Practical work

M2 – NPAC – 2022/2023

Sorbonne University
University Paris Cité
Paris Saclay University

List of proposed Practical Works

CEA-Saclay (max. 6 teams*)

- Neutron – Gamma Discrimination (2 teams)
- How can we measure the shape of a nucleus? (1 team)
- Muon lifetime measurement (2 teams)
- Muon tomography using Micromegas Detector (1 team)

(*presented by E. Berthoumieux*)

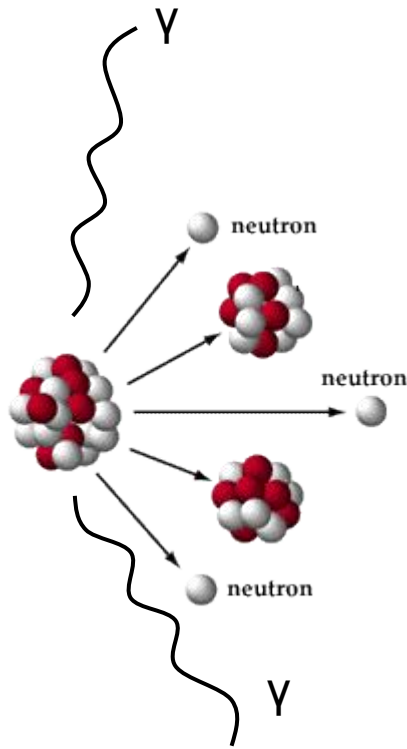* *1 team is composed by 2 or 3 students*

IJCLab-Orsay (max. 8 teams)

- Study of the Compton effect (2 teams)
- Muon lifetime measurement (3 teams)
- Cosmic-rays studies (1 team)
- Study of the decay of Positronium (2 teams)

(*presented by J. Biteau*)

(the Practical Work description can be found at :
https://npac.lal.in2p3.fr/wp-content/uploads/2022/Cours/TL/Fascicule-TL-2022-2023.pdf)

Neutron-Gamma Discrimination (2 teams)

Spontaneous fission source:
Emission of fission fragments,
gammas and neutrons

Aim: discriminate neutrons from gammas

Two complementary techniques:
- Time Of Flight (TOF)
- Pulse Shape Discrimination (PSD)

Tools: scintillators + PMT
- Inorganic: NaI(Tl); BaF_2
- Plastics: NE213
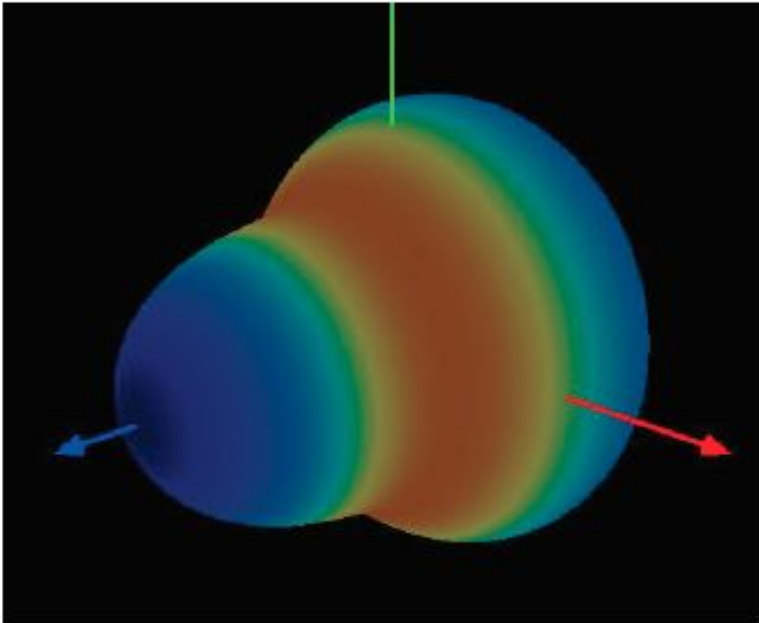- Organic liquid doped with Gd/Hf

Data acquisition and analysis
- DAQ card: MATACQ (signal sampling)
- Analysis: Python or ROOT tools

Supervisor: Eric BERTHOUMIEUX

By measuring the rotational band properties of ^{152}Sm, one can characterize the shape of the nucleus and deduce its axial deformation parameter

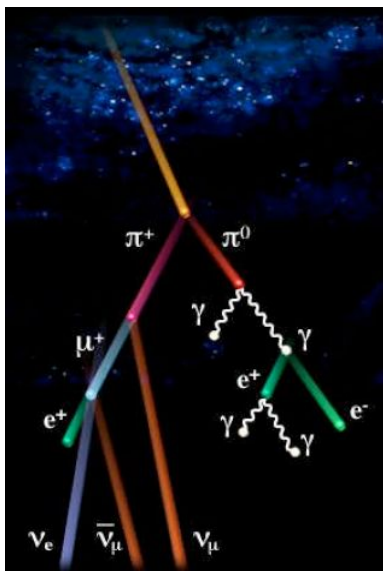**Aim: determine the shape of a nucleus**
Technique:
Gamma and electron spectroscopy

Tools: LaBr (fast timing detector) + Ge + Si

Data acquisition and analysis
- DAQ card: FASTER
- Analysis: Python or ROOT tools

Supervisor: **Pierre MORFOUACE**

Muon lifetime measurement (1 team)
1. Using STEREO demonstrator

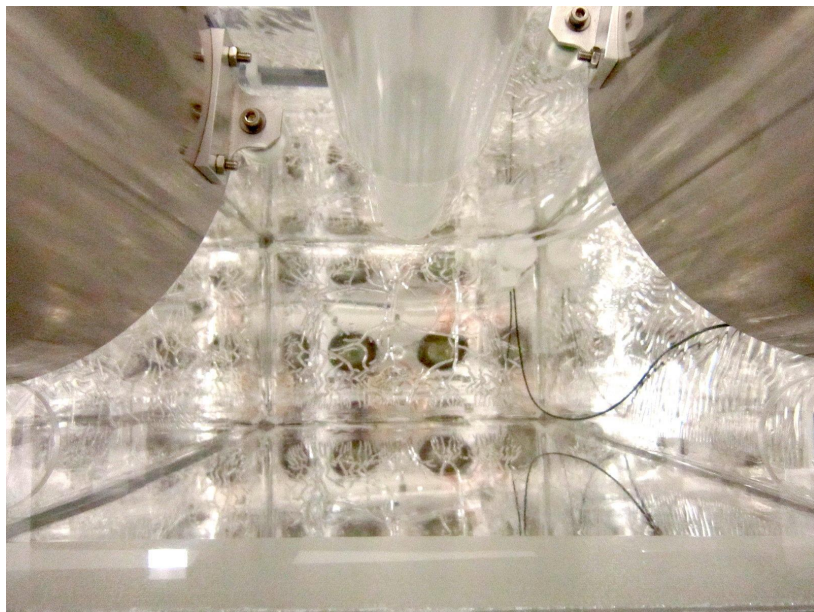**Aim: measure muon lifetime**

<u>Technique:</u>
Using Cherenkov effect in a water tank

<u>Tools</u>: 2 (recent!) PMT from
STEREO demonstrator

<u>Data acquisition and analysis</u>
- DAQ card: digital electronics
- Analysis: Python or ROOT tools

<u>Supervisor</u>: François BRUN
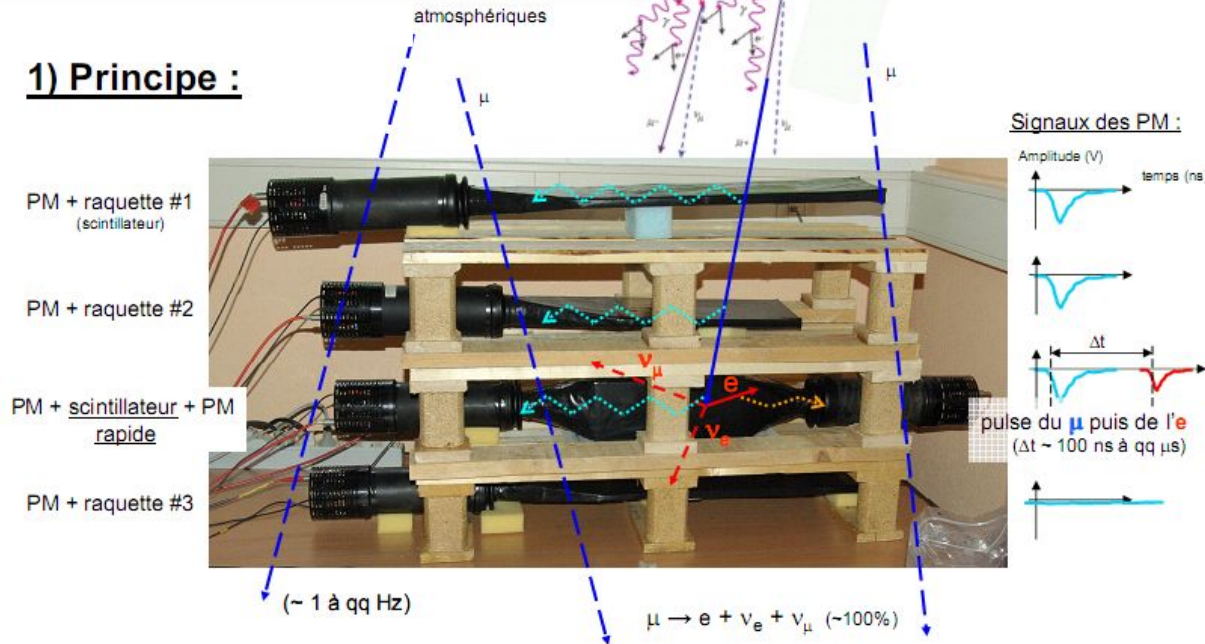
Aim: measure muon lifetime

Technique:
Isolate muon and electron signals using coincidences and anti-coincidences

Tools: plastics scintillators + PMT

Data acquisition and analysis:
- DAQ card: MATACQ (signal sampling)
- Analysis: Python or ROOT tools

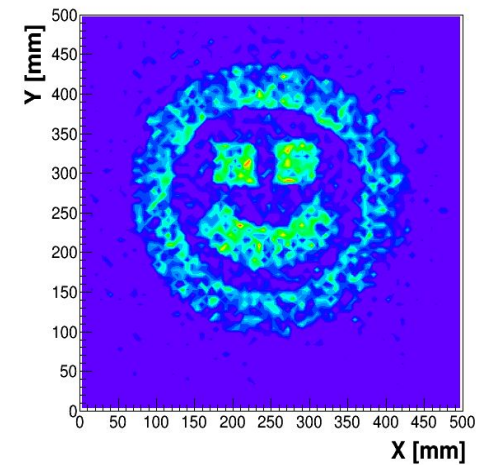**Supervisor: François BRUN**

Aim: perform tomography

Technique:
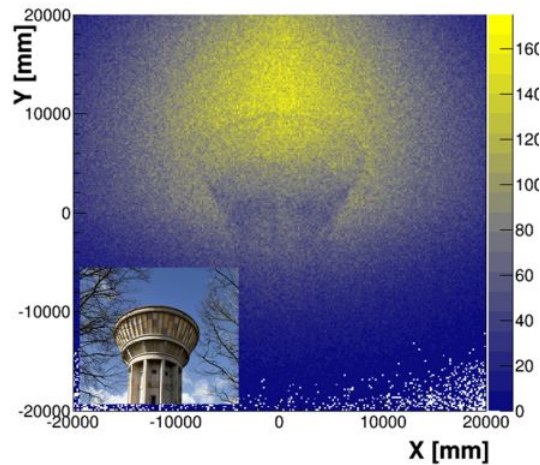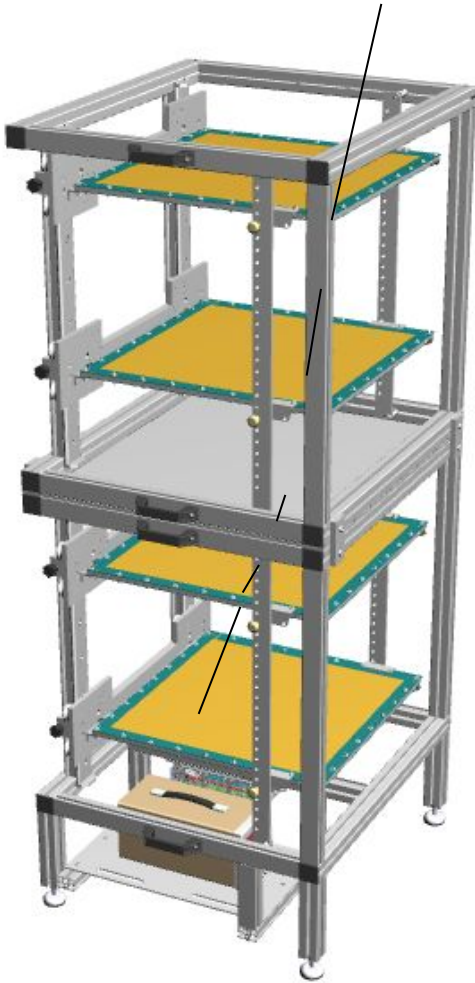Assembly and characterization of a tomographic bench

Tools: Micromegas gaseous detectors

Data acquisition and analysis
- DAQ card: digital electronics
- Analysis: ROOT tools

Supervisor: **Maxence VANDENBROUCKE**

RDV Tuesday September 6th 8:50 am
CEA Saclay - Orme des Merisiers Entrance

Bus 9 from RER B Le Guichet.
Stop at "Orme des Merisiers"

Remarks:
- ID
- Cash for the canteen if possible

Study of the Compton effect (2 teams)

Goal:
Study the Compton effect, by measuring the energy of the scattered photon, its angular dependence, and its differential cross section.
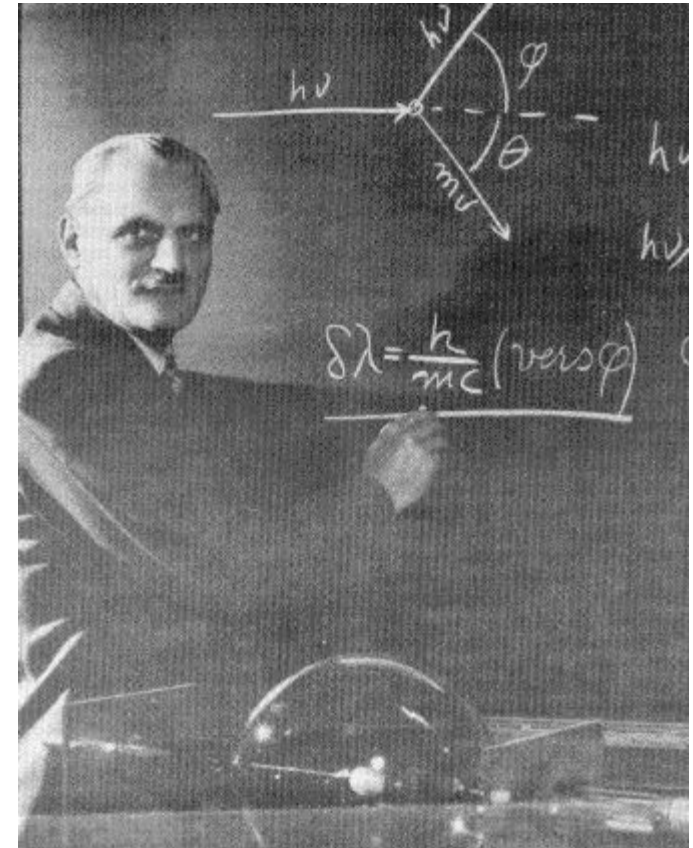
Method:
Coincidence measurements between incident and scattered gamma and scattered electron.

Material:
NaI(Tl) scintilators – NIM electronics – FASTER acquisition card.

Data analysis:
Python or ROOT tools.

Location: IJCLab Orsay
Supervisor: Matthew CHARLES

Muon lifetime measurement (2 teams)
1. Using a liquid scintillator

Goal:
Muon lifetime measurement.

Method:
Muon and electron detection.

Material:
Liquid scintillators – NIM electronics –
ISIPEAK/FASTER acquisition card.

Data analysis: Python or ROOT tools.

Location: IJCLab Orsay
Supervisor: Eleonora CAPOCASA,
                  Marco BOMBEN

Goal:
Muon lifetime measurement.

Method:
Muon and electron detection.

Material:
Water Cherenkov detector – NIM electronics – FASTER acquisition card.

Data analysis: Python or ROOT tools.

Location: IJCLab Orsay
Supervisor: Marco BOMBEN

Goal:
Measure the angular distribution of muons at the surface of the Earth.

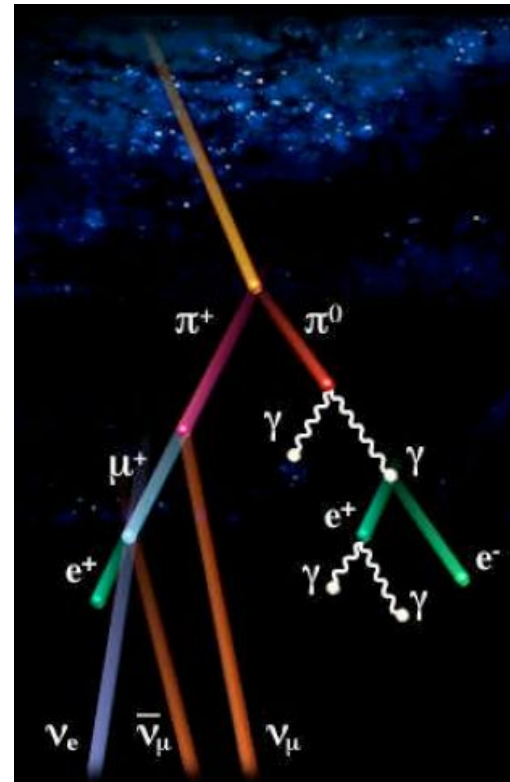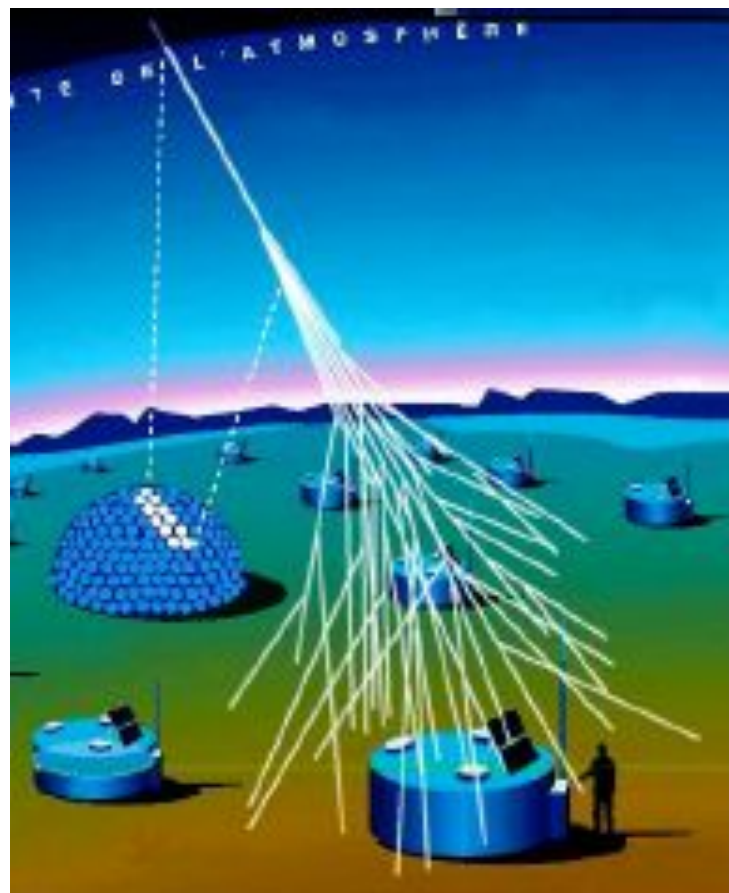**Method**:
Muon detection.

Material:
Plastic scintilators – NIM electronics – ISIPEAK acquisition card.

Data analysis:
Python or ROOT tools and Monte Carlo simulations and programming.

Better to have previous knowledge about MC simulation tools !

Location: IJCLab Orsay
Supervisor: Eleonora CAPOCASA

Positronium decay (2 teams)

Goal:
Study the decay of different states of positronium: ortho and para positronium.
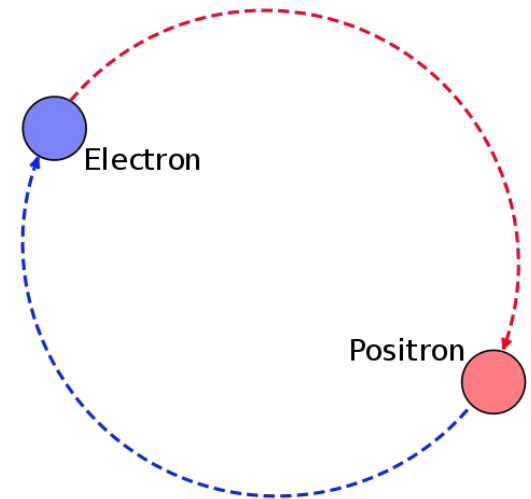
Method:
Coincidence measurements.

Material:
NaI(Tl) detectors – NIM electronics – FASTER acquisition card.

Data analysis:
Python or ROOT tools.

Location: IJCLab Orsay
Supervisor: Jonathan BITEAU

On the examination rules and more …

The aim of the laboratory work is to build one or more experiments using the available equipments to carry out a pre-defined physics measurement.

Five criteria are used in the final evaluation of the student laboratory work:
- autonomy and dynamism during the practical work (4 points)
- scientific interest for the subject (4 points)
- practical work logbook (2 points)
- the report (6 points)
- oral examination (10 minutes/team) (4 points)

You can find the template for the article here:
https://npac.ijclab.in2p3.fr/1st-semester-lectures-2223/

The template SHOULD NOT be modified. Limited to 4 pages.

Important dates:

- Week of 12th Sep. – free presentation of the subject by the students
- 14th Oct. – send report to supervisor(s) + J. Biteau and M. Vandebrouck
- 2nd November – oral examination

Organisation informations

The lecture on Security and Radioprotection is __mandatory__
(~1h following this presentation)

TL choice – Tomorrow morning (please read the TL booklet on the web)

Also:
- logbook presentation/distribution
- discussion about writing the report (more details last week of the TL)

Miscellaneous:
- TL: French or English for interaction with supervisors, for article (abstract in english)
- in case of absence: inform your direct supervisor
- library NPAC: code A5991
- if needed: IJCLab Library also
- schedule: 9h-12h, 14h-18h

Organisation informations (Covid)

- Mask recommended + wash your hands regularly

- Do not come if:
- Covid +
- Contact with Covid+
- You have symptoms

And keep informed by email :
- your supervisor(s)
- J. Biteau (biteau@ijclab.in2p3.fr), Eric Berthoumieux (eric.berthoumieux@cea.fr), M. Vandebrouck (marine.vandebrouck@cea.fr)