MONT
Montana Nanotechnology Facility

An NSF NNCI Node in the Northern Rocky Mountain Region

Y6 Site Report

David Dickensheets

NNCI Annual Meeting, Nov. 2-3, 2021

nano.montana.edu

Our Team

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Deputy Director

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(MPMS)

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Education Specialist
Carleton College
Science Education Resource Center

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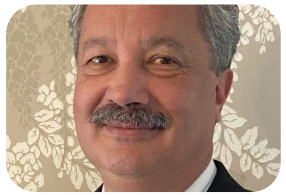
VP REDGE



Yves Idzerda
Dean, CLS

Brett Gunnink
Dean, COE

MONTANA STATE UNIVERSITY
Mountains and Minds

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MONT Impact and New Diversity Initiatives in Y6

a. What was your main challenge during Year 6 and how did you overcome it?

b. What new program did you introduce during Year 6?

c. What impactful research emerged from your site during Year 6?

d. What steps did your site take to improve on diversity and equity during Year 6?

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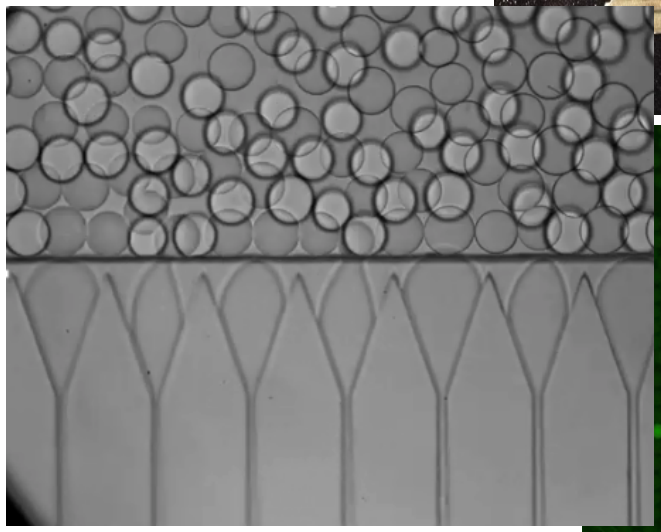
Impact: COVID-19 Research in MONT

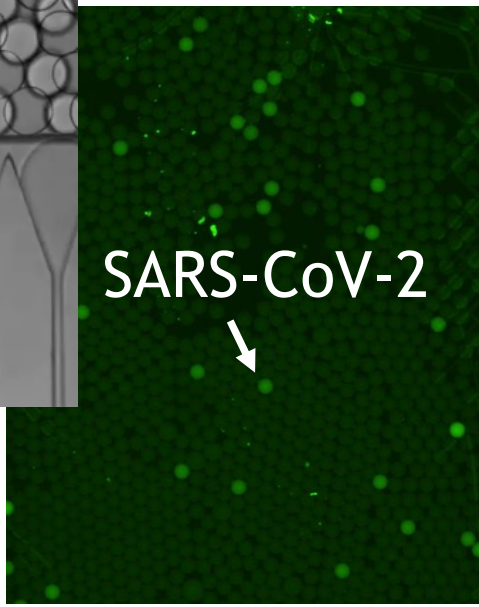
MONT use for COVID-19 related research

- RT-LAMP microfluidic chips for rapid, low-cost SARS-CoV-2 detection
- TEM imaging analysis of SARS-CoV-2 interactions in a novel human organoid tissue system
- TEM imaging of viruses in wild bat populations
- TEM analysis for developing methods for inactivating SARS-CoV-2 virus for the safe use of the virus in the national research community
- Cryo-SEM imaging of municipal waste water samples for detection of virus load

We use drop-based microfluidics to encapsulate human saliva in individual drops…



…and use isothermal nucleic acid amplification to detect SARS-CoV-2.



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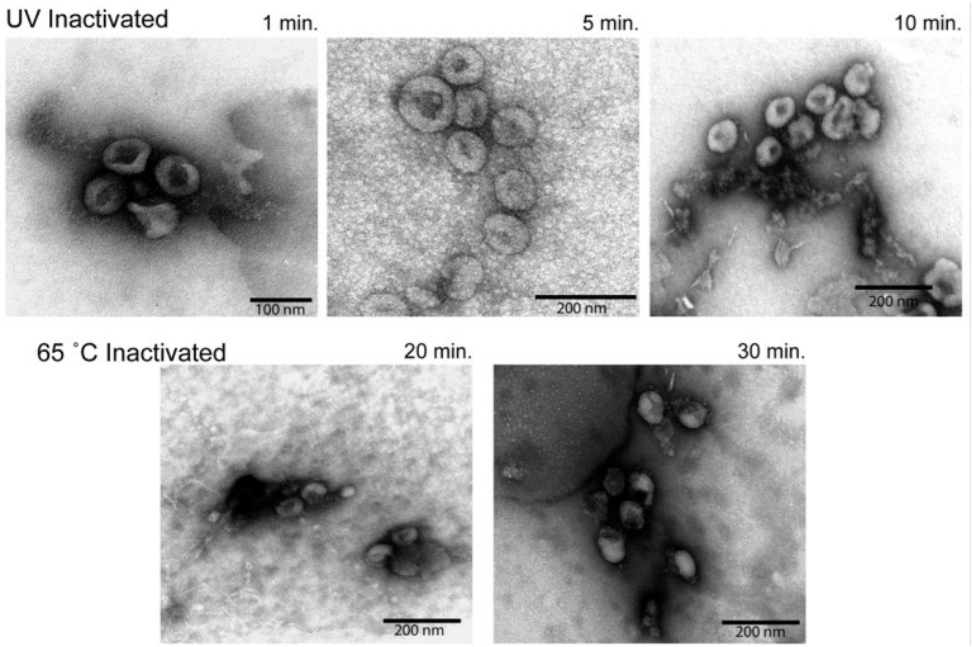

Effect of Inactivation Methods on SARS-CoV-2 Virion Protein and Structure, E.K. Loveday, K.S. Hain, I. Kochetkova, J.F. Hedges, A. Robison, D.T. Snyder, S.K. Brumfield, M.J. Young, M.A. Jutila, C. B.Chang, M.P.Taylor. *Viruses*, *13*, 562 (2021).

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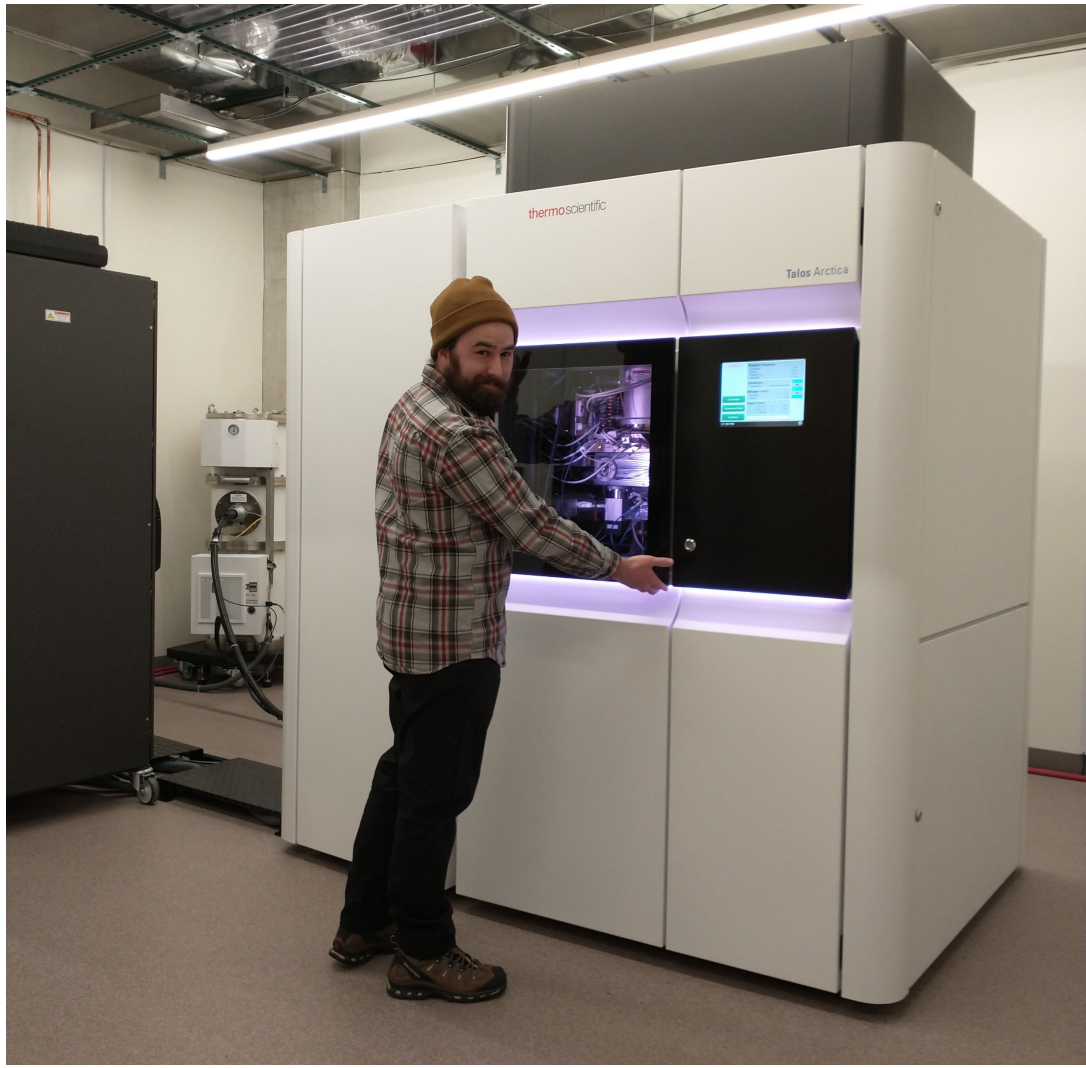
New Cryo-TEM: 200 kV Talos Arctica + Gatan K3 camera

Microscope in a box:
Fully automated, computer controlled.
Remote, unattended operation for extended periods.

Gatan K3 camera: Direct Electron Detectors (DED) with high frame rates (1500 frames per second, ~ 25 megapixels/frame (physical), 100 megapixels/frame in super resolution mode →150 gigapixels/sec)

Computational Resources (Rack Mounted):

- Gatan Camera Server
- Compute Server (Dell)
  64 Core (2x AMD 7282) 128 GB RAM
  2x Nvidia A40 GPU
- Storage Server
  160 TB local RAIDZ2 data storage + 100 Tb with Research Computing
- LTO-8 tape backup (coming).
- 10 GbE network with Globus End Point Access



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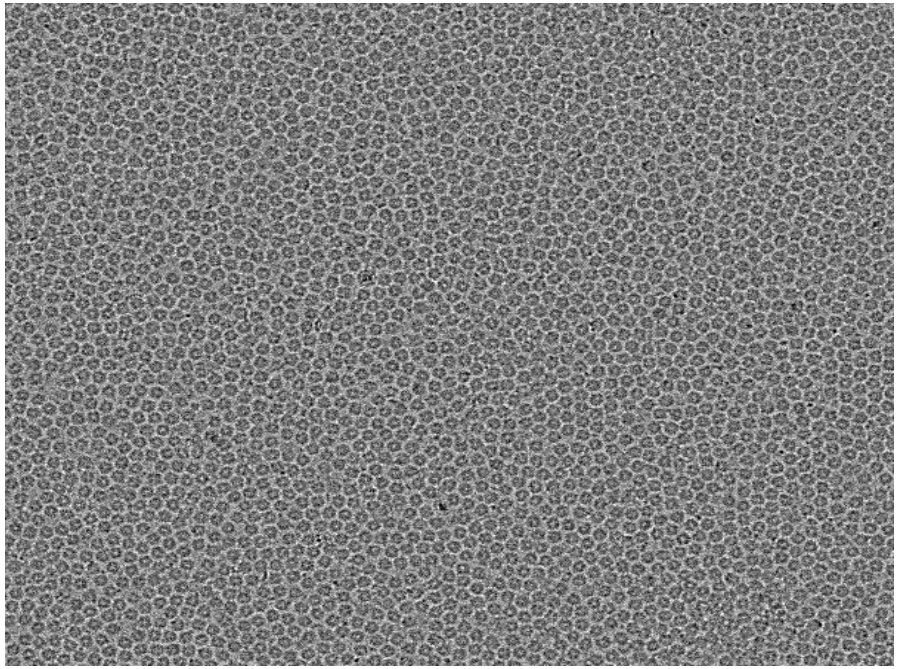
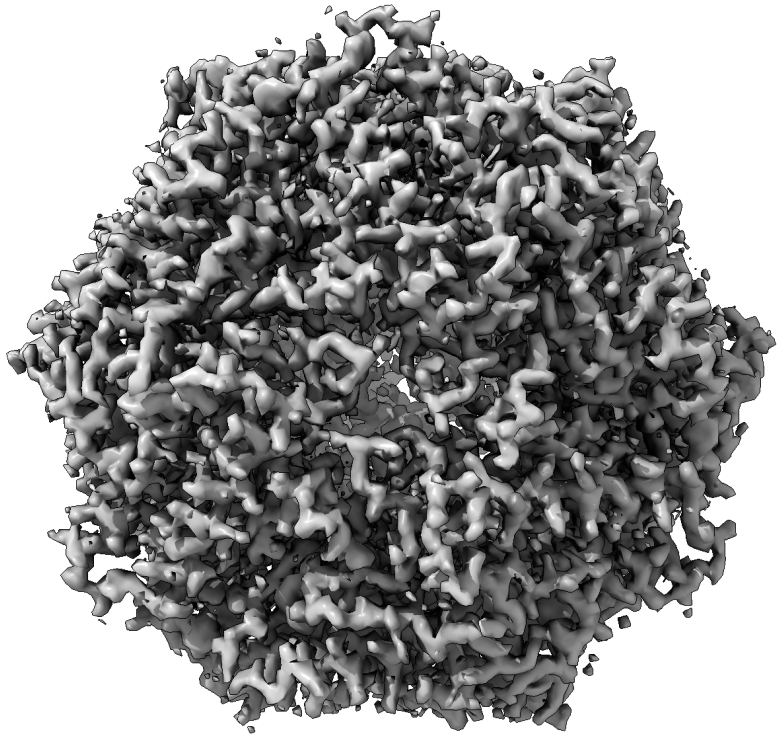
Single particle analysis

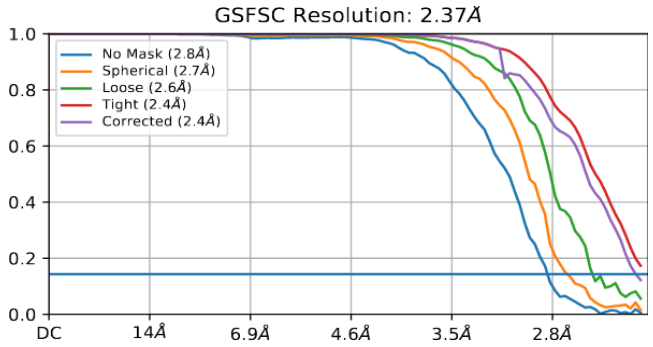
Pyrococcus furiosus DPS-like protein

- 200,000 particles
- 2.37 Å resolution
- Ordered water visible



Trevor Douglas*
Indiana
Medical Nanotech





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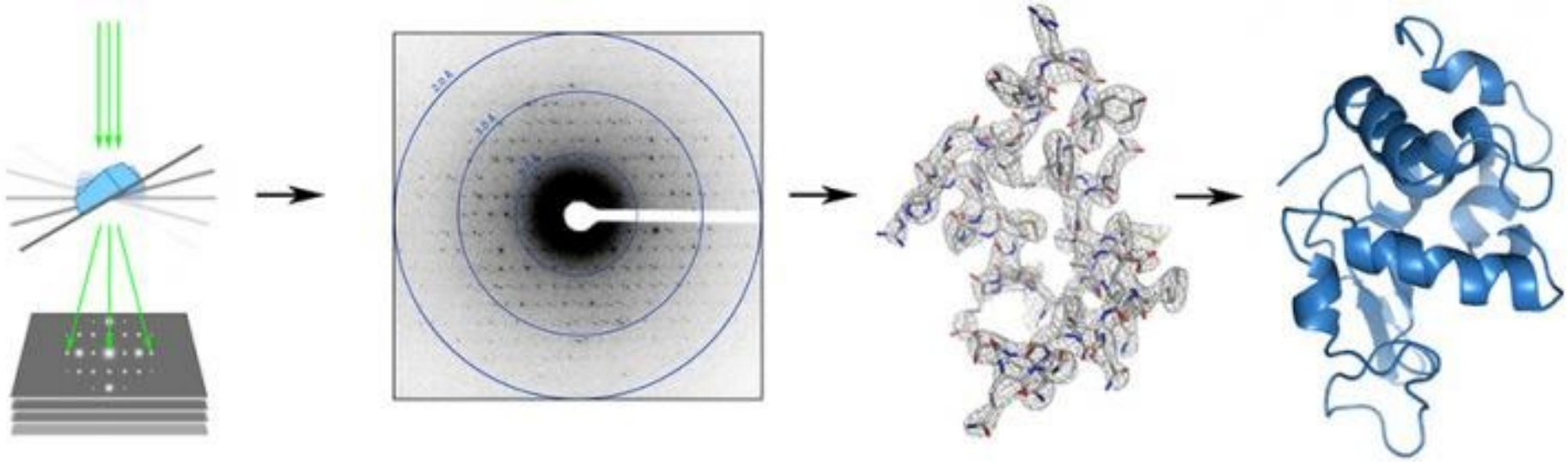
Coming Winter 2021/2022: cryo-EM Micro-Electron Diffraction

Talos Arctica cryo-TEM allows electron diffraction using submicron sized single crystals, both small molecule and macromolecule.



- Potentially equivalent to microcrystal synchrotron beamlines.
- Small molecule micro-ED trials this winter for our organic and materials science chemists.

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2D Quantum Materials and Devices at MONT

MonArk Quantum Foundry
A NATIONAL NETWORK OF 2D-QMaPs

www.monarkfoundry.org

NSF's Enabling Quantum Leap: Convergent Accelerated Discovery Foundries for Quantum Materials Science, Engineering and Information (Q-AMASE-i)


Yves Idzerda
Director


Hugh Churchill
Asst. Dir., UA


Nick Borys
Asst. Dir., MSU


Salvador Barraza-Lopez
Theory Lead

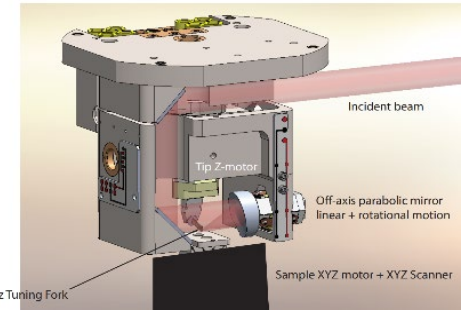

Anjan Reijnders
Industry Liaison

MonArk Scientific Thrusts

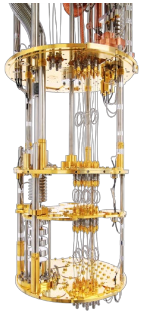
- 2D quantum emitters & quantum interconnects
- 2D quantum dots and qubits.
- 2D nonlinear media
- 2D magnetism quantum spin liquids
- + more!

MonArk Infrastructure Development

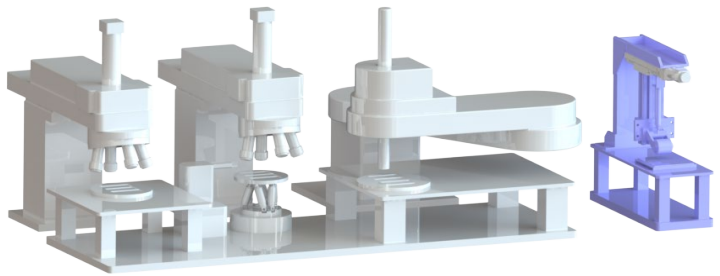
- 4 K nano-optics (MSU)



- mK qubit characterization (UA)



- Automated 2D material exfoliation and device fabrication (MSU and UA)



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MONT Education & Outreach

New! Mentored Research

MONT Empower Scholars Program

- MSU Empower serves UG students underrepresented in STEM
  - student center, drop-in tutoring, advising, research internships, and scholarships
- 7 scholarships have been awarded, 4 have completed a semester mentorship. Includes stipend and facility fees.
- Four assessments have been completed with three students reporting a new interest in **graduate school**, one is now conducting **independent research** and one **changed majors** from biology to environmental engineering. All reported a positive mentoring experience and a greater appreciation for nanoscience/technology.

Work of MONT Scholars awardee M. Espinal. Biomineralized cellulose fibers using jackbean enzyme coated with a thin film. This work may lead to hierarchical toughening of cement.

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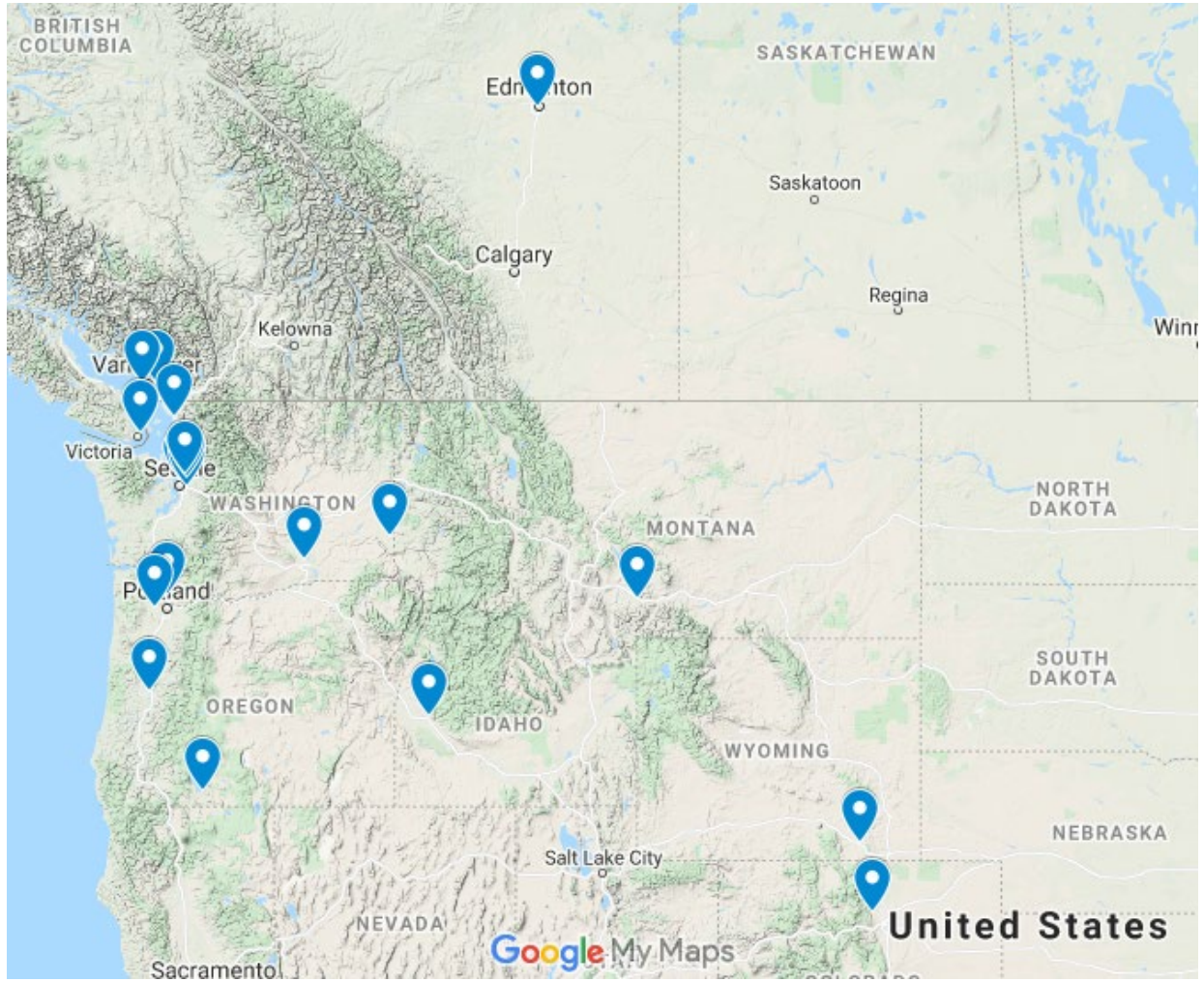
Growing the Impact of the NNCI Network

Northwest Nano-Lab Alliance

Joint effort by MONT / NNI

Regional Network, modeled after MINIC's NNLA

- ~ 21 Sites so far, including Universities, Community Colleges, Private and Government labs; several vendors participating too
- Goal: Build relationships, solve common problems, and grow awareness of capabilities, needs, vendors, and NNCI resources
- Biennial meeting at UW or MSU, plus virtual meetups
- First virtual meeting set for Nov. 8th and 9th, 2021 hosted by MONT – 60 registered so far



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Thank you!

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