

# The *VISPA*<sup>Ⓢ</sup> Internet-Plattform



**Martin Urban**, Martin Erdmann, Benjamin Fischer, Robert Fischer, Erik Geiser, Christian Glaser, Gero Müller, Thorben Quast, Marcel Rieger, Florian von Cube, Christoph Welling

**III Physics Institute A, RWTH Aachen University**

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# Environment inside Web Browser

The screenshot displays a web browser interface for a remote environment named 'VISPA Cluster'. The interface is divided into several sections:

- File Browser:** Shows a directory structure with folders like 'data', 'figures', and files like 'likelihood.py', 'matplotlibrc', 'plot\_data.py', 'plotting.py', 'plotting.pyc', 'pu...\_py', and 'pu...pyc'.
- Terminal:** Displays system information including CPU usage (332M/52.7G), memory usage (44.34 Mbr), and uptime (2 days, 10:03:03). It also shows a list of running processes with columns for PID, PPID, USER, VMEM, VSZ, STAT, and COMMAND.
- Code Editor:** Shows a Python script named 'likelihood.py' with the following code:

```
1 import argparse
2 import logging
3 import numpy as np
4 import scipy
5 import matplotlib
6 from matplotlib.path import Path
7 import matplotlib.patches as patches
8 from scipy import stats
9
10 matplotlib.use('Agg') # does run without installed
11 import matplotlib.pyplot as plt
12 import plotting
13
14 import purity
15
16 matplotlib.rc('figure', {'mathtext.latex': True})
17 # print matplotlib.matplotlib_fname() # which matplotlib
18
19
20 def get_data(ia):
21     """
22     function to get the data corresponding to a certain
23     :param ia: interaction model
24     :return: data contained in the file
25     :rtype: numpy array
26     """
27     # filename = "data/data likelihood " + ia + ".t"
28     filename = "data/Biersman/data likelihood " + ia
29     # filename = "/home/martin/ownCloud/Physik/biersman"
30     # filename = "/home/martin/ownCloud/Physik/biersman"
31
32     # For the first readin
33     data = np.genfromtxt(filename, comments="#", names=
34     np.save(filename[:-3]+"np", data)
35
```
- Execution Output:** Shows three histograms labeled 't\_bin\_9.png', 't\_bin\_8.png', and 't\_bin\_7.png' located in the directory '/home/murban/AnisotropyAnalysis/figures/png/hists'.

## Standard tools on top of remote resources

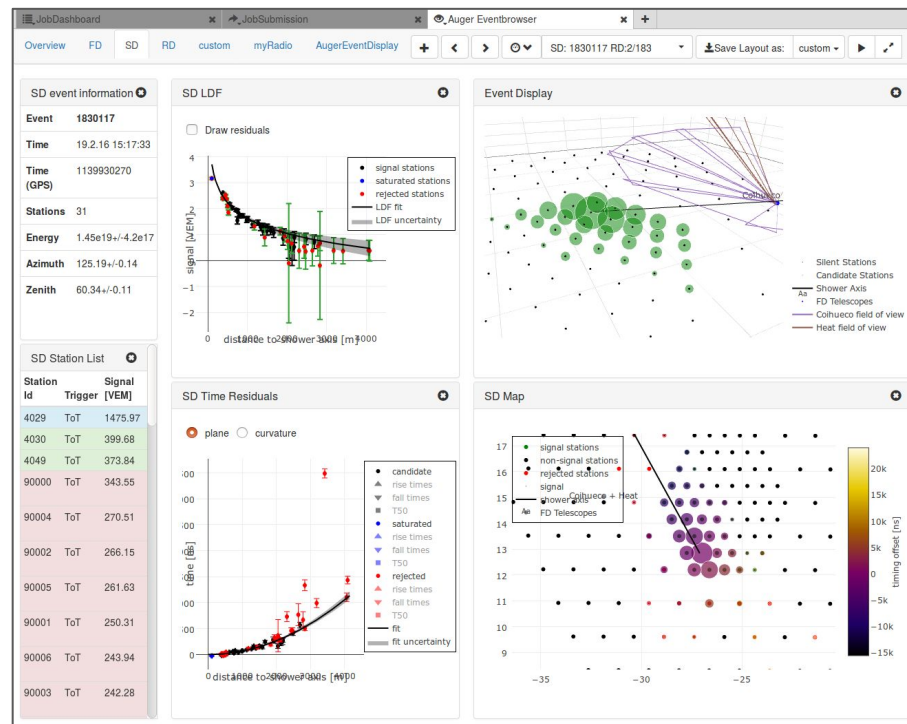
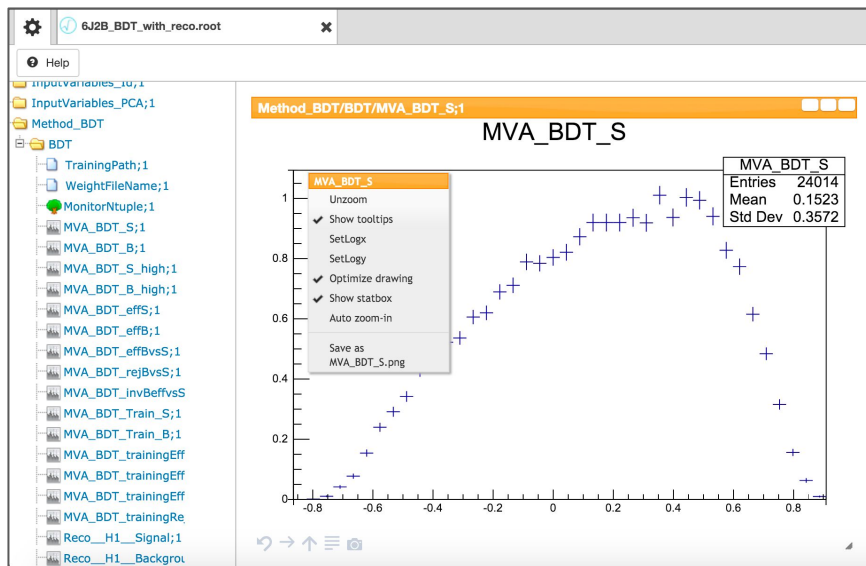
- File browser with up/download
- Code Editor with execution capabilities
- Terminal with full key support

Pioneering project for working with data through the web browser - from small to large resource requirements

## Developed and used since 2010

# Extensions

- Provide custom functionality
  - ROOT data browser
  - Browser for data of the Pierre Auger Observatory

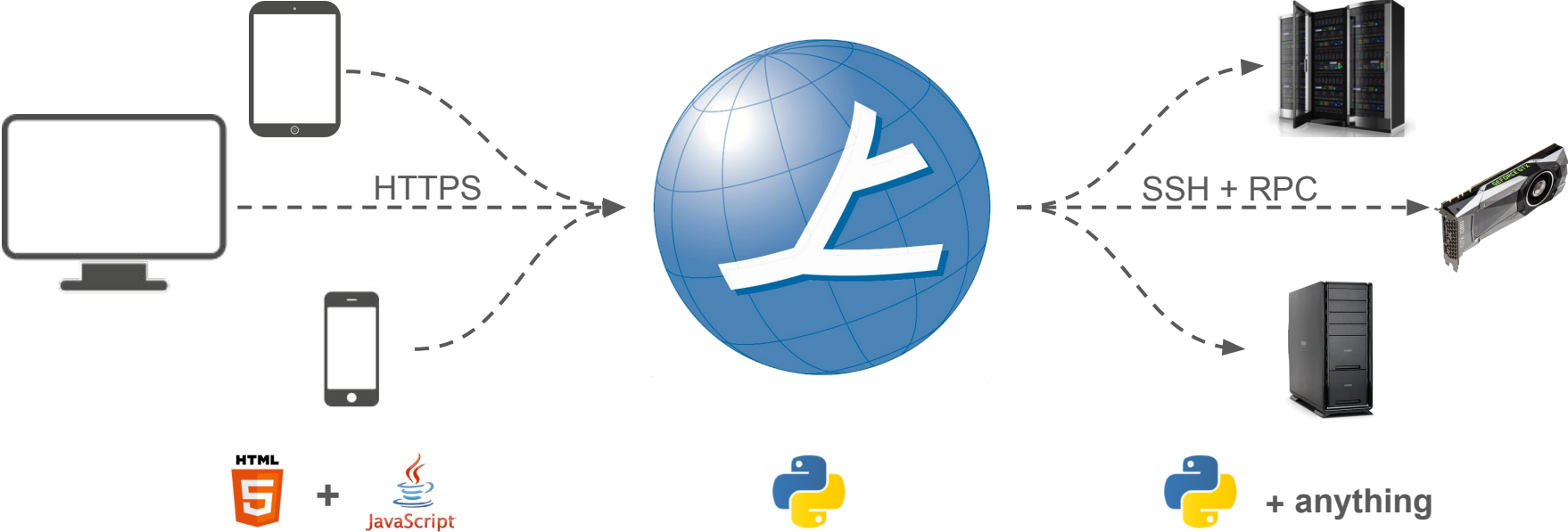


# Concept

**Clients:** modern Web-Browser

**Server:** VISPA

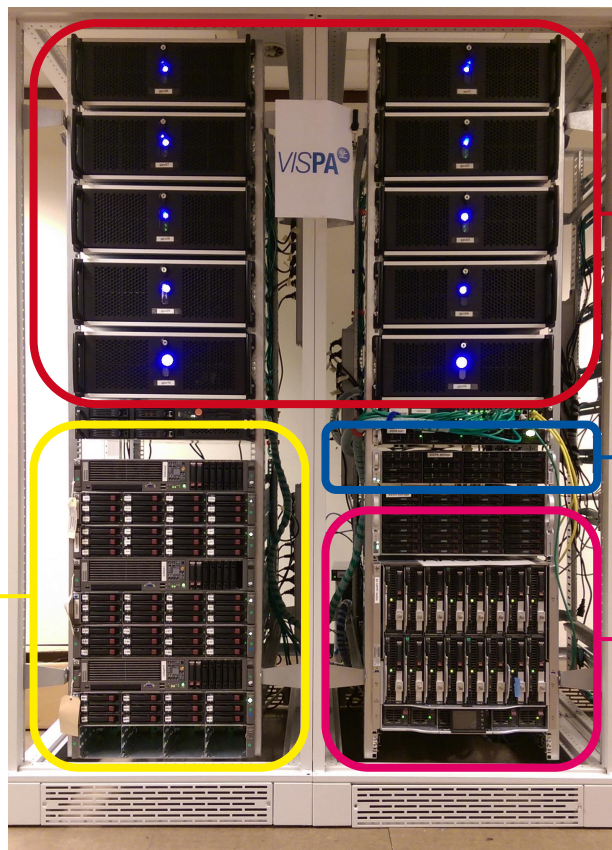
**Workspace:** any computing resource



Browser-based access to any computing resource

# The VISPA Cluster

- operated since 2012
- System successfully used for outreach, education and research



- 10 machines with each
- 2 GeForce GTX 1080
  - 64 GB RAM
  - 8 CPU cores

VISPA server

Storage (NFS mounted)

- Shared home
- Experiment data
- Scratch

CPU cluster with 16 x 8 cores

# Real-life experiences beyond research

- Blended learning
  - Lecture with hands-on analysis for experiments live experiments
  - Undergraduate physics course
- Homework
  - Integration of computer-based data-analysis with exercises, including correction and discussion
- Outreach
  - Pierre Auger Observatory and CMS Open Data
  - View/analyze public datasets



PIERRE AUGER OBSERVATORY

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### Online Analysis of Pierre Auger Data with VISPA

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.

VISPA is developed at the RWTH Aachen University in Germany and is used for teaching data analysis, e.g. in courses on particle and astroparticle physics for third-year undergraduate physics students.

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→ CMS → CMS Learning Resources

## CMS Learning Resources

This collection includes learning resources that use CMS public data. The items in this collection are suitable for education purposes.

### CMS HEP Tutorial

Go to the CMS HEP Tutorial

This tutorial by Christian Sander and Alexander Schmidt gives a basic introduction to fundamental concepts of data analysis in HEP experiments, using a small sample of specially released CMS data collected in 2011. It has been used for a one-week course in the context of a HEP workshop and a data analysis school. It should be most useful for undergraduate students who have a basic knowledge of particle physics, but without any experience in data analysis. Prerequisites are some knowledge of C++ and the ROOT data analysis framework (there are dedicated tutorials on ROOT as well).

### Online Analysis of CMS Data with VISPA

Start your analysis online

With the VISPA internet platform you can perform physics analysis with CMS public data in a web browser. Begin with the discovery of a boson in an example analysis. Then, you can develop your own ideas and visualise the scientific results.

VISPA is developed at the RWTH Aachen University in Germany and is used for teaching data analysis, e.g. in courses on particle and astroparticle physics for third-year undergraduate physics students.

### Particle Physics Playground

Go to the Particle Physics Playground

This site, by Matt Bellis, provides exercises that use real data from CMS (and now CLEO) to teach experimental particle physics. It is, however, not meant to be a fully comprehensive tutorial. The ideal student will have learned



# Big Data Workshop and University Class



## Big data workshop in astroparticle physics

- Deep Learning hands-on tutorial, 3 days
- Simultaneous usage by ~70 users
- Only web browser required



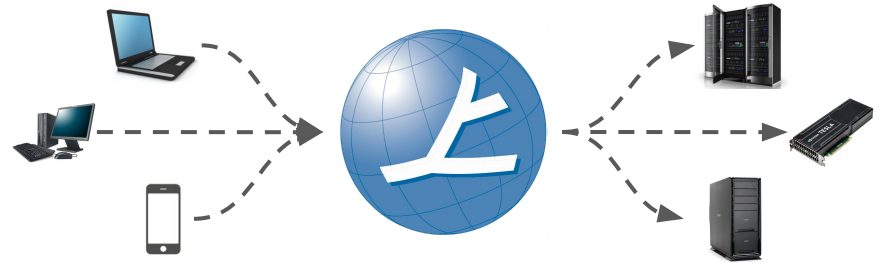
## University class on deep learning in physics research

- Master level, entire semester
- Heavy load peaks from ~ 50 users
- Theory classes and weekly practical exercise
- Increasing computational requirements over semester

# Summary and Conclusion

VISPA provides

- Access to remote computing resources
- Visualization in web browser
- Successfully employed in research, education and outreach



VISPA provides seamless access to computing infrastructure

- Guest accounts with limited resources
- Repository to set up your own instance
- <https://vispa.physik.rwth-aachen.de/>

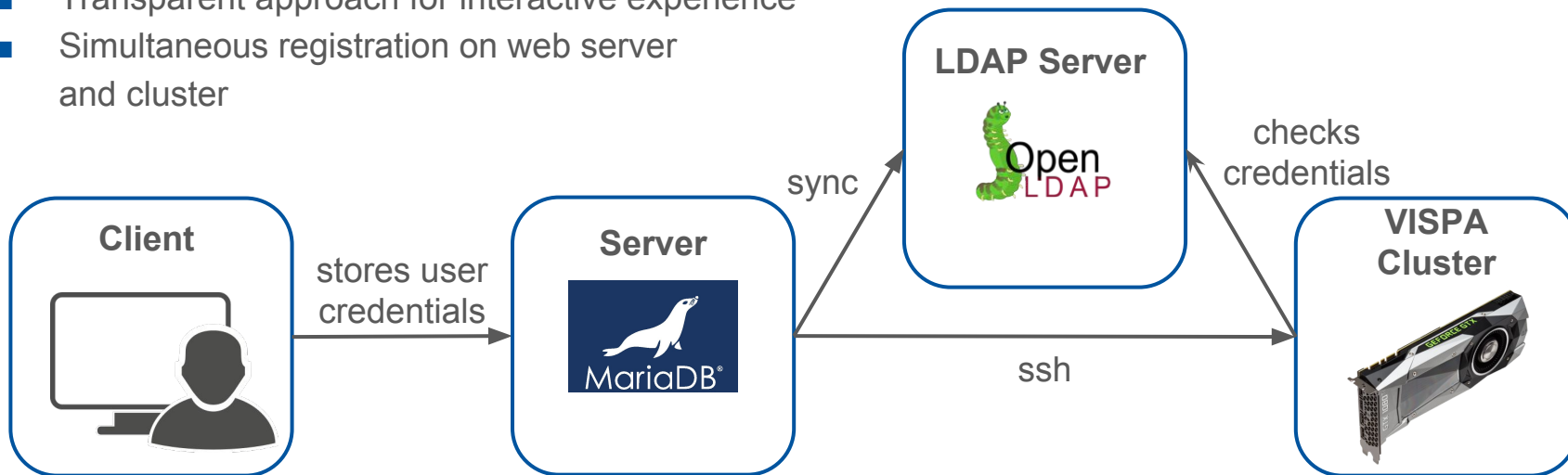




# Backup

# User Authentication at the VISPA Cluster

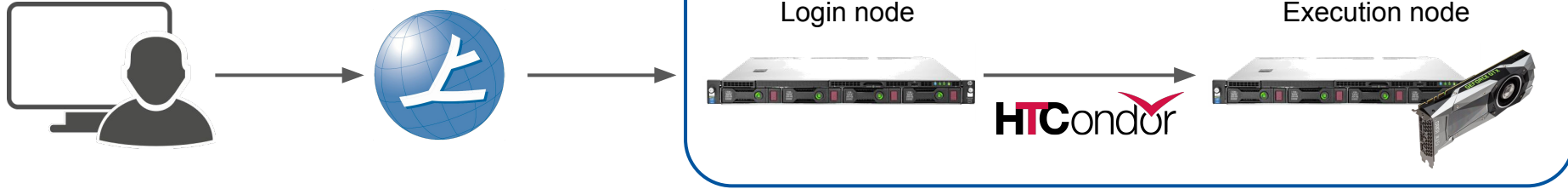
- Transparent approach for interactive experience
- Simultaneous registration on web server and cluster



- Automatic workspace connection to default workspace
- Different user groups, e.g. local research groups, students, guests

# Job Scheduling

- Small interactive jobs on login node allowed
- Resource distribution using HTCondor (“fair share”)
  - Dynamic slots for research jobs
  - Request GPU



- Automatic job generation script
  - Submission for inexperienced users
  - Arguments for precise job definition
- Direct submission from CodeEditor
  - Shown output gives “almost interactive feeling”
  - Lowers entry barrier

# Physics Research using the VISPA Cluster

## PScan Extension

- Explore high-dimensional file system structures: e.g. results of **parameter scans**
- Customize partitioning with regular expressions
- Display anything the browser can: images, pdfs, text, html

## TensorBoard Integration

- For visualisation of information gathered by TensorFlow
- In active development

