

## **Master project on Proton Radiography for Proton Beam Therapy**

### Introduction

In the near future a Proton Beam Therapy centre will be built in Groningen. We have started to collaborate with KVI and the UMCG in Groningen to improve the quality of the data on which the treatment plan is based. The idea of Proton Beam Therapy is to stop the protons in the tumour where they will deposit the major part of their energy, thereby destroying the tumour.

Currently, only the X-ray Computed Tomography data is used to determine the area that needs to be irradiated with protons to destroy the tumour. However, this data is not ideal to calculate the proton beam stopping power distribution as it is based on X-ray attenuation, which is a completely different physical process compared to the stopping of protons.

Therefore, we want to implement Proton Beam Computed Tomography, by shooting fast protons through the patient. To improve the information about where the protons are going to stop in the patient, we use a detector system that can track the beam both before and after the patient and at the same time will determine how much energy is dissipated in the patient.

### The project

In this project we are building such a proton radiography system at Nikhef and we test it both at Nikhef with e.g. cosmic rays and at KVI with a proton beam to reconstruct a phantom.

The topics on which we have on-going developments are the following:

- Building an improved version of the gaseous detectors that are used to track the protons.
- Electronic set-up to ensure proper synchronisation between the three detectors, as it is crucial that we can link the information from the three detectors for each event.
- Control software in python to control the event collection.
- Online analysis software in root to be able to verify the correct collection of data while we are taking data at KVI.
- Offline data analysis, also in root, to distinguish the different events based on data quality requirements, perform the track selection and fitting from the tracking detectors, reconstruct the energy dissipated in the object based on the deposited energy in the calorimeter and the initial beam energy and to perform the object reconstruction, based on all these parameters.