NET

Queen's Nuclear Engineering Team

INFORMATION PACKAGE

2026-2027

Who we are

Queen's Nuclear Engineering Team (QNET) is a new **student-led design club** at Queen's University at Kingston. Founded to bridge the gap between **theoretical physics** and **engineering** through **hands-on nuclear engineering projects** while fostering **industry connections.**

What we are trying to do

Our club's primary goal is to provide a platform for students who are interested in nuclear engineering to learn and apply their knowledge. While Queen's plays a massive part in the nuclear industry, undergraduate opportunities remain scarce. Through dedicated hands-on design and build projects, we hope to educate the next generation of nuclear engineers.

Our status

QNET is currently undergoing ratification, with plans to be ratified in September 2026. With already 30+ general members recruited, we have built our executive team and are currently developing materials for our launch this Fall.

Queen’s University at Kingston

Queen’s University is home to a highly respected Nuclear Materials Group, featuring two **UNENE Research Chairs** whose work spans nuclear materials degradation, corrosion control, and reactor life extension. This concentration of nuclear expertise makes Queen's one of Canada's **strongest recruiting grounds for emerging nuclear talent.**

The Reactor Materials Testing Laboratory (RMTL), led by **Professor Mark Daymond**, is a state-of-the-art research facility at Queen’s University dedicated to **designing, studying, and testing** the materials that will define the next generation of nuclear energy.

Queen’s Reactor Materials Testing Laboratory located at 136 Grant Timmons Drive in Kingston, ON.

The facility includes a proton and helium accelerator to simulate radiation damage experienced by materials inside fission and fusion reactors cores without the need for any radioactive samples.

The $17.5M lab showcases the existing nuclear infrastructure at Queen’s University. Having a world-class laboratory directly on campus provides our members opportunities in professional-grade nuclear research.

MAX-Nuclear at RMTL

The Materials at Extremes Nuclear Research Institute (MAX-Nuclear) is a Tier 1 Research Centre dedicated to material research in nuclear fission and fusion reactor environments. In 2015, RMTL was established, and now serves as a core research facility for MAX-Nuclear.

Our Materials Team Lead, **Noah Miggiani**, is conducting research as part of the MAX-Nuclear at Queen's University group this summer, under the Canada Excellence Research Chair in Impact of Radiation in Energy and Advanced Technologies, Dr. Yanwen Zhang.

Noah Miggiani, Materials Team Lead

"This summer, I have gained invaluable experience as part of the RE-MAT group within MAX-Nuclear. Guidance from my group has helped me achieve a deep understanding of material behaviour under irradiation. My work so far has been centered around SRIM, the industry-standard material irradiation simulation software. I have developed a Python library to automate calculations and plotting of the results from these simulations. With these greatly increased data analysis capabilities, I am investigating similarities between ion and neutron radiation. This will provide a greater insight into the use of ions as surrogates to study reactor materials behaviour under neutron irradiation."

Our Launch Timeline

Foundation

February 2026 - April 2026

- Build Executive Team
- Finalize Framework
- Determine Pilot Project

Build-Up and Development

May 2026 - August 2026

- Team leads work on their teams scope and goals
- QNET School Development
- Build internal infrastructure
- Plan fall kickoff events
- Acquire project funding
- Create marketing materials

Launch

September 2026 - April 2027

- Recruit general members
- Build team culture
- Launch QNET School
- Begin full development of inaugural project
- Create social media content showcasing progress
- Get ratified

The Future

April 2027 and beyond

- Establish industry partnerships
- Build a long-term project roadmap
- Develop more involved projects
- Mentor new leadership and ensure continuity
- Collaborate with faculty research groups

Introducing the 2026-2027

NET

Executive Team

9 Team Leads, 4 Directors

TEAM LEADS

MECH LEAD

Tochukwu Odiwa
BASc Candidate for
Engineering Physics, Mechanical Option
Class of '28
Sobey Scholar '24

MECH LEAD

Aidan Woods
BASc Candidate for
Engineering Physics, Mechanical Option
Class of '28

ELEC LEAD

Arsalan Vahidi
BASc Candidate for
Engineering Physics, Electrical Option
Class of '28

ELEC LEAD

Boden Parent
BASc Candidate for
Electrical Engineering
Class of '29

MECH LEAD

Gabriel Brannon
BASc Candidate for
Engineering Physics, Mechanical Option
Class of '28

MECH LEAD

Tejas Marwaha
BASc Candidate for
Engineering Physics, Computing Option
Class of '28

RESEARCH LEAD

Justin Hooey
BASc Candidate for
Engineering Physics, Electrical Option
Class of '27

RESEARCH LEAD

Ella Adair
BASc Candidate for
Engineering Physics, Materials Option
Class of '28

MATERIALS LEAD

Noah Miggiani
BASc Candidate for
Engineering Physics, Materials Option
Class of '28

DIRECTORS

FINANCE

Alex Hayes
MSc Candidate for
Particle Astrophysics

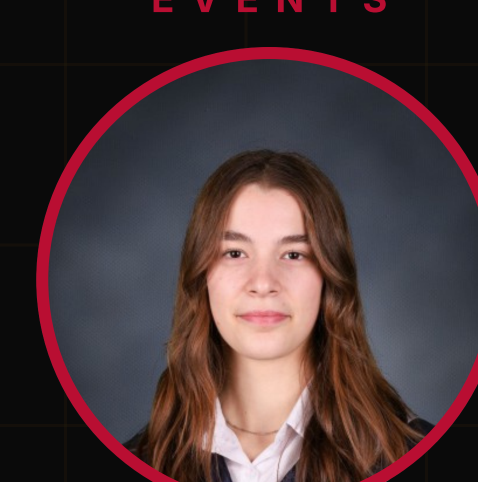
SPONSORSHIP

Alyssa Maticka
BASc Candidate for
Mechanical Engineering
Class of '28

MARKETING

Regan Lane
BASc Candidate for
Mathematical Physics
Class of '29
2025 Schulich Leader

EVENTS



Naomi Cain
BASc Candidate for
Engineering Physics, Materials Option
Class of '28

HEADS

FOUNDER AND PRESIDENT

Ryan Haghi

BASc Candidate for
Engineering Physics, Mechanical Option
Class of '28

"I started QNET to provide a platform for Queen's undergrads who aspire to go into the nuclear industry. Having a design club like QNET not only gets people thinking about nuclear engineering early on in their undergrad, but it also helps this generation learn about the nuclear industry where they otherwise wouldn't be exposed to it. We have such a great opportunity to change the way people think about nuclear engineering, and I couldn't have a better team to accomplish our goals for this year. I am so excited to see what QNET does in our inaugural year and in the many years that follow."

OUR FACULTY ADVISOR

Francesco Ambrogi, Ph.D.

Assistant Professor, Mechanical & Materials Engineering

Ph.D., Queen's University, Mechanical Engineering, 2024
MASc, University of Bologna (Italy), Energy and Nuclear Engineering, 2019
BASc, University of Modena and Reggio Emilia (Italy), Mechanical Engineering, 2015

MATERIALS TEAM

This specialized branch of QNET bridges the gap between mechanical design and nuclear physics. The team focuses on modeling atomic-level interaction, evaluating material degradation, and predicting how structural materials behave under intense reactor conditions.

While the other sub-teams focus on project design and build, the Materials team focuses on simulations and virtual testing. Students in this branch can be expected to:

- Utilize industry-standard ion irradiation modeling software like SRIM to predict radiation depth, energy deposition, and primary material damage production in critical components
- Research and analyze reactor materials to safely predict how they will respond to operational stresses
- Model degradation, microstructural responses, and other mechanical properties and effects

MEET THE LEAD

MATERIALS LEAD

Noah Miggiani

BASc Candidate for
Engineering Physics, Materials Option
Class of '28

Noah is a third-year Engineering Physics student specializing in Materials. This summer he is gaining hands-on nuclear industry experience conducting real-world research at Queen's through MAX-Nuclear. Working under Canada Excellence Research Chair, Dr. Yanwen Zhang, Noah focuses on cutting-edge radiation damage mechanics. He brings his professional experience to QNET, providing opportunities for general members to learn from him.

MATERIALS STUDIES

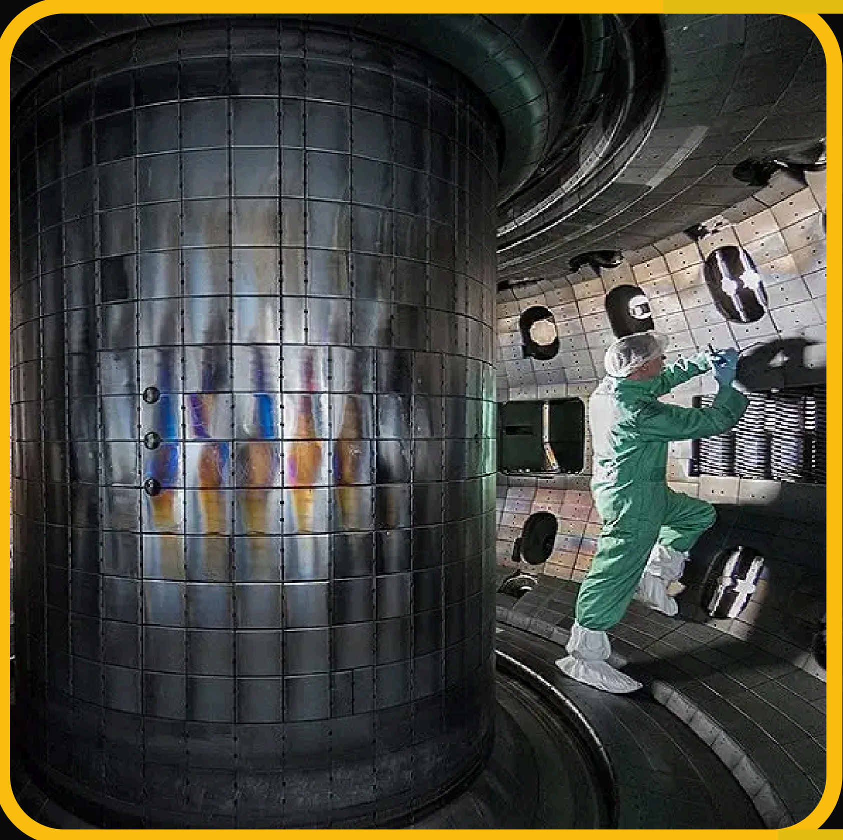
Although the Materials Team plays a crucial role in developing our projects, they will have their own studies independent of our flagship build. As of July 1st, 2026, the Materials sub-team has completed preliminary research to establish three potential study tracks.

Ion Surrogates for Neutron Radiation Damage

This track compares the difference in neutron beams and ion beams in both their recoil spectra and energy deposition partitioning. By comparing which locally-available ions produce spectra and energy-partitioning profiles that most closely mimic real neutron damage, researchers can identify better surrogates for running more accurate experiments with ions rather than neutrons — which are harder to use precisely, as they carry no charge. Our team plans to utilize SRIM simulations, as it is uniquely suited for capturing the recoil spectra and doesn't require any physical experiments aside from experimental validation.

Athermal healing of irradiation damage

This track looks into the mechanisms behind athermal processes due to high electronic energy deposition in irradiation by swift ions. Our team aims to run a literature review to determine electronic stopping power thresholds for irradiation-induced annealing and amorphization. By running SRIM simulations of common reactor wall materials against various ions, this track identifies the most efficient ion-target combinations for inducing healing effects without amorphizing (to cause further damage to) the material, and could extend the service life of reactor components.



Candidate Materials for Near-Future Fusion Reactors

This track evaluates the damage incurred by candidate fusion reactor wall materials, such as single-phase concentrated solution alloys (SP-CSAs), copper alloys, and tungsten alloys, when exposed to ions like hydrogen and helium found in fusion plasma environments. By combining SRIM simulations with a literature review, we gather insight on current research centered on selecting durable, plasma-facing inner wall materials for near-future energy systems.

2026-2027

NET Projects

Project Philosophy

Before introducing the projects we are actively developing, we've created a Project Charter that all potential QNET projects must follow:

01. Teaches Nuclear Concepts

Providing members with tangible, hands-on experience with nuclear physics.

02. Involves Multiple Disciplines

Nuclear engineering is a vastly interdisciplinary field, therefore our projects must reflect that.

03. Achievable within Timeline and Resources

Scoped appropriately to be completed safely and effectively by a student team.

Our executives are currently preparing the framework of three (3) different projects, including comprehensive feasibility reports, technical risk assessments and the establishment of strict milestones and checkpoints for their respective teams.

We believe general member contribution is crucial, and will let general members vote on which project out of the three will be QNET's build for the 2026-2027 school year. This process ensures that our entire general body is deeply invested in the mission from day one.

Projects Forenote

All information related to the projects below is tentative and is subject to change. As of July 1st, 2026, all three flagship projects have completed a comprehensive feasibility report to determine sponsorship goals. Each project was evaluated under two distinct scenarios: a Minimum Budget required for essential technical success, and an Ideal Budget that outlines the optimal fiscal scenario required to bring our ideas to life.

Any inquiries surrounding additional project information and/or sponsor integration can be sent to r.haghi@queensu.ca

Project A:

Nuclear Cleanup Rover

The nuclear cleanup rover, developed and conceived by Tejas Marwaha and Gabriel Brannon, serves as a remote-control handling platform explicitly designed to replace human intervention during hazardous nuclear operation.

Project Scope and Specifications

Objective: To design, model, and assemble a highly functional mobile chassis carrying a multi-jointed robotic arm capable of traversing a restricted zone, retrieving localized material, and securing it into storage.

Technical Specifications:

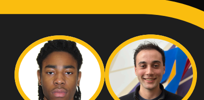
- Must feature a 360-degree horizontal rotation shoulder base with vertical and horizontal elbow and wrist tracking joints
- Must stably lift and transport targeted objects weighing between 0.25 to 1.0 kg without failure
- Must be fully operated from a safe distance using a remote controller or dedicated web application

By developing this project, students actively:

- Gain an understanding of how reactor control rods are handled, inspected and moved within automated reactor systems
- Learn the safe transportation and storage constraints required to move nuclear fuel components
- Develop a clear understanding of radiation detection

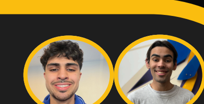
In addition, students develop valuable technical skills depending on what sub-team they are in.

Mechanical Sub-Team



- Develop advanced proficiency in CAD and additive 3D printing
- Learn how to run computational stress, strain and load-distribution simulations
- Gain practical experience in structural tolerance design, mechanical joint design, and end-effector gripper mechanics

Software Sub-Team



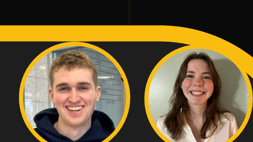
- Write low-latency control logic in either C (microcontrollers) or Python (microprocessors)
- Learn and implement advanced forward and inverse kinematics math equations
- Design off-site UI via software apps or web platforms (IoT)

Electrical Sub-Team

- Learn how to map custom schematics into PCBs
- Understand voltage regulation and basic power architecture
- Gain experience in electrical safety, noise isolation and emergency power cutoffs.

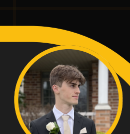
This project creates research opportunities for both the Research and Materials Team.

Research Sub-Team

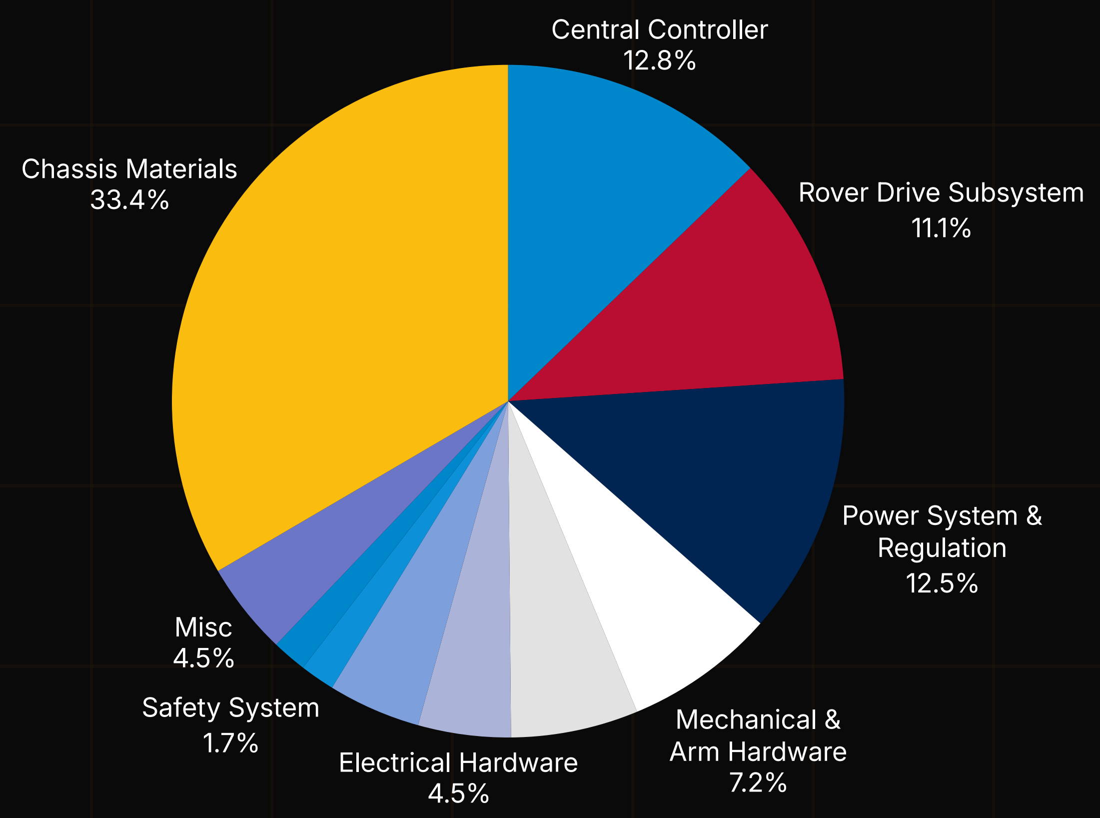


- Draft formal roadmaps to evaluate the rover's scalability
- Create engineering reviews that compare our rover's design and metrics against real-world nuclear robotics
- Write case studies on how automated logic vs manual control is utilized during containment failures

Materials Sub-Team



- Model the mechanical stress, wear and thermal degradation profiles of different structural mediums over long-term operations
- Research and analyze safe substitute materials to predict how the physical arm would react if it were handling real structural reactor components from irradiation



Estimated Cost

Our preliminary assessment of the **Rover** project is estimated to cost **$1060 - $1385**. Any additional surplus will go towards additional sensors, better components, and most importantly, stronger materials to construct the rover.

Project B:
SMR Cooling System

The SMR Cooling System, developed and conceived by Aidan Woods and Justin Hooey, is designed to simulate a real-world SMR cooling system, equipped with a Cooling Tower.

Project Scope and Specifications

Objective: To design, model, and assemble a highly functional cooling system modeled after Small Modular Reactor (SMR) cycles to evaluate heat rejection and to test the cooling system's effectiveness in simulated disasters.

Technical Specifications:

- Must feature four focus systems: a mock reactor core that generates heat, a primary convection cycle, a secondary steam cycle, and integrated control systems
- Must operate with working fluid temperatures of 90 - 120 degrees Celsius
- Working fluid will be non-toxic and non-flammable
- Loop must possess proper calculations for pressure vessel limits and safety thresholds to manage potential vacuum or over-pressure safety hazards.

By developing this project, students actively:

- Develop an understanding of real-world reactor operations
- Gain an understanding of power generation cycles
- Learn real-world reactor operational anomalies and power-less accident scenarios

In addition, students develop valuable technical skills depending on what sub-team they are in.

Mechanical Sub-Team

- Develop advanced proficiency in CAD, parametric assemblies, and technical drawings
- Learn how to calculate safety thresholds, pressure vessel limits, and structural geometries for high-temperature piping systems.
- Gain practical experience in scaling multi-loop fluid convection geometries using lightweight rapid-prototyping materials.

Software Sub-Team

- Write control software to track real-time system temperatures, pressures, and other parameters
- Learn and implement automated safety logic to handle simulated operational anomalies
- Design UI and sensor integration to monitor the system

Electrical Sub-Team

- Learn how to map complex power layouts and custom hardware schematics into prototypes
- Understand voltage regulation and basic power architecture
- Gain experience in sensor wiring and safe electrical practices

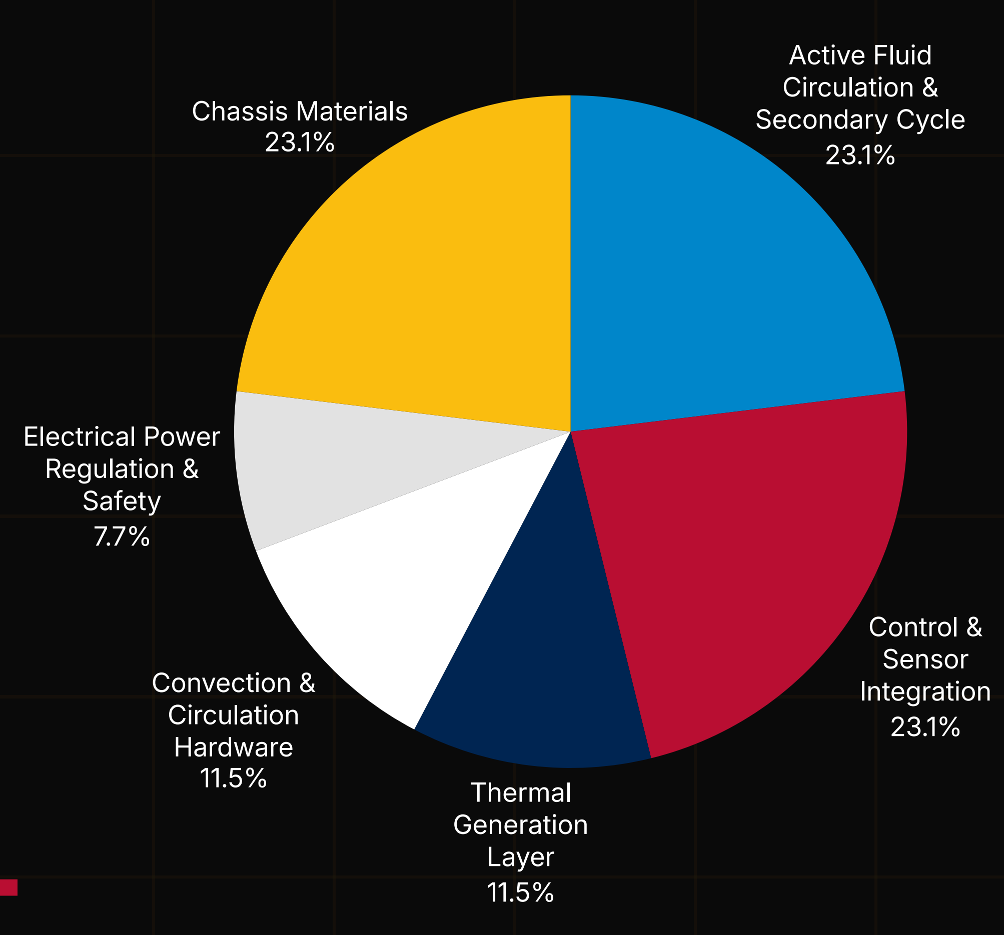
This project creates research opportunities for both the Research and Materials Team.

Research Sub-Team

- Draft formal proposals evaluating the effectiveness of the design
- Create engineering reviews that compare our student-scale loop against active SMR cycles
- Write case studies analyzing real-world incidents and how it could have been handled better

Materials Sub-Team

- Model the structural integrity of scaled pressure vessel mockups
- Research non-toxic, non-flammable working fluids to find the most optimal profile
- Predict material degradation profiles under operating conditions.



Estimated Cost

Our preliminary assessment of the **SMR Cooling System** project is estimated to cost **$800 - $1000**. A full scale industrial loop with proper fluid handling, telemetry and data acquisition is estimated to cost **$3,500 to $5,000.**

Project C:

Gamma Ray Imaging

The Gamma Ray Imaging Project, developed and conceived by Tochukwu Odiwa and Arsalan Vahidi, aims to build a scaled down, low-cost medical imaging prototype based on the mechanisms of a PET scan.

Project Scope and Specifications

Objective: To design, model, and assemble a Gamma Ray Imaging system that is able to pinpoint the exact location where radiation originated from in 3D space.

Technical Specifications:

- Utilizes two identical detector sets with a crystal array made out of BGO to convert incoming invisible gamma rays from a decaying thoriated tungsten rod to a faint spark of light, and semiconductors to convert the light into an electrical pulse.
- The system must be enclosed in a box to prevent light leaking in
- The system must precisely map out the coordinates of the detectors to calculate and draw intersecting vectors (lines of response) between the two sets, generating a reconstructed 3D image of the object

By developing this project, students actively:

- Gain an understanding of the physics behind positron decay
- Learn how the nuclear industry is able to map radiation outside of a basic Geiger counter
- Study quantum mechanisms such as the photoelectric effect and Compton scattering
- By using thoriated tungsten welding rods, students will gain experience with natural decay chains and basic radiation safety

In addition, students develop valuable technical skills depending on what sub-team they are in.

Mechanical Sub-Team

- Develop advanced proficiency in CAD in developing a light-tight enclosure
- Learn how to run computational stress, strain and load-distribution simulations
- Gain practical experience in structural tolerance design and mechanical joint design

Software Sub-Team

- Understand and utilize Field-Programmable Gate Arrays (FPGA) instead of basic Arduino
- Learn and implement high-speed clocks to time-stamp incoming pulses at the nanosecond
- Write scripts to handle spatial data processing, using linear algebra and trigonometry to calculate the LOR and convert them to a rendered 3D Image

Electrical Sub-Team

- Master Transimpedance Amplifier circuits to convert small signals into readable voltages from the semiconductors
- How to build a circuit that actively filters out noise
- Learn how to design, lay out and order a custom PCB that integrates the sensors, amplifiers and power sources

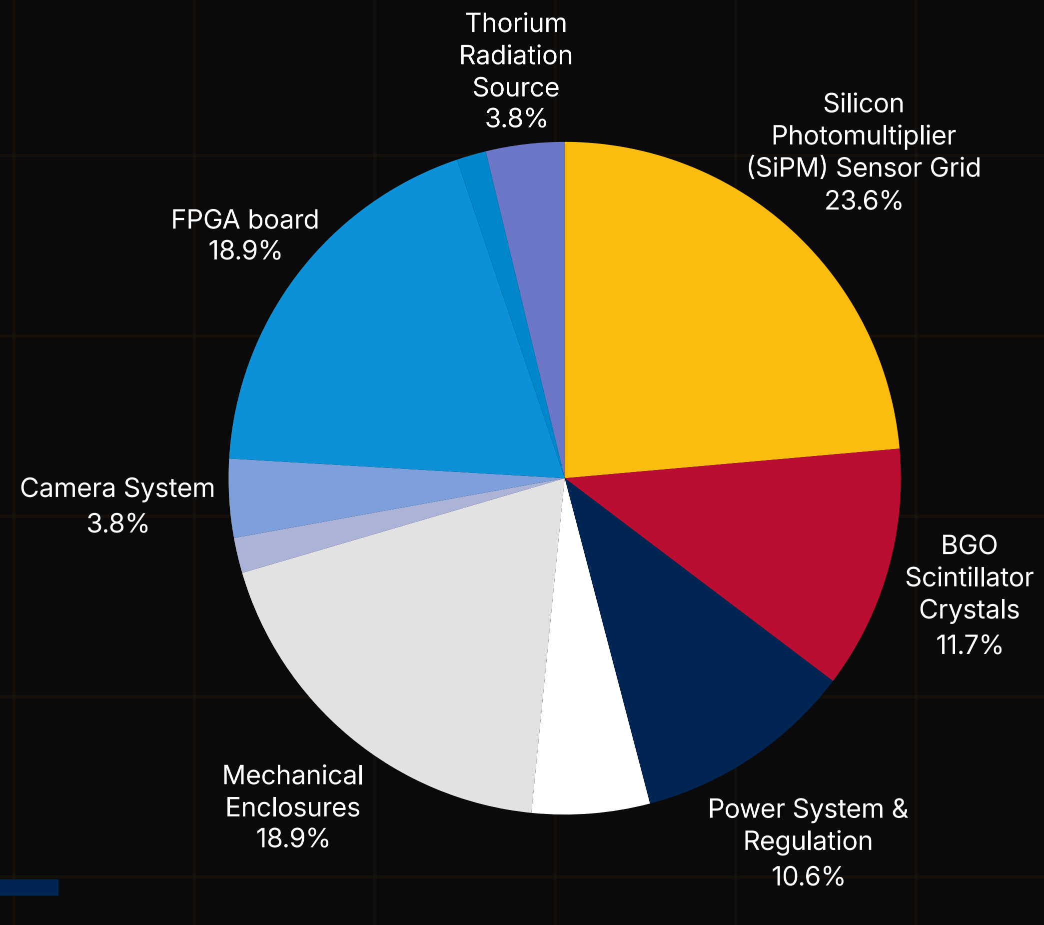
This project creates research opportunities for both the Research and Materials Team.

Research Sub-Team

- Compare the differences between a BGO crystal and a LYSO crystal
- Investigate the mathematical scalability of the project to create a circular ring assembly similar to real-world PET scans

Materials Sub-Team

- Explore how prolonged exposure to gamma radiation causes the semiconductors to misbehave (bit flips)
  - Investigate how to use thermal healing principles to reverse these effects caused by radiation.



Estimated Cost

Our preliminary assessment of the **Gamma Ray Imaging** project is estimated to cost **$822 - $1242**. An additional budget of **$4,000** would allow the use of LYSO crystals, high-end FPGA boards, RF connectors and lab-grade enclosures. This would open up new pathways in developing the project, as well as greater implications for the Research and Materials Team.

NET School

As QNET is open to all students, we need to ensure that all general members achieve a baseline level of nuclear engineering understanding. Developed by our dedicated Research Team, QNET School is a program operating before any builds commence that teaches students the fundamentals of nuclear engineering, as well as lessons catered to specific sub-teams. Just as importantly, it connects members directly to the nuclear industry — through facility tours, guest lectures from active professionals, and early exposure to the organizations shaping Canada's nuclear future.

Baseline Knowledge

QNET School provides all members, regardless of background, an opportunity to learn and explore common nuclear and engineering concepts.

Industry Connections

Members meet and learn from active nuclear professionals — through guest lectures, facility tours, and early exposure to organizations like the CNSC, OPG, and CNL.

Experiential Assets

QNET School teaches concepts through hands-on projects and bi-weekly interactive workshops. This will lead up to actual nuclear facility trips to the SLOWPOKE-2 Facility and potential guest speakers.

Potential Guest Speakers

Acting WDD Director at CNSC, Queen's Alum

John Thelen

Director of the SLOWPOKE-2 Facility at RMC

Pavel Samuleev

Vice President and CSO of CNSC, Queen's Alum

Dean Haslip

and more...

Capstone Design Contest

At the end of their studies, students will join groups of 3-5 to conceptualize and defend a real-world nuclear facility project of their choosing. The groups will present their pitch to a panel of judges for potential incentives.

$500

Potential Maximum Capstone Cash Prize

Direct Educational Value

Sponsorship funding is directed fully towards high-impact experiential education:

- Funding the $100 - $500 cash prize to secure student commitment
- Covers safety, travel and access fees to various facilities (Port Hope, RMTL)
- Coursera certifications to allow students to finish QNET School with actual credentials
- Facilitating hosting logistics to bring in active nuclear professionals and Queen's Alumni from the CNSC, OPG, and CNL.
- Sponsoring the components for QNET School projects such as cloud chambers and Geiger counters for real-time radiation mapping demonstrations.

Get involved today.

ARE YOU A SPONSOR?

Fuel the next generation of nuclear engineers.

Explore sponsorship

queensnuclear.ca/sponsors

ARE YOU A STUDENT?

Help us build it from scratch.

Join now

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ARE YOU FACULTY?

Help shape a team from the ground up.

Get in touch

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