The Development of

VISPA @ WEB

by

Matthias Komm

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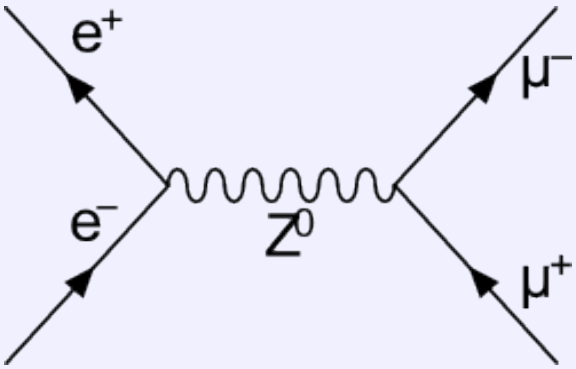
Tutors:
Prof. Dr. Martin Erdmann, Dipl.-Phys. Gero Müller
III. Physikalisches Institut A

Physics analysis



- HEP example: Measurement of Z^0 mass
- Challenge: working efficiently with a huge amount of data
- Today's approach: Analysis is programmed with C++

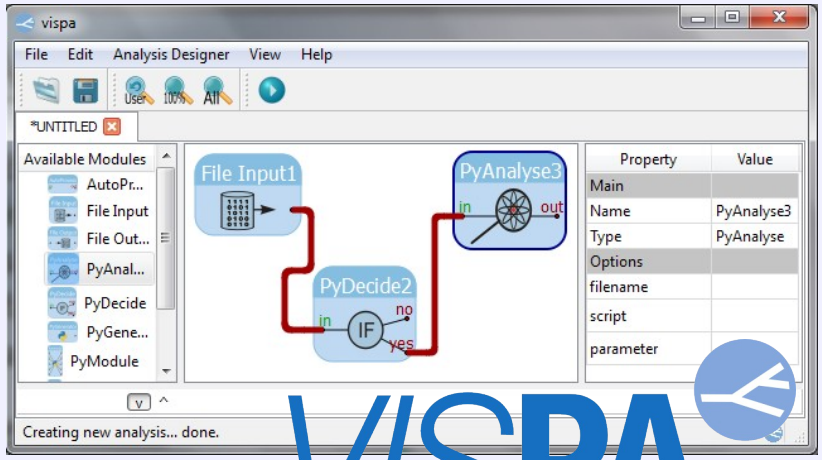
in C++ written analyses:

- analysis can be optimized to run very fast
- unclear, difficult to read
- no fast prototyping
- Physicists lose focus, have to learn a complex language
- analysis code must be maintained

Alternative:

Graphical Development Environment:

- intuitive
- simple development
- fast modifiable/exchangeable
- analysis logic is visualized

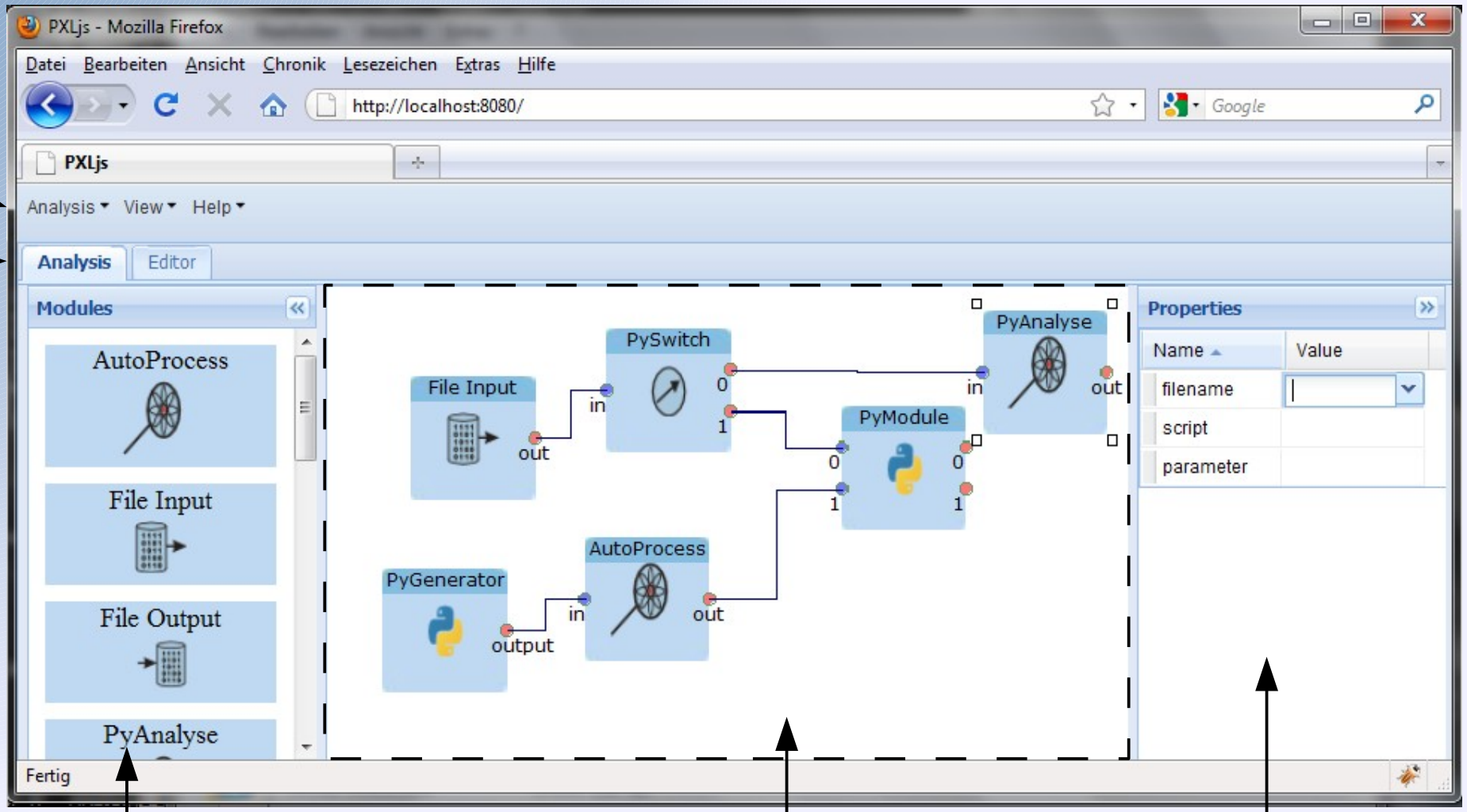


VISPA

+ web based:

- no installation, no administrator rights needed
- independent of the client's computer resources
- working together over the web
- access to experiment specific software (e.g. CMSSW)

The VISPA @ WEB program



Menu

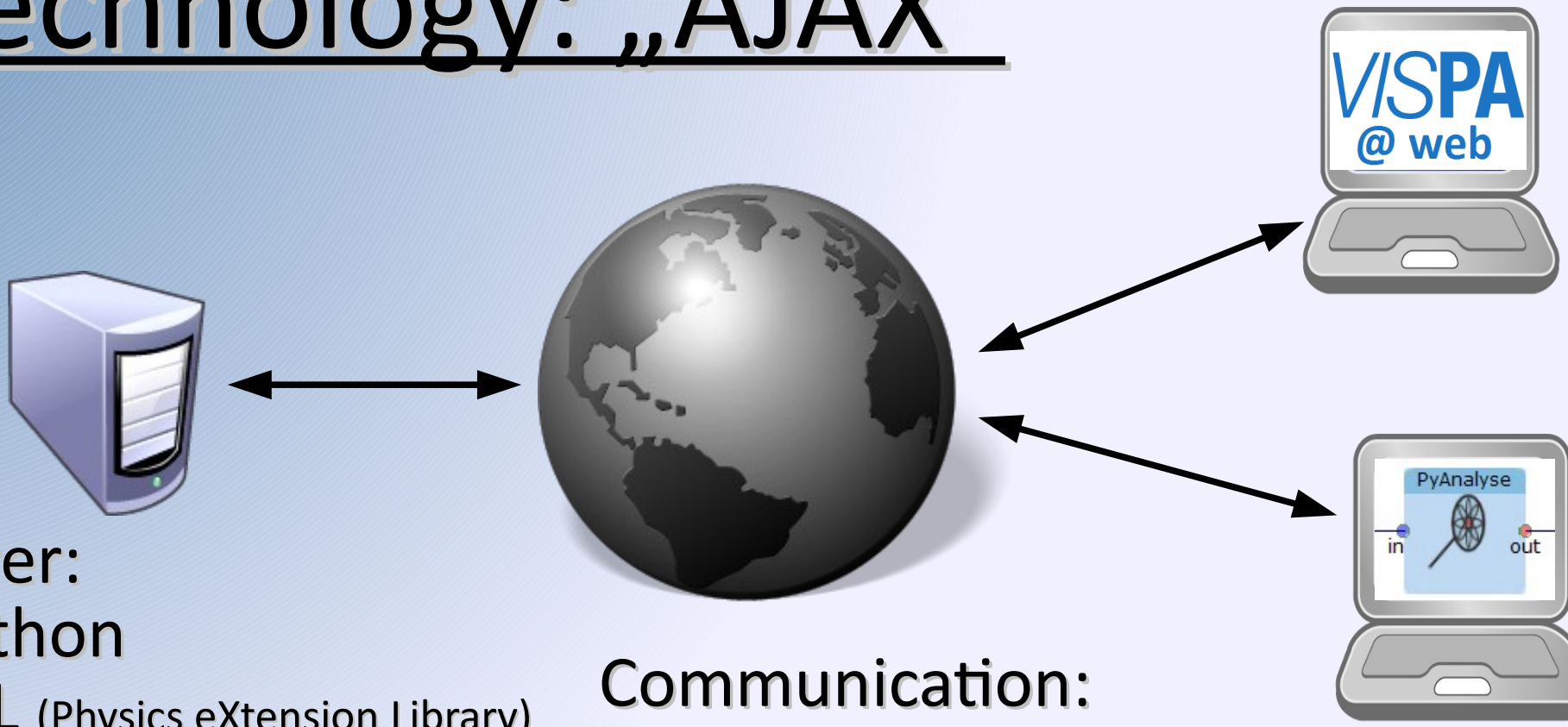
Tabs

available modules

workflow

module's options

Technology: „AJAX“



Server:
- Python
- PXL (Physics eXtension Library)

Communication:
- HTTP
- JSON

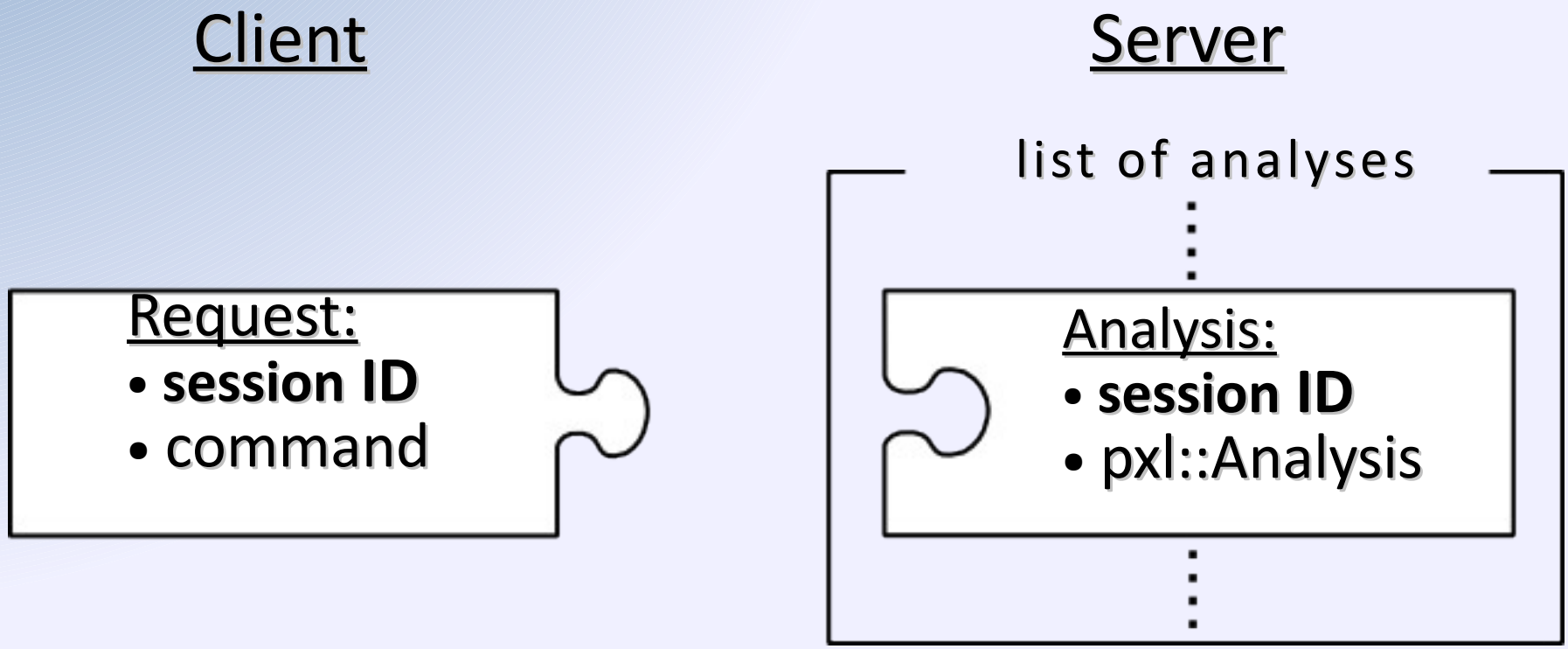
Client:
- Web Browser
- Java-Script

→ AJAX = **A**synchronous **J**avaScript **a**nd **X**ML

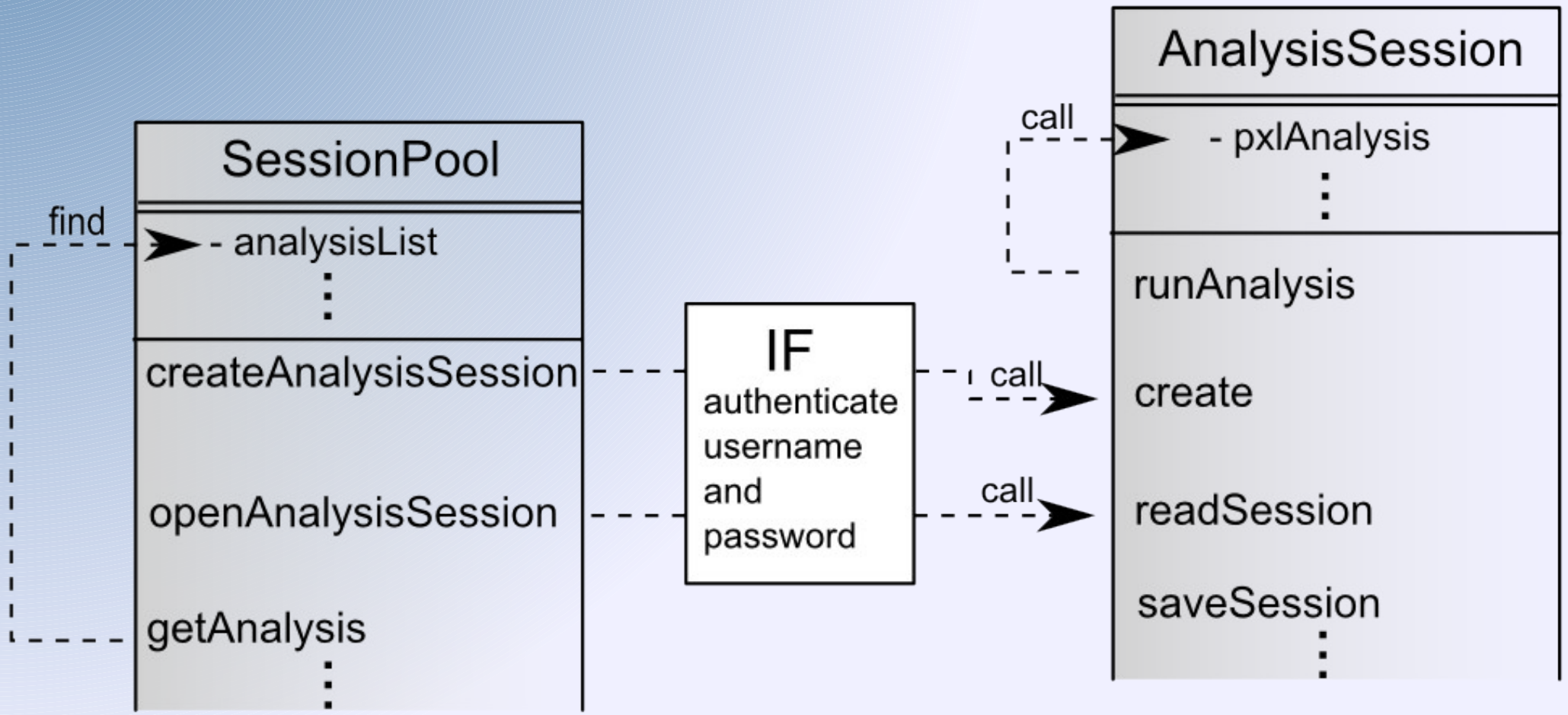
Web Server

Requirement: assigning physics analyses to client

→ Identification by **analysis session ID**



Session Management



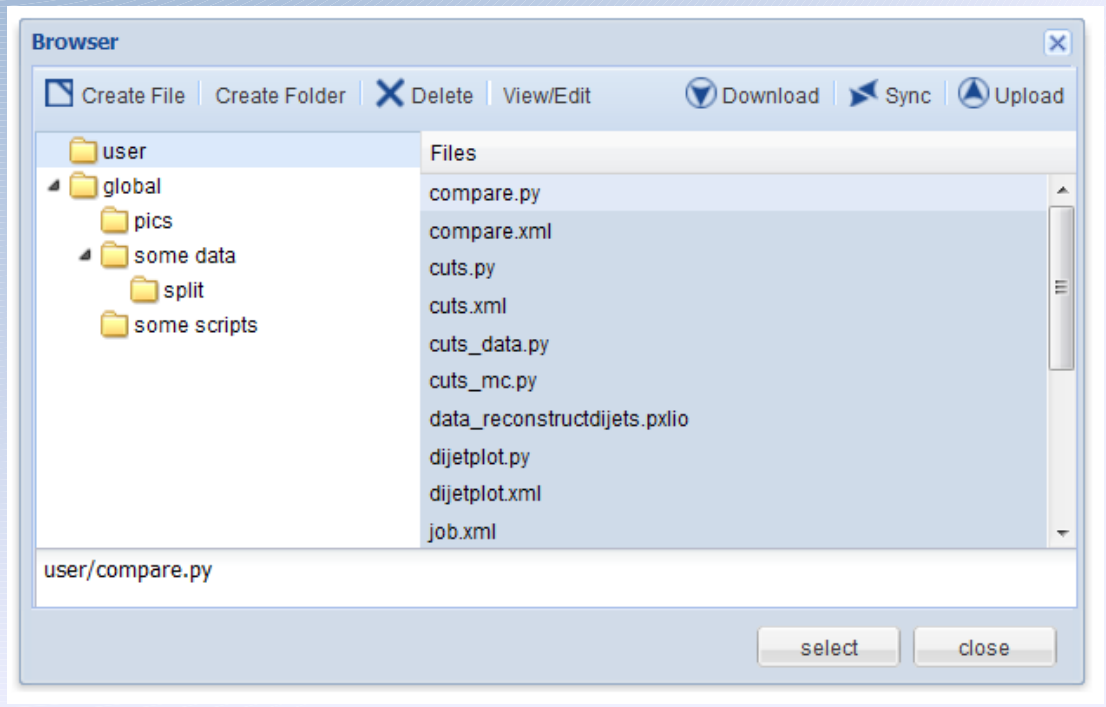
The file browser

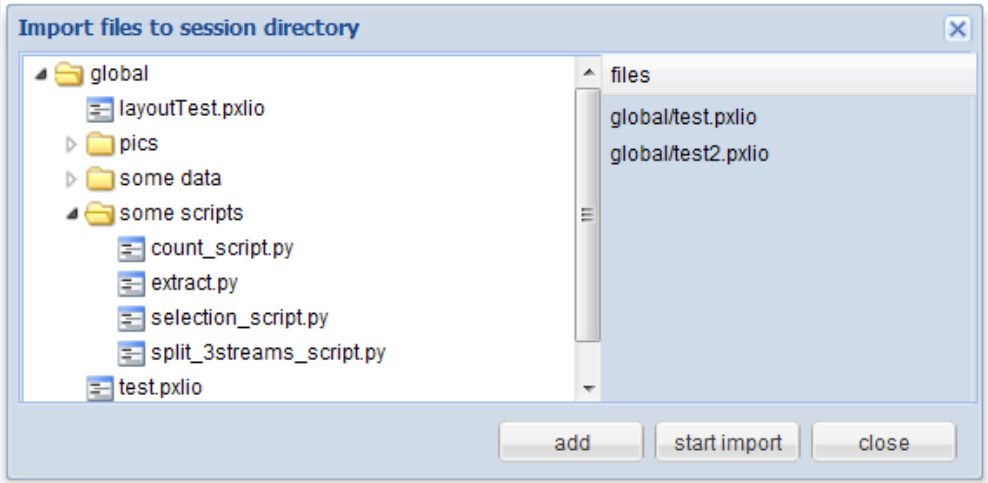
User has access to:

- user specific folder
- global (read-only) folder

For editing:

user can copy files from '/global' → '/user' with importer





The virtual file system

Clients are allowed to create/ modify files on server

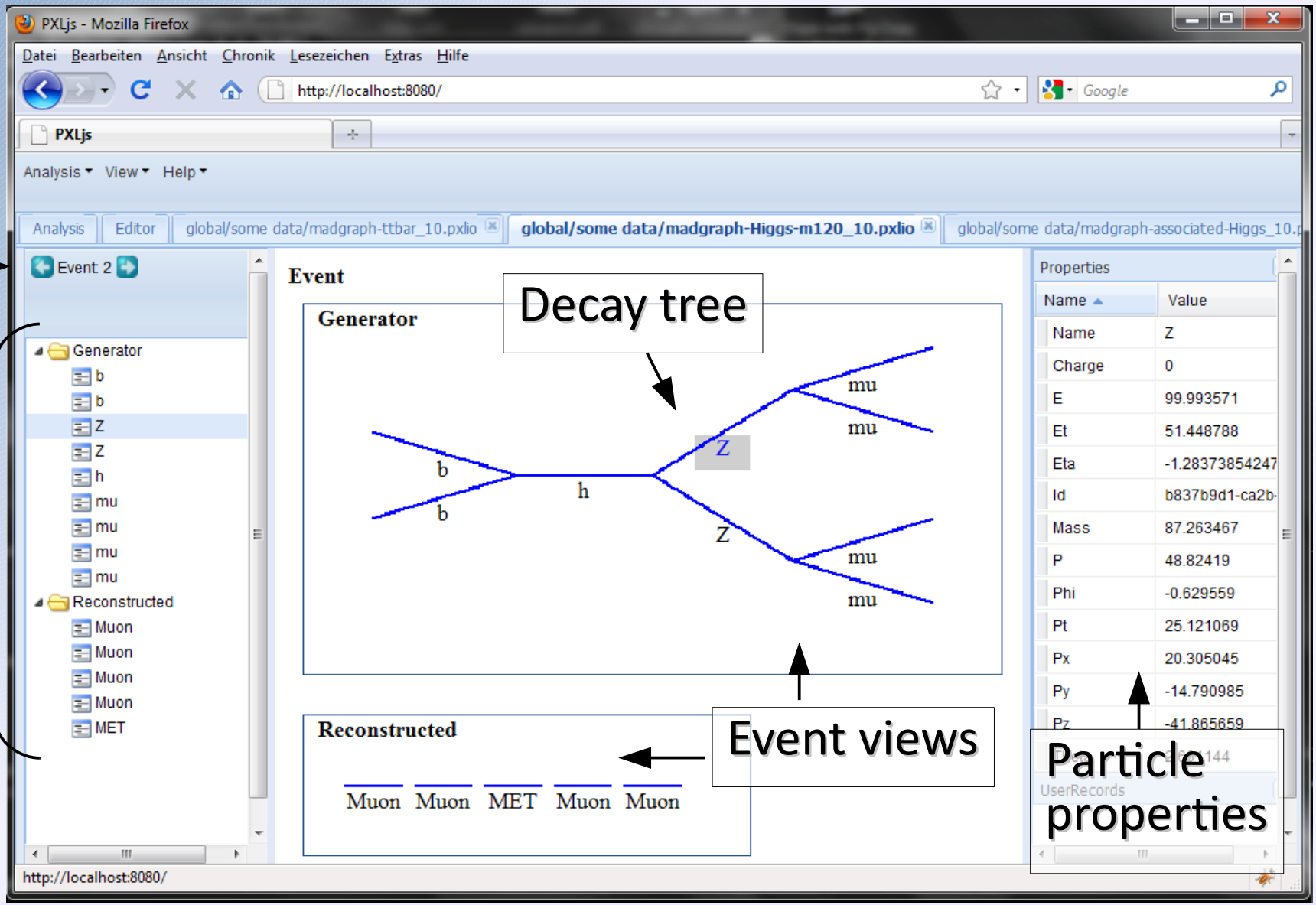
Security:

- clients should not work directly with the server's file system
- filter file extensions

Use a virtual file system: Translate the file paths

→

Data browser



Accessing 'pxlio' files

For displaying an event:

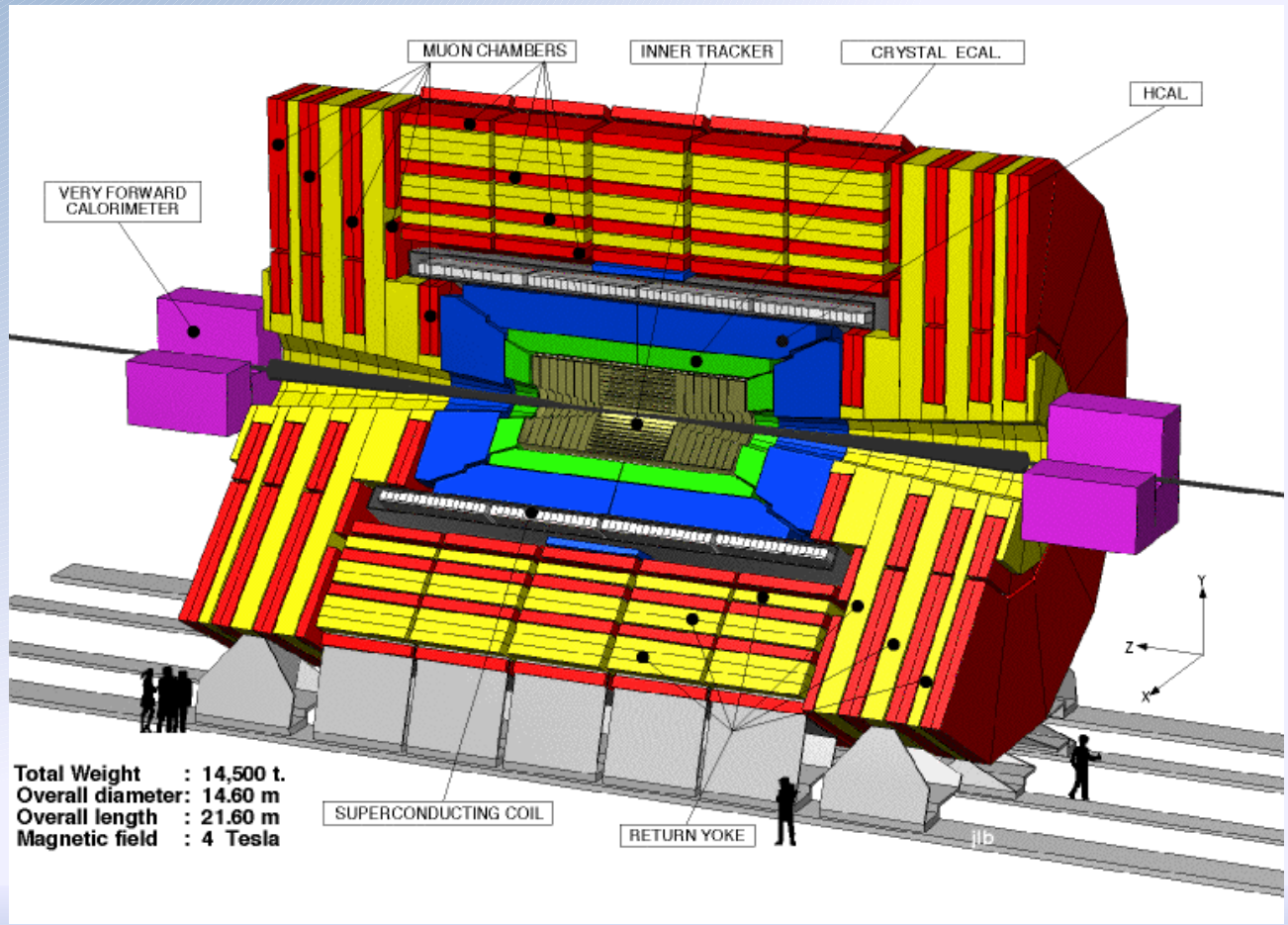
- Access information
  - properties
  - user records
  - layout positions
- convert into special format

→ Level of information is controllable

```
{
  EventID
  records <array>
        {name, value}
  EventViews <array>
        {
          Name
          Particles <array>
                {
                  Name
                  id
                  prop <array>
                     {name, value}
                  records <array>
                     {name, value}
                  x1, x2, y1, y2
                }
          records <array>
                {name, value}
        }
}
```

A Demonstration:

- Dijet mass measurement with CMS data:
  - LHC (Large Hadron Collider), pp-collider at CERN
  - CMS (Compact Muon Solenoid), general purpose detector at LHC



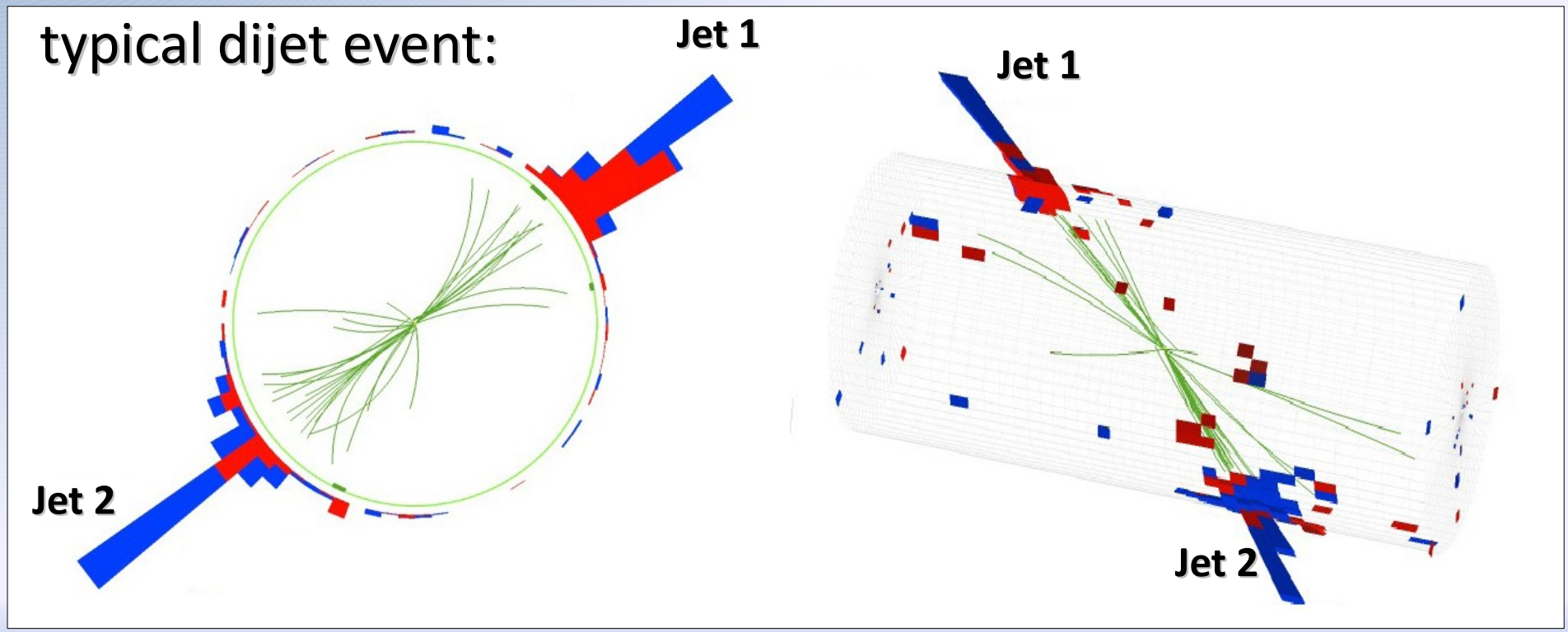
Jets:

Strong interaction of final state quarks
→ hadronic showers → jets

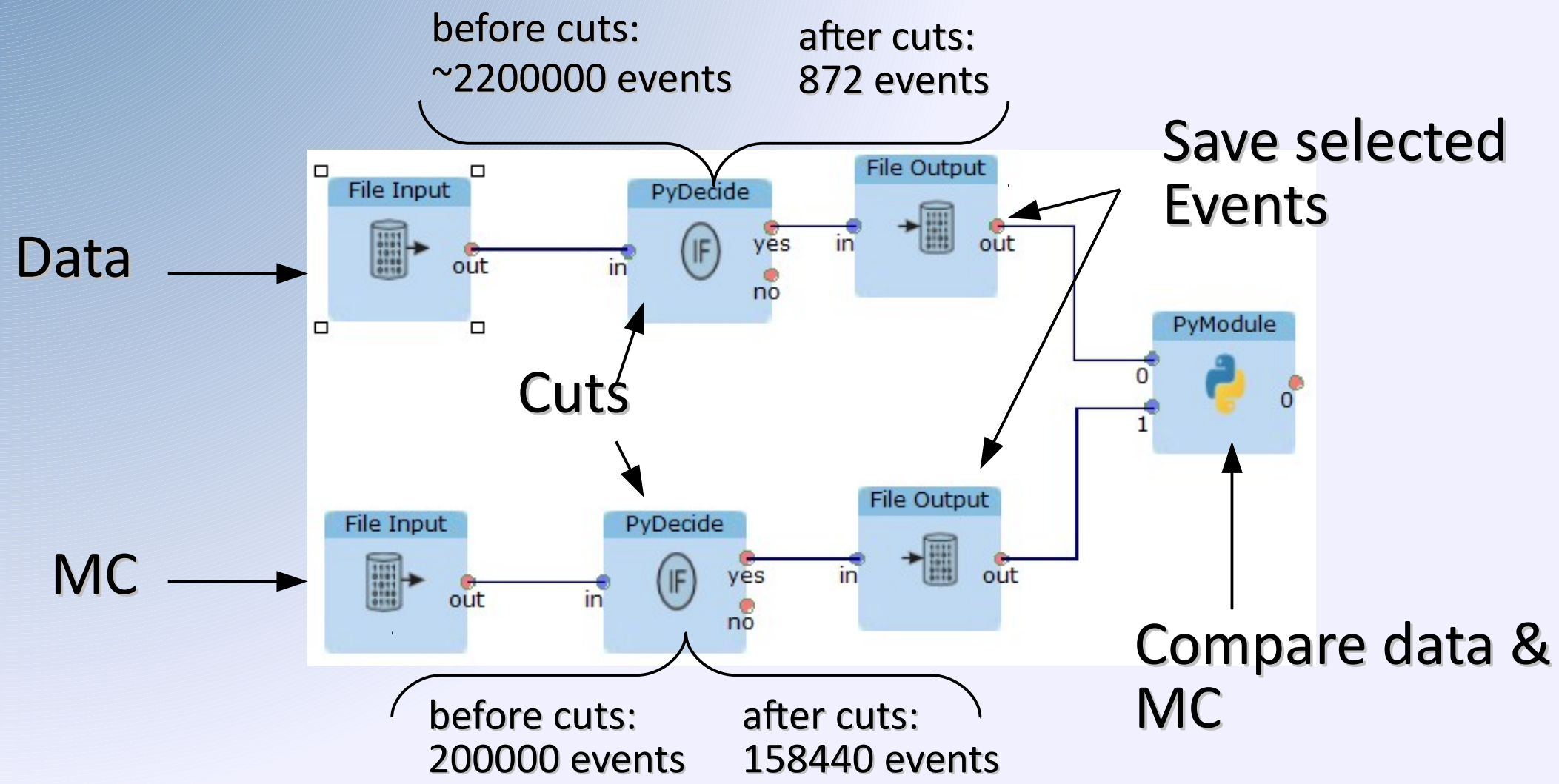
- **Dijet mass** → quantity for the center-of-mass energy of an interacting two quark system

$$m_{Dijet} = \sqrt{(E_1 + E_2)^2 - (\vec{p}_1 + \vec{p}_2)^2}$$

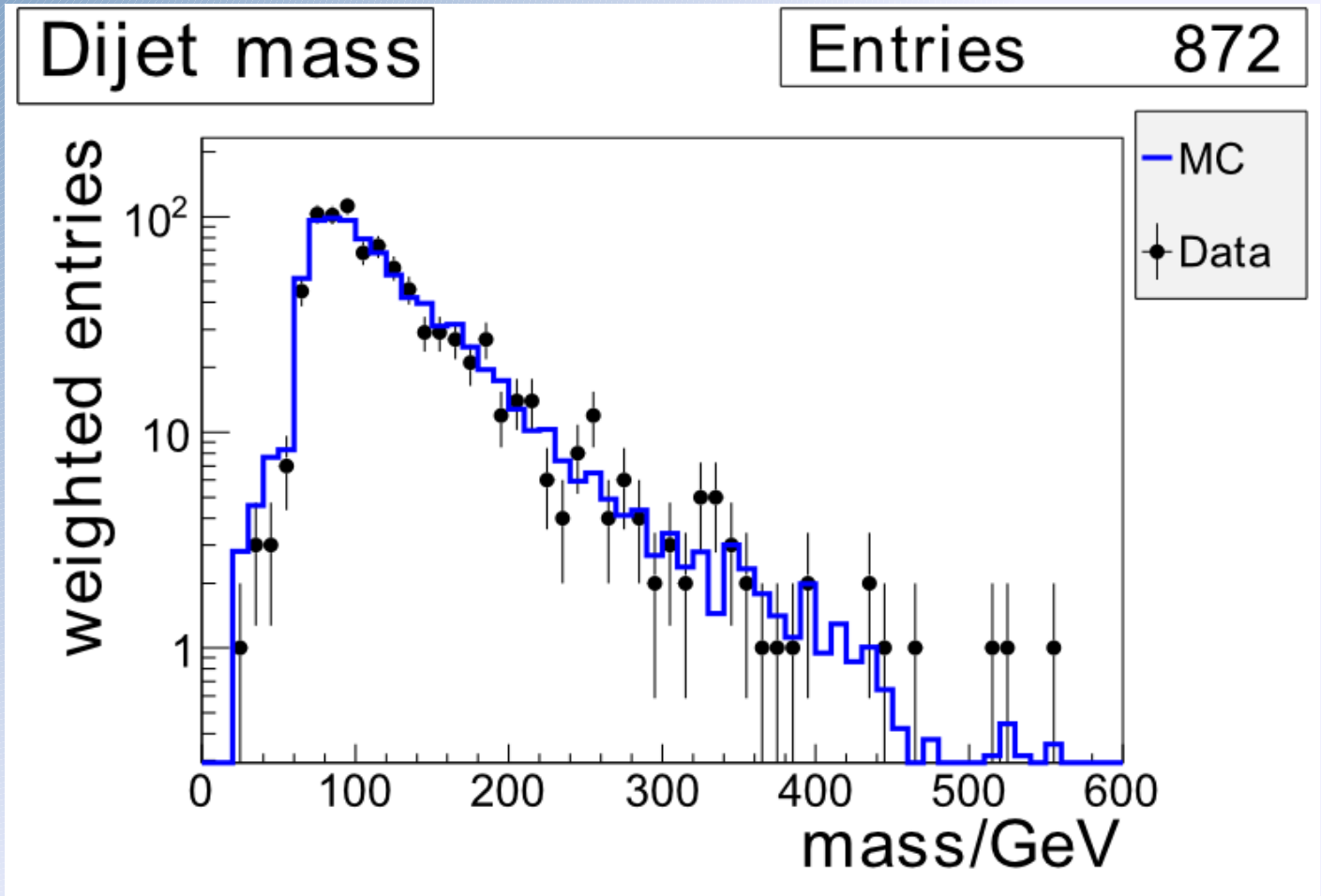
typical dijet event:



The Analysis:



Result:



→ Monte-Carlo describes the data well within the uncertainties

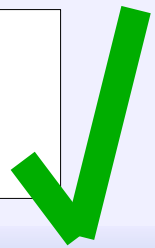
Conclusion:

- Implementation of VISPA @ WEB:
  - used various libraries (PXL, JavaScript frameworks)
  - developed new concepts like analysis session mangement
  - demonstrated its capabilities with a dijet analysis

New possibilities:

- a new way to perform physics analyses
- redirects the focus back to the physics
- analyses with any degree of complexity (PXL)
- physicists can share their datasets over the web

Prototyping, performing and verifying physics analyses with a standard web browser



Further information:

→ Bachelor thesis: Matthias Komm, *Development of the VISPA @ WEB program and Measurement of the dijet mass with CMS, 2010*

Thank you for your attention!
Questions?

Backup: The Analysis data

- Data: recorded at $\sqrt{s} = 7\,TeV$ in April 2010, ~2200000 events with minimum bias trigger
- Monte-Carlo: QCD Pythia with full detector simulation, 200000 events

Applied Cuts:

- Leading and sub-leading jet: $p_T > 30\,GeV$
  - $|\eta| < 2.6$
  - $EMF > 0.01$
  - $n90Hits > 1$
  - $fHPD < 0.98$

872 data events, 158440 MC events selected