MONT
Montana Nanotechnology Facility

An NSF NNCI Node in the Northern Rocky Mountain Region

David Dickensheets

NNCI Annual Meeting 2023

nano.montana.edu

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MONT Team

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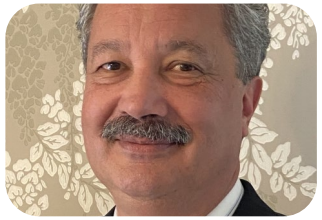

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Education Specialist

Carleton College
Science Education Resource Center

CARLETON COLLEGE
NORTHFIELD, MINN. EST 1866

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Core Facilities

Coordinated access and training for shared equipment housed in 5 campus facilities:

ICAL
Imaging and Chemical Analysis Lab

MMF
Montana Microfabrication Facility

CBE
Center for Biofilm Engineering

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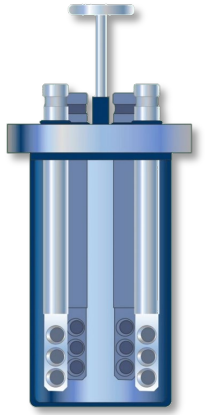
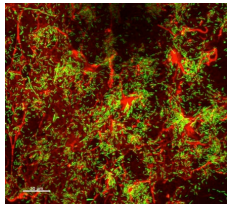
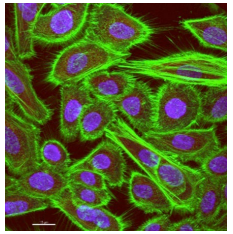
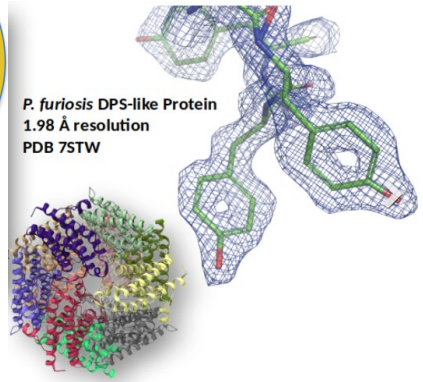






MPMS
Metabolomics, Proteomics & Mass Spectrometry Facility

TEM
Transmission Electron Microscope



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Outline

Panel Topic

What can a set of future nanotechnology infrastructure sites do to expand their impact regionally?

Presentation Theme: Current ways MONT is having "Regional Impact"

1. Users (Research and Development + Economic Impact)
2. Outreach / Education / Workforce
3. Partnerships with Regional Nano-facilities (NWNLA)
4. How can this impact be enhanced in the future?

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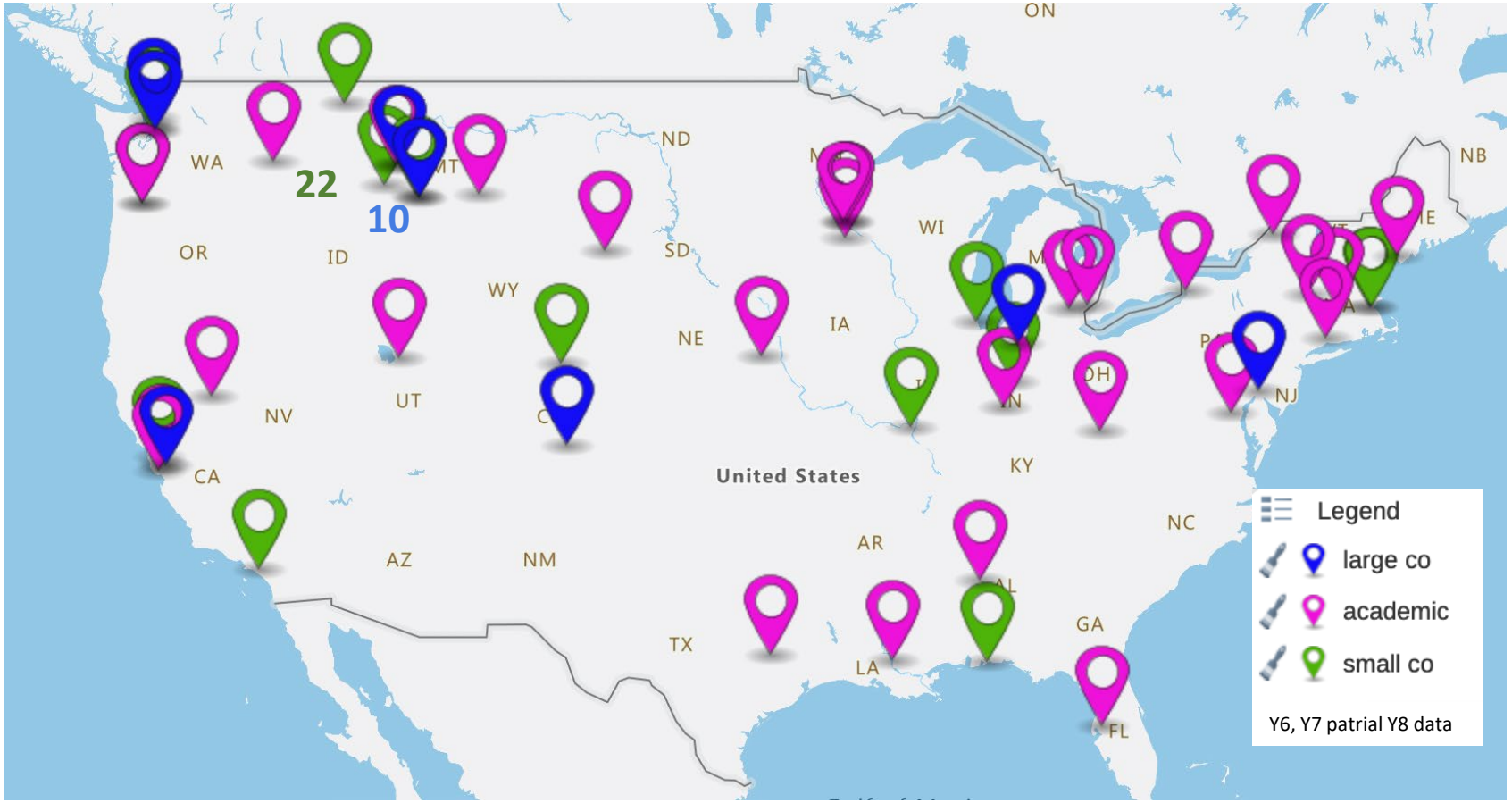
User map (past 30 months)

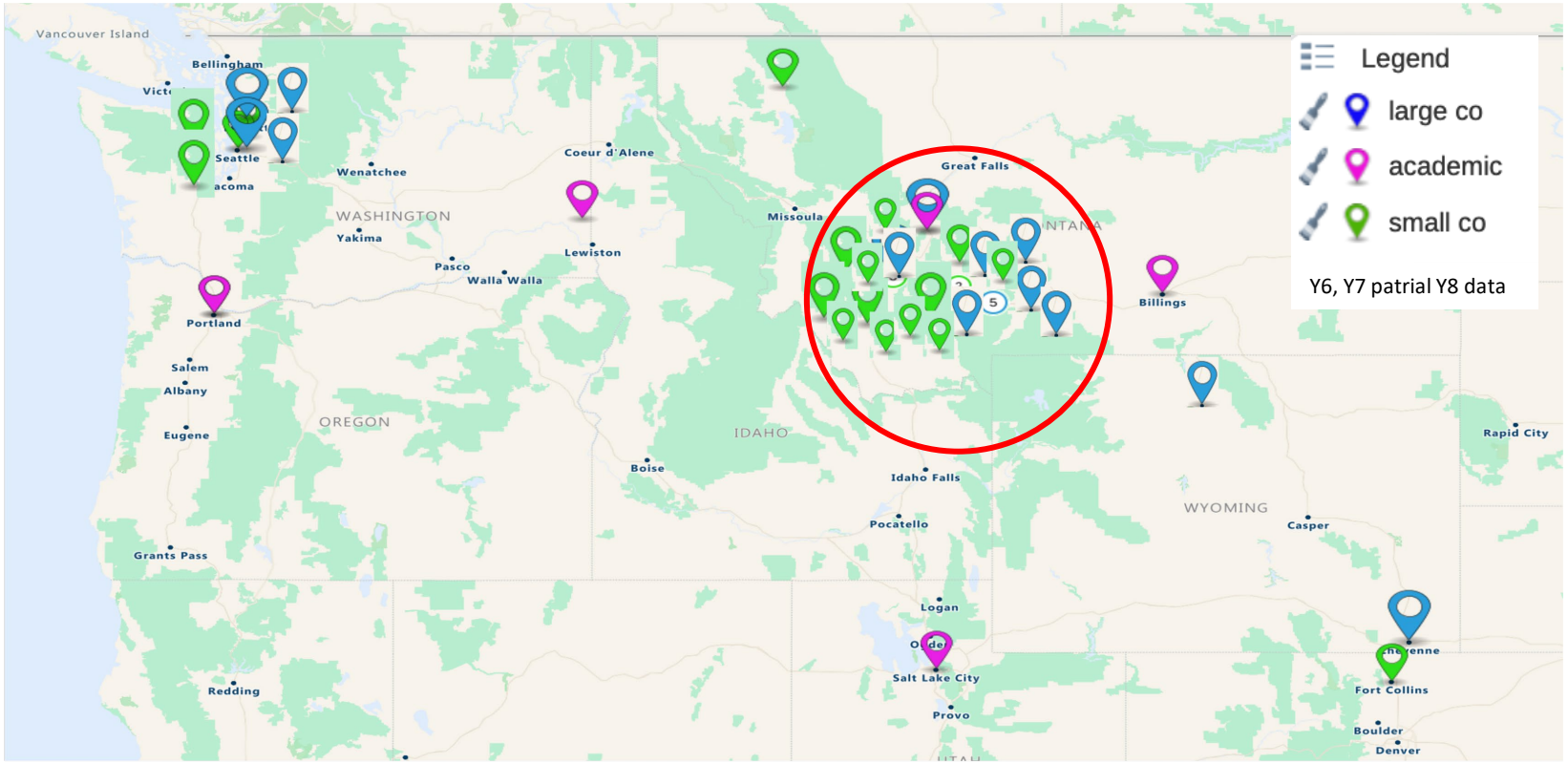
Shows a national user base...



User map (past 30 months)

… but the concentration of activity in our region is also obvious.

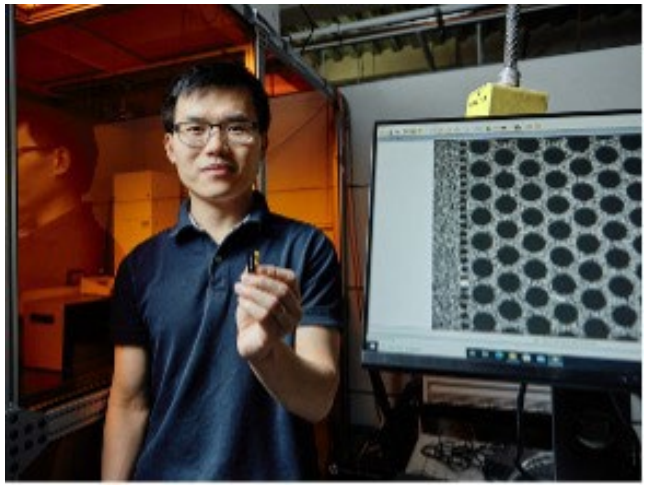
It is easier for users who are in our region to use our facility.



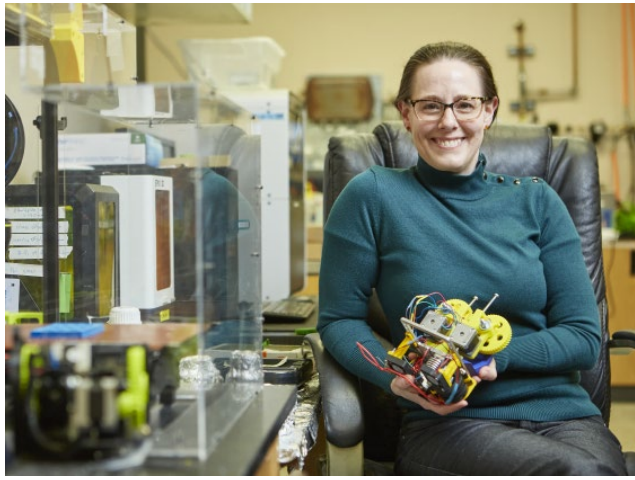
Positive Impact for our Users

Dr. Robin Gerlach received a $1.2M NSF grant for continuing algae research.

MONT faculty user Dr. Stephan Warnat has received a $500,000 award from the USDA.



Dr. Yaofa Li received a $500,000 NSF CAREER award.



Dr. Cecily Ryan received a $700,000 NSF CAREER award.

- MONT provides facilities supporting high-impact, nationally competitive research
- Includes several NSF CAREER awards
- 49 PIs, $67.9M in research funding (18 NSF projects, $21.3M, DBI, CMMI, ECCS, EEC, EAR, OPP, DMR, PHY, OIA)

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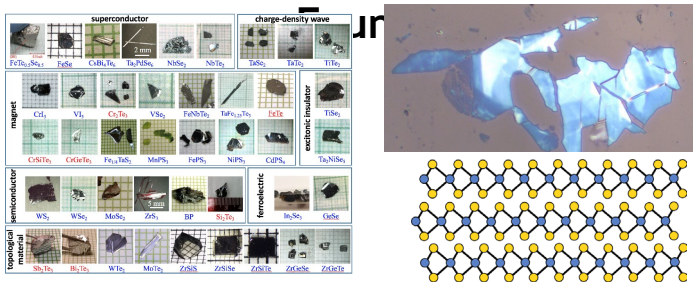
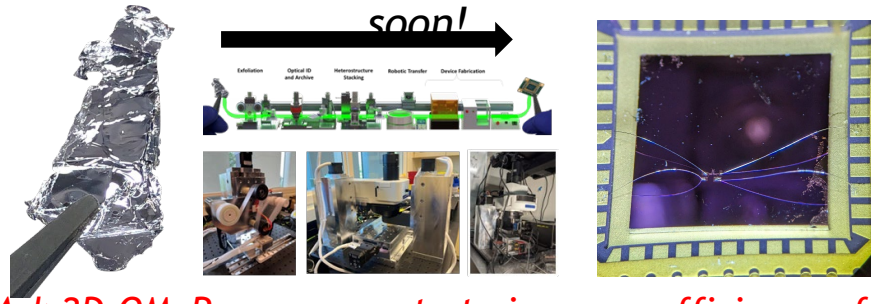
Regional Impact: Quantum needs nano

Introduction to 2D quantum materials research and the MonArk NSF Quantum



Many exciting opportunities in 2D quantum materials

2D Quantum Materials Pipeline preview:
accelerated 2D quantum materials research coming soon!

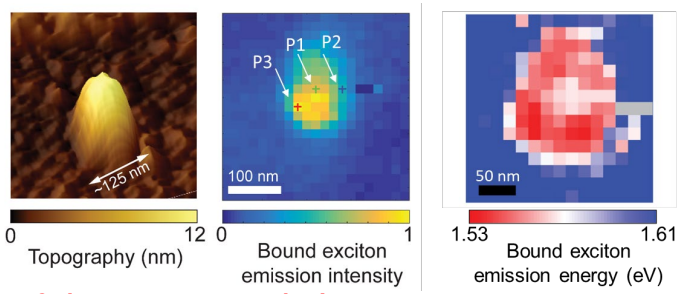


MonArk 2D-QMaPs are on route to improve efficiency of 2D quantum materials research with robotic automation

MONT is partnering with MonArk Quantum Foundry
- A national resource for 2D quantum materials development
- Influenced by NNCI model for open access

MonArk Quantum Foundry
A NATIONAL NETWORK OF 2D-QMaPs

Nano-optical studies of quantum emitter systems in 2D semiconductors



Nanoscale fabrication and characterization is essential for engineering and understanding 2D quantum materials

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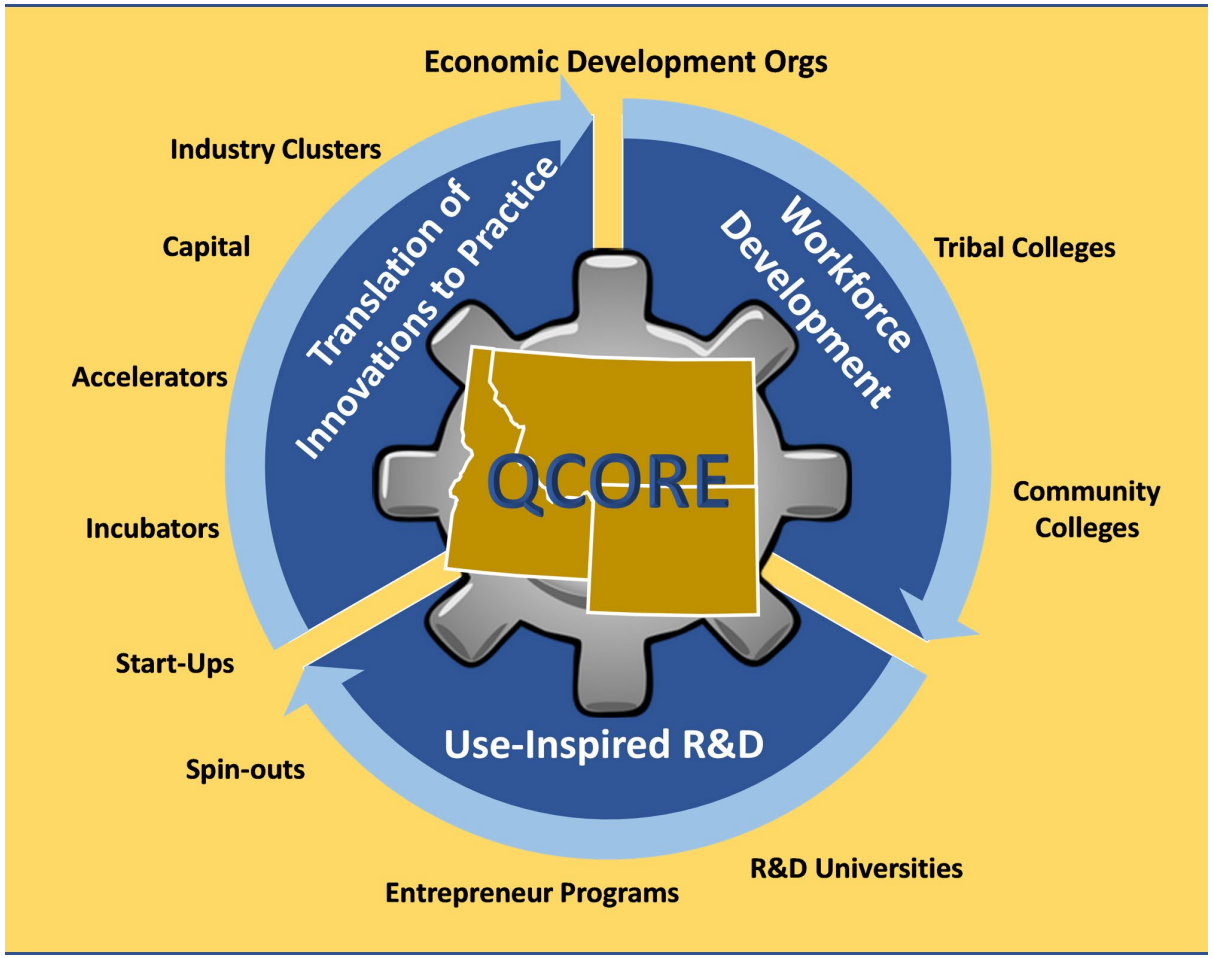
Regional Impact: Quantum needs nano

May 2023
NSF Engines Award

Award includes collaborations with several MONT industrial users. MSU is the lead.



UNIVERSITY OF WYOMING

MONTANA STATE UNIVERSITY

BOISE STATE UNIVERSITY

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Economic and Commercial Impact

External Users SBIR/STTR Awards 2022

- $5.3M Phase I and Phase II awards

- AdvR, Bozeman, MT Phase I, SBIR, DOE DE-SC0022448, $250k
- AdvR, Bozeman, MT Phase I, SBIR, DOE DE-SC0022454, $250k
- AdvR, Bozeman, MT Phase II, SBIR, DOE, DE-SC0021483, $1.5M
- AdvR, Bozeman, MT Phase I, SBIR, DOD, N68335-22-C-0468, $140k
- AdvR, Bozeman, MT Phase I, STTR, NASA, 80NSSC22CA024, $750k
- AdvR, Bozeman, MT Phase I, STTR, NASA , 80NSSC22PA927, $150k
- AdvR, Bozeman, MT Phase II, STTR, NASA, 80NSSC22CA028, $750k
- Resodyn, Butte, MT Phase I, SBIR, DOD, SP4701-22-P-0057, $100k
- NWB Sensors, Bozeman, MT Phase I, SBIR, DOE, DE-SC0022503, $250k
- GlyderTech, Bozeman, MT Phase II, SBIR, DOD, FA8649-22-P-0909, $1.2M

AdvR

NWB Sensors, Inc.

GLYDERTECH

Resodyn™ CORPORATION

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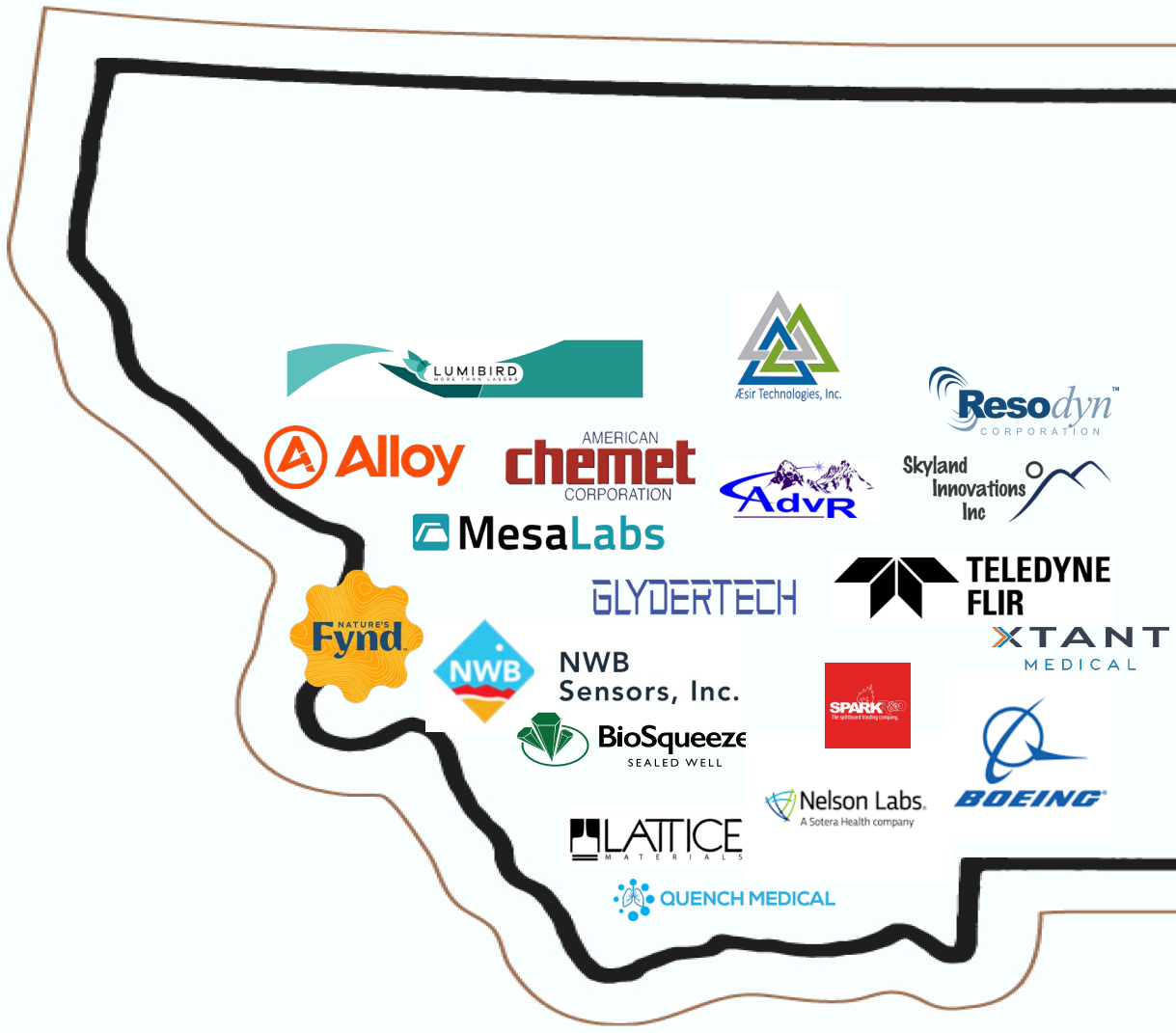
Economic Impact is Regional



In first 6 mo. of Y8 we have served 24 companies, 8 large and 16 small (32 users).

All are based in, or have satellite locations, in Southwest MT.

Over 140 people employed in small business and over 400 in large companies.

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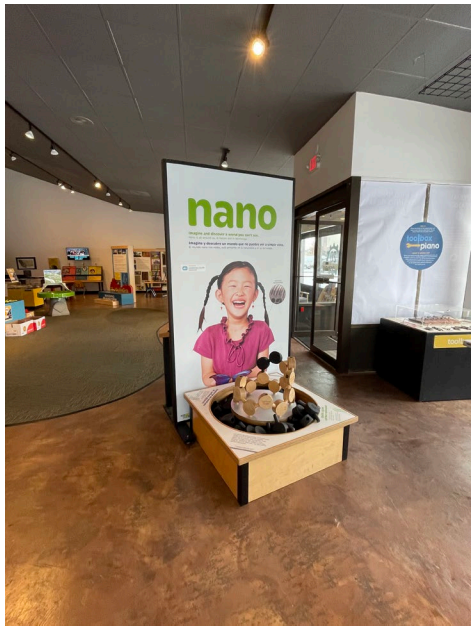
Education and Outreach is regional and national

- Montana 4-H – following MSU's Land-Grant mission, connecting rural regions to nano science/technology
  - 4-H Congress, July, on campus – Lab activities silver nano particles, and making tiny things
- Partner with Salish Kootenai College (Flathead Reservation)
  - SKC students → MSU, Dr. Clay Compton, Salish Kootenai College, plans to visit ICAL with his students to characterize airborne particles, SKC is also partnering on an MRI grant in ICAL.
  - MONT hosted 35 SKC summer program middle and high school students for 1.5 days in our labs and a field day in Yellowstone National Park
- MSU in-person youth camps and activities
  - STEAM Day – 2 day camp for middle school girls
  - MSU Science Day, 170 5th graders
  - MSU Shadow Day
- New Partnership with Montana Science Center
  - Hands on labs
  - NISE Network's Nano Exhibit
- Teacher Support
  - Scholarships for 2 Montana teachers in nano@Stanford's NanoSIMST course
  - MSSE Solar Cells for Teachers course at MSU
  - SERC teacher professional development webpages



NISE Net display at Montana Science Center.

SALISH KOOTENAI COLLEGE

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Education and Workforce Development

- User Education and Training
- Nanotech for Teachers
  - MS in Science Education
    - "Solar Cells for Teachers"
  - RET participants
  - Participate in teacher workshops throughout the year
  - Scholarships for 2 Montana teachers in nano@Stanford's NanoSIMST course
- REU
  - Support for 4 REU students in MONT along with travel to NNCI Convocation in August.
  - Supporting REUs in nano-Earth Sciences
  - Hosted 2023 NNCI REU Convocation
- In-Class Education
  - 11 courses use MONT for laboratory activities
  - Mentored research experience (UG and Grad)
- Student Staff in facilities
  - >10 undergraduates employed to help operate facilities

MSU Courses With Labs That Rely on MONT Facilities		
BCH 524	Biochemical Applications of Mass Spectrometry	MPMS
CHMY 333	Honors Organic Chemistry II	MPMS
CHMY 421	Instrumental Analysis	MPMS
EELE 407	Introduction to Microfabrication	MMF
EELE 408	Photovoltaic Systems	MMF
EELE 418	The Art of Biochips	MMF
EELE 505	MEMS Sensors and Actuators	MMF
EMEC 467	Micro Electromechanical Systems	MMF
GEO 302	Mineralogy and Optical Mineralogy	ICAL
GEO 591	Precambrian Biosphere	ICAL
MTSI 551	Advanced Materials Characterization	ICAL

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Improving Geographic Coverage

Northwest Nano-Lab Alliance (NWNLA)
Joint effort between MONT / NNI

- Regional network, modeled after MINIC's NNLA
- Build relationships, solve common problems, and grow awareness of capabilities, needs, vendors, and NNCI resources
- Biennial meeting at UW or MSU
- 2nd meeting held Aug. 3 & 4, 2023 at University of Washington in-person. ~60 Attendees
- Increased the number of participating institutions to nearly 30 (up from 17 at the first meeting). Meeting includes a mix of informational talks, panel discussions, breakouts, vendor displays, and social events.

NWNLA participating institutions

https://www.nano.uw.edu/nni/northwest-nanotechnology-laboratory-alliance/

Improving Geographic Coverage

Northwest Nano-Lab Alliance (NWNLA)
August 2023, University of Washington

Smaller institutions like Whitworth and Western Washington University were really enthusiastic about this event. How do we include facilities like them in a future infrastructure program?

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https://www.nano.uw.edu/nni/northwest-nanotechnology-laboratory-alliance/

Growing Regional Impact

Northwest University Semiconductor Network

- Micron Technology announced the formation of the Northwest University Semiconductor Network, a partnership created to develop the next generation of the semiconductor industry's workforce in June 2023
- The new network is comprised of 13 founding-member universities across six states, including MSU.
- **Northwest STEMM Summit - Achieving Equity & Excellence**: Hosted by Micron, attended by more than 100 individuals from colleges, universities and companies from all across the Northwest.
- Still early stages, but Micron is providing some resources for enhanced training/outreach – more to announce later

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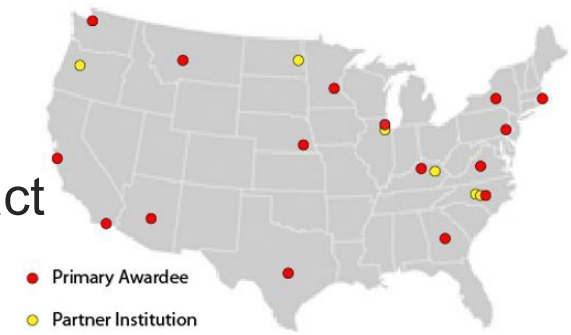
Maximizing Regional Impact of a Future Infrastructure Program

- Geographic Distribution of Sites is Important
  - Regional impact is felt most strongly within a day's drive of facility
  - Economic benefit via regional businesses can have significant local impact



- How can we support more facilities, geographically distributed?
  - NWNLA (and other regional alliances) can be one mechanism (NNCI – driven)
  - Northwest University Semiconductor Network might be another (Industry – driven)
  - Can a future NSF Infrastructure Program catalyze/incentivize/support more partnerships?

- Increase ways we use our facilities for workforce-targeted education
  - Partner with target industry partners to grow coursework capacity ($ should flow!)
  - Leverage our facility staff programs to specifically include traineeships
    - Add staff positions that are primarily training opportunities (can be UG students, CC students, veterans, etc.; again, industry can help with $$ for this)
    - Facilities can enjoy a larger technical staff – better service to users (professional staff may need new skills)
    - Industry benefits from a growing pool of trained and "favorably inclined" job candidates

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Thank you!

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REU Convocation 2023