Proposal Title: Quantum Algorithms for Conformal Geometry with Speedup for Medical Imaging Processing and Other Applications

Abstract/Overview. This proposal aims to build a foundation of efficient quantum algorithms to speed up solutions to challenging problems in topological data analysis and conformal geometry that have real-life applications, such as in medical imaging processing, computer vision, materials design, engineering, etc. This team is formed by a physicist, a computer scientist, and their students and aims to tackle the above problems with interdisciplinary approaches. This project advances both PIs' research programs; more explicitly, it creates a new research program exploiting their expertise and fits into an important direction in quantum information science (QIS). The interdisciplinary nature of the project can advance knowledge in both conformal geometry and quantum algorithmic design. It will open an exciting field of what we call quantum computational conformal geometry, leading to applications of quantum advantage that will potentially benefit society. Such efforts align with one of the eight QIS research frontiers identified by the National Quantum Coordination Office in their Quantum Frontiers Report in 2020, namely, "Expanding Opportunities for Quantum Technologies to Benefit Society." The members of this team have been meeting to discuss problems in this new direction since January 2022 and have obtained some promising preliminary results. The support of the Spring Seed Grant will be timely and contribute to the expansion of ideas described in this proposal and can bolster the chance to win external funding. The opportunity provided by this Seed Grant also expands the QIS research profile, in particular, in the area of quantum algorithms and quantum advantage, of Stony Brook University.