Unique Qualifications & Capabilities:

- Quantum Process Characterization
  - Gate Set Tomography (GST)
  - Randomized Benchmarking
  - Mutually Unbiased Bases
  - Error bars and statistics
  - Compressive sensing

- Multi-Qubit Simulations & Choreography
  - Dynamically, actively controlled
  - Open-system, chain-boson model
  - Markovian and non-Markovian

- Selected References
  - March Meeting T38.00005 (2015)
  - JMP, 50, 012107 (2009)
  - PRB, 78, 014302 (2008)
  - PRL, 90, 087901 (2003)

We are interested in supporting:

- Full characterization of multi-qubit errors
  - Experiment design and statistics
  - Maximum likelihood with error bars
  - Including correlations and crosstalk

- Simulations to understand and fix errors
  - Open-system master equations
  - Time dependent, non-Markovian
  - Dynamically controlled, corrected

- Computer Aided Design & Choreography
  - Higher fidelity physical qubits
  - Open-loop qubit control during ops
  - Closed-loop feedback scheduling

Areas of interest:

- Non-Markovian correlations, crosstalk
  - Boson exchange
  - Residual entanglement
  - Active resets

- Protective collective behavior
  - Sub- and/or super-radiance
  - Meta-stable logical states

- Quantum error correction & control
  - Open loop
  - Active, closed-loop
  - Autonomous

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Figure: GST on the Bloch Sphere

Gates: \( G_k = \{\text{Null, } G_x, G_y, G_z, \text{ Idle}\} \)
Fiducials: \( F_i = \{\text{Null, } G_x, G_y, G_x^2, G_y^2, G_y^3\} \)

\[ \rho = |0\rangle \langle 0| \]
\[ \rho_x = E_2 \]
\[ \rho_y = E_3 \]
\[ \rho_z = E_6 \]
\[ \rho_2 = E_5 \]
\[ \rho_4 = E_4 \]

Tőmos: \( D_{jk} = \text{Tr} [ E_i (G_k (F_j (\rho)))] = \langle \langle E_i | G_k | \rho_j \rangle \rangle \)

\( \langle \langle E_i | G_k^n | \rho_j \rangle \rangle, \langle \langle E_i | (G_k G_l)^n | \rho_j \rangle \rangle, \langle \langle E_i | (G_k G_m)^n | \rho_j \rangle \rangle \)