Faisal Shah Khan

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RESEARCH STATEMENT

A central focus of my current work is the development of quantum-native trading infrastructure. This project is underway with researchers from Duke University, the University of Maryland, and North Carolina State University, including experts in ion-trap quantum systems. Drawing on recent advances in quantum game theory, this work models trading as a strategic interaction governed by quantum correlations—specifically, entanglement. By implementing these models on ion-trap quantum hardware, we demonstrate a realized quantum advantage in the form of higher-paying market Nash equilibria. These results, published in *Quantum Economics and Finance*, provide experimental evidence that quantum computing can uncover alpha—excess returns relative to traditional benchmarks—through novel, hardware-driven trading strategies. The findings suggest a promising role for quantum systems in the design of next-generation financial infrastructure.

In parallel, I am exploring quantum behavioral strategies in extensive-form games, with particular emphasis on quantum discord as a minimal, yet scalable, non-classical resource. Unlike entanglement, discord offers a more physically realizable path to quantum advantage in decision-making systems. This research aims to extend game-theoretic rationality beyond classical boundaries in settings with imperfect recall and asymmetric information.

These efforts build on a foundation of earlier research supported by Khalifa University and the Swedish Foundation for International Research Cooperation. Previous projects included the design of a quantum random number generator (Kammiya), the development of secure quantum communication protocols for autonomous systems, and the application of quantum optimization techniques to epidemic control and smart infrastructure.

Looking ahead, my work will continue along two interrelated trajectories:

1. **Applied Quantum Game Theory** — advancing both the theoretical underpinnings and hardware implementations of strategic interaction in quantum environments.

2. **Quantum-Informed Systems Design** — developing secure, intelligent infrastructure through quantum-enhanced modeling, sensing, and communication frameworks.

These interests reflect a long-standing commitment to interdisciplinary research at the nexus of mathematics, game theory, and business applications. I emphasize collaborative development, real-world deployment, and mentorship, with a strong focus on training students at all levels in research-driven inquiry.

I welcome opportunities to collaborate across academia and industry and to supervise graduate research in applied quantum computing, operations research, and mathematical modeling.