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EXP 12: Nachweiseigenschaften von Driftkammern/ Detection characteristics of drift tubes

F-Praktikum Review Day

Rosmarie Wirth

Specific points of reflection: Aim

Aim of the experiment

- What is the emphasis of the experiment?
  → **Understand how dirft tubes are used for muon tracking**
    - setup system to detect muon in drift tube

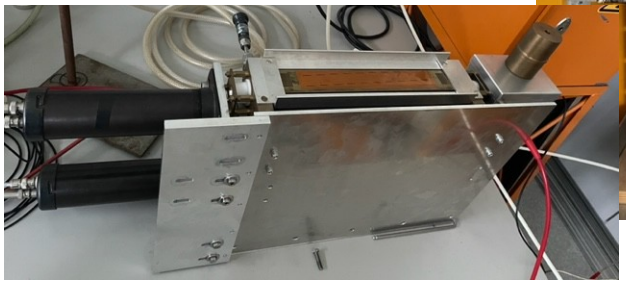
  → **Calculate relation between drift time and muon radius**
    - understand and setup a trigger system
    - digitize analog signal
    - develop code to analyze digital data

- How does it compare to state of the art experiments in the research field
  → drift tubes are used as muon trackers in e.g. ATLAS/CMS

Overview

Steps to complete

1. Calibrate the HV with a FE55 source
2. Observe muon signals in the drift tube
3. Implementing triggersystem
   → start first scintillator and PMT
   → ADC and counter for first scintillator
   → repeat with second scintillator
4. Test triggersystem and tune it
5. Setup FADC for overnight data taking
6. Start working on data analysis
7. Second long run of data taking
8. Analyse data with selfmade code



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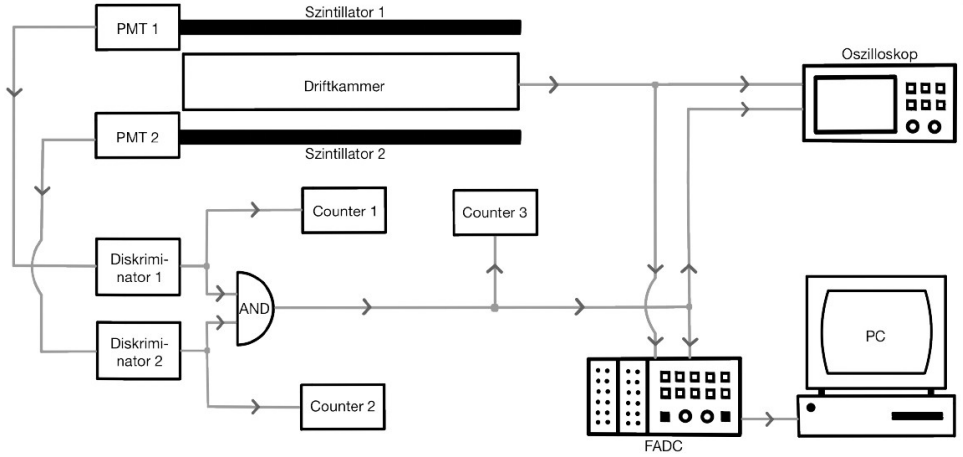
Triggersystem:



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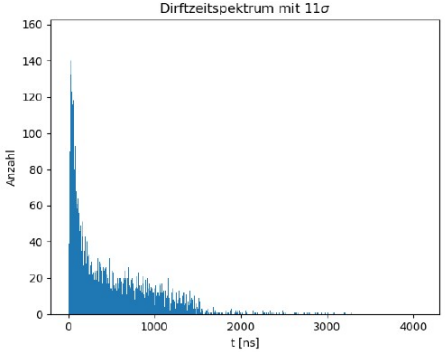
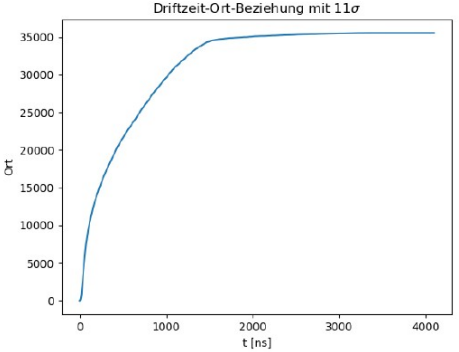
```python
import numpy as np
import matplotlib.pyplot as plt

class Data:
    """ The Data class is basically a container for an array that contains the raw voltage
        This class offers a method to plot the event using matplotlib

        Author: Stefan Bieschke
        Date: 02/12/2018
    """
    def __init__(self,data_array,event_number):
        """ Constructor
            Initializes a new Data object with the raw data measured by a FADC given as parameter. Also sets an event number.

            Author: Stefan Bieschke
            Date: 02/12/2018

            Parameters
            ----------
            dataArray : array
                Array containing the raw voltage readings from the FADC
            eventNumber : int
                Number of the event
        """
        self._raw_data = data_array
        self._event_number = event_number


    def get_drift_time(self,threshold,calibrated,triggertime = 0):
        """ Returns the drift time of this event's Data in nanoseconds
            The DataSet must be calibrated prior to calculating the drift time.

            Author: Stefan Bieschke
            Date: 02/12/2018

            Parameters
            ----------
            threshold : float
                threshold in volts that must be undershot in order to find drift time

            calibrated : bool
                specifying if DataSet is calibrated

            triggertime : int
                Time in the event where the trigger is located in ns

            Returns
            -------
            int
                Drift time in nanoseconds
        """
        #TODO: implement
        return 0
```





Specific points of reflection: Scientific Context

Scientific contest

- How is the experiment linked to the scientific bachelor program?
  → Experimental Particle Physics lecture:
    - How to detect particles?
    - How do different particles interact with matter?

- Added value to the experiment to the lectures
    - Hands on experience
    - Seeing differet detection methods in action
    - How to measure drift times and deduce a relation
    - Analysis of own data
    - Probably first contact to object oriented programming

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Specific points of reflection: Link to modern research

Link to modern research in the physics department

- What is the modern application of this technologies / experimental methods
  → Muon tracking in different particle physics experiments
- In which group are these technologies / experimental methods applied
  → Neutrino group (ship, LHC@SND), ATLAS/CMS
- What skills do the students gain which can be used in the research group?
  → Working with oszilloscope, ADC, FADC
  → Setting up trigger system
  → Data analysis with python
- What is the difference between state of the art equipment and the F-praktikum setup?
  → several drift tubes for track reconstruction,
  → cylindrical tubes,
  → …

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Grade your experiment

Each F-praktikum experiment accounts for 2.5 LP (= 2.5 SWS)

Students take:
- 1.5 - 2 days in the lab, + long data takings
- 1 – 2 days for data analysis under my supervison
→ 3 full days of work on side

Theory / preparation	Setup / experimental	Data taking	Analysis	Protocol
2.5	1.5	1.5	1	2.5

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Specific points of reflection: Experimental setup

Experimental setup (The black box)

- Do students have the possibility to assemble the setup?
  → Yes!
- Can they modify parameter? What is the largest systematic effect?
  → Yes! Adjusting setup to see a signal at all/only noise.
- Do they learn how is the measurable “signal” obtained?
  → Yes. Focus on understanding the signal and physics to setup trigger system.

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Specific points of reflection: Data analysis

Data analysis method

- Digitally taken data needs to be analyzed be the students
- Frame skript is provided
  - → itroduces the concepts of object oriented programming
  - → only provides a frame no functionality
  - → students follow steps to complete the code
  - → usually many discussions on data analysis, code structure, … needed
  - → final code should run the full data analysis automatically