Cool Title

Oslo Cyclotron Laboratory
Project FYS-3180

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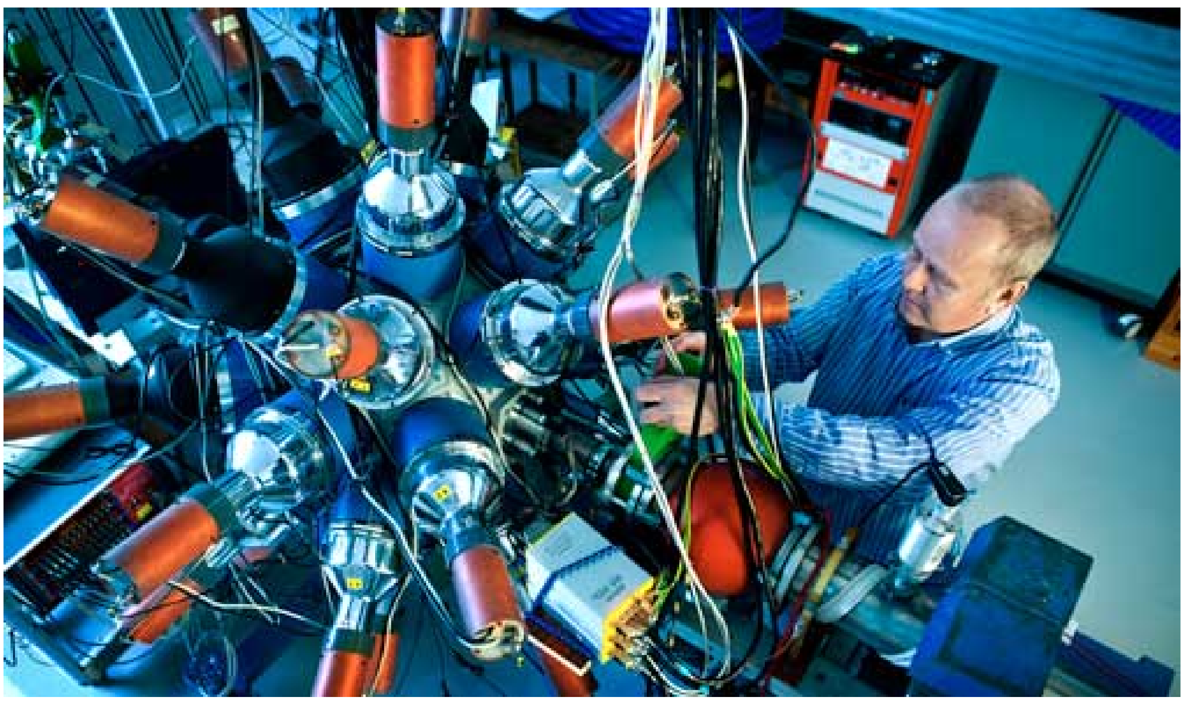

Figure 1: Magne Guttormsen working on the CACTUS/SiRi detector. From `http://www.mn.uio.no/fysikk/english/research/about/infrastructure/OCL/`

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1 Motivation and purpose

The purpose of this article is to give an (brief) introduction to detectors, systems and methods used in experimental nuclear physics. Important because blablabla learning about how to prepare and conduct an experiment and most importantly analyze and interpret the possible error sources.

Will give an short introduction to the OCL In this project we will focus on the basics of how the cyclotron works and

We will choose a particular reaction and prepare as for a real experiment by calculating (....energy lost in the ...kin...). We will then use data from an earlier experiment, analyse it and discuss possible error sources(?). Will also vertify/compare data with exsisting databases(?).

We will learn the terms: prompt time, particlebananas, thicknessspectra ++ (?)

Goal: particle-gamma coincidence matrix

2 Theory of experimental nuclear physics, what to measure

We know the energy of the beam, the Q value, the final energy of the emitted particles and their angle. We can therefore get the excication energy of the final nucleus

introduce to a general reaction and Q val so easy to talk about siri/cactus

then how to /what to measure

3 Experimental method, how to measure

3.1 The basic consepts of a cyclotron

A cyclotron is a particle accelerator for charged particles. The particles are accelerated with an external electric field and together with a magnetic field the particles are contained in an orbit inside the cyclotron. In nuclear physics a cyclotron is used to accelerate charged particles so that they leave the cyclotron with desired energy. The goal is then to study nuclear reactions that occur when the particle beam is directed to a target with different detectors.

A simple cyclotron consists of two half -cylinders placed side by side as in figure 2. Every time the particles pass between the two cylinders they are accelerated by an oscillating electric field. Therefore the particles increase speed and radius for every half round. Inside the

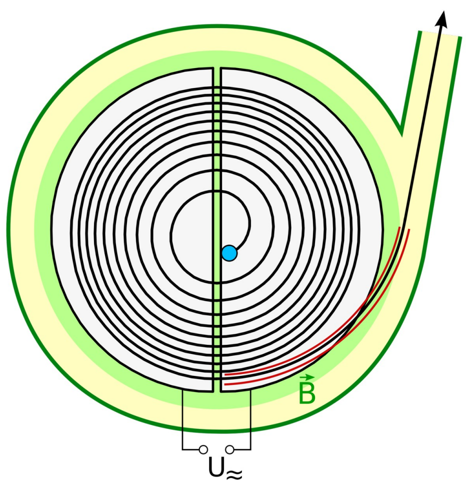

Figure 2: cyclotron copyright something.

cylinders the electric field is zero, but there is a magnetic field perpendicular to the plane showed in figure 2 that contain the particles in a circular orbit. When the radius of the particle beam is bigger than the radius of the cylinders the particles leave the cyclotron.

3.2 The Oslo Cyclotron laboratory (OCL) and the Oslo method(?)

The Oslo Cyclotron Laboratory (OCL) houses the only accelerator in Norway for ionized atoms in basic research[1]. The accelerator is used in various fields of research for instance nuclear physics and nuclear chemistry. Other applications for the Cyclotrone are the production of isotopes for nuclear medicine. The reasearch in nuclear physics at Oslo Cyclotron Laboratory mainly focus on studying the level densities and radiative strength functions where the overall goal is to better understand the nuclei. The

We can see the cyclotron vault to the far right in figure 3 with the cyclotron (MC-35 Scanditronix Cyclotron) at the bottom right. The beam of the accelerated particles travels from the cyclotron along the beam line through a switching magnet and to a analyzing magnet that directs the beam 90 degrees and out of the cyclotron vault. The beam then goes through another swiching magnet and into the experimantal hall and finally hitting the target chamber and the CACTUS-SiRi array to the far left. The swiching magnets can direct the beam to one of the other target stations, but we will only have a closer look at the CACTUS and SiRi detectors.

deflectors ? slits ?

3.2.1 The CACTUS and SiRi detectors

The CACTUS/SiRi detector can be used to study particle-gamma coincidences. In figure 4 we see an illustration of a particle from the beam hitting a target nucleus. After the reaction a gamma-ray and a particle is emitted in addition to the resulting nucleus beeing changed. We see that the gamma is measured by the CACTUS detector and the emitted particle by the SiRi detector.

[1] http://www.mn.uio.no/fysikk/english/research/about/infrastructure/OCL/index.html

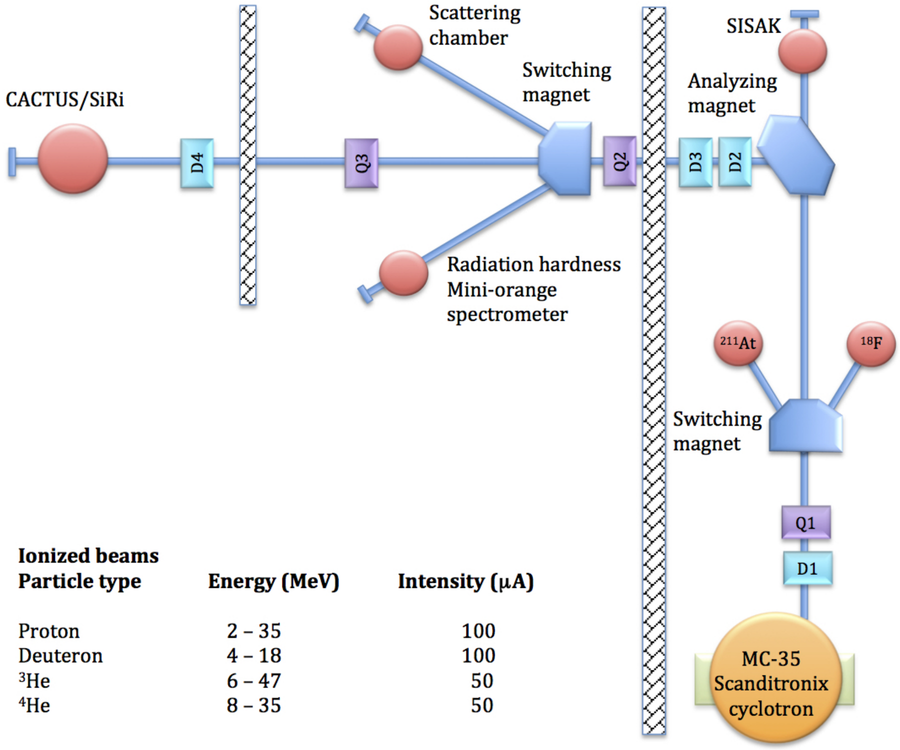

Figure 3: The experimentall hall of the Oslo Cyclotron Laboratory.

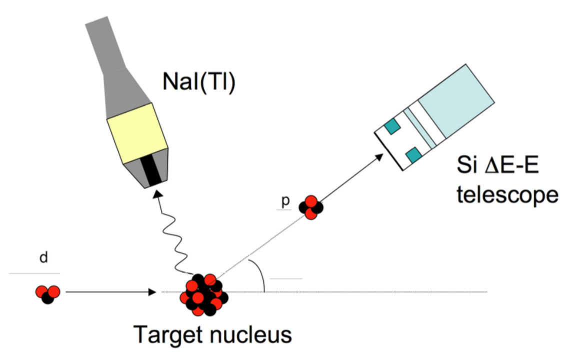

Figure 4: The CACTUS/SiRi detector used to study particle-gamma coincidences.

When looking at the front picture (figure 1) it is not hard to imagine where the CACTUS detector have gotten its name from. The detector consists of 28 NaI detectors spherically distributed around the target chamber, pointing out like a Cactus. The NaI detectors are very efficient gammadetectors.... Scintillators ?

The SiRi-array measure the energy of a particle and consists of 8 Si detectors on a ring. Each detector is divided into 8 strips which makes it possible to also measure the angle of the particle. In figure 5 we see the Silicon Ring (SiRi) to the left and a drawing of one of the detectors on the right with the induvidual strips marked.

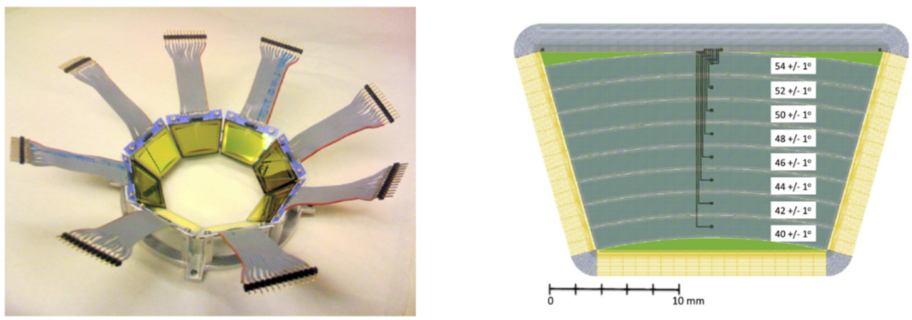

Figure 5: The SiRi detector used to measure the energy of a particle from a particle-gamma coincidence. The Silicon Ring (SiRi) to the left and a drawing of one of the 8 detectors on the right with the induvidual strips marked.

4 How to analyze experimental data

The gamma radiation and particle(utsending) is measured with the CACTUS and SiRi detectors. The dataset consists of event files; large files where each measured parameter from each nuclear reaction is written down. There are millions of event files that have been analyzed and sorted out. —>possible to folllow the experiment back to the beginning and "see" what happened.

4.1 Distinguishing particles: Particle bananas

4.2 The theory of coincidence matrix

5 Choice of target/reaction (?)

Choose a reaction (Si) We will calculate the parameters that are important for the experiment (with software kin) We will use data from an earlier experiment.

spesifics: we are going to analyse data from a reaction which a 16MeV proton beam on a 28Si target . the goal is to get familiar with the experimental methods at OCL and the data analysis

6 Preparation before experiment: kin software

7 Results/Data

7.1 Raw particle-gamma coincidence matrix

8 Analyze of the dataset

8.1 Final particle-gamma coincidence matrix

9 Discussion and Experiences