Center for Integrated Nanotechnologies (CINT)

We utilize modeling, synthesis, characterization, and nanofabrication to create advanced materials for integration into technologies impacting national priorities

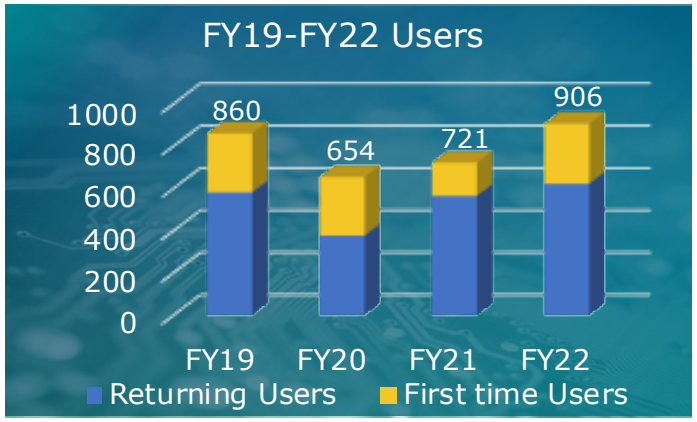
CINT-Core (Albuquerque)

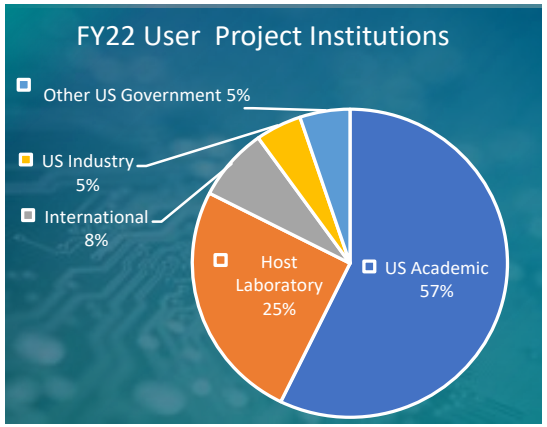
Jeff Nelson
Director

Adam
Rondinone
Co-Director

CINT-Gateway (Los Alamos)

We have a vibrant and growing user community

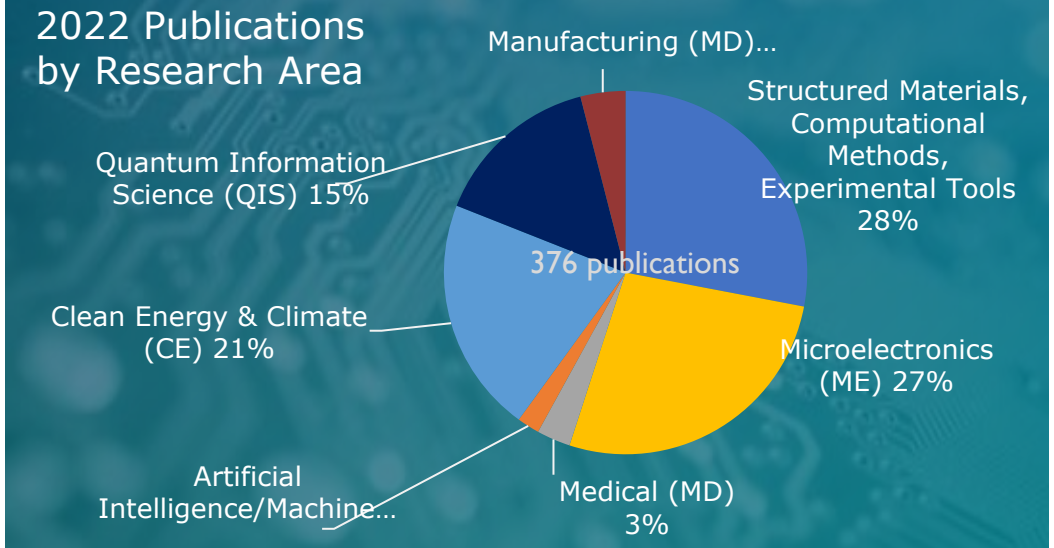




Scientific Thrusts

- In-Situ Characterization and Nanomechanics
- Nanophotonics and Optical Nanomaterials
- Quantum Materials Systems
- Soft, Biological, and Composite Nanomaterials

Thrusts align with strengths of host laboratories, amplifying capabilities and expertise for our users



U.S. DEPARTMENT OF ENERGY | Office of Science

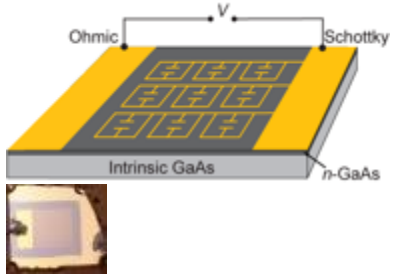
Sandia National Laboratories | Los Alamos NATIONAL LABORATORY

Brookhaven National Laboratory | MOLECULAR FOUNDRY | OAK RIDGE National Laboratory | Argonne NATIONAL LABORATORY

Scientific Impact Drives User Community Engagement – "Top Three"

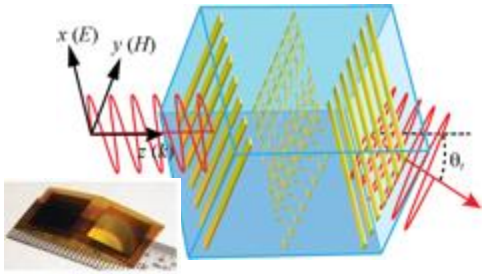
Metamaterials / Metasurfaces Photonics@ CINT

Active metamaterials



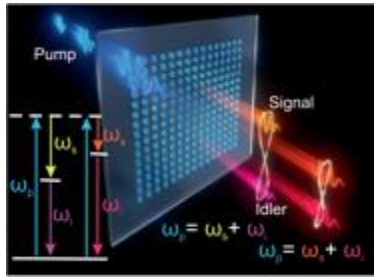
Nature, **2006**

Flat optics – metasurfaces



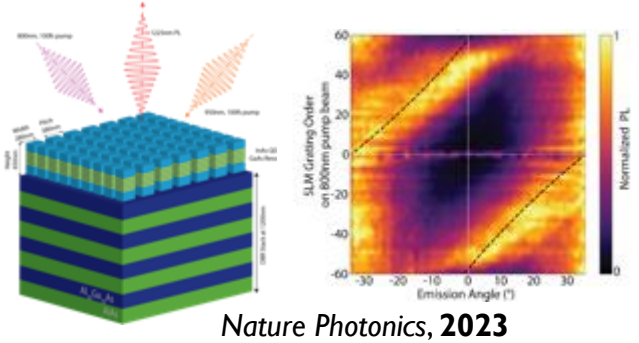
Science, **2013**

Quantum metasurfaces



Science, **2022**

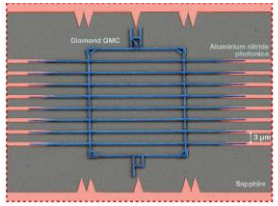
Metasurfaces, incoherent emission control



Nature Photonics, **2023**

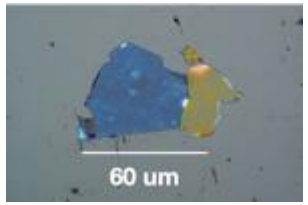
Quantum Information Sciences @ CINT

Nanoimplantation of Quantum Defects



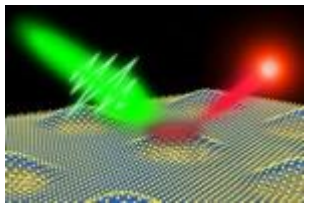
Nature, **2020**

Diamond NV for Sensing



APL, **2022**

2D Quantum Emitters



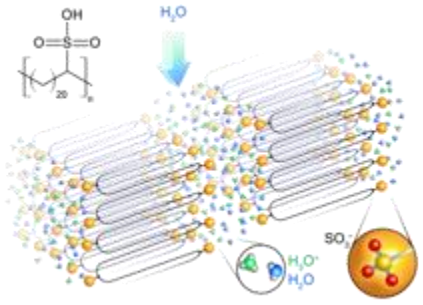
Nature Commun., **2021**

Precision Single Photon QDs

APL Photonics, **2021**

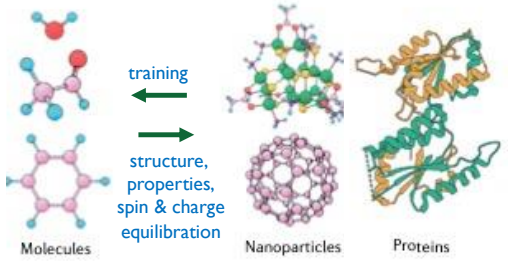
Computational Materials Science @ CINT

Molecular dynamics for soft materials properties



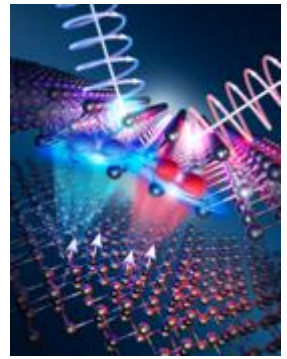
Nature Materials, **2018**

Neural network models for chemical processes



Nature Commun., **2021**

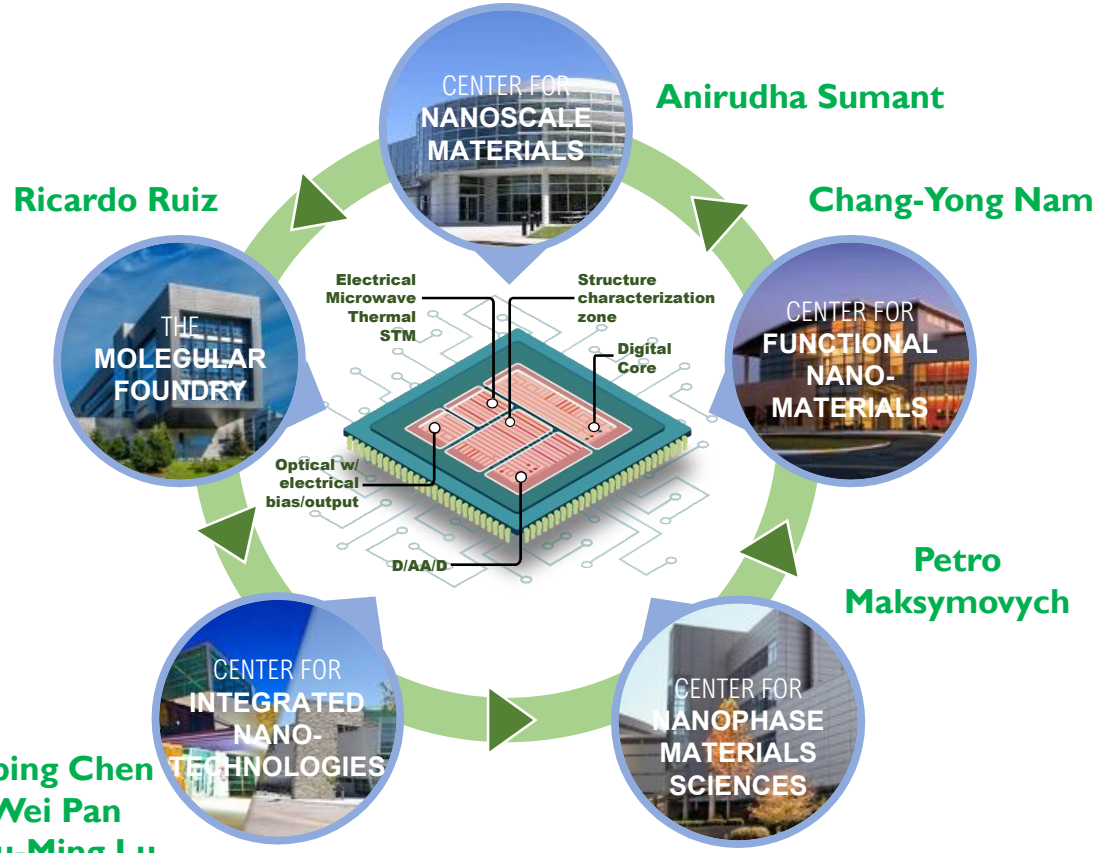
Electronic structure for exotic states of quantum materials



Nature Materials, **2023**

NSRC Working Group on Microelectronics

Collective resource to accelerate *CHIPS and Science Act* innovation and economic impact



Industry and University Research Needs

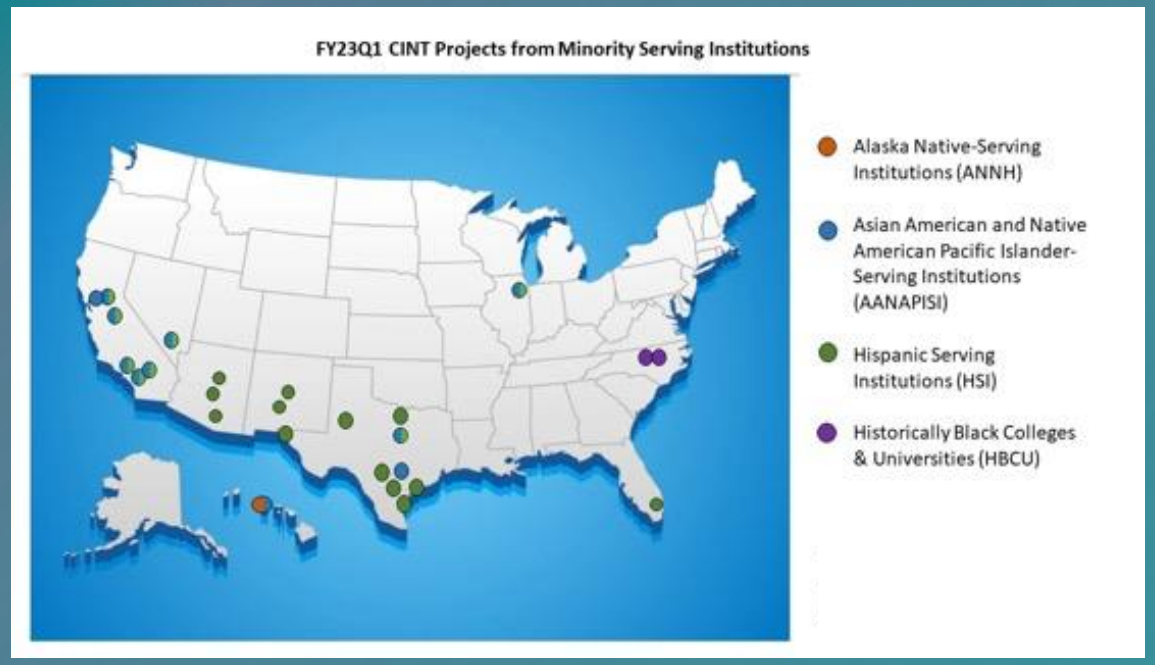
- Metrology, Modeling and AI for 3D Heterogeneous Integration
- Materials Synthesis
- Integration of Non-Conventional Materials and Device Architectures
- Tools for Next-Generation Lithographic Patterning
- Advanced In-Situ / Operando Characterization

Combined Capabilities, Expertise, and Facilities

- **40,000 sq. ft. of flexible, fast-turn cleanrooms** for nanofabrication and integration of early stage materials, devices and architectures
- More than **100 materials synthesis laboratories** for inorganic, organics, and hybrid composites
- More than **30 unique measurement capabilities** for *metrology, property, performance, and in-situ / operando studies*
- **Atomic to microscale modeling tools,** including AI/ML for Lab to Fab correlations
- ***Portal to other DOE*** Facilities and User Facilities

CINT serves a diverse, equitable, and inclusive user community

113 (38%) of the 301 US Academic projects are from MSIs



Strengths of the user community

- Strong regional support of MSI users
- Sustained support for existing users
- Healthy growth of new users
- Balance of user projects from academia, government, and industry
- Regional small business well represented in user community

To strengthen our user community, we need to-

- Increase institutional growth
- Expand access for HBCUs
- Grow large-industry user base (contact sport)
- Improve remote access of data & research equipment

CINT Initiatives

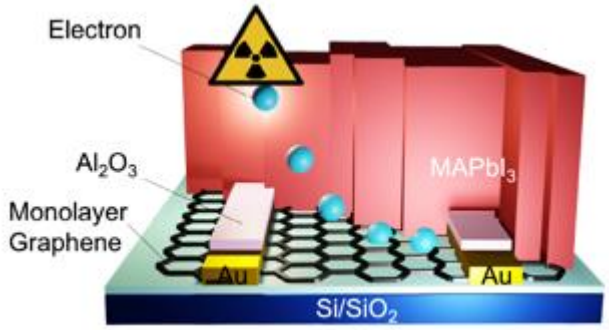
- Investing operational funds and host laboratory funding opportunities to expand access to data & equipment
- Engaging broadly in host laboratory DEI efforts
- Outreach at technology-focused conferences and events
- Engaging with regional state and local economic development groups- *Chips and Science Act* is an excellent opportunity
- Sponsor undergraduate and graduate summer & year-round interns through internal host laboratory LDRD programs
- Increasing outreach and visibility through Linkedin and other social media platforms

CINT's NSRC recapitalization investments will position our user community to advance microelectronics, quantum, and clean energy S&T

Microelectronics, quantum devices, and clean energy science & technologies rely on the ability to -

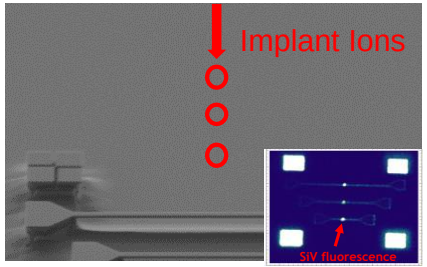
- synthesize *advanced and complex thin films*,
- *fabricate* those films to demonstrate new science and innovative technologies

X-ray detector structure



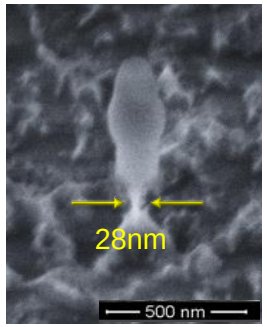
APL, **2023**

Diamond nanobeams



Science, **2016**

Integration of detachable diamond-based quantum sensors



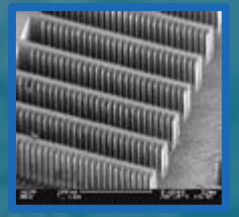
Courtesy Keshab Sapkota, CINT, **2023**

Next-Generation Capabilities for Nanoscience

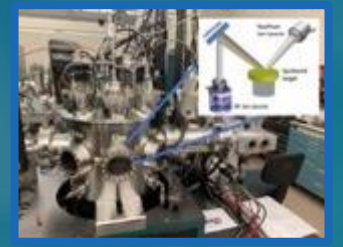
- ***Expanding the Limits of Nanofabrication***
- ***Accelerating Nanoscale Materials Discovery and Design***
- Decoding Nanoscale Dynamics and Heterogeneity

Advanced III-V Heteroepitaxy

Advanced Etch and Lithography



Dual Ion Beam Sputter System



Value proposition to the user community

- Provides users access to difficult-to-synthesize materials and heterostructures
- Benefits users who work to develop new materials but cannot fabricate them at their home institutions