

**Fermi National Accelerator Laboratory  
LDRD Project Data Sheet - FY17**

**Project ID:** FNAL-LDRD-2017-038

**Project title:** Quantum Computing using Superconducting Radio Frequency Technology

**Principal investigator:** Alexander Romanenko

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

We propose to design, manufacture, and study single and multiple unit quantum computing structures based upon a combination of ultra-high Q superconducting radio frequency, SRF, host cavities and embedded Josephson junction qubit(s). The goal is for this work to achieve within the next few years a working high coherence 50+ qubit quantum computer.

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

Quantum computers propose to provide a new degree of computational power that potentially could revolutionize certain calculations that are relevant for High Energy Physics (HEP). Current limitations include lifetime and de-coherence issues with storing quantum information. This project will utilize existing expertise in High Energy Physics in SRF technology, cryogenics, and other technical abilities to help overcome the limitations and position HEP to be a contributor to this possible computing revolution.

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

Bid package prepared for the dilution refrigerator and PO issued. An order was placed for Josephson Junction based Qubits. These items will allow for R&D to start in earnest in FY18.

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

The dilution refrigerator is to be commissioned and integrated with both cavities and Qubits. Initial measurements will be performed.

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

<b>Prior year(s) costs</b>	<b>FY17</b>	<b>FY18</b>	<b>FY19</b>	<b>Total</b>
N/A	61,705	800,000	400,000	1,261,705

Project Start Data: 3/01/2017

Total Approved Project funds: \$ 1,400,000