Cornell NanoScale Science & Technology Facility

NNCI ANNUAL CONFERENCE
Nov. 2-3, 2021

Chris Ober, Lester B. Knight Director
Claudia Fischbach-Teschl, Associate Director
Ron Olson, Director of Operations
Lynn Rathbun, Laboratory Manager

Cornell NanoScale Facility

Prof. Christopher Ober
PI, Director

Prof. Claudia Fischbach-Teschl,
Co-PI, Assoc. Director

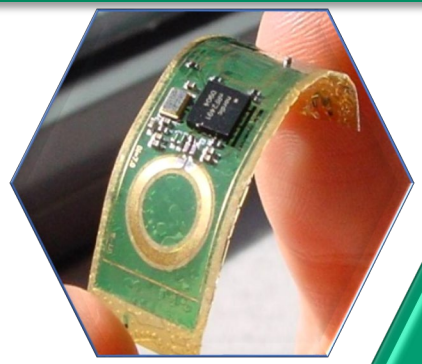
Ron Olson
Director of Operations

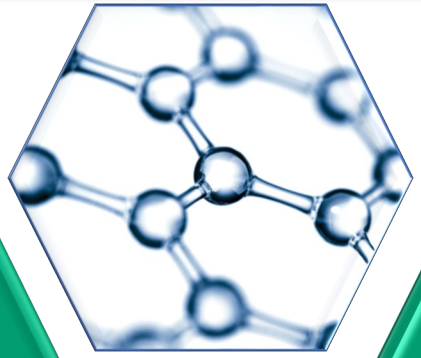
Lynn Rathbun, Ph.D.
Laboratory Manager

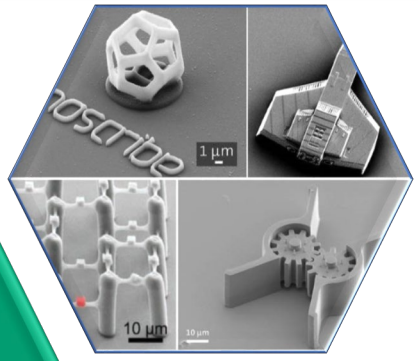
- We are a uniquely capable nanofabrication facility within NNCI
- Site of strong, active biology, physics, electrical engineering and materials research activities
- Educator of the next generation of interdisciplinary engineers and scientists
- Engine of economic development
- Provider to large external user community (~40%)
- >40 years of experience as a successful user facility focused on nanofabrication
  - New strategic directions and activities

Addressing NSF's 10 Big Ideas on Data Revolution, Quantum Leap, Convergence, Rules of Life, Future of Work, …

CNF Strategic Focus







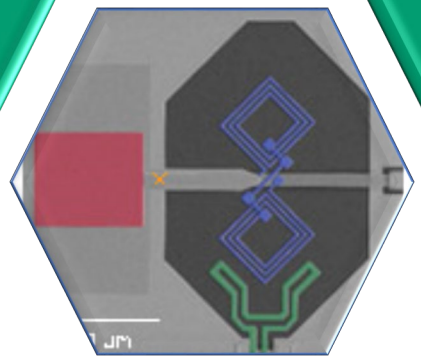
Life Sciences

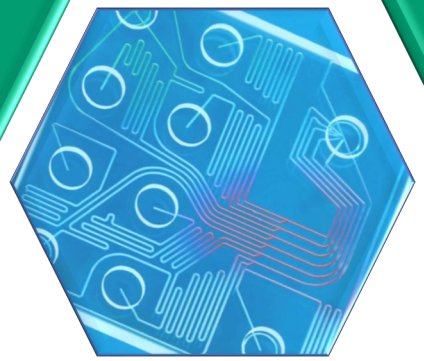
Hetero-integration

Quantum Information Devices

2D Materials

3D Fabrication and Characterization





Research Communities:

- **Understanding the Rules of Life**
- **Transform Quantum/Quantum Leap**
- **Nano-Enabled Internet of Things**

National Nanotechnology Coordinated Infrastructure

New Facilities 1

New Partnerships with Existing CU Facilities to Bring New Capabilities into CNF and NNCI

High Frequency Test Lab

Existing Equipment

- DC probe station and electronics
- Microwave probe station
- "Load Pull" RF test station

Applications:
Heterointegration and Quantum Device Testing

MRI 2021- mm wave network analyzer

- Ultrawide band vector network analyzer
  - One of the first in the world
  - Single sweep DC to 220 GHz
- Automated Probe station
  - 1 µm precision
  - Thermal chuck

National Nanotechnology Coordinated Infrastructure NSF

New Facilities 2 & 3

Cornell Visualization and Imaging Partnership (CVIP)

- CNF and the Cornell Institute of Biotechnology (Biotech) have partnered to create a shared Life Science characterization and imaging facility.
- CNF users will access a broad range of 3-D characterization tools including a variety of confocal microscopes, super-resolution microscopes, and micro/nano-xray-CT scanning.

Cornell Multiscale 3D Fabrication Partnership (CM3FP)

- CNF has partnered with the Cornell Mechanical Engineering department's Rapid Prototyping Lab to make a broad range of 3-D printing technologies available to our users.
- CNF and RPL staff will act as a gateway to these new 3-D printers, providing consultation, software services, design help, billing, and user support.

Research Community

- **Understanding the Rules of Life**

Quantum Science at CNF and Cornell

Cornell Nanoscale Facility

- High purity materials deposition/etch
- New tools (e.g. atomic layer etch)
- Heterointegration and packaging

CCMR MRSEC

- Materials, Characterization and Theory
- World leading electron microscopy
- Quantum light sources and quantum sensing of materials

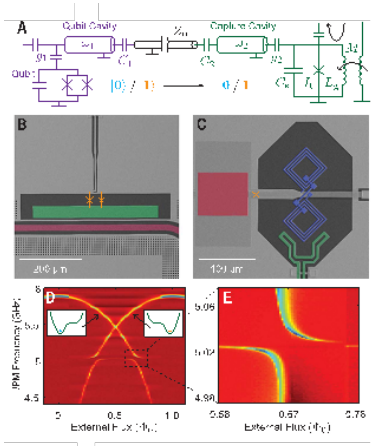
High Energy Synchrotron Source

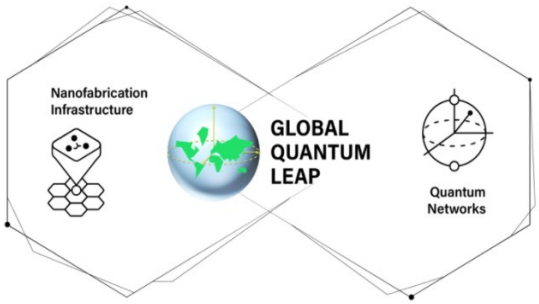
- High Magnetic Field (HMF) beamline
- Study quantum materials in persistent magnetic fields

2D Materials MIP

- New interface materials—that do not exist in nature

- **CNF is a key part of a growing research ecosystem investigating quantum materials, quantum devices and quantum systems**
- **Provides nanofabrication, heterointegration and packaging while partnering with centers supporting quantum research**





Global Quantum Leap (AccelNet – a network of networks)

Research Community

- **Transform Quantum/Quantum Leap**

National Nanotechnology Coordinated Infrastructure

New Center Partner Digital Agriculture STC

Center for Research on Programmable Plant Systems (CROPPS)

The CROPPS STC will generate a new paradigm for observing, recording, and modulating plant responses to their environment—the Internet of Living Things (IoLT).

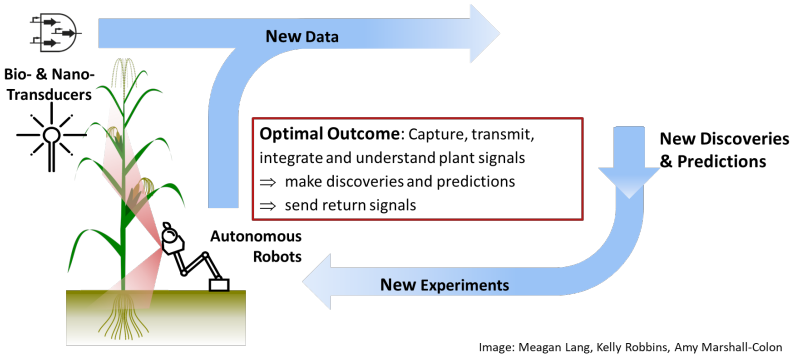


Image: Meagan Lang, Kelly Robbins, Amy Marshall-Colon

Research Community

- **Nano-Enabled Internet of Things**

New Equipment

New Equipment Highlights

- **UHV Load Locked Evaporator (Angstrom Eng.)**
  - In-situ ion beam cleaning
  - GLAD (Glancing Angle Deposition) with rotation, and sample heating
- **Savannah Atomic Layer Deposition Sys. (Veeco)**
  - Al, Pt, Pd, and Ru
  - Ozone generator
- **HDP-PECVD System (Plasma Therm)**
  - High density SiO_2, Si_3N_4, a-SiC, and a-Si films at low temperatures
- **Spectroscopic Ellipsometer (Woollam)**
  - Measuring thin film thicknesses and optical constants of multilayer thin film stacks
  - Parallel detection for rapid measurement and full wafer mapping of film properties
- **Dektak Profilometer (Brucker)**
  - 4Å repeatability
  - Can process up to 200mm wafers
  - 3D mapping