

Multidisciplinary Research (MDR): An Engine for Innovation



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PRESENTED BY

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What is innovation?

- Anything new and useful
 - Creates new capacity, value
 - Significant positive change
- It can be
 - An item, system or a service
 - Evolutionary or revolutionary
- It is rarely born fully grown



Innovation process

- It is the artistic process
 - Vision
 - Creativity
 - Intuition
- Balanced against
 - Ability
 - Time/resources
- Informed by science
- Enabled by technology

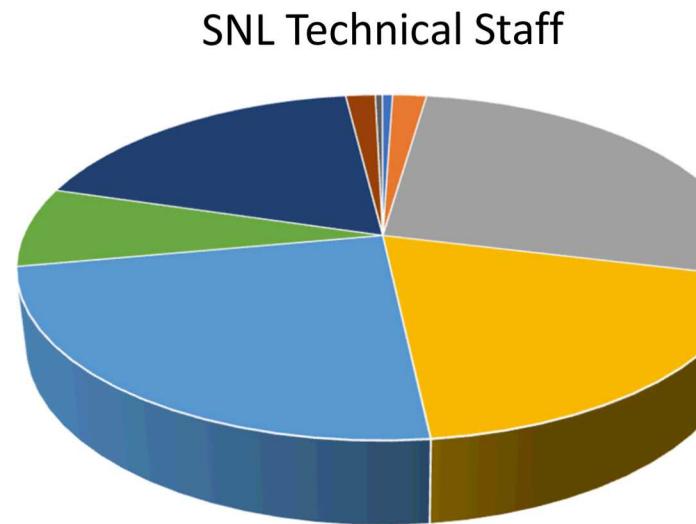


Characteristics of innovative research teams

- Collaborative problem solving and collective genius
- Inclusive
 - Diversity of skills and perspectives
- Open communication
 - Minds and mouths
- Actively seek to
 - Combine opposing ideas
 - AND not OR
 - Reconfigure ideas into new ways

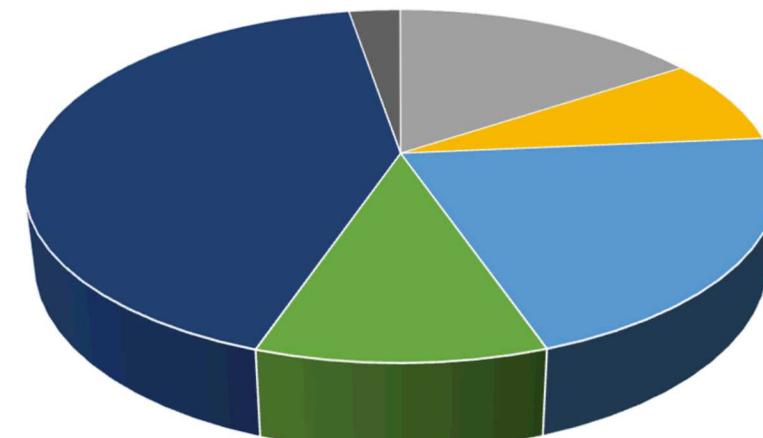


At Sandia we have a technically diverse workforce



- Biology
- Chemistry/Engr
- Computer Science
- Electrical
- Geology
- Mechanical
- Nuclear/Physics
- Systems
- Cognitive

Nuclear Security and Nonproliferation Technical Staff



- Computer Science
- Electrical
- Mechanical
- Nuclear/Physics
- Systems
- Cognitive

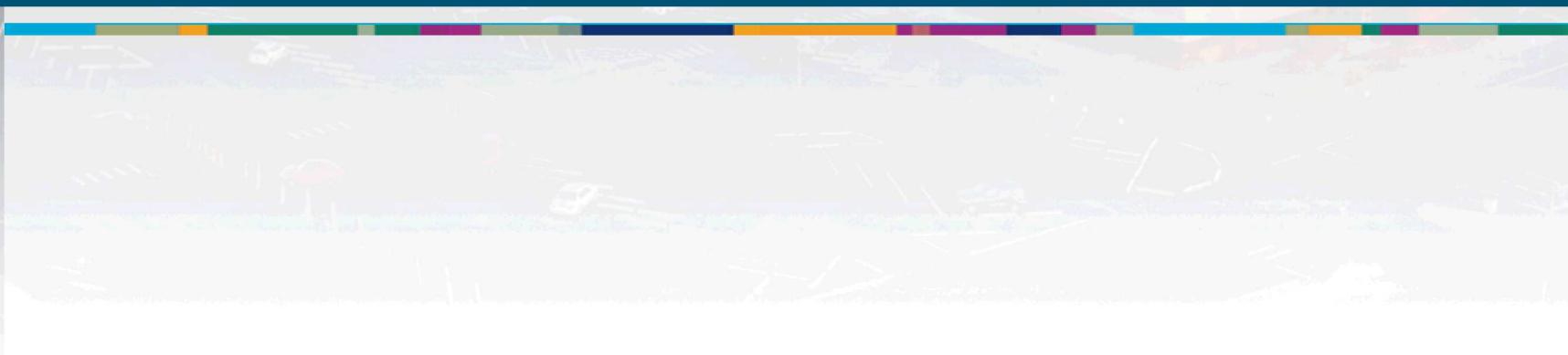
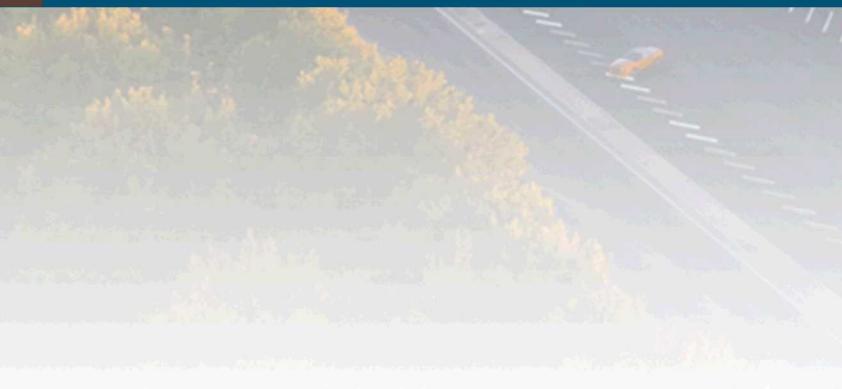
6 MDR teams are needed for many of our challenges

- Understand application space
 - Translation of need to requirements
 - What it must do
 - How it must do it
 - Operational environments
 - Threats/vulnerabilities
 - Iterate with end users
- Assess and evaluate technical approaches
 - Disciplines
 - Technical risks
 - Technical Readiness Level (TRL)





MDR examples-applied to Global Nuclear Security and Safeguards Mission



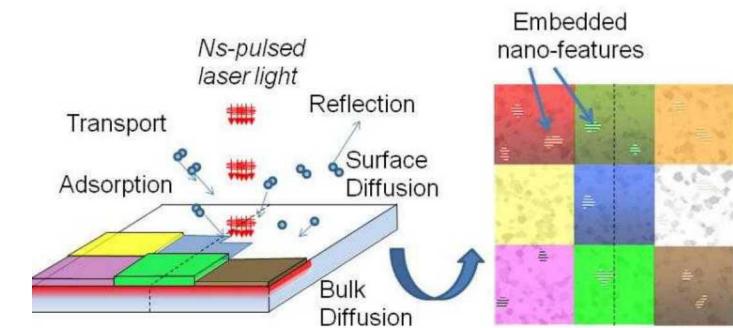
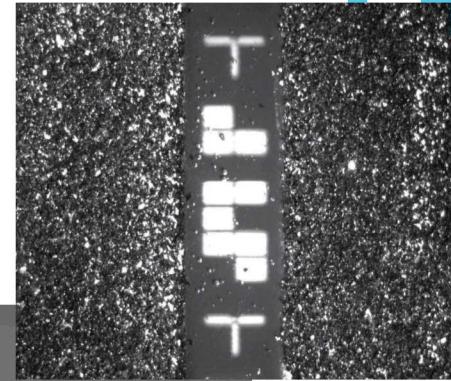
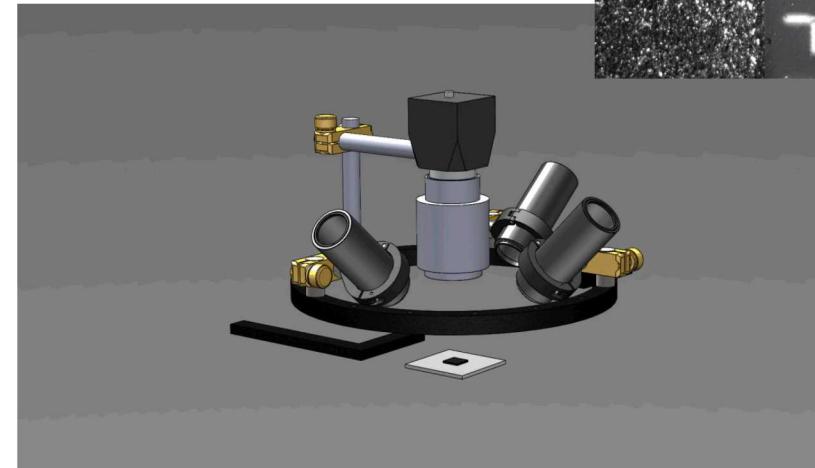
Technical Challenge: Track Item

- Item Tag
 - Provides ability to uniquely identify asset
 - Can provide evidence of tampering
- Risks to Tags include
 - Complexity
 - Compromise
 - Counterfeit
- Efficiency in lifecycle deployment is optimal
- Technically skilled adversaries make tag research and advancement a necessity



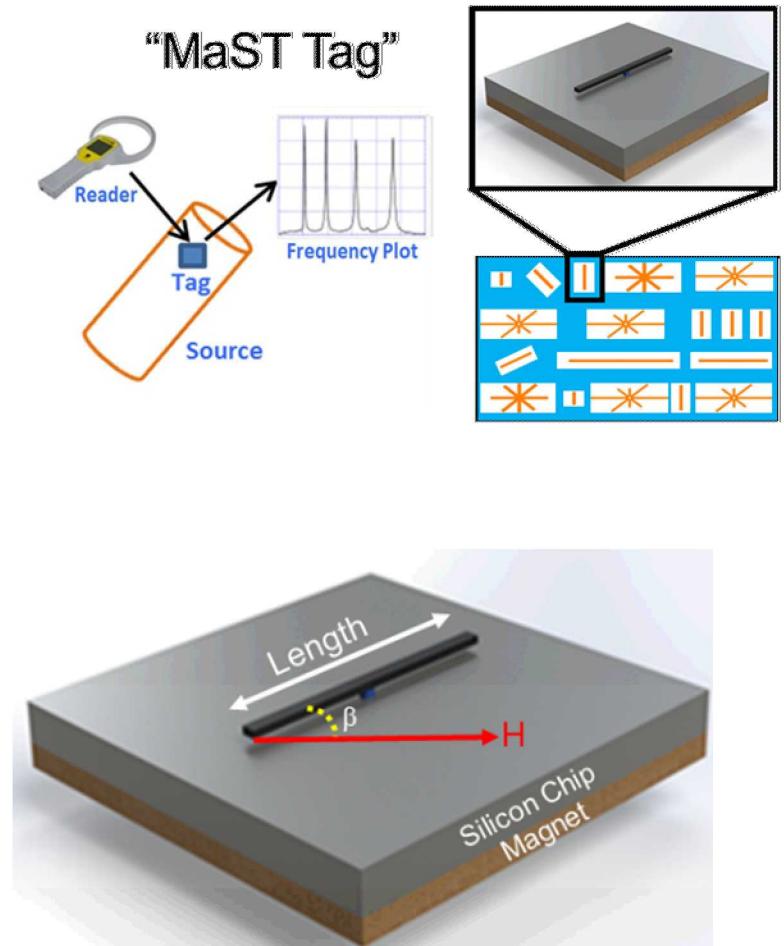
Tags research: RPT & USE

- Reflective Particle Tags (RPT)
 - Hematite particles embedded in adhesive matrix that creates unique and difficult pattern to duplicate
 - Skills on research team: Nonproliferation safeguards, chemistry, physics, optics, modelling, and software engineer
- Unique Surface Encoded (USE) Tag
 - Intrinsic, unique identification markings and patterns
 - Skills on research team: Nonproliferation safeguards, chemistry, physics, material science



Tags research: MaST

- Magnetic Smart Tag
 - Multi-resonator arrays that create unique response to near-field AC magnetic field interrogation.
 - Skills on research team: Nonproliferation safeguards, electrochemistry, physics, material science, microelectronics



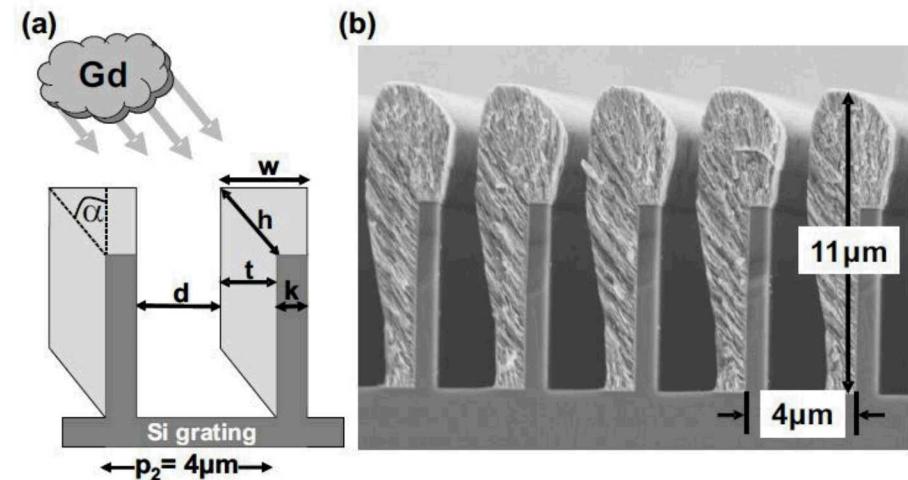
Resonator Frequency is determined by the resonator length and magnetic bias angle, β .

Technical challenge: Material Characterization

- Neutron based measurements (i.e. scattering) recognized as key technique for elucidating broad range of physical phenomena
 - Atomic structure
 - Electromagnetic interplay
 - Interactions and flow of colloids and macromolecules
 - Dynamics and superstructure of complex biomolecule assemblies
- One recent research need requires coherent neutron beam
- The physicist defined the parameters of the beam but then needed to achieve it
 - Previous research by Swiss team resulted in prototype Gd neutron gratings

Materials Characterization: Neutron Gratings

- Neutron Grating
 - Creation of coherent neutron beam as an interrogation technique
 - Skills on research team: additive manufacturing, physics, chemistry, electrochemistry, vacuum science



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In conclusion

- Innovation results in new, often paradigm shifting, capabilities
- Diverse and inclusive research teams provide opportunities to explore broad range of options
 - Multidisciplinary team members allow for broad solution sets to be explored
- I have presented a few of the MDR projects in Global Nuclear Security and Safeguards at SNL
 - Many have patented IP
 - Some are continuing
 - Teams that were built continue to explore new opportunities and innovations



Thank you for your time.

Questions?

