

# Fermi National Accelerator Laboratory

## LDRD Project Data Sheet - FY18

**Project ID:** FNAL-LDRD-2018-041

**Project title:** Quantum Networks Using Time-bin Photonic Qubits

**Principal investigator:** Cristián Peña

**Project description:** (short description and explanation of cutting edge, high-risk, high-potential science or engineering)

This LDRD project aims to produce a fully functional quantum network based on commercial optical fibers with the capability to distribute time-bin photonic quantum states (qubits) across distances of tens of kilometers by employing an intrinsic property of a multi-qubit system: entanglement.

**Tie to Mission:** (explain the project's relevance or anticipated benefits to Fermilab's and DOE's missions)

Quantum information science and technology has the potential to revolutionize computation, communication, and help solve fundamental question in physics. Communication and interconnection of quantum devices are critical for the success of this emergent field and is an active topic of R&D. Fundamental research on quantum communication will not only bring transformational advancements in long-distance communication through unbreakable quantum key distribution protocols and in high performance computation through networks of quantum computers, but may even result in groundbreaking results on the nature of space-time and elucidate the connection between entanglement and quantum gravity.

**Previous year's accomplishments:** (as applicable)

N/A

**Work proposed for current fiscal year and anticipated / desired results:**

Progress towards construction, support and operation of the Fermilab Quantum Network (FQNET), a fully functional quantum network with the capability to teleport time-bin photonic qubits across the Fermilab site. Benchmark state-of-the-art quantum communication rates using commercially available superconducting nanowire single photon detectors (SNSPDs) and advance quantum communication rates by at least 20%.

**Project funding profile:** (costs, budgets, projected budgets, and total)

Prior year(s) costs	FY18 ½	FY19	FY20	FY21 ½	Total
N/A	60,000	200,000	100,000		360,000

Project Start Date: 3/15/2018

Total Approved Project funds: \$ 360,000