Developing a scalable quantum computing architecture that can withstand decoherence to the extent necessary for real-world applications poses an enormous scientific and technological undertaking. One route forward involves stabilizing exotic topological phases of quantum matter harboring emergent particles known as non-Abelian anyons. With these degrees of freedom in hand, one can in principle construct physical qubits that by themselves function as good logical qubits, thus obviating the need for large-scale error correction. Within this topological approach to quantum computation, the requisite topological phenomena could either be *intrinsic* to a material’s internal dynamics or *engineered* in judiciously designed heterostructures. In this talk, I will first describe the current status of the 5/2 fractional quantum Hall plateau, a classic example of a (potentially) intrinsic non-Abelian topological phase. In light of recent thermal Hall measurements indicating a particularly surprising non-Abelian state, I will show that this many-body condensed matter problem is as enigmatic as ever from both a theoretical and numerical perspective [1]. Next, I will turn to recent efforts toward engineering a prototype topological qubit in the Majorana nanowire platform. Within this context, I will describe our recent proposals aimed at verifying topological protection in these devices via time-domain measurements designed to demonstrate (or falsify) the system’s exponential insensitivity to all sources of local noise [2,3]. Finally, several directions of future research in these and related areas will be discussed.

