



LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS
partículas e tecnologia

[LIP-EduLab]

ideas and perspectives for a LIP lab for schools



Catarina Espírito Santo, Fernando Barão

LIP, November 2018

plan for today

- motivation and framework
- getting started: the first activities
- plans and possibilities
- discussion



[motivation and
framework]

*LIP always had an active outreach and education programme,
and a strong link to the school community*

for teachers



Portuguese language teachers
programme, P. Abreu

for students



IPPOG's masterclasses in
Particle Physics, P. Abreu

in the lab



Estágios Verão
P. Abreu, A. Gomes
and many others

Environmental radiation project
L. Peralta

A. Maio, C. Abreu, ... with the participation and support of many people

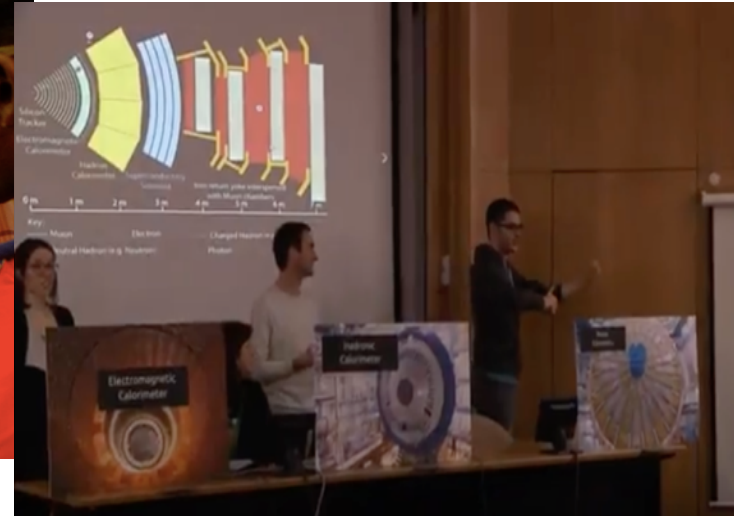
we now have a few things we didn't have before...



New premises in Lisboa



LIP-ECO group



Wider participation!

this should allow us to go further!

- host high school students engaged in laboratory activities
- develop more projects with schools throughout the school year
- organize more activities at LIP, e.g. open days, science fairs, visits of schools, ...
- For students and also for teachers
- coordination and resource sharing between LIP nodes

Developing a LIP-EduLab

- about particle physics, but also about its tools
- an education lab at LIP, for hands on activities and open projects
- supporting also projects developed in the school
- an activity programme along the year, with teachers and students

A project to develop in steps, with the collaboration of all the LIP community



[getting started: the first activities]

the space (Lx)

Step 1: Furniture
(by: IKEA)



LIP-EduLab (207)



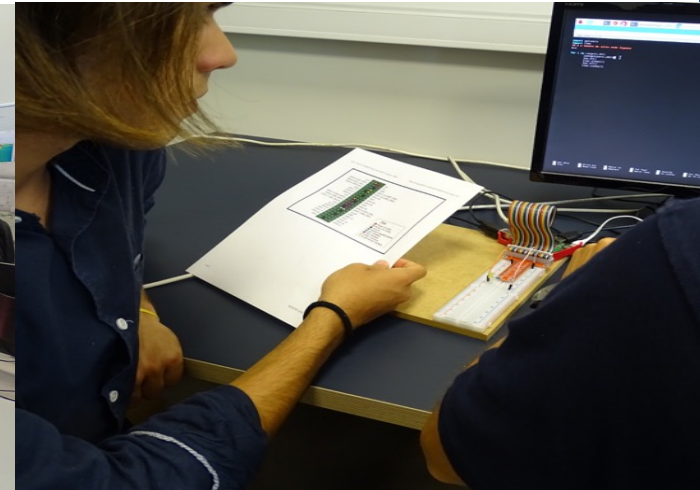
LIP-ECO room (206)

the first reality test

"Ciência Viva in the Lab" 2018

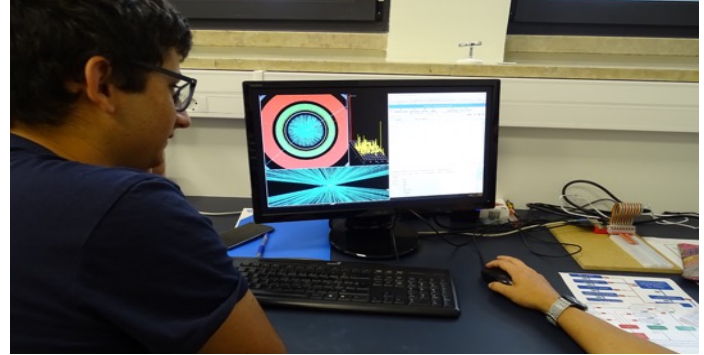
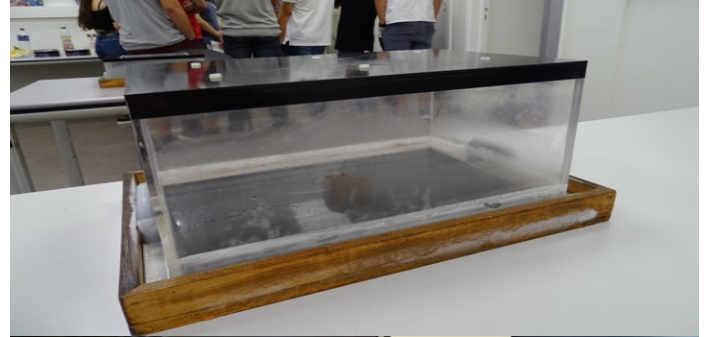
C. EspSanto, F. Barão, A.S. Nunes, P. Abreu, A. Gomes, S. Andringa, R. Gonçalo, R. Conceição, B. Tomé, J. Sampaio, L. Alves

1. detecting particles
2. analysing and understanding the data
3. the tools of particle physics



1. detecting particles

build your own cloud chamber



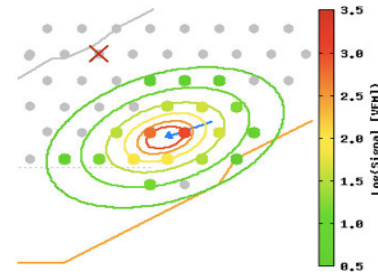
2. analysing and understanding the data

exploring LHC (ATLAS)

and cosmic ray (Auger) data

The Public Event Explorer

The public event display of the Pierre Auger Observatory is hosted at [CNEA](#) in Argentina (please note that it does take a while to load up).

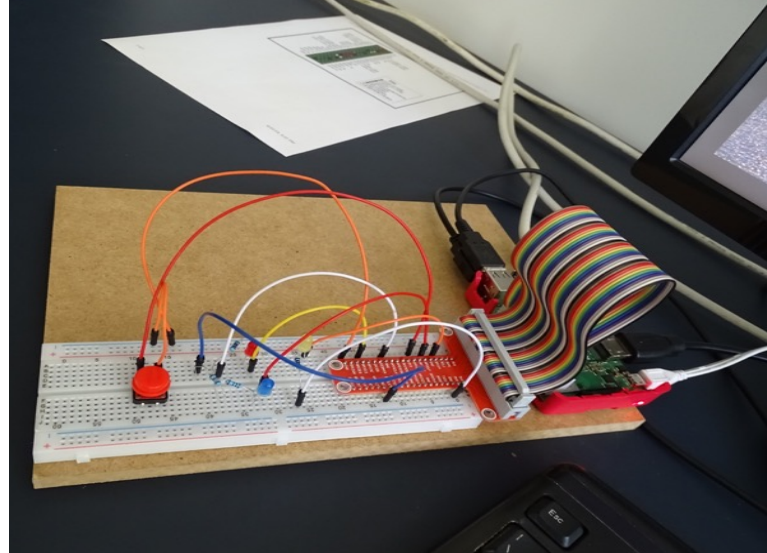


The Pierre Auger Collaboration agreed on making 1% of its data available to the public. The [CNEA](#) website allows browsing over the events collected since 2004, and is updated daily. You can enter an event Id in the search window, search for an event with the event selection menu, or display an event already in cache. You can also download an ascii file with all events.

3. the tools of particle physics

To operate a large particle physics experiment we need to control a large number of devices and to read a lot of sensors

using a Raspberry Pi, we program in python to control simple devices and to read, register and represent graphically our data



pilot project 2018/2019

particle physics and its tools

F. Barão, C. Espírito Santo, A.S. Nunes, N. Castro, H. Carvalho



With RBE - Rede de Bibliotecas Escolares

*a journey to the world of particle physics in which we explore the activities and tools of particle physicists –
a mixture of seminars, bibliographic research and hands-on laboratory work*

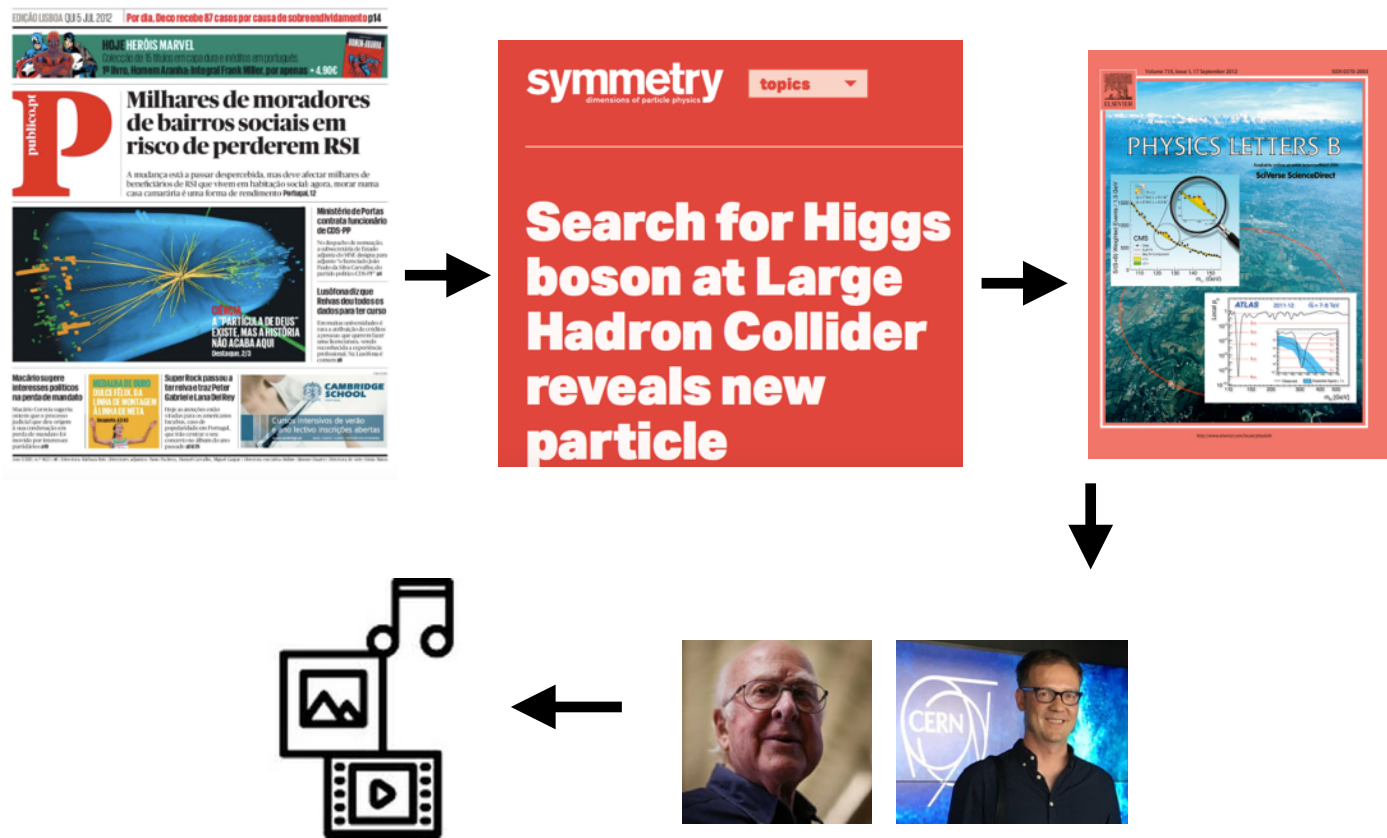
1. seminars on particle physics, its methodologies and tools
2. from science news to scientific discovery: a path through scientific communication and culture
3. the tools of particle physics

E.S. D. Filipa de Lencastre (Lisboa), E.S. Restelo (Lisboa), E.S. Padre Benjamim Salgado (Joane)

Open to other schools

from science news to scientific discovery: a path through scientific communication and culture

exemple: Higgs discovery



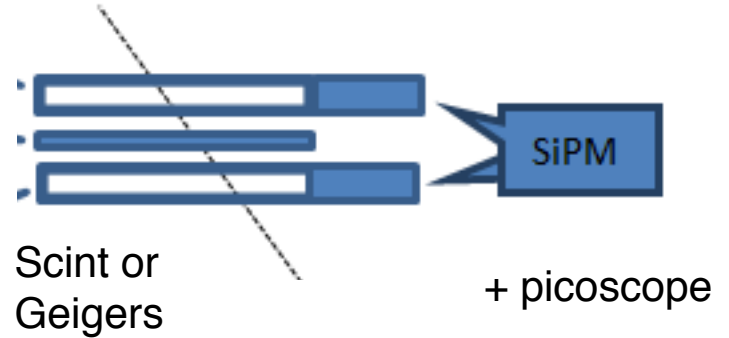
the tools of particle physics — Activities at the LIP-EduLab

1 Introduction to python and sensors;
the pendulum example



Using the RPi
and a photogate,
measure T and v

2 Particle detectors:
homemade cloud chambers,
muon telescopes



Talks

“Das partículas ao Universo. . .”, M. Pimenta

8 Nov ES D. Filipa de Lencastre

9 Nov IES Restelo

“Da notícia à descoberta científica”, C. Esp. Santo

16 Nov ES Filipa de Lencastre, ES Restelo

“Observar é medir”, F. Barão

7 Dec LIP

“Observar o invisível”

speaker TBD

15 Mar, LIP

Activities

Dec 2018 - May 2019

Project “From the science news to the scientific discovery”

Jan - May 2019

Activities at the LIP-EduLab

1 Introduction to python and sensors; the pendulum example

2 Introduction to particle detectors: homemade cloud chambers,
Geiger counters, muon telescopes

3 Possibility of complementary data analysis activities

May 2019 — Closing session

Young Researchers Night and LIP anniversary celebration

2018/2019

Other ongoing/possible activities

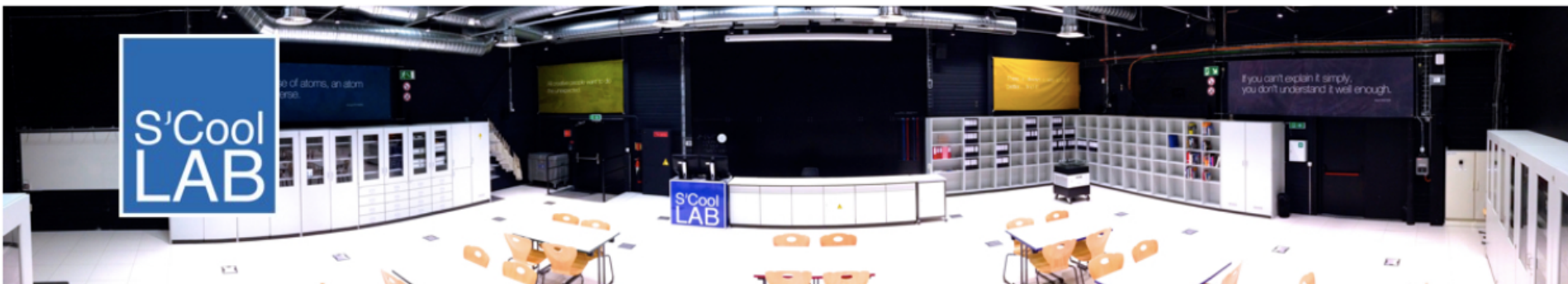
- seminars in schools —> New: list of offers now in the outreach page
- possible collaboration with the new Clubes Ciência Viva na Escola —> waiting for approval
- (limited) support to schools in the development of specific projects
 - Santarém - Cosmic rays and the Auger public data set
 - E.S. Benfica, Cloud chambers + MIT Cosmic Watch detector
- analysing and understanding the data — exploiting the LHC open data?
- ...



[plans and possibilities]

for inspiration

S'Cool Lab — CERN



[S'Cool LAB Workshops](#)

[S'Cool LAB Summer CAMP](#)

[Resources](#)

[Our Team](#)

[For CERNies](#)

Welcome to S'Cool LAB

for inspiration

S'Cool Lab — CERN



- cloud Chambers
build and observe a particle detector

- electron tubes

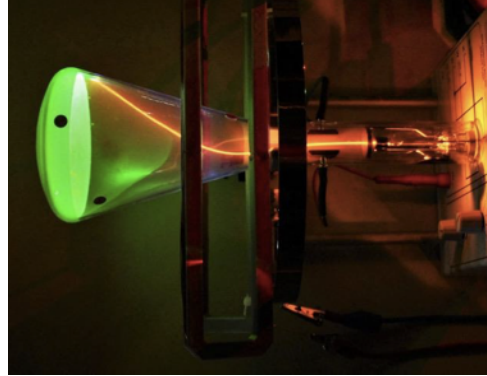
basics of particle acceleration, electric
and magnetic fields

- 3D printed experiments
 - ATLAS magnetic field
 - magnetic particle trap

for inspiration

S'Cool Lab — CERN

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build and observe a particle detector
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basics of particle acceleration, electric
and magnetic fields
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for inspiration

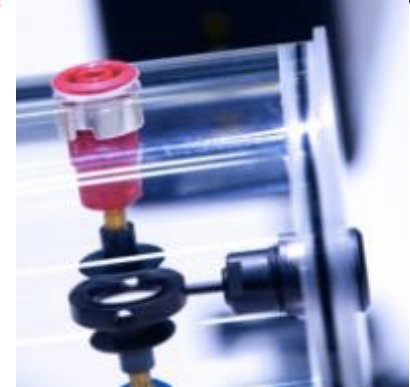
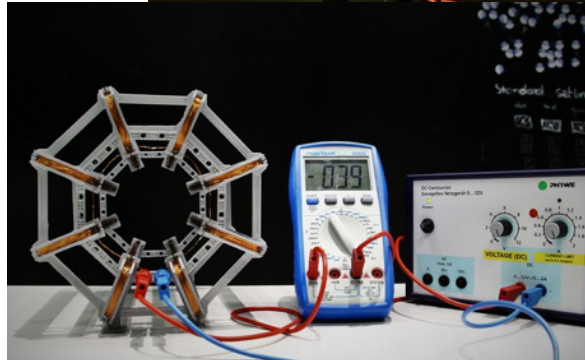
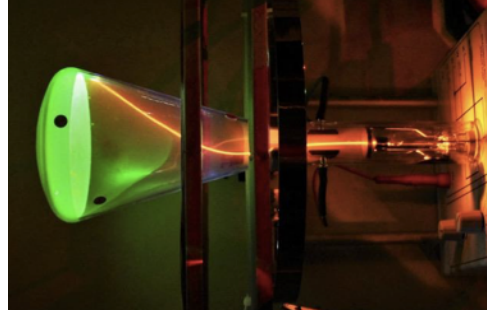
S'Cool Lab — CERN

- cloud Chambers
build and observe a particle detector

- electron tubes

basics of particle acceleration, electric
and magnetic fields

- 3D printed experiments
 - ATLAS magnetic field
 - magnetic particle trap



accelerating particles

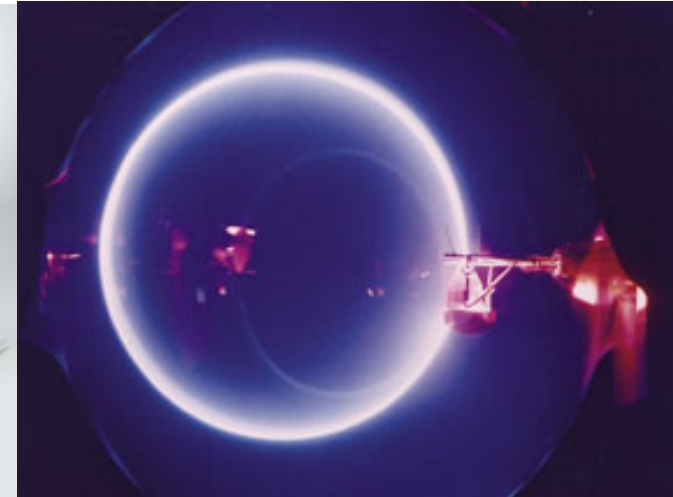
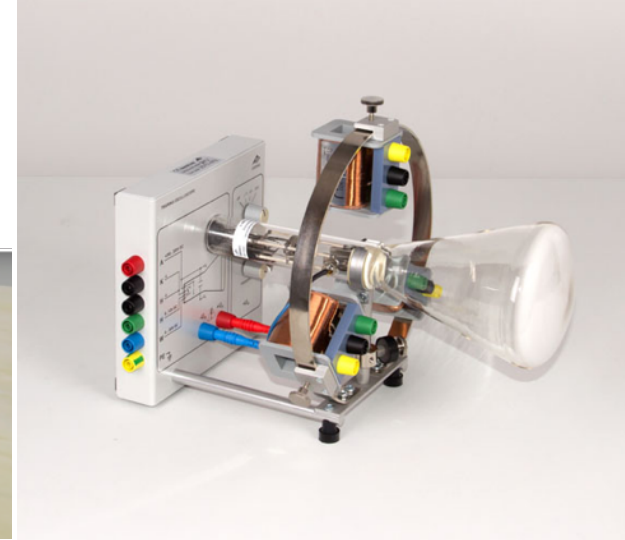
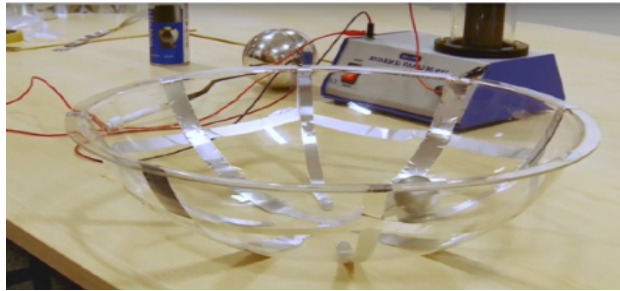
- Electron tubes

basics of particle
acceleration,

electric and magnetic
fields

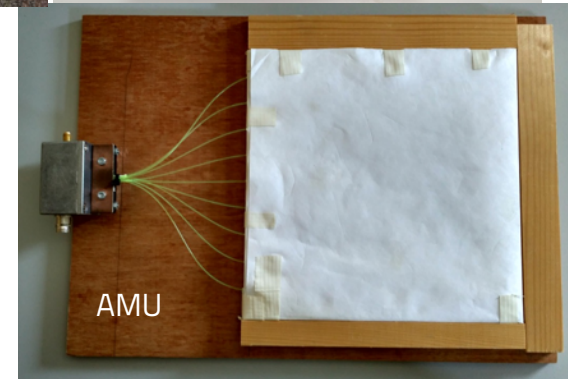
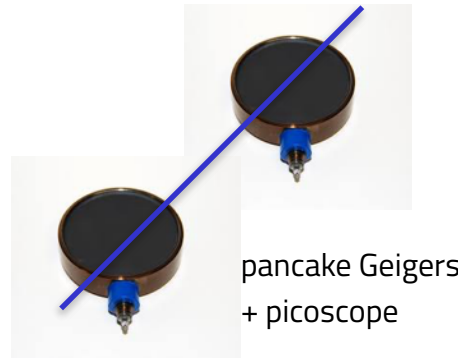
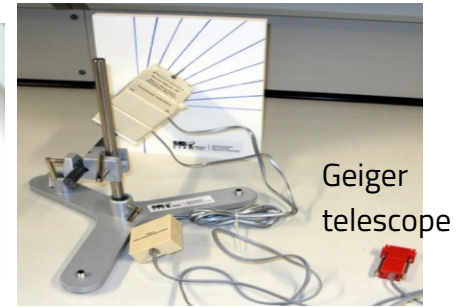
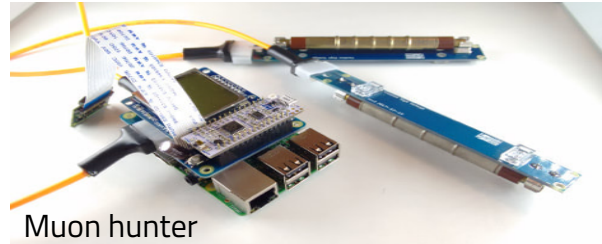
electron charge

- Van der Graaf?



detecting particles

- cloud Chambers
build & observe a particle detector
- cosmic muons telescopes
 - Geiger telescopes
 - scintillator telescopes
 - tests of optical components - LOMaC
- technology choices
 - RPi + python
 - Arduino + C



other ideas — example: “LIP in space”

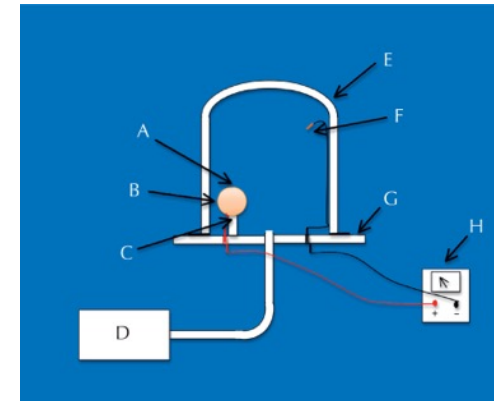
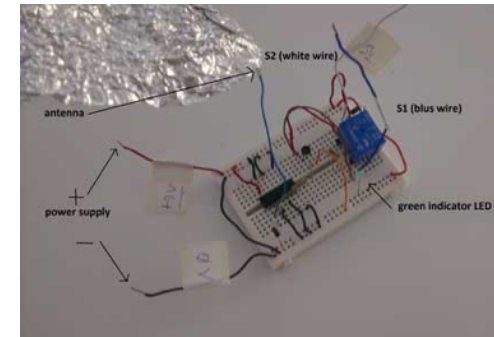
1. living in the ISS - RPi + senseHAT project

- sensors: temp, pressure, humidity, attitude, Tracking — display + alarm

2. solar wind and space weather

- simulating aurorae
- effects of solar wind on circuits

3. particle physics at the ISS: AMS data



<https://www.scienceinschool.org/2013/issue26/aurorae>

https://www.scienceinschool.org/2014/issue29/solar_wind



[discussion]

<https://wiki-lip.lip.pt/ProjectosDiversos/LIP-EduLab>