William Homier

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Statement of Interests and Goals

I want to work on physics that turns fundamental ideas into technologies that change the world. My interest in physics grew through studying history, where events like World War II and the Cold War showed how scientific breakthroughs such as nuclear energy, jet engines, rockets, satellites, and early computing pushed humanity forward on a massive scale. I became fascinated by how abstract concepts, like the atom or the structure of the universe, could lead to discoveries as profound as nuclear power, space exploration, and the Big Bang. That curiosity made me wonder what overlooked mysteries today, such as dark matter, might unlock tomorrow. These questions drew me to physics to understand how deep theory becomes real innovation, and my goal is to contribute research that advances both knowledge and technology for society.

At McGill, as an Honours Physics student, I built a strong foundation in mechanics, electromagnetism, special relativity, and computational methods. I also participated in engineering design teams including the McGill Drones and Vertical Flight Society and McGill Formula Electric, where I gained exposure to system design, testing, and collaborative hardware work. These experiences strengthened my practical problem solving skills and my ability to work effectively in teams.

I am especially drawn to research that blends experiment, simulation, and fundamental theory, with primary interests in nuclear and particle physics, a strong curiosity about plasma physics, and a growing fascination with cosmology and dark matter. Projects that explore these areas interest me because they challenge me to think critically, solve difficult problems, and produce results that have real impact.

Through a summer research position, I hope to contribute using my background in electronics, programming, and experimental design while gaining deeper experience in instrumentation and data analysis. I plan to continue into graduate studies and pursue a career in physics research.

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Preferred Summer Research Projects

1. Autonomous antenna station development for ALBATROS

The ALBATROS project's focus on mapping the low-frequency radio sky aligns with my interest in experimental astrophysics. I have read parts of the ALBATROS instrument paper and related reports, and I am fascinated by how the array combines autonomous stations and interferometry to collect data in a remote, radio-quiet environment. While the project focuses on developing and testing hardware and software for the stations, I am motivated by broader questions about the dark ages of the universe and how observations of the 21 cm signal could eventually reveal early matter distribution and the role of dark matter. Through my coursework and participation in engineering design teams, I have worked on team projects and done hands-on system testing, which sparked my interest in experimental work. I hope to contribute to testing and software while gaining hands-on experience.

2. 3D Hydrodynamic Modeling of Relativistic Heavy Ion Collisions of Deformed Nuclei

This project bridges my interest in the high-energy origins of the universe with my passion for high-performance computing. The opportunity to work with the MUSIC hydrodynamics code is a perfect fit for my programming background. I have experience across a wide stack of languages including C++, Python, and SQL, which allows me to not only run simulations but understand and optimize the underlying numerical workflow. I am specifically interested in how the "shape space" of colliding nuclei (from footballs to pear-shapes) dictates the final momentum-space anisotropy. My ability to write robust, efficient code will allow me to systematically vary shape parameters and analyze the resulting physical data with high precision, assisting Dr. Wu and Prof. Jeon in probing the properties of Quark-Gluon Plasma.

3. THz-driven point projection electron microscopy

The Quantum Dynamics Laboratory represents the exact kind of frontier technology that drew me to physics via my interest in historical breakthroughs. Designing a collimator to switch between real-space imaging and diffraction mode is a task that directly utilizes my experience with NX CAD software from McGill Formula Electric. I am excited by the prospect of using COMSOL field simulations to verify local field strengths—a task that requires the same iterative design-and-test mindset I applied to drone systems. My technical versatility, ranging from mechanical assembly to C-based programming, will allow me to assist in building the radial micro-electron lens and testing electron deflection within the vacuum chamber. I am highly motivated to contribute to the commissioning of this state-of-the-art instrument and to participate in the TrUST NSERC CREATE program.