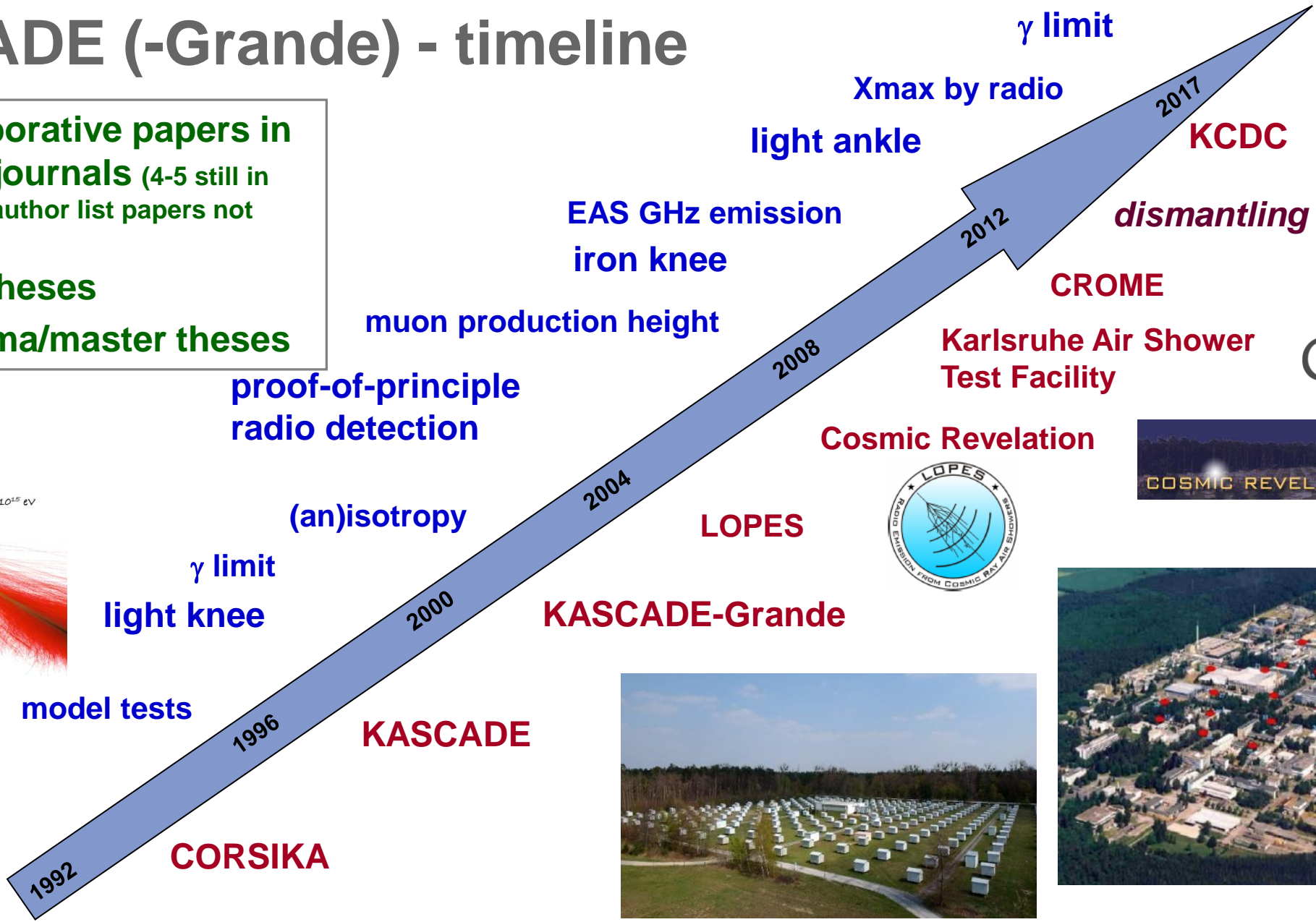
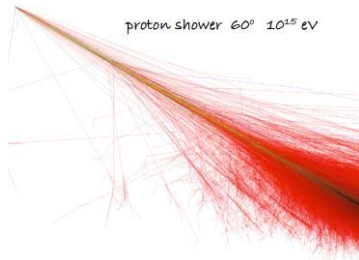


Open access of scientific data:  
<https://kcdc.ikp.kit.edu>



# KASCADE (-Grande) - timeline

- 58 collaborative papers in reviewed journals (4-5 still in queue, short author list papers not included)
- 57 PhD theses
- 86 diploma/master theses



Proposal

**CORSIKA**

model tests

light knee

$\gamma$  limit

(an)isotropy

proof-of-principle  
radio detection

muon production height

EAS GHz emission  
iron knee

light ankle

Xmax by radio

$\gamma$  limit



**KASCADE**

**KASCADE-Grande**

**LOPES**

Cosmic Revelation



Karlsruhe Air Shower  
Test Facility

**CROME**

**CROME**



2012

dismantling

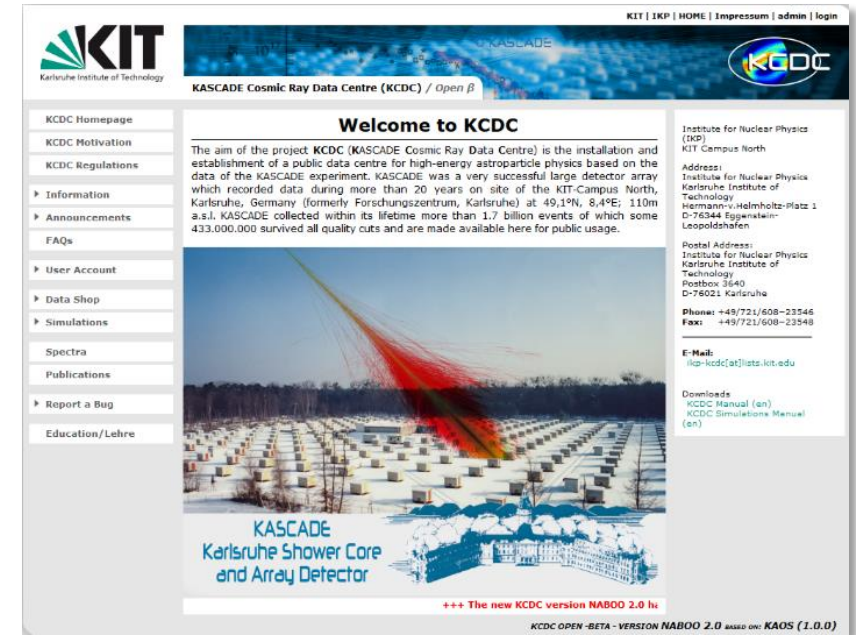
**KCDC**



2017

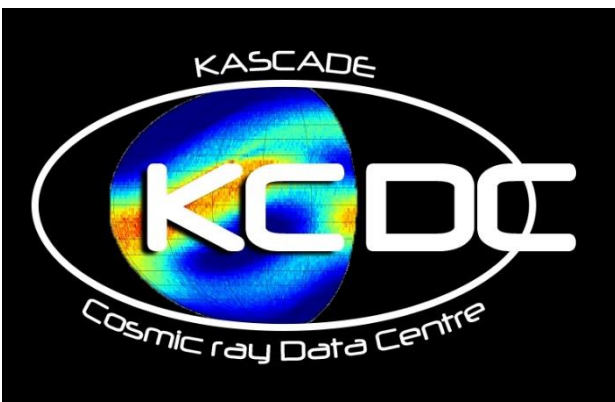
# KASCADE Cosmic ray Data Centre

- Motivation and Idea of Open Data:
  - public access to the data
  - data has to be preserved for future generations
- Web portal:
  - modern software solution
  - release the software as Open Source
  - educational courses
- Data access:
  - new release (Feb. 2017) with  $4.3 \cdot 10^8$  EAS
  - simulation data
- Pioneering work in publishing research data in astroparticle physics



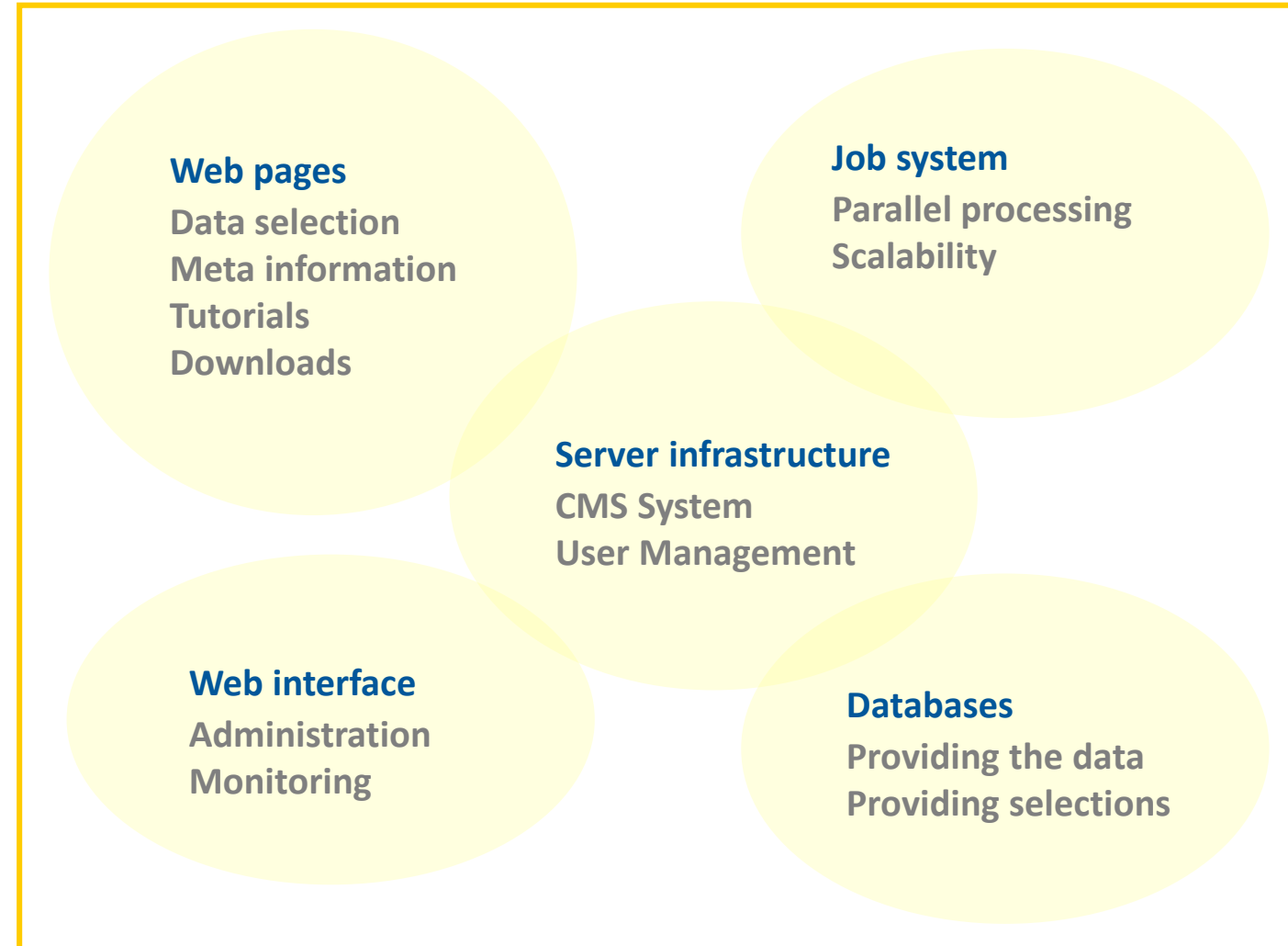
<https://kcdc.ikp.kit.edu/>

[J.Phys.Conf.Ser. 632 (2015) 012011]



# 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

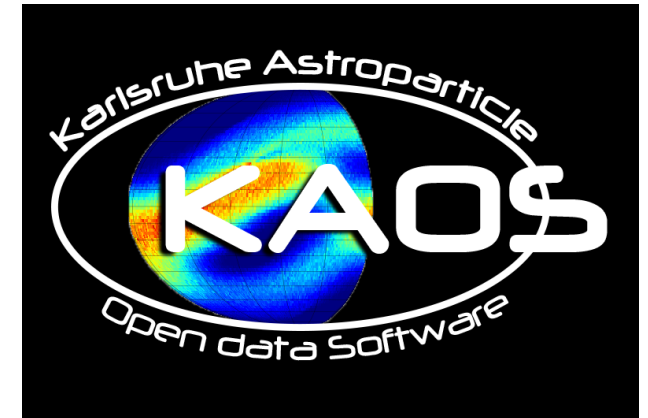


# KCDC, the software

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 by  
other experiments

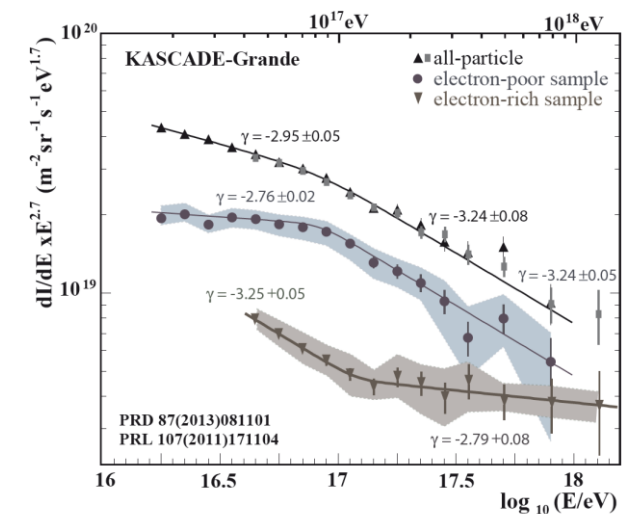
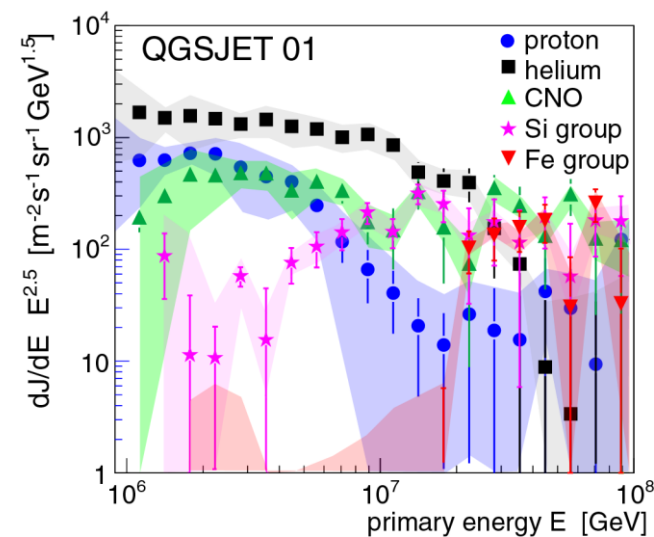
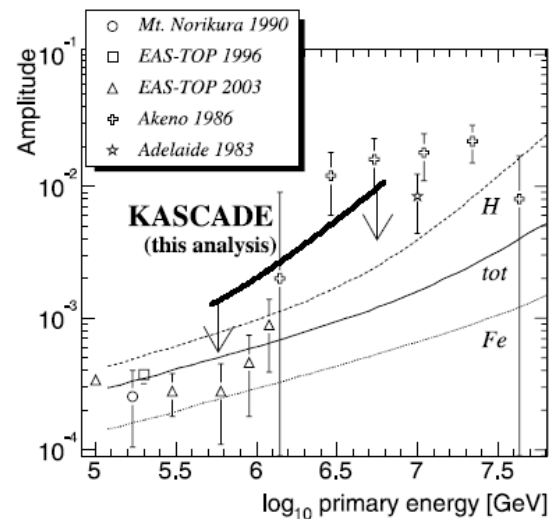
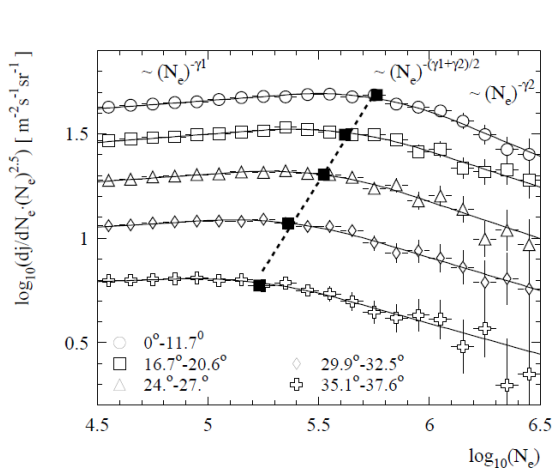
- Publication foreseen under Open Source License
- General software solution for open access to (astroparticle) data
- Following the concept of open access to research data
- Modular, flexible framework for data publication
- Good scalability (e.g. to large computing centers)
- Simple configuration via web interface
- Based solely on Open Source Software  
(Python, Django, HTML/Javascript and CSSdata provider)





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*
- **Physical Review Letters 107 (2011) 171104**  
*Kneelike Structure in the Spectrum of the Heavy Component of Cosmic Rays Observed with KASCADE-Grande*
- **etc.**



# KCDC data shop

[[ haungs ]] | KIT | IKP | HOME | Impressum | admin | logout

**KIT**  
Karlsruhe Institute of Technology

KASCADE Cosmic Ray Data Centre (KCDC) / Open B

### KCDC Data Shop

Components Available	Components Selected	Quantities and Cuts	
Calorimeter	General Info	<input type="checkbox"/> Toggle all	General Info
	KASCADE	<input type="checkbox"/> Air Temperature range: -20 to 50 °C	Add Cut
	GRANDC	<input type="checkbox"/> Air Pressure range: 960 to 1040 hPa	Add Cut
		<input type="checkbox"/> DateTime range: 1998-05-08 to 2012-01-15	Add Cut
		<input type="checkbox"/> Global Time range: 8.945e+8 to 1.255e+9 sec	Add Cut
		<input type="checkbox"/> Mt range: 0 to 9.99e+8 m	
		<input checked="" type="checkbox"/> Run Number range: 877 to 7417	Add Cut
		<input checked="" type="checkbox"/> Event Number range: 1 to 2e+6	
		<input type="checkbox"/> e/y E-Deposit range: 0 to 2e+4 MeV	
		<input type="checkbox"/> u E-Deposit range: 0 to 1000 MeV	
		<input type="checkbox"/> Arrival Times range: -1550 to 2550 ns	
		<input type="checkbox"/> Grande Deposit range: 0 to 1e+5 MeV	
		<input type="checkbox"/> Grande Arrival range: 1000 to 1e+4 ns	

**Verify & Submit Request**

**Welcome to the Datasshop**

On the left hand site you may select available detector components. Hovering the mouse over such a component, will give you some information on it. Once selected, you may click on the components name to view and select quantities associated with that detector. You may also deselect components using the left arrow. In right most column, you may select quantities for shipping and add cuts, that will be used to select only events passing these. On verification: Yellow means it has been corrected, red means you have to adjust your input. Is it a valid number? Is the lower bound larger than the upper bound?

[details -> KCDC Manual]

KCDC OPEN BETA - VERSION NAB00.00 based on KAOS (1.0.0)

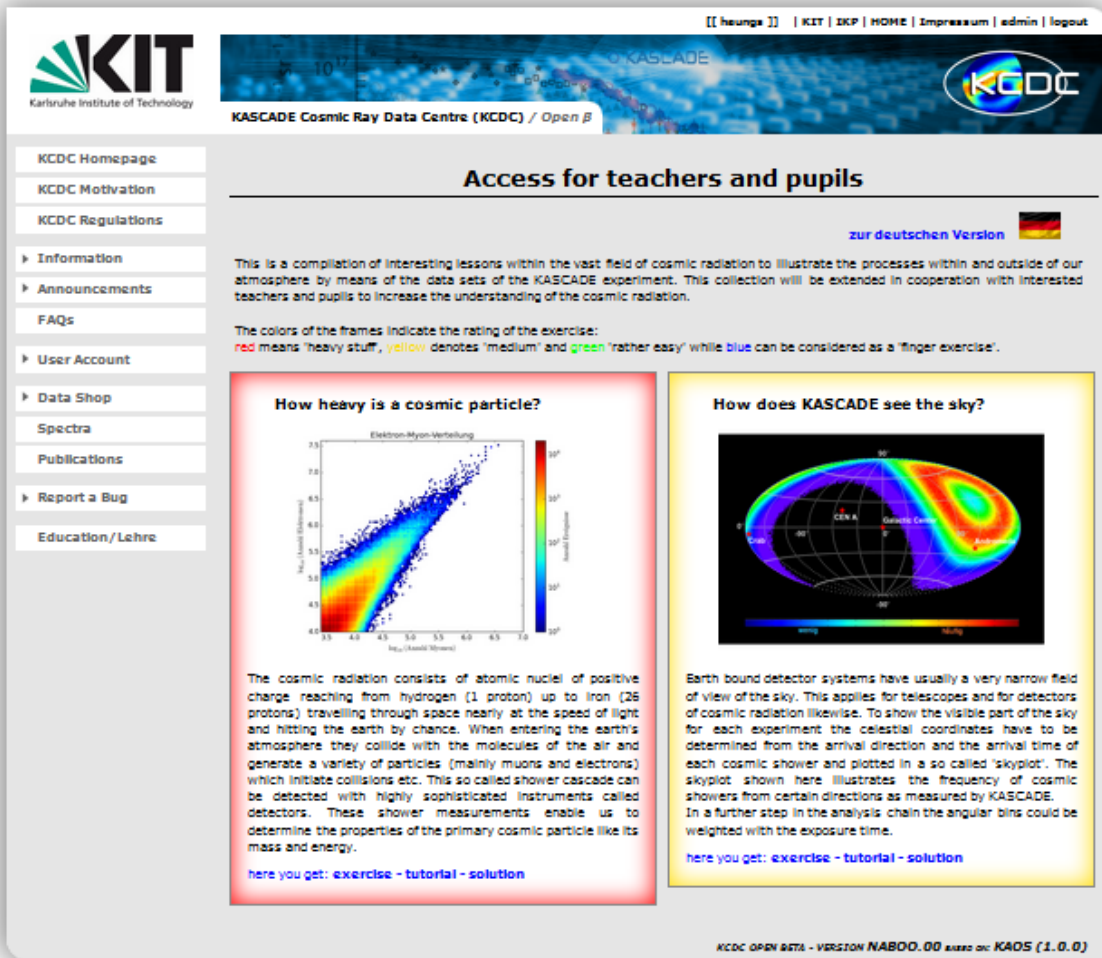
## Output:

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

Data as ASCII, ROOT and HDF5 files

Commented header give information about the content





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

- **Education portal**

- first tutorials are up  
(in German and English at the moment)

- knowledge database on KASCADE, astrophysics and related topics

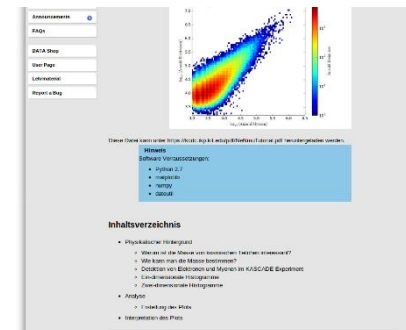
- step by step tutorials of simple data analyses

- 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

# 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 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

[ haungs ] | HOME | KIT | IKP | IMPRESSUM | ADMIN | LOGOUT

**KIT**  
Karlsruhe Institute of Technology

KASCADE Cosmic Ray Data Centre (KCDC) / Open  $\beta$

**KCDC**

KASCADE Cosmic Ray Data Centre (KCDC) / Open  $\beta$

### 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



# NABOO 2.0 is released!

27.10.2017



KASCADE Cosmic Ray Data Centre (KCDC) / Open  $\beta$

KCDC Homepage

KCDC Motivation

KCDC Regulations

Information

Announcements

FAQs

User Account

Data Shop

Simulations

General Info

QGSjet-II-02

QGSjet-II-04

EPOS-1.99

EPOS-LHC

SIBYLL-2.1

SIBYLL-2.3

Spectra

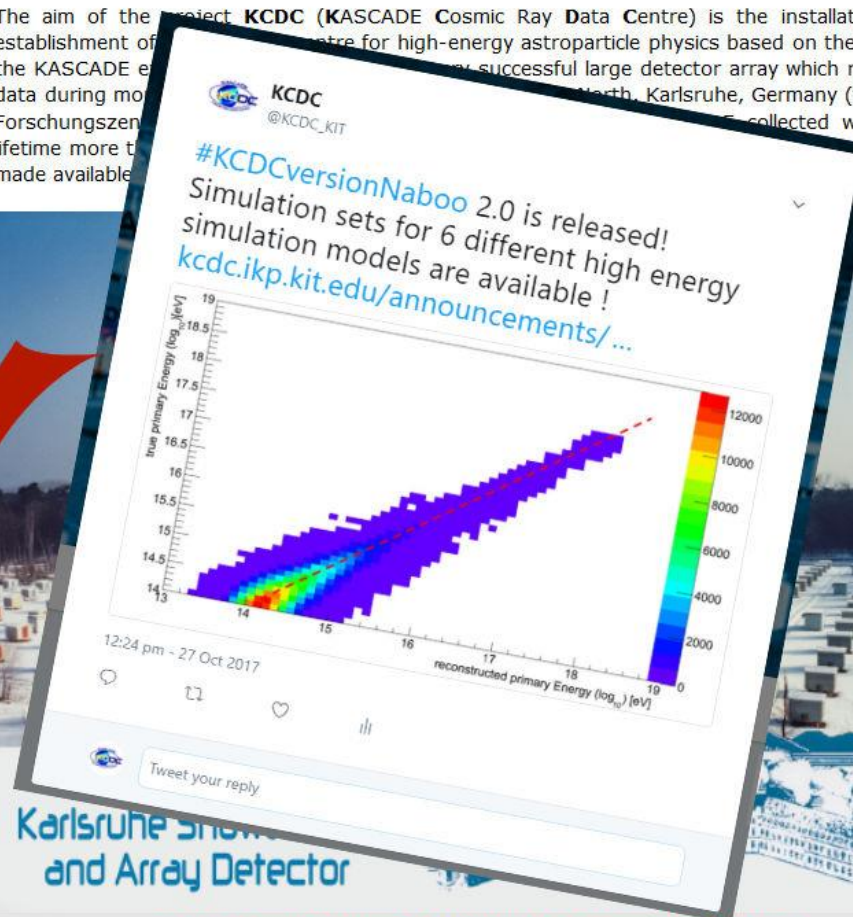
Publications

Report a Bug

Education/Lehre

## Welcome to KCDC

The aim of the project **KCDC** (KASCADE Cosmic Ray Data Centre) is the installation and establishment of a data centre for high-energy astroparticle physics based on the data of the KASCADE experiment. The KASCADE experiment is a very successful large detector array which recorded data during more than 20 years at the Karlsruhe Institute of Technology (KIT) Forschungszentrum für Hadronenphysik in Karlsruhe, Germany (formerly Forschungszentrum für Hadronenphysik). The data collected within its lifetime more than 10<sup>17</sup> events and are made available to the scientific community.



Institute for Nuclear Physics (IKP)  
KIT Campus North

Address:  
Institute for Nuclear Physics  
Karlsruhe Institute of Technology  
Hermann-v.Helmholtz-Platz 1  
D-76344 Eggenstein-  
Leopoldshafen

Postal Address:  
Institute for Nuclear Physics  
Karlsruhe Institute of Technology  
Postbox 3640  
D-76021 Karlsruhe

Phone: +49/721/608-23546  
Fax: +49/721/608-23548

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

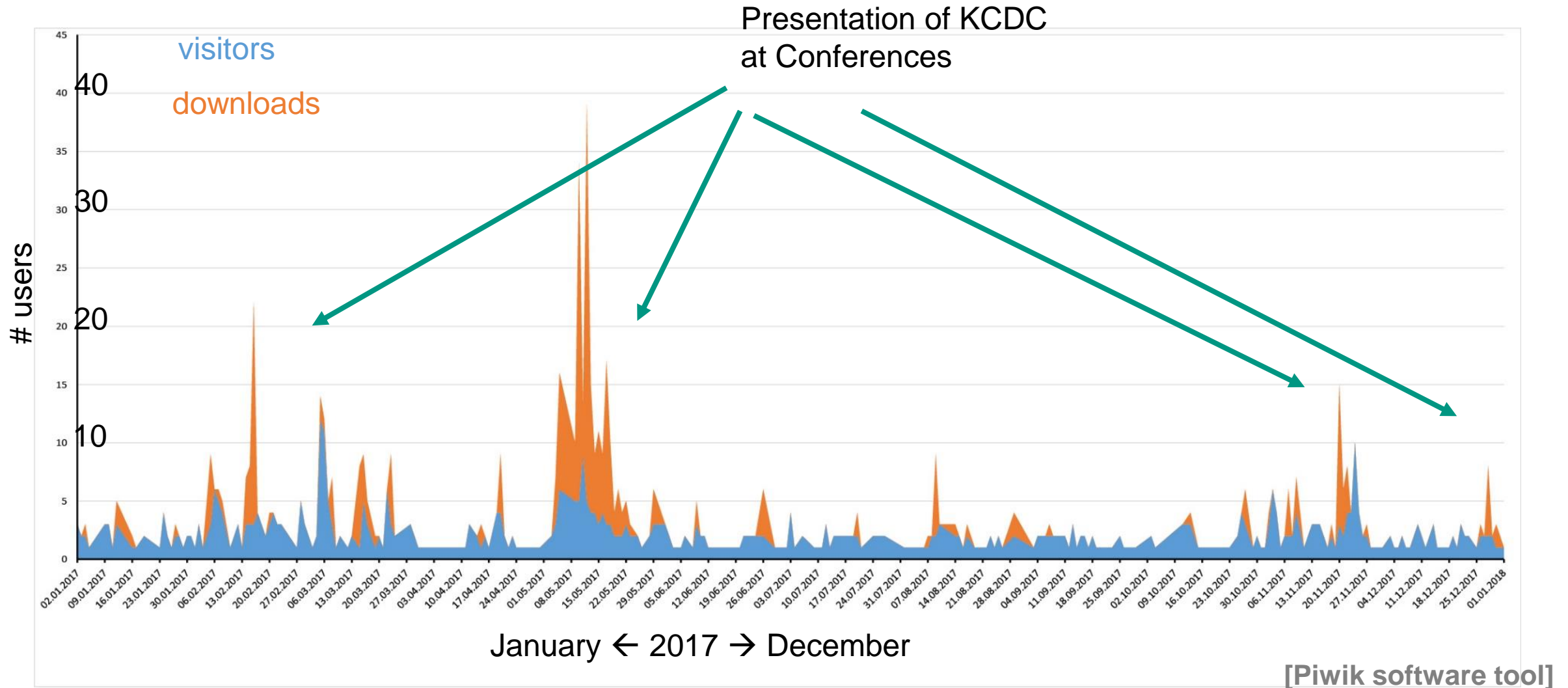
Downloads  
[KCDC Manual \(en\)](#)  
[KCDC Simulations Manual \(en\)](#)

+++ The new KCDC version NABOO 2.0 has been released !!! +++

KCDC OPEN - BETA - VERSION NABOO 2.0 BASED ON: KAOS (1.0.0)



# KASCADE Cosmic ray Data Centre



# Usage

Zeitspanne: 2014  Alle Besuche 

## Besucherkarte

1.3k Besuche



## Land

Land	Besuche
 Deutschland	862
 USA	158
 Frankreich	99
 Griechenland	52
 Rumänien	23
 Großbritannien	12
 Italien	10
 unbekannt	10
 Russische Föderation	9
 Brasilien	6
 Schweiz	6
 China	5
 Indien	5
 Japan	4
 Polen	4
 Österreich	4
 Argentinien	3
 Finnland	3
 Mexiko	3
 Portugal	2
 Spanien	2
 Armenien	1
 Australien	1
 Bangladesch	1
 Belgien	1

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

The screenshot shows the homepage of the KADC Cosmic Ray Data Centre (KCDC). At the top left is the KIT logo (Karlsruhe Institute of Technology). To the right, there are navigation links: [haungs] | HOME | KIT | IKP | IMPRESSUM | ADMIN | LOGOUT. Below the navigation is a banner with the text "KASCADE" and "KASCADE Cosmic Ray Data Centre (KCDC) / Open B". The main content area features a greeting: "The KCDC Team greets you!". Below this is a large photograph of six team members standing outdoors, holding a sign that reads "KASCADE KCDC COSMIC RAY DATA CENTRE". A left-hand sidebar contains a menu with the following items: KCDC Homepage, KCDC Motivation, Regulations, Information (with sub-items: Data Format, KCDC Team, About KCDC, About KASCADE), Announcements, FAQs, User Page, DATA Shop, Lehrmaterial, and Report a Bug.

Thanks the support of the KASCADE Collaboration



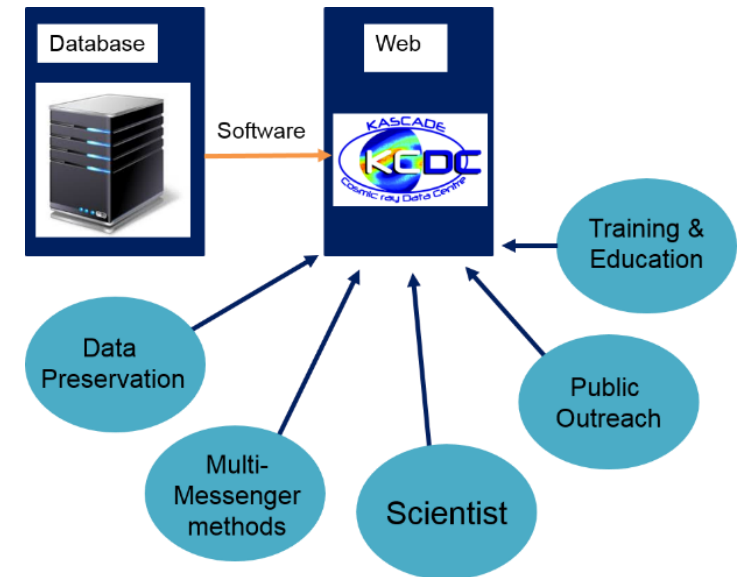
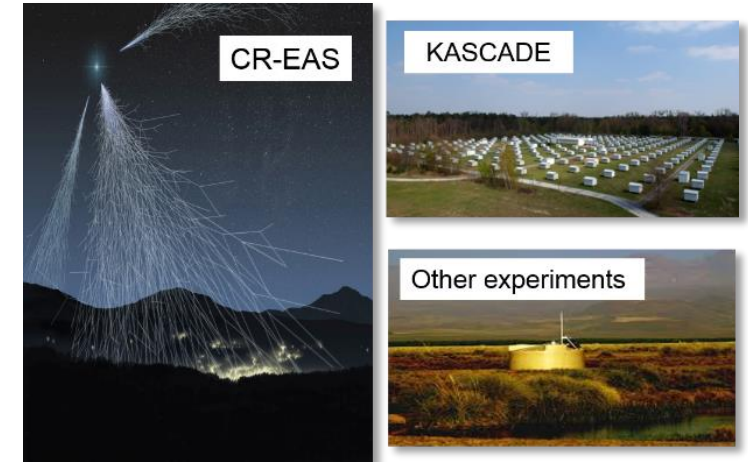
# Towards a (global) Analysis & Data Centre in APP

## Motivation:

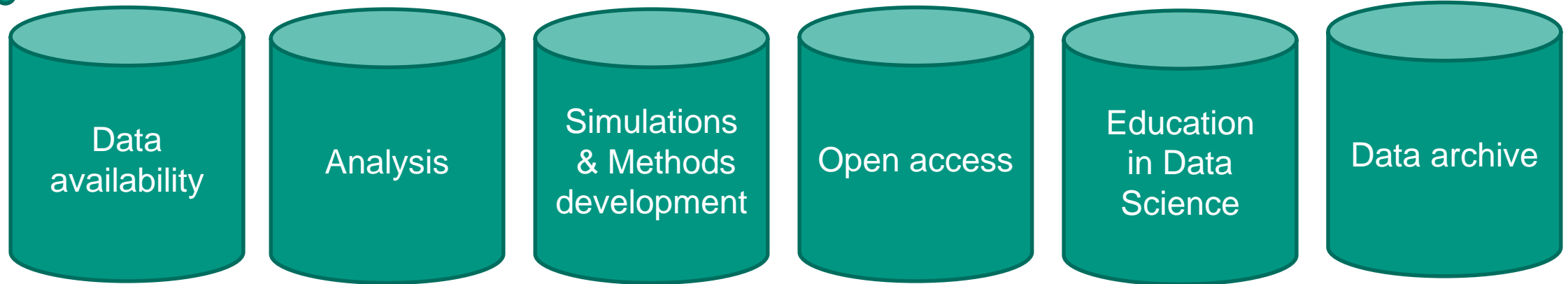
- Astroparticle Physics requests for multi-messenger analyses. This needs an experiment-overarching platform
- High demand in (German and international) community
- APP Observatories are globally distributed (no CERN or ESA)

## Important steps:

- Develop an open science system based on KCDC and the KIT GridKa environment
- Develop integrated solutions of distributed data storage algorithms and techniques
- Allowing community to perform multi-messenger analyses with deep learning methods



# Analysis and Data Centre in Astroparticle Physics



- **Data preservation** ----  
like DPHEP, KCDC
- **Metadata preservation** ----  
like KCDC
- **Data storage (archive)** ----  
like DPHEP, GridKa
- **Computing services (Grid vs. Cloud)** ---  
like CERN Tier-centres
- **Data access (policy, technology, rate)** ---  
like GridKa, KCDC
- **Training on Data use (maintenance, tutorials)** ---  
like KCDC, VISPA, CDS
- **Data analysis, Simulation, modeling** ---  
like GridKa, advanced VISPA?
- **Data science, workflows** (tools, e.g. deep learning, tutorials) ---  
like VISPA
- **Data publication / Outreach** ---  
like KCDC, masterclasses
- **Data education** ---  
like KCDC, GridKa-school
- **Data exchange** ---  
like AMON, GAVO
- **Data catalogues** ---  
like Re3Data

Partly realized  
in individual  
experiments

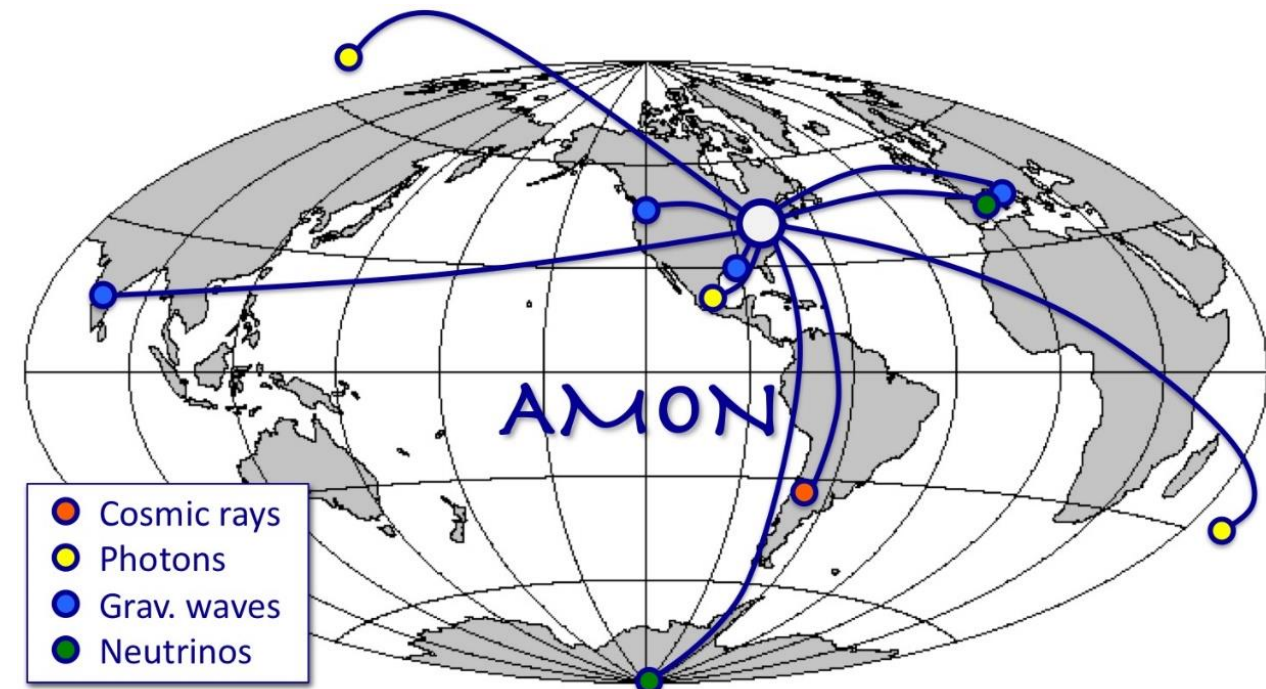
# Exchange of Data / Alert systems

<http://amon.gravity.psu.edu/>

## Members and Prospective Members

Observatory	Contact	Letter of Collaboration	MoU in Review	MoU Signed
ANTARES	Juergen Brunner	✓	✓	✓ MOU
Auger	Miguel Mostafa	✓	✓	✓ MOU
FACT	Adrian Biland			✓ MOU
Fermi	Julie McEnery	✓		
HAWC	Ignacio Taboada	✓	✓	✓ MOU
IceCube	Doug Cowen	✓	✓	✓ MOU
Las Cumbres Observatory Global Telescope (LCOGT)	Todd Boroson	✓	✓	✓ MOU
LIGO	Gabriela Gonzalez	✓		
Large Millimeter Telescope	Alberto Carramiñana	✓	✓	✓
MASTER	Vladimir Lipunov			✓ MOU
Palomar Transient Factory	Tom Prince	✓		
Swift	Scott Barthelmy	✓	✓	✓
VERITAS	Abe Falcone	✓	✓	✓

Membership to AMON is open to any relevant facility, subject to signing of the AMON MOU.






# Example Astronomy: Strasbourg astronomical Data Center



Centre de Données astronomiques de Strasbourg  
*Strasbourg astronomical Data Center*

<http://cds.u-strasbg.fr/>




Entry point to all services 




Object database 



Catalogue database 



Interactive sky atlas 

Combines many of the earlier mentioned issues:

- User Portal
- Data bases
- Tools
- Catalogues...

→ What is different in astroparticle physics?


Diversity of Data, calibration, format, analysis, ...

![also very different for low energy astroparticle physics experiments]!

In Germany: GAVO in Heidelberg!

# Example Particle Physics: Data Preservation



Preservation Model		Use Case	
1	Provide additional documentation	Publication related info search	Documentation
2	Preserve the data in a simplified format	Outreach, simple training analyses	Outreach
3	Preserve the analysis level software and data format	Full scientific analysis, based on the existing reconstruction	Technical Preservation Projects
4	Preserve the reconstruction and simulation software as well as the basic level data	Retain the full potential of the experimental data	

## Data Preservation:

- Define objectives of the data persistency in HEP.
- Exchange information concerning the analysis models: abstraction, software, documentation etc. and identify coherence points.
- Hardware and software persistency status.
- Review possible funding programs and other related international initiatives.
- Converge to a common set of specifications in a document that will constitute the basis for future collaborations.

<https://www.dphep.org/>

D. South, DPHEP collaboration

# Data Catalogues

<http://www.re3data.org/>

- Sample and links to repositories of scientific data, mostly results, not the “data”.

e.g., search for “Cosmic Rays”:

Found 7 result(s):

- [World Data Center for Cosmic Rays](#) [WDCCR](#)
- [KASCADE Cosmic Ray Data Centre](#) [KCDC](#)
- [Spitzer Science Archive](#) [SHA](#)
- [World Data Center for Solar-Terrestrial Physics, Moscow](#)
- [Virtual Space Science Observatory](#) [VSSO](#)
- [LAADS Web](#)
- [High Energy Astrophysics Science Archive Research Center](#)

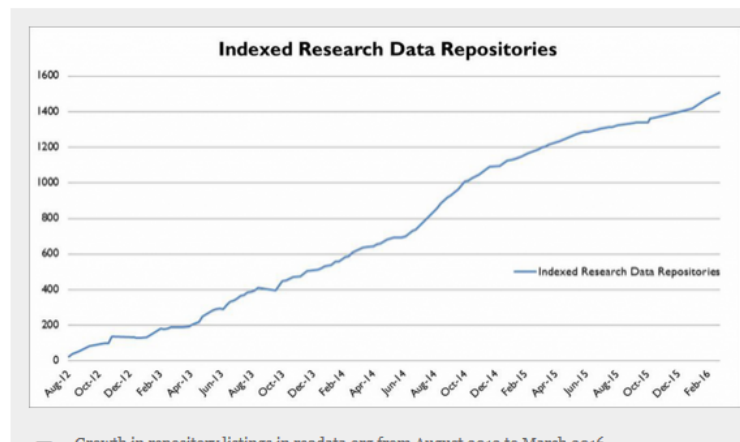
**re3data.org**  
REGISTRY OF RESEARCH DATA REPOSITORIES

Home Search Browse Suggest FAQ About Schema API Contact Legal notice / Impressum

## re3data.org Reaches a Milestone & Begins Offering Badges

Posted on April 13, 2016 by re3data.org team

re3data.org has reached a milestone of identifying and listing 1,500 research data repositories, making it the largest and most comprehensive registry of data repositories available on the web. It has grown steadily since its launch four years ago to cover a wide range of disciplines from around the world.



Growth in repository listings in re3data.org from August 2012 to March 2016

SEARCH

A SERVICE BY



PARTNERS





# Outreach

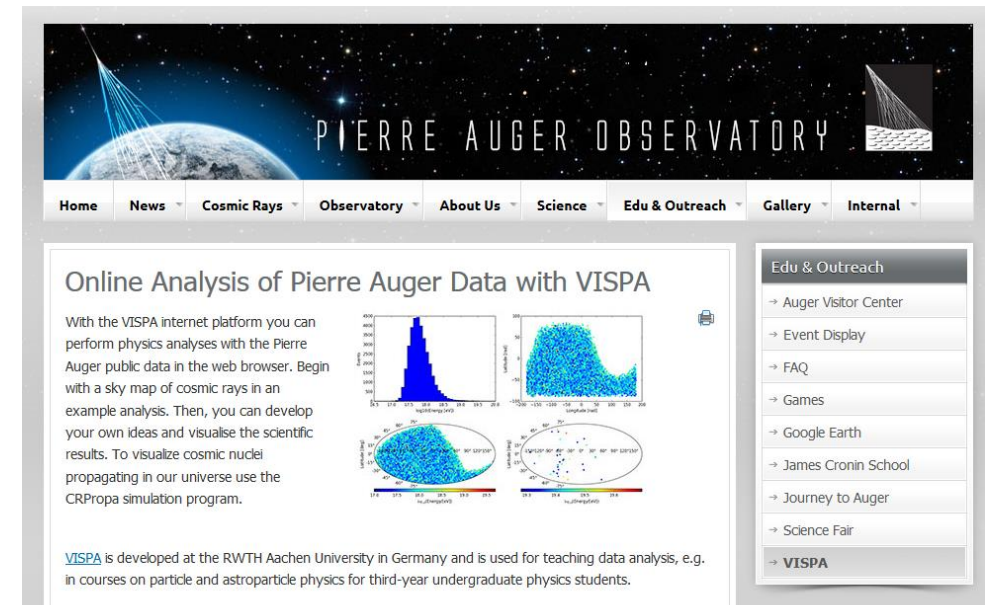
- **VISPA** to analyze Auger data
  - Learning Deep Learning 😊
  - Algorithms & data analysis in own browser
  - Example analysis
  - Writing own algorithms
  - Visualizing own results

- **Masterclasses**
  - Netzwerk Teilchenwelt
  - (Auger & IceCube)

- **Cosmic Days**

- (GridKa school)

- .....



The screenshot shows the Pierre Auger Observatory website. The main header features the text "PIERRE AUGER OBSERVATORY" with a background image of the Earth and cosmic rays. Below the header is a navigation menu with items: Home, News, Cosmic Rays, Observatory, About Us, Science, Edu & Outreach, Gallery, and Internal. The main content area is titled "Online Analysis of Pierre Auger Data with VISPA". It contains a paragraph explaining the platform: "With the VISPA internet platform you can perform physics analyses with the Pierre Auger public data in the web browser. Begin with a sky map of cosmic rays in an example analysis. Then, you can develop your own ideas and visualise the scientific results. To visualize cosmic nuclei propagating in our universe use the CRPropa simulation program." To the right of the text are four plots: a histogram of energy, a sky map, a distribution of arrival directions, and a distribution of arrival times. Below the plots is a link to the VISPA development page at RWTH Aachen University.



The screenshot shows the "Netzwerk Teilchenwelt" website. The header features a logo of a circular network and the text "NETZWERK TEILCHENWELT ..... QUARKS, ELEKTRONEN & CO. ...". Below the header is a navigation menu with items: DAS PROJEKT, AKTUELLES, MITMACHEN, ANGEBOTE, STANDORTE, MATERIAL, and FORUM. The main content area is titled "Astroteilchenphysik" and features a large image of a cosmic structure. Below the image is a paragraph: "Astroteilchenphysik und Elementarteilchenphysik folgen einem gemeinsamen Ziel: die Struktur und Entstehung der Materie zu erklären. Kosmische Teilchen spielen dabei eine wichtige Rolle:". To the right of the main content is a sidebar with sections: "Dow", "Vide", "Teilc", "Link", "Inter", "Wel", "Astr", "Karr", "Zeit", "Cos", and "Artik".

# Initiative for a (global) Analysis & Data Centre in Astroparticle Physics

## National Data Centre for Astroparticle Physics

### Initiative for a Data and Analysis Centre for Astroparticle Physics

2 November 2017  
Karlsruhe Institute of Technology (KIT)  
Europe/Berlin timezone

Overview

Scientific Programme

Timetable

Contribution List

Author List

Registration

Registration Form

Participant List



[Campus Plan](#)

**for the slides, please click left on "Contribution List"!!!**

**preliminary Agenda: click left on 'Timetable' or below on 'Poster'**

Organizing Committee: Andreas Haungs (KIT), Christian Stegmann (DESY), Achim Streit (KIT), Sabine Bucher (KIT)

November 2017:

40 Participants

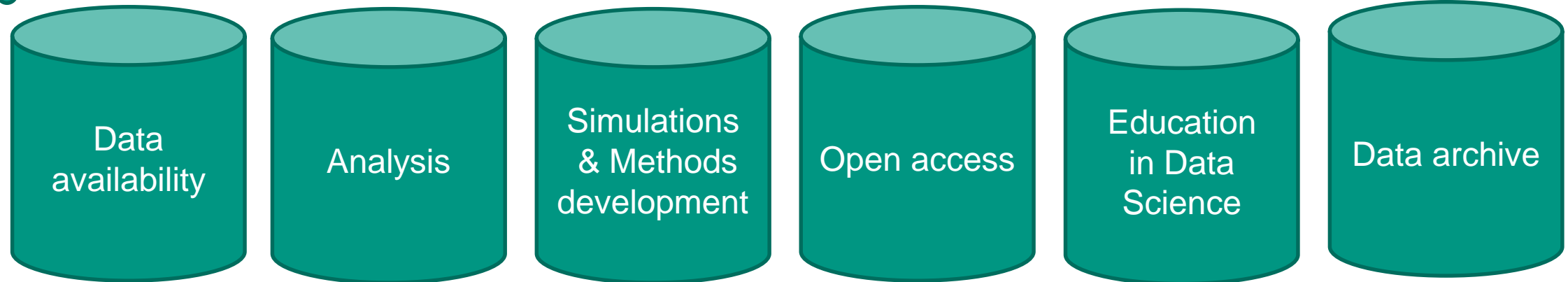
Helmholtz + University groups

## Goals:

- Data catalogues & computing resources
- Analysis & simulations
- User support & user platforms
- FAIR principles of data handling  
**FINDABLE-  
ACCESSIBLE-  
INTEROPERABLE-  
REUSABLE**
- Drafting white paper....

# Initiative for a (global) Analysis & Data Centre in Astroparticle Physics

## Analysis and Data Centre in Astroparticle Physics



### Next steps:

- Helmholtz & Universities define the specific needs.
- Secure funding & 'organize' hardware
- Implementation and: Start 😊