1135-81-3215 **Krysta M Svore*** (ksvore@microsoft.com), 1 Microsoft Way, Redmond, WA 98052.
Mathematics of Topological Quantum Computing and its Implementations.

In 1981, Richard Feynman proposed a device called a Quantum Computer to take advantage of the laws of quantum physics to achieve computational speed-ups over classical methods. Quantum computing promises to revolutionize how and what we compute. Over the course of three decades, quantum algorithms have been developed that offer fast solutions to problems in a variety of fields including number theory, optimization, chemistry, physics, and materials science. Quantum devices have also significantly advanced such that components of a scalable quantum computer have been demonstrated. In this talk, we will present the mathematics behind topological qubits, as well as the mathematical foundations behind the implementation of large-scale fault-tolerant quantum computers. We will cover the requirement for a quantum computer to execute operations that can be implemented fault-tolerantly, i.e., without a proliferation of errors, which gives rise to problems in unitary approximation. For example, all known fault-tolerant gate sets lead to countable subgroups of $SU(d)$ generated by elements with algebraic entries and an interesting family from so-called S-arithmetic groups are conjectured to yield the best possible approximations. (Received September 27, 2017)