled 'Your last requests were:' and contains a table of job requests. Each row shows the job start time, current status (all 'SUCCESS'), and buttons for 'Details', 'Delete', 'Resubmit', and 'Download'. A 'User Information' box on the right provides instructions on how to use the interface, including how to check job status, delete jobs, and change profile information. A link to the 'KCDC Manual' is also present.

Job from	current status:
Nov. 4, 2013, 11:20 a.m.	SUCCESS
Nov. 4, 2013, 12:08 a.m.	SUCCESS
Nov. 4, 2013, 12:08 a.m.	SUCCESS
Nov. 4, 2013, 12:01 a.m.	SUCCESS
Nov. 1, 2013, 10:50 p.m.	SUCCESS
Nov. 1, 2013, 10:49 p.m.	SUCCESS
Nov. 1, 2013, 11:34 a.m.	SUCCESS
Oct. 31, 2013, 4:09 p.m.	SUCCESS
Oct. 31, 2013, 4:02 p.m.	SUCCESS

Output:

zip-archive with data, metadata, and the EULA (end user licence agreement)

Data as ASCII file

Commented header give information about the content

The screenshot shows the 'Preselection Download Page' with a navigation menu on the left and a main content area. The navigation menu includes: KCDC Homepage, KCDC Motivation, Regulations, Information, Announcements, FAQs, DATA Shop, User Page, Lehrmaterial, and Report a Bug. The main content area has a header with '[kdcadmin] | HOME | KIT | IKP | IMPRESSUM | ADMIN | LOGOUT' and a banner for 'KASCADE Cosmic Ray Data Centre (KCDC) / Open β '. Below the banner is the title 'Preselection Download Page'. The main content area contains the text 'You have chosen the preselection "Full Data". Download [here](#)'. At the bottom right, there is a small text 'OPEN BETA - VERSION : WOLF359.01'.

In future:

options for different formats of the output:
ASCII, ROOT and HDF5 files

Law and Order

open data publication

- no ready available open data licence
- free access to data and web portal
- good scientific practice for work with data
- citation of collaboration, KIT, and the web portal mandatory
- free redistribution of data “as is”

KCDC approach

- licence based on EULA model (as usually for software)
- licence details: following the industry
- flexible and adaptable to our needs
- signed during registration & shipped with each data package

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KASCADE
KASCADE Cosmic Ray Data Centre (KCDC) / Open β

KCDC

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Regulations - Legal Aspects of KCDC

End User Licence Agreement for using the KCDC webportal and the KCDC data (EULA)

This EULA provides the rights and duties of the usage of the KASCADE Cosmic Ray Data Centre (KCDC) webportal (hereinafter called WEBPORTAL) as well as the corresponding scientific KCDC data (hereinafter called DATA). The Karlsruhe Institute of Technology (KIT) is the owner of the WEBPORTAL which contains DATA, as well as printable materials about KCDC and online or electronic documentation about KCDC (hereinafter called DOCUMENTS), and related modules (hereinafter called SERVICES) of KCDC.

Please read this EULA carefully. By using the WEBPORTAL or by using any SERVICES or by downloading DATA, You (You, as the licensee, are hereinafter called YOU) agree that this EULA is enforceable like any written contract signed by YOU. If YOU do not agree to all of the terms of this EULA, click on the button that indicates that YOU do not agree to accept the terms of this EULA (if applicable) and do not continue the use of the WEBPORTAL, the provided DATA, or the

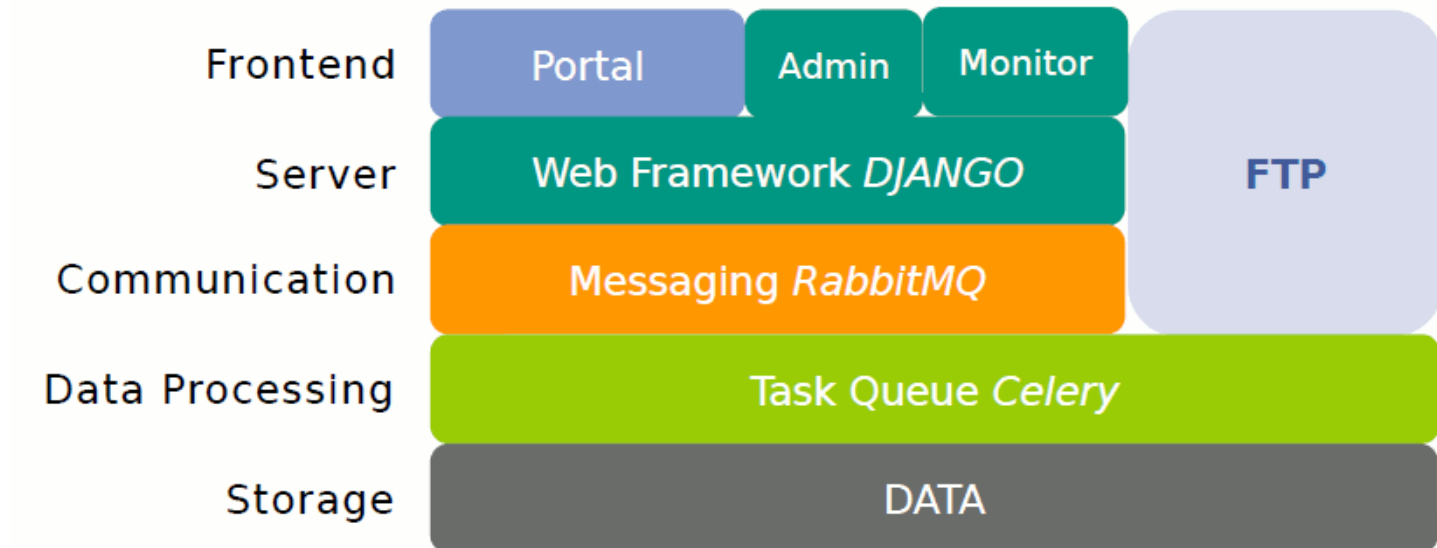
KCDC, the software

providing a modern software solution

for publishing KASCADE data for a general audience

In a second step: release the software as Open Source for free use

- Publication foreseen under Open Source License
- Following the concept of open access to research data
- Simple configuration via web interface
- Based solely on Open Source Software
(Python, Django, HTML/Javascript and CSSdata provider)



Tutorials and Teaching

- **The goal: Providing the data to a general public**

- **Education portal (in development)**

- first tutorial is up
(only in German at the moment)
- knowledge database on KASCADE, astrophysics and related topics
- step by step tutorials of simple data analyses
- including a modern programming language code example
- interpretation and discussion of the outcome
- cooperation with local teachers and pupils
- later offering to teachers dedicated lessons for high schools

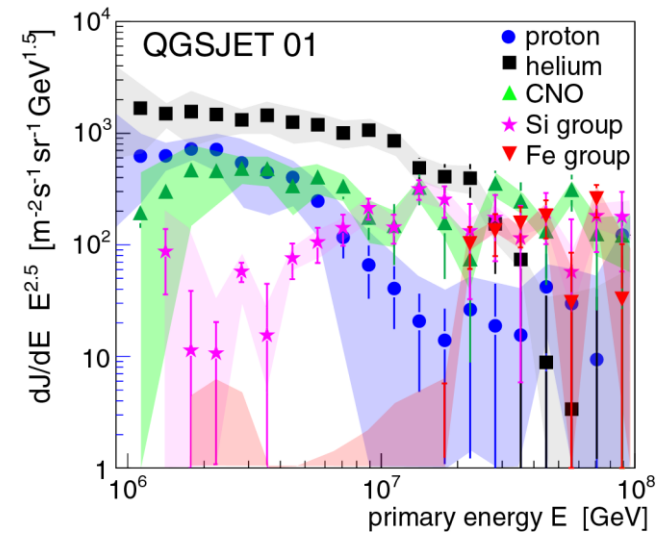
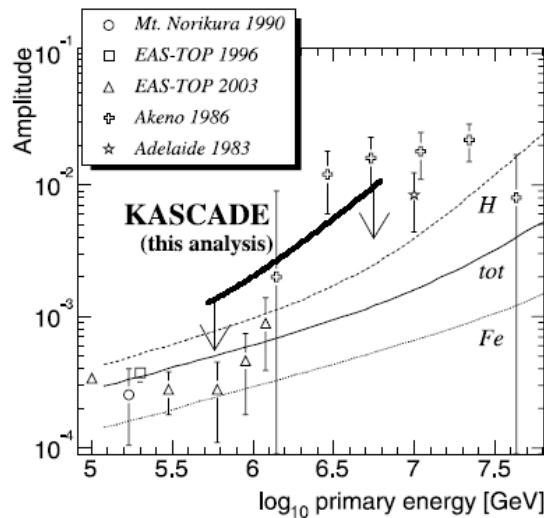
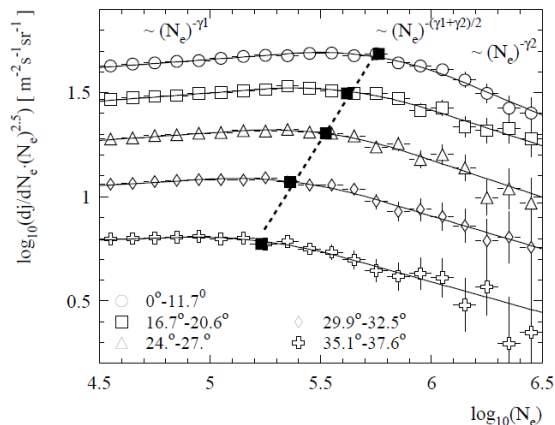
- introduction
- physics background
- step-by-step analysis
- source code example
- discussion
- interpretation
- pdf download of all

Physics with KCDC

1.6·10⁸ KASCADE EAS events of first data release are available

This is the data set for analysis works like

- **Astroparticle Physics 19 (2003) 703-714**
Measurement of Attenuation and Absorption Lengths with the KASCADE Experiment
- **The Astrophysical Journal 608 (2004) 865-871**
Search for Cosmic-Ray Point Sources with KASCADE
- **Astroparticle Physics 24 (2005) 1-25**
KASCADE Measurements of energy spectra for elemental groups of cosmic rays: Results and open problems
- **etc.....**



Future

The KASCADE Cosmic ray Data Center

- since November 2013

- KCDC open beta release to public
- More than 160 million events of the KASCADE experiment with 15 parameters per event

- Next steps

- Extending the educational portal
- Improving data selection process
- Adding more data of KASCADE

- future

- Adding data of other experiments
- Publication of the software
- Inclusion in long-term data archive networks
e.g. Re3data, repository for scientific data <http://www.re3data.org/>

KASCADE(-Grande): Mission Accomplished !!



1996



2013



open access to research data
<https://kcdc.ikp.kit.edu>

2014

<https://kcdc.i kp.kit.edu>

The screenshot shows the website interface for the KASCADe Cosmic Ray Data Centre (KCDC). At the top left is the KIT logo (Karlsruhe Institute of Technology). To its right is a navigation menu with links: [kcdcadmin] | HOME | KIT | IKP | IMPRESSUM | ADMIN | LOGOUT. Below the navigation is a banner image with the text "KASCADe" and "KASCADe Cosmic Ray Data Centre (KCDC) / Open β ". On the right side of the banner is the KCDC logo. The main content area features a greeting: "The KCDC Team greets you!". Below this is a large photograph of the KCDC team, consisting of six people standing outdoors. One person in the center is holding a sign that reads "KASCADe KCDC Cosmic Ray Data Centre". On the left side of the page is a vertical sidebar menu with the following items: KCDC Homepage, KCDC Motivation, Regulations, Information (with a dropdown arrow), About KASCADe, About KCDC, KCDC Team (highlighted), Data Format, Announcements (with a dropdown arrow), FAQs, DATA Shop, User Page, Lehrmaterial, and Report a Bug.

Thanks the support of the KASCADe Collaboration
Thank you!

Exercise with KCDC

Determination of the Attenuation Length of the Electron Component in extensive air-showers

Attenuation Length Λ_e : describes the average decrease of the electron number N_e with increasing atmospheric depth X (at fixed primary energy)

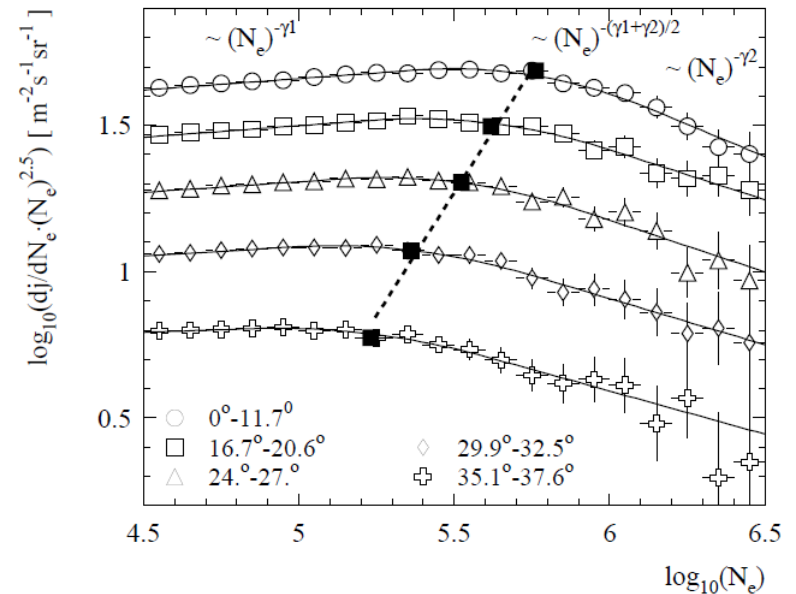
$$\langle N_e(X) \rangle \propto \exp(-X/\Lambda_{N_e})$$

Why of interest?

- *Understanding of shower development*
- *Test of hadronic interaction models*
- *Composition measurements*

You need:

- *KASCADE EAS-data from KCDC*
- *Read/Analysis/fitting/plotting tools*



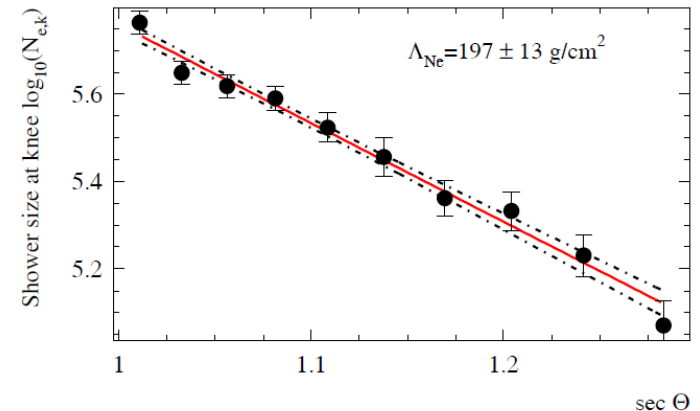
Exercise with KCDC

Determination of the Attenuation Length of the Electron Component in extensive air-showers (2)

Steps to do:

- Differential shower size spectra for different zenith angular ranges by KASCADE-data from KCDC
- Select a fixed primary energy by taking a structure of the primary energy spectrum: the knee
- Plot dependence of shower size with zenith angle using

$$\langle N_e(\Theta) \rangle \propto \exp\left(-\frac{X_0}{\Lambda_{N_e}}(\sec \Theta - 1)\right).$$



Based on: Astroparticle Physics 19 (2003) 703-714

Measurement of Attenuation and Absorption Lengths with the KASCADE Experiment

Exercise with KCDC

Determination of the Attenuation Length of the Electron Component in extensive air-showers (3)

Details:

• KCDC:

get data: N_e and Θ and micro time for all events with cuts
 - $N_e > 4.5$, E and N_{mu} -cut, area $< 90m$ radius, zenith < 40 degree



<https://kcdc.ikp.kit.edu>

• Create spectra:

- spectra for angular ranges of same solid angle
 e.g.: 5 ranges: -16.7; -24; -29.9; -35.1
 - estimate normalization factors:

area, steradian, time

(The entire sphere has a solid angle of $4\pi sr$)

(total time via the time difference between two events)

- multiply by 2.7 in N_e (don't forget to divide by bin size)

• Estimate knee positions (take care: threshold...)

- either by fitting the spectra

(N_e instead of E)

- or by hand....

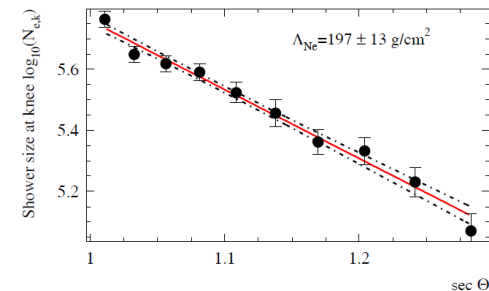
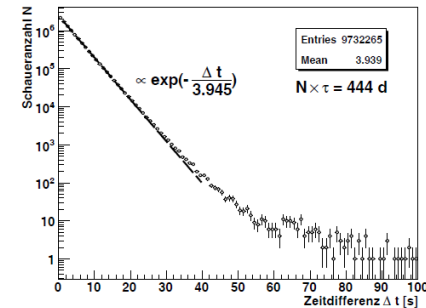
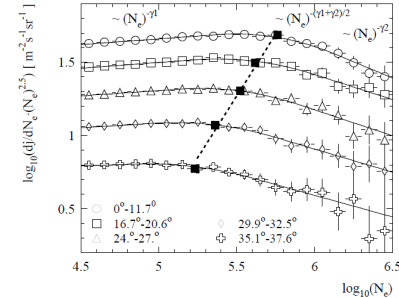
$$I(E) = I_0 \cdot \left(\frac{E}{E_{knee}}\right)^{-\gamma_1} \cdot \left(1 + \left(\frac{E}{E_{knee}}\right)^\epsilon\right)^{\frac{\gamma_1 - \gamma_2}{\epsilon}}$$

• Plot shower size at knee vs. Sec zenith angle

- fit it and determine the attenuation length

-be happy!

$$\langle N_e(\Theta) \rangle \propto \exp\left(-\frac{X_0}{\Lambda_{N_e}}(\sec \Theta - 1)\right).$$



Based on: Astroparticle Physics 19 (2003) 703-714

Measurement of Attenuation and Absorption Lengths with the KASCADE Experiment

Exercise with KCDC

Determination of the Attenuation Length of the Electron Component in extensive air-showers (4)

Room for Improvement:

- **At the spectra**
 - more zenith angular ranges
 - fit the spectra
 - interpolate knee position
- **Attenuation curve**
 - apply constant intensity cut top select same energy
(same intensity = same energy) you need integral spectra
- **Determine attenuation length for different primaries**
 - select „light“ and „heavy“ EAS (via muon/electron ratio)

....

Based on: Astroparticle Physics 19 (2003) 703-714

Measurement of Attenuation and Absorption Lengths with the KASCADE Experiment