

COVER LETTER

Pierre-Antoine Graham

Vienna physics PhD

Dear Prof. Schuch,

My interest in the interaction of quantum many-body physics, quantum computing and quantum information brings me to apply for a PhD position in your group. From high-temperature superconductors to superconducting qubits, ideas from each of these disciplines have reached me as my journey through academia started. They sparked my desire to become a leader in the second quantum revolution making no compromise between concrete application and theoretical sophistication. The rigor and diversity of the methods used by your group would allow me to satisfy this ambition and produce a body of research I will be proud of.

In the light of a diverse exploration from quantum many-body physics to modified theories of gravity, I discovered myself a passion for exotic phases and control of quantum systems. With three condensed matter internships, I was introduced to spin liquids, topological materials and quantum phase transitions in high temperature superconductors. These experiences are the origin of my desire to tackle challenges in the simulations of strongly correlated systems and critical phenomena at quantum phase transition. This winter, I will delve deeper in these challenges by working with Prof. Yin-Chen He on a novel way to study emergent conformal symmetry associated to critical phenomena called the "Fuzzy Sphere" method. I find your research on the classification of exotic phases particularly appealing because it provides a unifying perspective on my past research.

Following a project about the chaos assisted tunneling of a superconducting qubit, I became strongly interested in the control of quantum materials applied in new technologies. The fact I was working with the sophisticated ideas of chaos theory to ultimately improve quantum gates was fulfilling and laid the basis of my current career ambitions. Working in your group, I could explore elaborate mathematical ideas while advancing the models at the root of technology.

Throughout my research experiences, entanglement has always fascinated me with the multitude of complex phenomena arising from its deceiving simplicity. I am drawn to tensor network methods because their elegance and simplicity would allow me to push the understanding of complex quantum systems further with a more explicit view of their entanglement structure. They would also provide an algorithmic aspect to my research which would connect with my view of computer science as a dimension of theoretical physics research. I learned programming with increasingly difficult programming challenges and my appreciation of computer science is tied to finding algorithms that render possible seemingly impossible tasks.

I am currently studying as a Perimeter scholars international student. I received the PSI award for collaboration, inclusion and excellence and would be thrilled to bring my problem solving skills, multidisciplinary background and collaborative spirit to your group. I feel it provides an environment where I can reach my full potential in this century of great scientific opportunities.

Sincerely,

Pierre-Antoine Graham