


Open Data

Workgroup 5

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**OPEN
DATA**

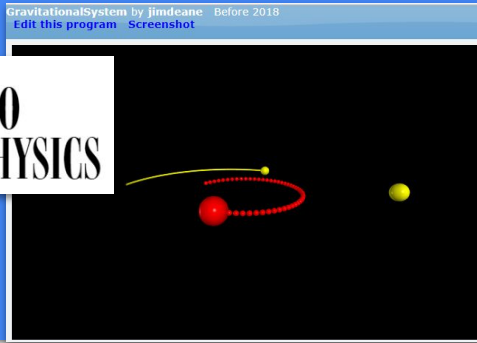


OPEN DATA

- Open Data : Data from scientific, governmental, or other organizations
- What makes it “open”? -- Sharing datasets
- Who can use it?
- Where do you find it?
 - <http://opendata.cern.ch/>
 - Google with “open data” in the search terms!

Python

RHETT ALLAIN DOT-PHYSICS 07.12.16 03:32 PM
**HOW TO USE PYTHON TO
TEACH HIGH SCHOOL PHYSICS**



RHETT ALLAIN DOT-PHYSICS 04.24.15 08:58 AM
**I DARE YOU TO CHANGE THIS
NUMERICAL CALCULATION**

```
ball_pos=ball_pos+dr
gvec=( -9.8,0) #gravitational field
t+=dt
dt=0.01 #size of the time step
#putting the loop as "while True" means it runs forever
#you could change this to while t<= 10: or something
while t<=1:
    norm=|R| #this says 1000 calculations per second

    #L is the length of the spring, from the holder to the
    #ball_pos-holder_pos

    #remember that mag(R) gives the magnitude of vector R
    #remember that norm(R) gives the unit vector for R
    F=-k*(mag(L)-L0)*norm(L) #this is Hooke's law

    #this calculates the net force
    F+=ball_acc

    #update the momentum
    ball_p=ball_p+F*dt
```

- Python: A popular, powerful, free computer language.
 - According to TIOBE, an industry source, Python is the fourth most popular programming language today.
 - Also very popular in HEP
 - Popularity leads to tools, use, documentation and help.

High-energy physics analysis in the Python ecosystem

Alex Pearce
alex.pearce@cern.ch

PyROOT

How to use ROOT with Python (PyROOT)

PyROOT is a [Python](#) extension module that allows the user to use ROOT from the Python interpreter. This is done generically using the ROOT dictionary

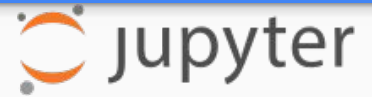
January 2017
Meeting, CERN



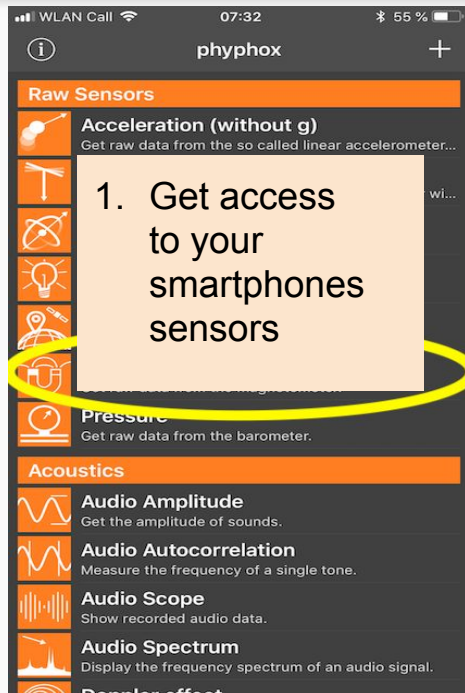
Jupyter and MyBinder



- Jupyter: Open source system to program and run Python code in a notebook-like environment.
- MyBinder: A web app that permits opening Jupyter notebooks from Github easily online.
- These combined with storage of your Jupyter files in a Github repository make it easy to manage and deploy files.



Record data from smartphone sensors with **phyphox** App (android & iOS)



Sensors*

- Magnetometer
- Barometer
- GPS
- Accelerometer
- Gyroskop
- Microphone
- (Light sensor)

StopWatch

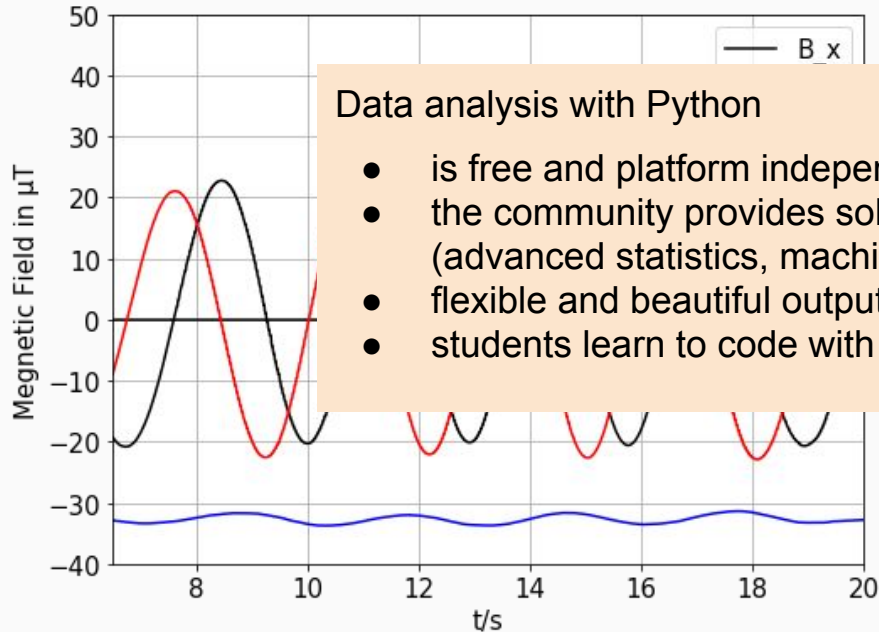
Many experiments

Remote control

* depending on the phone

Visualize and analyze the data with Python

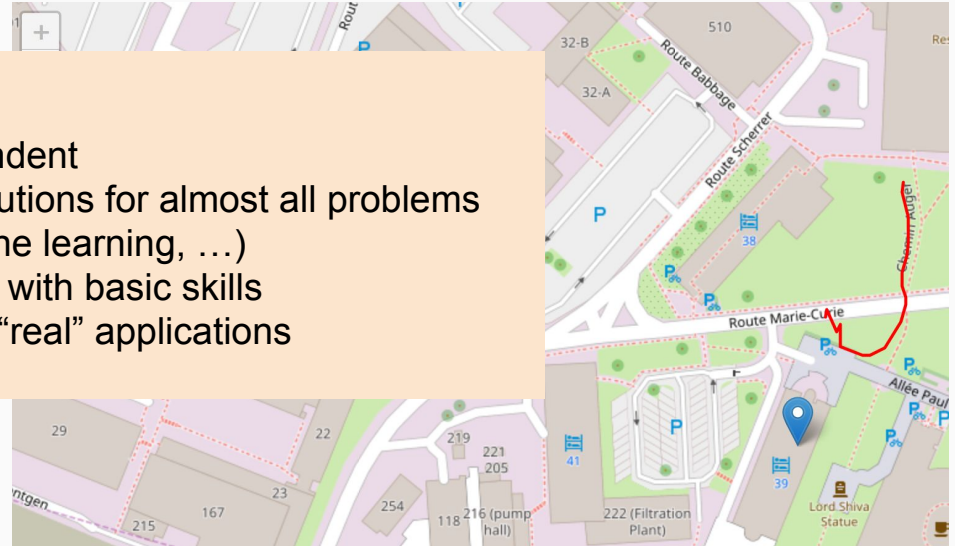
merry-go-round - magnetic field vs. time



Data analysis with Python

- is free and platform independent
- the community provides solutions for almost all problems (advanced statistics, machine learning, ...)
- flexible and beautiful output with basic skills
- students learn to code with “real” applications

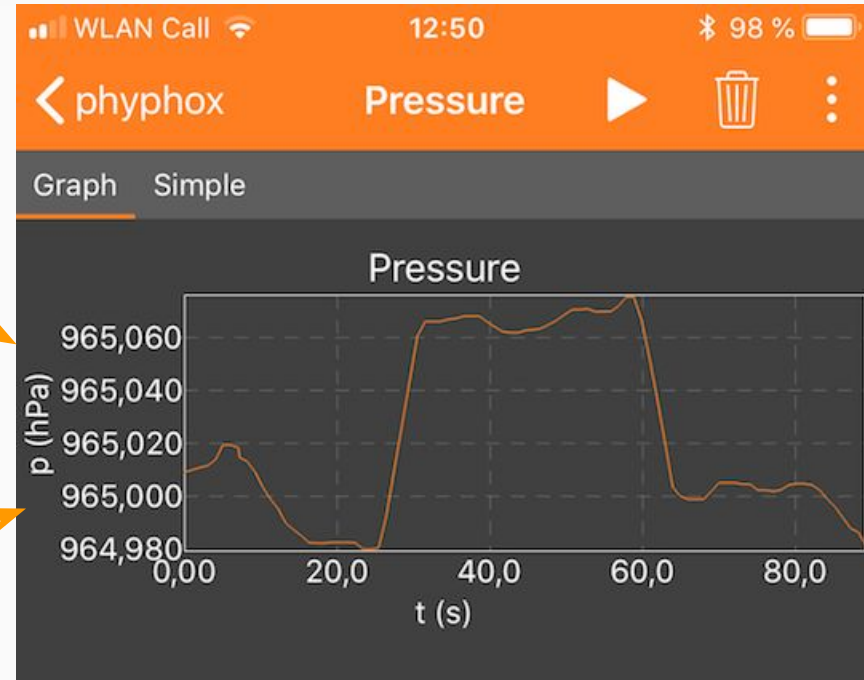
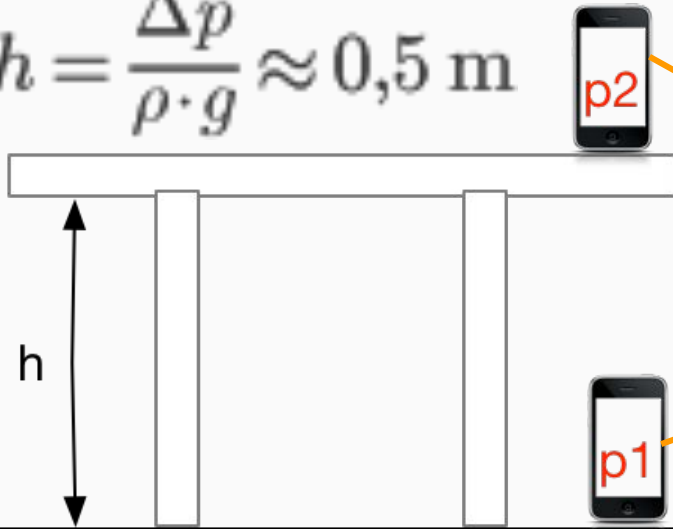
CERN GPS-track from B39 to Restaurant 1



and much more...

Pressure Sensor Demo

$$h = \frac{\Delta p}{\rho \cdot g} \approx 0,5 \text{ m}$$



Direct to the code!



The code is divided in two sections:

Basic skills:

- Import Phyphox data;
- Plot and preliminar analysis;
- Linear regression.

Advanced skills:

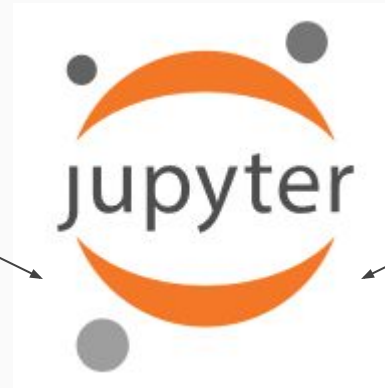
- Infer new quantities;
- Analyze the behaviour of these quantities;
- Physical considerations.

Simple example for teachers: pressure data in the elevator (going up and down).

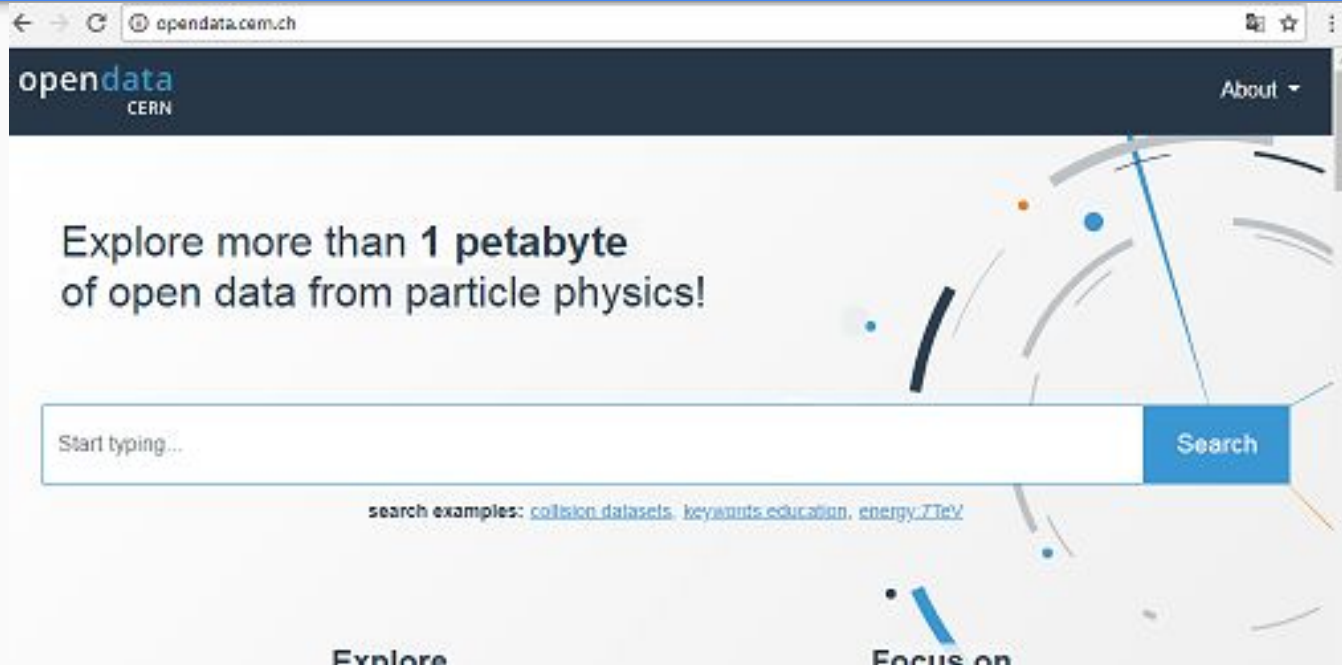
Where is particle physics?



DataDataDataDataDataDataDataDataDataDataDataDataDataDataDataDataDataDa



CERN Open Data portal <http://opendata.cern.ch/>



The screenshot shows the CERN Open Data portal homepage. At the top left, the browser address bar displays "opendata.cern.ch". The header features the "opendata CERN" logo and an "About" dropdown menu. The main content area has a large heading: "Explore more than 1 petabyte of open data from particle physics!". Below this is a search bar with the placeholder text "Start typing..." and a blue "Search" button. Underneath the search bar, there are search examples: "collision datasets", "keywords", "education", and "energy_TeV". At the bottom, the words "Explore" and "Focus on" are partially visible. The background of the page is a stylized particle detector diagram.



How to implement? Problems and solutions



GitHub resource



J/Psi task



Teacher's guide

Where to find everything

Source:

<https://media3.giphy.com/media/l3q2Ph0l1osaagoQE/giphy.gif>



Open Data

- CERN:
 - <http://opendata.cern.ch/>
- General:
 - <https://www.europeandataportal.eu/>
 - <https://www.opendatasoft.com/a-comprehensive-list-of-all-open-data-portals-around-the-world/>
- Many others

Notebooks and extended stuff:

<https://github.com/cms-opendata-education/HST-2018>

reisneran Update README.md		Latest commit c92bfff 2 minutes ago
data	Add files via upload	9 hours ago
elevator_student.ipynb	Add files via upload	3 hours ago
elevator_teacher.ipynb	Add files via upload	3 hours ago
gps_teacher.ipynb	Add files via upload	3 hours ago
merry-go-round_teacher.ipynb	Add files via upload	3 hours ago
Analyzing Smartphone Data with Jupyter Notebooks Teachers Guid...	Add files via upload	9 hours ago
Dimuon J_Psi for High School (Student Version) - German.ipynb	Add files via upload	5 minutes ago
Dimuon J_Psi for High School (Student Version).ipynb	Add files via upload	7 hours ago
Dimuon J_Psi for High School (Teacher Version with Code) - Germa...	Add files via upload	5 minutes ago
Dimuon J_Psi for High School (Teacher Version with Code).ipynb	Add files via upload	7 hours ago
JPsi for High School Teachers Guide.docx	Add files via upload	7 hours ago
JPsi for High School Teachers Guide.pdf	Add files via upload	7 hours ago
README.md	Update README.md	2 minutes ago
requirements.txt	Update requirements.txt	2 days ago

Smartphone

Particle Physics

HST-2018

Tasks and documentation developed by the open data workgroup at CERN HST 2018. There are two main tasks here:

High School Level Task using smartphone data recorded with phyphox app & Jupyter notebooks

You can run these notebooks in binder by using the link below. Refer to the teachers' guide document for further details.




- Elevator - measure air pressure: -- elevator_student.ipynb -- elevator_teacher.ipynb
- Merry-go-round - measure magnetic field: -- merry-go-round_teacher.ipynb
- GPS - show a gps track on a map: -- gps_teacher.ipynb



Click here to open the notebooks

High School Level Task using CMS open data & Jupyter notebooks to find evidence for J/Psi

You can run these notebooks in binder by using the links below. Refer to the teachers' guide document for further details.

- Student Version: 
- Teacher Version (with code): 
- Student Version / Teacher Version (with Code) German: 

Teacher's Guide

Smartphone

- Objectives
- Resources Provided
- Background knowledge
- Instructions for Teachers
- Differentiation
- Tasks

Teacher's Guide

Particle Physics

- Why should I use this task?
- Target group & required knowledge
- Skills developed
- Some particle physics
- Jupyter Notebooks
- Differentiation and assessment
- Using Jupyter notebooks in general

Thanks to all our
Workgroup supervisors!

