



Quantum Integrated Sensor Systems Interdisciplinary Research Theme

2018 Year End Report



College of Engineering & Applied Science
UNIVERSITY OF COLORADO BOULDER

2018 Quantum Integrated Sensor Systems IRT Annual Report

IRT Scope and Mission

The goal of the IRT was to engage the engineering faculty in the area of quantum, an area of great national importance with the recent passage of the National Quantum Initiative Bill in December 2018.

Most Significant IRT Accomplishments in 2018

The most significant accomplishment was the establishment of a campus quantum initiative, that encompasses the entire University, not just engineering (Jun Ye, Director; Steve O'Neil, Exec. Director; Juliet Gopinath, Associate Director). Primary units involved include Engineering, Physics, Chemistry, JILA and NIST. The IRT seed grant program merged into a bigger QUEST program, managed by RIO, with a pool of \$800K (contributions from RIO, NIST, Engineering, Physics and Chemistry). Projects with PIs from different departments were solicited, a 'mixer' was held, and a substantial number of submissions included engineering faculty. Considering that we do not have a single faculty member in engineering solely focused on quantum, this is a major achievement. Additionally, a seminar series (joint between engineering and JILA) will start in March 2019.

Seed Grant Summary

- Dark excitons at 4K in WSe₂ & single quantum emitters triggered by the strain induced by an AFM tip (PI: Baowen Li)
 - QUEST seed grant application based on results (with Xiaobo Yin, Markus Raschke)
- New silicon nitride microresonators fabricated and under test to measure squeezing (PIs: Svenja Knappe, Shu-Wei Huang)
 - Joint NSF proposal (with Univ. of MD College Park), for submission on 01/31/2019
- Lidar for high-resolution ranging and intensity measurements of underwater objects with single photon counting detectors (PIs: Kelvin Wagner and Jeffrey Thayer)
 - NASA NSTRF proposal submitted, *Cross-Cutting Space-Based LIDAR Sensing Systems and Modalities*
- Packaged liquid droplets, with quality factor measurements (PIs: Juliet Gopinath and Victor Bright)
 - White paper, DARPA (Dr. Ron Polcawich) on liquid droplets encouraged for seedling funding

Next Steps and Anticipated Milestones

- Formal establishment (announcement, website etc.) of campus quantum center
- Involvement of core group of Engineering faculty in campus quantum center
- Successful completion of quantum faculty searches in engineering, as well as Physics

- Seed grant competition winners announced and results from these projects used to seed center level projects

IRT Performance Metrics

Industry Collaboration

New external collaborations

- Lockheed Martin CTO briefed on quantum (Knappe, 11/18)
- Los Alamos National Laboratory (Conference call, 11/18)

Technology transfer, IP generation, and start-ups

- ASTRALite (Startup company, Thayer)
- Fathom Computing Advisory Board (Wagner), Consultant (Gopinath)
- Lockheed Martin Coherent Technologies (Wagner)
- Lambdametrics (Wagner)

Reputation

Faculty in national leadership positions

- Quantum sensing/metrology (Greg Rieker, James Thompson, Sae Woo Nam)
- Quantum networking/communication (Won Park, Konrad Lehnert)
- Quantum matter (John Price, Xiaobo Yin)
- Quantum computing (Alexandra Kolla, Grahame Smith, Dietrich Leibfried)
- Education (Sarah Miller, Heather Lewandowski)
- Industry (Dana Anderson, Chris Muldrow)

National Press for IRTs

- None to report

Recognition by peer institutions

- None to report

Proposals and Projects

Multi-department proposals/projects (> \$1M)

- 22 seed grants submitted to QUEST (internal seed grant program for 2019)
- Coordinating a campus response to the Mid-scale Research Infrastructure-1 (Mid-scale RI-1) call from NSF (*organization effort led by Victor Bright*)
- L. Jessup (PI), Quantum Computing & Information Science Faculty Fellows (QCIS-FF), Proposal to fund a computer science faculty member in area of quantum (2018)
- J. T. Gopinath (PI), L. Shalm (Co-PI), W. Park (Co-PI), P. Bierhorst (Co-PI), S. W. Nam (Co-PI), A loophole-free Bell test on a chip, *To be submitted to Enabling Quantum Leap: Quantum Idea Incubator for Transformational Advances in Quantum Systems* (2019)

- J. Thayer, NASA NSTRF proposal submitted, *Cross-Cutting Space-Based LIDAR Sensing Systems and Modalities* (2018)
- J. T. Gopinath and V. M. Bright, White paper, DARPA (Dr. Ron Polcawich) on liquid droplets encouraged for seedling funding (2018)
- J. T. Gopinath, On-Chip Entanglement, Preparation, Manipulation, and Detection for Integrated All Quantum Optical Information Processing, NSF RAISE TAQs, \$1M, 1/1/19-12/31/21
- Z. Popovic and Cold Quanta (D. Anderson), STTR (2018)

Center-scale proposals/projects (> \$10M)

- None to report.

APPENDIX

IRT Members

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