MAHMUD AZAM, University of Saskatchewan
TQFTs and Quantum Computing

Quantum computing is captured in the formalism of the monoidal subcategory of $\mathbf{Vect}_{\mathbb{C}}$ generated by $\mathbb{C}^2$ – in particular, quantum circuits are diagrams in $\mathbf{Vect}_{\mathbb{C}}$ – while topological quantum field theories, in the sense of Atiyah, are diagrams in $\mathbf{Vect}_{\mathbb{C}}$ indexed by cobordisms. We outline a program to formalize this connection. In doing so, we first equip cobordisms with machinery for producing linear maps by parallel transport along curves under a connection and then assemble these structures into a higher category. Finite dimensional complex vector spaces and linear maps between them are given a suitable higher categorical structure which we call $\mathbb{F}\mathbf{Vect}_{\mathbb{C}}$. Finally, we realize quantum circuits as images of cobordisms under higher monoidal functors from these modified cobordisms to $\mathbb{F}\mathbf{Vect}_{\mathbb{C}}$, which are computed by taking parallel transports of vectors and then combining the results in a pattern encoded in the domain category. This talk reports on joint work with Steven Rayan.