De verschillende projecten van TN voorjaar 2023

ASIA_TNA22_010	Datascience in het lab	
ASIA_TNA22_011	Kwantummechanica	
ASIA_TNA22_012	STM	
ASIA_TNA22_013	Aquaponics	
ASIA_TNA22_014	Dubbelbrekende fiber	
ASIA_TNA22_017	Zwaar water	
ASIA_TNA22_019	Een manuele knie tester voor gebruik in de klinische praktijk	
ASIA_TNA22_020	Raket	
ASIA_TNA22_021	Glow	
ASIA_TNA22_023	De Nederlandse Energietransitie interactief gemaakt	
ASIA_TNA22_024	Project TEMNOS: Automatisch batterij detectiesysteem	
ASIA_TNA22_025	Project Helios: Het recyclen en hergebruik van zonnepanelen	
ASIA_TNA22_026	Quantum computing	

Er zijn 13 projecten totaal

Longitudinal study of a patient with diabetes type 1

ASIA_TN22_010

What: Diabetes is a disease that affects about 422 million people worldwide [1]. In the Netherlands alone about 1 in 14 people are affected by the illness [2]. Diabetes is a chronic health condition characterized by highly fluctuating levels of glucose (sugar) in the bloodstream, which can lead to a variety of health problems, such as heart diseases and strokes [3]. A relatively new technology in the monitoring of glucose levels is a Continuous Glucose Monitor (CGM), which enables a better insight in glucose data due to more frequent measurements around the clock. This creates the opportunity for more accurate statistical analyses and predictions

Goal: Give advice to a type 1 diabetes patient on glucose and insulin intakes. This advice will be based on statistical analyses of their glucose data over a period of three years.

Importance: By analyzing the CGM data, improved control of the glucose levels can be achieved. This could greatly improve the health of diabetes patients. In the future, this project could even contribute to an automatic system for the control of glucose levels.

ENGINEERING PHYSICS

Students:

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Mirjam Hochstenbach	**Fontys School of Natural Sciences Applied Physics**
Timo van Doorn	**Fontys School of Natural Sciences Applied Physics**
Client:	**Fontys, Datascience in het lab**
Contact at Client:	**Ernst de Reeder Ilse van der Vondervoort Jo Theunissen**
Fontys Coach:	**Jo Theunissen**

Fontys
University of Applied Sciences

[1] World Health Organization. "Diabetes." https://www.who.int/health-topics/diabetes, cited on 21/03/23
[2] Diabetes Fonds. "Diabetes in cijfers." Retrieved from https://www.diabetesfonds.nl/over-diabetes/diabetes-in-het-algemeen/diabetes-in-cijfers?gclid=Cj0KCQiA7bucBhCeARIsAIOwr-8rcsC4l9QFHbMVwuXIhObzbVPGmKUCzg8c4pISYhZyzx3QscrRS2YaAvsZEALw_wcB, cited on 21/03/23
[3] Better Health Channel. "Diabetes - long-term effects." Retrieved from https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/diabetes-long-term-effects#about-diabetes-%E2%80%93-long-term-effects, cited on 21/03/23

Kwantummechanische simulaties situaties voor opdrachten in het vak quantum world

ASIA_TN21_011

Niet alles in de kwantummechanica kan analytisch uitgerekend worden. Voor het minor vak Quantumworld worden meerdere kwantummechanische problemen met behulp van simulaties opgelost (zowel met Matlab als Python):

$$-\frac{\hbar^2}{2m}\left(\frac{\psi_{i+1}-2\psi_i+\psi_{i-1}}{\Delta x^2}\right)+V(x)\psi_i=E\psi_i$$

Uiteindelijk wordt de volgende vergelijking opgelost door gebruik te maken van lineaire algebra:

$$\begin{pmatrix} \frac{1}{\Delta y^2}+V_1 & -\frac{1}{2\Delta y^2} & 0 & \dots & 0 \\ -\frac{1}{2\Delta y^2} & \frac{1}{\Delta y^2}+V_2 & -\frac{1}{2\Delta y^2} & \dots & 0 \\ 0 & -\frac{1}{2\Delta y^2} & \frac{1}{\Delta y^2}+V_3 & \ddots & \vdots \\ \vdots & \vdots & \ddots & \ddots & -\frac{1}{2\Delta y^2} \\ 0 & 0 & \dots & -\frac{1}{2\Delta y^2} & \frac{1}{\Delta y^2}+V_{N-1} \end{pmatrix} \cdot \begin{pmatrix} \psi_1 \\ \psi_2 \\ \psi_3 \\ \vdots \\ \psi_{N-1} \end{pmatrix} = E' \begin{pmatrix} \psi_1 \\ \psi_2 \\ \psi_3 \\ \vdots \\ \psi_{N-1} \end{pmatrix}$$

Het doel van ons project is om een opgaven boekje te maken met een set aan opdrachten die gemaakt kunnen worden. Hiervoor wordt ook docentenhandleiding bijgevoegd.

ENGINEERING PHYSICS

Students:

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Simon Versmissen	**Fontys School of Natural Sciences Applied Physics (TN)**
Stan Tops	**Fontys School of Natural Sciences Applied Physics (TN)**
Leroy Teegelbeckers	**Fontys School of Natural Sciences Applied Physics (TN)**
Client:	**Fontys University of Applied Scienes (TN)**

Fontys
University of Applied Sciences

Contact at Client:	**Willem-Jan van Harskamp**
Fontys Coach:	**Willem-Jan van Harskamp**

Table Top STM: Breng atomen in beeld

ASIA_TN22_012

Students:

Mr. Jorn van de Laar	**Fontys School of Natural Sciences Applied Physics**
Mr. Roan Jansen	**Fontys School of Natural Sciences Applied Physics**
Mr. Tim Mulder	**Fontys School of Natural Sciences Applied Physics**
Client:	**Fontys University of Applied Scienes**
Contact at Client:	**Inge Leermakers**
Fontys Coach:	**Inge Leermakers**

Binnen de semiconductor wereld wordt gebruik gemaakt van “scanning probe microscopes” (SPM). Deze microscopen bieden de mogelijkheid om naar een oppervlak te kijken op atomaire schaal. Hierdoor is het mogelijk om een ruwheid te zien van enkele atomen dik te zien. In diverse processen is dit van belang zoals in het maken van chips of het onderzoeken van het gedrag van elektronen in vaste stoffen. Onder de SPM valt de “scanning tunneling microscope” (STM). Deze gebruikt een naald waarvan het uiteinde slechts een atoom dik is. De STM scant een substraat door de naald op een afstand van minder dan 1 nm van het substraat te houden. Bij deze kleine afstand is het mogelijk dat er een stroom loopt tussen de naald en het substraat als gevolg van tunneling. Middels een regelsysteem wordt een piezo element zodanig aangestuurd dat de stroom constant blijft tijdens een scan over het oppervlak. Een plot van de beweging van het piezo element geeft hierdoor een afbeelding van het oppervlak op atomaire resolutie.

Binnen de opleiding Technische Natuurkunde is de “Naio table top STM” aangeschaft om deze techniek voor studenten beschikbaar te maken. Momenteel ontbreekt nog de benodigde kennis achter de STM, waardoor de invloeden en vereiste instellingen van de parameters onbekend zijn. De STM moet uiteindelijk te gebruiken zijn tijdens de practica van de studenten, welke circa 4 uur duren. Echter, is dit momenteel niet mogelijk doordat de juiste instellingen voor de STM nog onbekend zijn en het niet mogelijk is om deze te bepalen in de tijdspan van een practicum. Hierdoor is dit project ontstaan, waarbij het doel is om de werking van de STM te achterhalen en de nodige instellingen te bepalen zodat deze beschikbaar zijn voor andere studenten.

De opleiding eist dat er een duidelijke aanpak is opgesteld zodat tweedejaars Technische Natuurkunde student snel data kunnen verkrijgen zonder dat zij begrip hebben van de werking van de STM. Daarnaast moet er een duidelijke handleiding komen over de werking van de STM en de regeltechniek erachter. Een ander probleem is dat er momenteel beschikking is over slechts twee substraten, goud en graphite. Om het gebruik van de STM te stimuleren wordt daarom in dit project ook onderzoek gedaan naar andere mogelijke substraten.

Aquaponics Het meten van het elektrische veld van een plant

ASIA_TN22_013

Currently 54% of the area in The Netherlands is used for agriculture. Following recent events like the so called "nitrogen-crisis" and the "housing-crisis" this use of land has become a point of debate. One solution for this problem can be vertical farming or so-called city farms. Using aquaponics, the combination of hydroponics, the growing of plants in water, and aquaculture, the cultivation of water animals, the production of food can be moved to the city and use less area than the current agriculture. These aquaponic systems are however a challenge maintain.
To solve this issue, the aquaponic system can be integrated into a control system.

For this control system several inputs are needed. One of these is the amount of photosynthesis the plants are performing. Current devices for measuring this using the so-called PAM method are 15.000 euro. We are trying to develop our own sensor using the same method that is affordable and usable in ambient light. Using this method we will be able to measure the amount of photosynthesis as well as its efficiency.

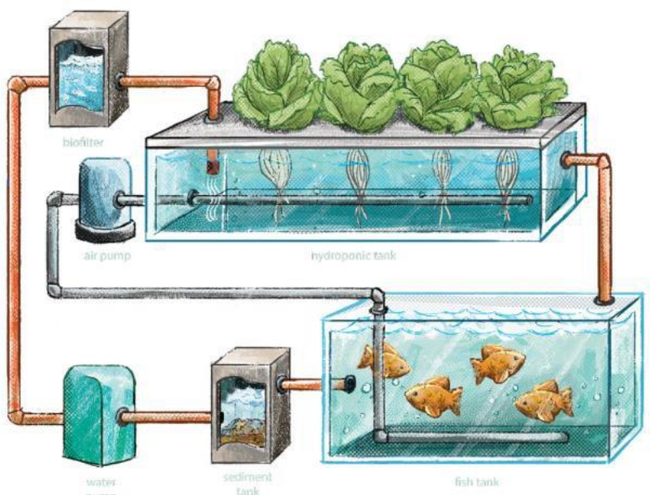
Students:

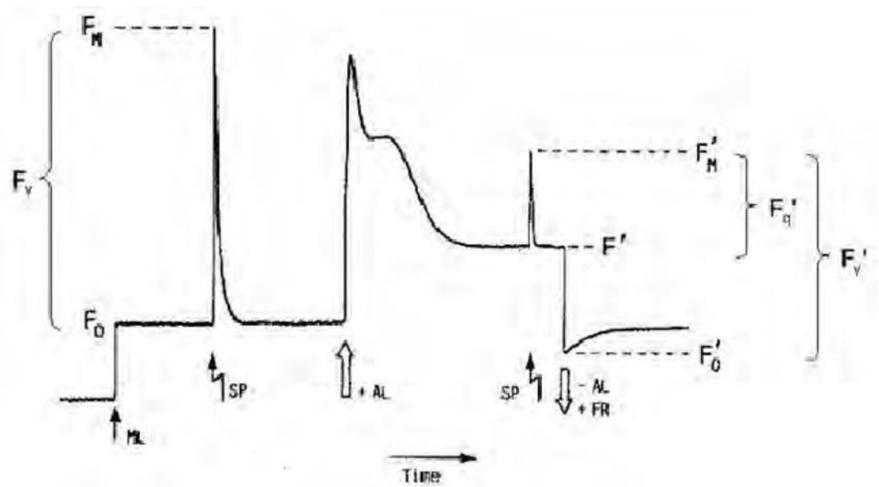
Patrick Krebaum	**Fontys School of Natural Sciences Applied Physics**
Thomas van Maaren	**Fontys School of Natural Sciences Applied Physics**
Mats Roelofs	**Fontys School of Natural Sciences Applied Physics**
Jos van der Steen	**Fontys School of Natural Sciences Applied Physics**
Basten van der Vorm	**Fontys School of Natural Sciences Applied Physics**

Client: **Bedrijf: Fontys Onderzoeksthema Detection and Measurement, Lectoraat TNW Fontys Eindhoven**

Contact at Client: Urs Wyder, Victor Snels en Lotte Spanjers

Fontys Coach: Lotte Spanjers



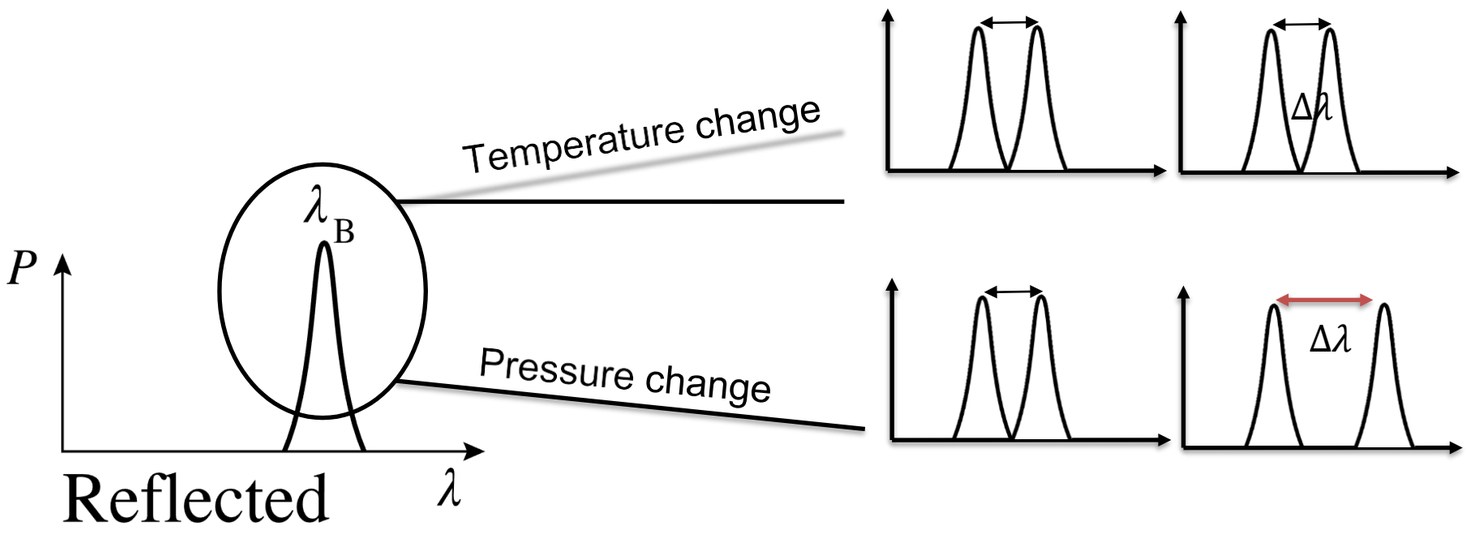


Dubbelbrekende Fiber
ASIA_TNA22_014

In recent years, the development of temperature and pressure sensors are encountering limitations. These limitations are mostly seen at hospitals when a patient is undergoing an MRI scan, the magnetic field distorts and breaks the sensors. One solution is to use an optic fiber to measure the temperature and pressure.

Because this fiber will only use light as it is an information carrier, it will not be affected by the magnetic field from the MRI.
The properties of light that passes through the fiber will change, due to the deformation of the fiber with temperature and pressure.

When using a Fiber Bragg Grating, (FBG), a small portion of the inserted light will be reflected back. The reflected spectrum consists of two peaks with a very small Δλ, due to the birefringence of the core.
The hypothesis is that the delta of these peaks will stay consistent due to changes in temperature but, will increase when pressure is applied. This would allow for differentiation between the changes in temperature and pressure.



ENGINEERING PHYSICS

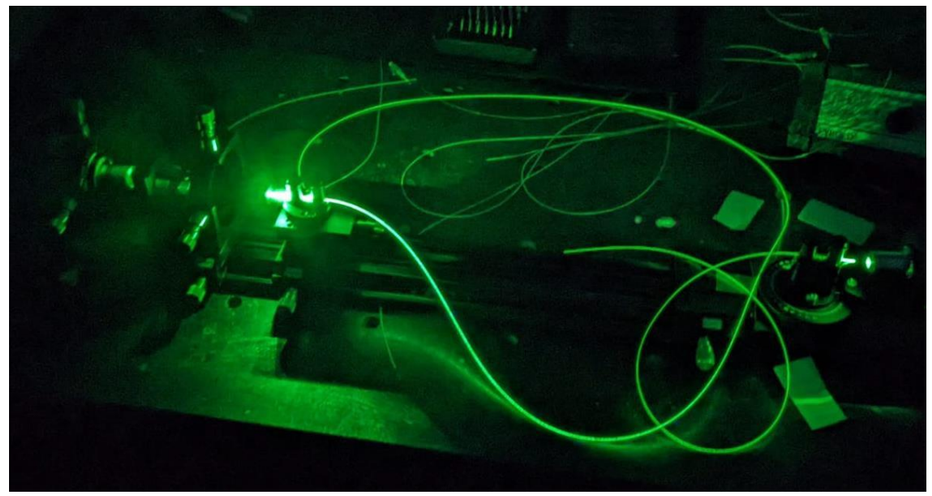
Students:

Bas Hankel;	**Fontys School of Natural Sciences Applied Physics**
Bram Spijkerman;	**Fontys School of Natural Sciences Applied Physics**
Jakob Schep;	**Fontys School of Natural Sciences Applied Physics**
Sjoerd Wijgerse;	**Fontys School of Natural Sciences Applied Physics**
Tom van de Goor;	**Fontys School of Natural Sciences Applied Physics**

Client: **Fontys School of Natural Sciences Applied Physics**

Contact at Client: **U.Wyder, V.Snels and L.Spanjers**

Fontys Coach: **U.Wyder**



Recycling heavy water

ASIA_TNA22_017

The company GE Healthcare produces radioactive fluorine isotopes using a cyclotron. In this process, heavy water is used. Heavy water is very expensive and cannot currently be reused because the fluorine is extracted from the heavy water using a chemical separation method, which contaminates the heavy water.

To solve this problem, we are going todevelop a method for evaporating the heavy water so that the fluorine and heavy water can be separated without contaminating the heavy water. We will be using a prototype that utilizes distillation to evaporate the heavy water.

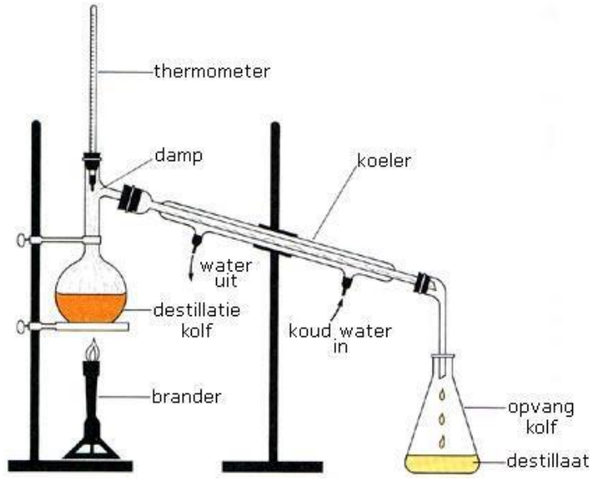


Figure 1: Example of experimental prototype for destilation..

ENGINEERING PHYSICS

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Tamara van Lee Rouschop — **Fontys University of Applied Sciences, Engineering physics**

Dror Daan Israël — **Fontys University of Applied Sciences, Engineering physics**

Pol Frankena — **Fontys University of Applied Sciences, Engineering physics**

Client: **GE healthcare**

Contact at Client: **Gerrie Lange**

Fontys Coach: **Mark Smeijers**

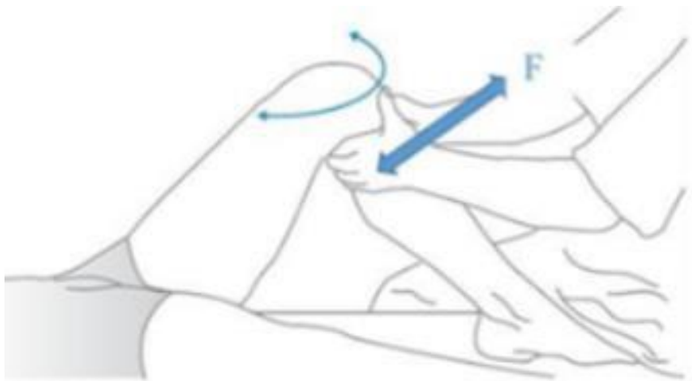
Development of the Manual knee tester (MKT)

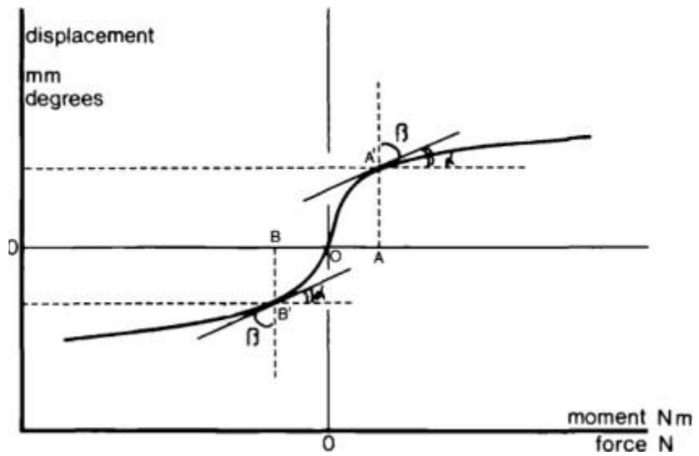
ASIA_TN21_019

This project is a follow up on the projects of the Manual Knee Tester (MKT). The start of this project was done by fontys A-fase and K-fase students from fontys, as by students from fontys engineering. They have made a prototype and tested different sensors to create a graph where the force is plotted against the displacement.

Now the project will be continued by further investigating sensors to measure the discplacement and force with the suggested methods from the previous ASIA groups. As the current sensors do not fit the mandatory accuracy. By investegating the sensor will be concluded if it is possible to maintain the current method of measuring with the limited budget or if it needs another accurate approach. This will recommend literature studies on sensors as multiple kalibrations.

As for the summa students they will focus on improving the current prototype of the MKT as the current prototpe is fragile and unpleasant for the patient. Further on will they intergrate the approved sensors inside the new prototype.





ENGINEERING PHYSICS

Students:	
Mr. Jakob Vullers	**Fontys School of Natural Sciences Applied Physics**
Mrs. Nikira de Haas	**Fontys School of Natural Sciences Applied Physics**
Mrs. Nika Mentges	**Fontys School of Natural Sciences Applied Physics**
Mr. Thomas Stiphout	**Summa mechnical engineering**
Mr. Teun Aarts	**Summa mechnical engineering**
Client:	**VOF Kinesiometrics**
Contact at Client:	**Dhr. Gerrit van Zoest**
Fontys Coach:	**Mr. Victor Snels**

Characterizing multi-pixel photon counters used for measuring cosmic radiation.

ASIA_TN22_020

The student team Payload for Radiation measurement and Radio-interferometry in Rockets Revisited (PR4) is focusing on the development of a payload on the REXUS 32 rocket. Currently, there is a suspicion that there is a correlation between the amount of cosmic radiation and cloud formation. Investigating this correlation is the goal of the team.

When measuring cosmic radiation, multi-pixel photon counters (MPPCs) are used to detect photons. These sensors require a bias voltage between 50 V and 70 V to function. When the sensor detects a photon, the circuit is shorted. The bias voltage should not be too high, as this can cause the sensors to short without detecting a photon, resulting in a false positive. When the bias voltage is too low, it may not cause a short circuit when a photon hits the detector, resulting in a false negative. The main problem is that the ideal bias voltage is unknown for the sensors. Additionally, this bias voltage also varies per sensor and depends on the temperature.

The goal of this project is to investigate the optimal bias voltage for multiple MPPCs, in a temperature range of -20°C to 60°C. The optimal bias voltage refers to the required voltage at which the MPPC makes the minimum amount of false positive measurements and is maximally sensitive. This is done to minimize the chance of false positive measurements. A light-tight measurement setup is required for this purpose, which does not currently exist. The second goal is therefore to design and create this light-tight setup. This measurement setup is then used to achieve the first goal.

figure 1: The logo used by the PR4-Team.

APPLIED PHYSICS

Students:	
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Kevin van Dueren den Hollander	**Fontys School of Natural Sciences Applied Physics**
Jurriën Lubbers	**Fontys School of Natural Sciences Applied Physics**
Samuel Deurloo	**Fontys School of Natural Sciences Applied Physics**
Client:	**PR4 Team**
Contact at Client:	**Roel Jordans**
Fontys Coach:	**Saskia Blom**

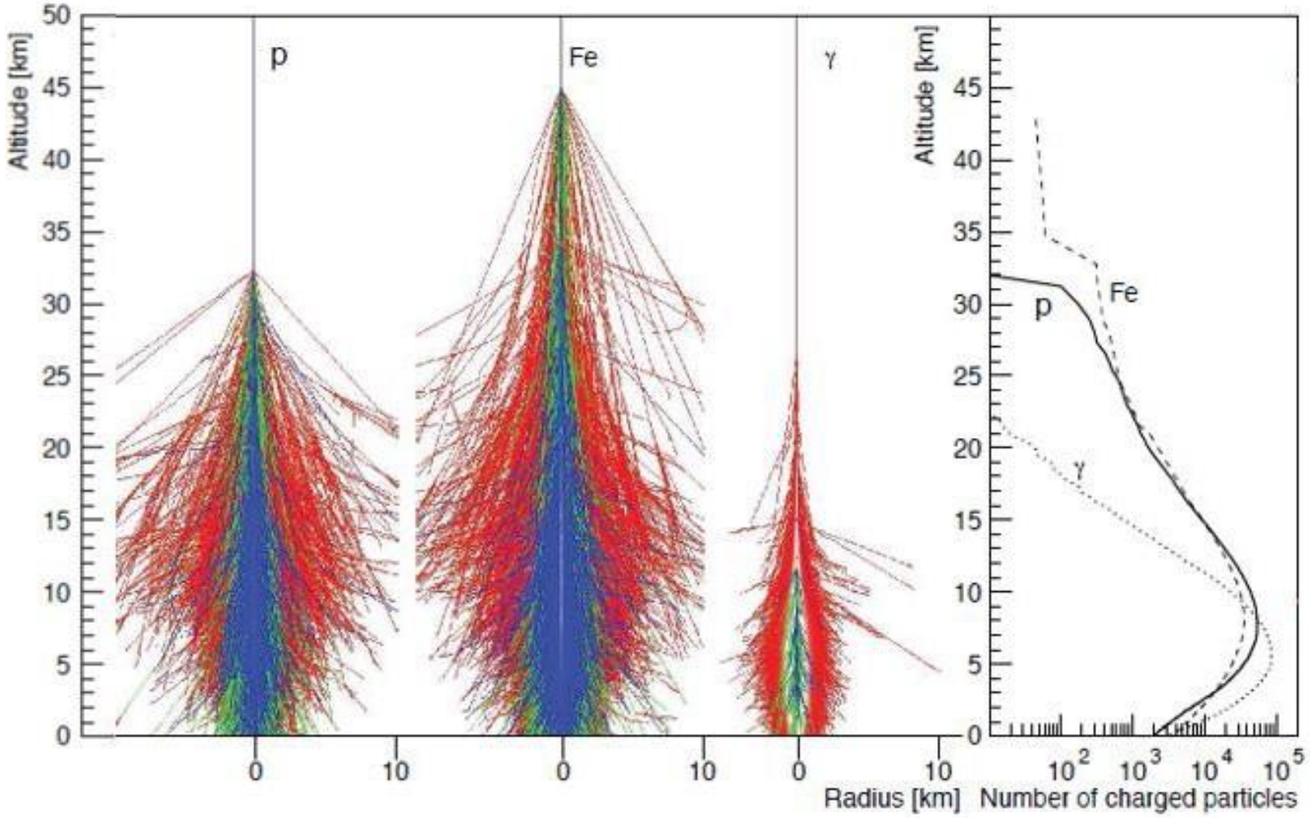

figure 2: Extended Air Shower of a proton in the atmosphere.

GLOW - The visualisation of sound

ASIA_TN22_021

Annually, a large festival called GLOW takes place in the city centre of Eindhoven. GLOW is a free-to-attend light art festival that has been attracting many visitors since 2006 with light shows and illuminated art on various iconic buildings. The company Sorama wants to, in collaboration with students of TN and SUMMA Mechatronics, create an art object to be presented at GLOW 2023 with the theme ‘The Beat’.

Most people are not aware of the effects that sound can have on the human ear. Unconsciously, our ears endure a lot by going to music festivals, just listening to music or by simply crossing the street. Noise pollution is something we deal with every day. To create awareness on this topic, an art installation will be built to put on GLOW. This design will be interactive as well as informative for the people attending GLOW. This way people will be made aware of the impact of sound while enjoying art in a gamification way.

Students:

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Roel A.E. Gerlings	**Fontys School of Natural Sciences Applied Physics**
Sven M. Munnik	**Fontys School of Natural Sciences Applied Physics**
Celine A.S. Pijpers	**Fontys School of Natural Sciences Applied Physics**
Wessel Klijn	**SUMMA College of Engineering Mechatronics**
Niels Spanjaards	**SUMMA College of Engineering Mechatronics**
Sybe van Nuland	**SUMMA College of Engineering Mechatronics**
Client:	**Sorama**
Contact at Client:	**Ellen Moerman**
Fontys Coach:	**Ir. Bart Smit**

Sorama
make sound insightful

GLOW

De Nederlandse Energietransitie interactief gemaakt

ASIA_TN21_023

Students:

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Elise Kuppens 3820491 — **Fontys School of Natural Sciences Applied Physics**

Ramon Boer 4041496 — **Fontys School of Natural Sciences Applied Physics**

Nick Willemsen 3489078 — **Fontys School of Natural Sciences Applied Physics**

Client: **Het Koninklijk Instituut voor Ingenieurs, Jan**

Contact at Client: **Vleeshouwers (Tu/e)**

Fontys Coach: **Lotte Spanjers**

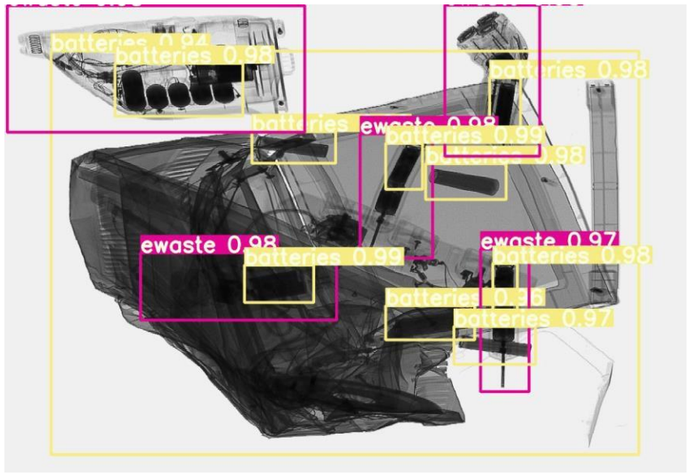
Hoewel de energietransitie in Nederland essentieel is in ons dagelijks leven, is bij het grote publiek weinig bekend over deze transitie. Gebaseerd op een rapport over de energietransitie in Nederland geschreven door KIVI (Koninklijk Instituut Van Ingenieurs) is daarom een applicatie gebouwd. Het doel van deze applicatie is om het groter publiek kennis en inzicht te geven over de energietransitie. Gebouwd in een LabVIEW programma is een game waarin de gebruiker ervoor moet zorgen dat in Nederland genoeg energie geproduceerd en/of geleverd wordt. Deze game heeft een aantal beperkende factoren bevatten zoals; de CO_2 uitstoot, de vraag naar energie en de bekostiging van de energietransitie van Nederland. Met het spelen van de game hopen we onder andere de volgende gedachten te stimuleren: “Welke energie stroomt van waar naar waar?”, “Op welke plaatsen raakt het energienetwerk overbelast?”, “Waar moet meer energie worden opgewekt?” en “Waar wordt energie weggegooid?”.

Temnos: battery detection and removal

ASIA_TN21_024

Student team CORE and ASIA group 24 are in development of an installation named TEMNOS that can recognize batteries in waste streams using artificial intelligence (AI). The installation can prevent hazardous waste fires caused by hidden batteries, which are number one cause of fires in the recycling industry and metal industry. By detecting batteries more efficiently, TEMNOS can reduce the risk of such fires. A concept is being build to determine the presence of batteries in phones. It uses robotics, machine learning, convolutional neural networks and an X-ray for autonomous operation.

Students:	
Marcel van Rooij	**Fontys School of Natural Sciences Applied Physics**
Karel Smolders	**Fontys School of Natural Sciences Applied Physics**
Jochem Westbroek	**Fontys School of Natural Sciences Applied Physics**
Robin van de Hogen	**Fontys School of Natural Sciences Applied Physics**
Charlotte Meulendijks	**Fontys School of Natural Sciences Applied Physics**
Bastiaan de Graaf	**Fontys School of Natural Sciences Applied Physics**
Client:	**CORE Changemakers**
Contact at Client:	**Dirk van Meer (CEO)**
Fontys Coach:	**Victor Snells**



Project Helios: recycling and re-use of solar panels

ASIA_TN21_025

Solar panels are widely used in our daily lives. Their are found on the roofs of houses, or in solar parks. The demands of the usage of the solar panels on the buildings of businesses is also growing. Due to different circumstances, the lifespan of a solar panel can be diminish due to weatherability and solar cell quality. Therefore the solar panels have a typical lifespan of 20-25 years until they have lost too much of their efficiency. The old solar panels will be switched out with new solar panels when they are finished. They could be replaced earlier due to new innovations such as improved efficiencies and reduced costs.

These days, there are more requirements to re-use the solar panel for a second life. Furthermore, organisations are more concernced with the safety of recycling and recovery of the solar panel. A lot of solar panels are thrown away or shredded.

During the period of the project, we analysed and looked into the possibility to re-using the solar panels. We concentrated at looking to remove the EVA layer of the solar panel wherefore the glass of the solar panel is as pure as possible. One of the ways to remove the EVA layer is to use pyrolysis. Before we are able to conclude if the glass is pure after pyrolysis, we executed multi TGA's and FTIR to analyse the presents of EVA on the glass.

Students:

Ruben Deckers	**Fontys School of Natural Sciences Applied Physics**
Gemma Kronenberg	**Fontys School of Natural Sciences Applied Physics**
Sander Verlijsdonk	**Fontys School of Natural Sciences Applied Physics**
Emma Vianen	**Fontys School of Natural Sciences Applied Physics**
Client:	**CORE changemakers**
Contact at Client:	**Dirk van Meer**
Fontys Coach:	**Saskia Blom**

An introduction to Quantum Computing

ASIA_TNA22_026

This ASIA project is aimed at designing a entry level curriculum for a Quantum Computing master for Engineering Physics. The subject matter of this curriculum will consist of the cornerstones of Quantum Computing such as Matrix and Dirac notation as well as the basics of superposition and entanglement. Further subjects in this course consist of: Stern-Gerlach apparatesus, Bell states, EPR paradox, Quantum cryptography and Mach-Zehnder interferometers.

Each subject will include dedicated programming assignments as well as thought experiments in order to give more insight into each subject. In some cases, where applicable, physical experiments will be design for the student to perform.

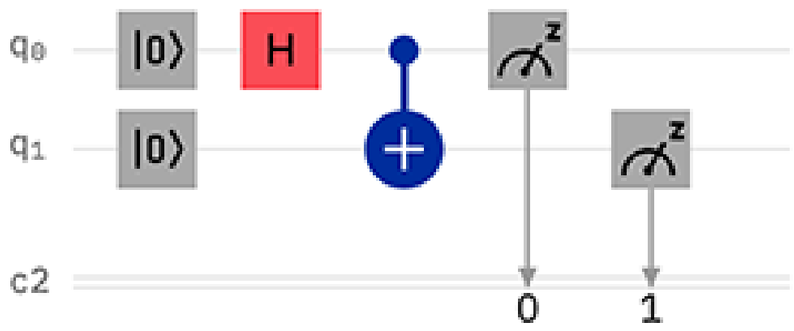


Figure 1: The Quantum circuit required to create a Φ^+ Bell state.

ENGINEERING PHYSICS

Students:

Mr. Daan Laureijssen — **Fontys University of Applied Sciences, Engineering physics**

Mr. Daniel Rouschop Dror — **Fontys University of Applied Sciences, Engineering physics**

Mr. Onno Salemans — **Fontys University of Applied Sciences, Engineering physics**

Mr. Stijn Pollen — **Fontys University of Applied Sciences, Engineering physics**

Client: **Fontys University of Applied Scienes**

Contact at Client: **Willem-Jan van Harskamp & Urs Wyder**

Fontys Coach: **Willem-Jan van Harskamp**