

ONRI JAY BENALLY

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PROFICIENT SKILLS

[Expert in Bold]

HARDWARE:
Dilution refrigerator: Bluefors XLDsl • microwave packaging • cryogenic wiring + mixing chamber configuration.
Optical & electron-beam lithography: **Karl Suss-MA6** • Heidelberg DWL200 • **Raith EBPB-5000+ (100 kV)**.
Deposition & plasma etching: Ion Probe • PECVD • ALD • RIE • **IBE** • **sputtering** • **e-beam evap.**
Imaging: SEM • AFM • surface 2D/ 3D profilometry • 3D-scanning microscopy • 1-photon excitation.
Machining & additive manufacturing: metal mill • lathe • **FDM** • SLA • IR LASER cutting (150W).

SOFTWARE:
 Qiskit • **Qiskit Metal (Q – EDA)** • **MS Office** • AutoCAD • **Fusion 360** • **KLayout** • LinkCAD • MuMax3 • Git • Tcl/Tk • Julia • Python + GPT-4 • Colab • **Blender 3D Graphics** • **SimScale CFD** • **Elmer FEM** • **Quanscient Allsolve** • LaTeX • Genisys BEAMER • Linux Terminal + RealVNC.

PROBLEM SOLVING & COMMUNICATION:
 Ethical leadership • **optimism** • project management • **quantum technology advocacy** • **idea generation** • 1st principles & finite element methods • **rapid prototyping**.

EXPERIENCE

QUANTUM HARDWARE ENGINEER – PHD INTERN • INTERNATIONAL BUSINESS MACHINES CORPORATION (IBM) • THOMAS J. WATSON RESEARCH CENTER | KEVIN TIEN GROUP (YORKTOWN HEIGHTS, NY)
[\[MAY 2024 – AUGUST 2024\]](#)

- Advanced the development & accuracy of quantum-limited amplifier readout for **large-scale quantum computing systems** by automating the process of low temperature quantum device materials characterization.
- Realized **high throughput testing** of resonator devices from experimental fabrication splits. Disassembled, reassembled, & utilized a **Bluefors XLDsl dilution fridge** for all my experiments.
- Generated extensive documentation of highly experimental microwave resonator-based loss probing of Nb & NbOx thin films at a cold temperature of **10 mK**. (Josephson traveling wave parametric amplifier [**J-TWPA**] materials).
- Recognized for my high-quality presentations involving my work on cryogenic testing automation of superconducting thin films in IBM's Quantum Lab.
- Recognized by IBM executive leadership for initiatives in quantum hardware visualization via [Qiskit Metal + Blender 3D animation](#) & [Indigenous American language](#).

GRADUATE RESEARCH ASSISTANT • UNIVERSITY OF MINNESOTA • NANO MAGNETISM & QUANTUM SPINTRONICS LAB | JIAN-PING WANG GROUP | ECE DEPT. (MINNEAPOLIS, MN)
[\[FEBRUARY 2020 – JUNE 2022\]](#)

- Successfully **trained/ mentored** 11 new academic users (PhD-level) & 1 faculty on **high-yield quantum device fabrication** & electron microscopy in the cleanroom.
- Developed recipes & protocols for patterning high-yield Perpendicular **Magnetic Tunnel Junctions** (p-MTJs) used in spin-orbit torque magnetic random-access memory (**SOT-MRAM**), computational random-access memory (**CRAM**), & **magnetic brain interface chips**. Device sizes (100 nm – 6 µm). Alloys: PtSn, PtSi, CoPd, CoSi, TaN, FePd, CoFe.
- Wrote recommendation letters to recruit & train new academic researchers.
- Co-authored several peer-reviewed publications on spintronic devices composed of **energy-efficient, newly engineered metal thin films** (p-MTJs, Hall bars, Hall crosses, µ-resonators, & µ-coils).

STUDENT TECHNICIAN • UNIVERSITY OF MINNESOTA • ADVANCED IMAGING SERVICE FOR OBJECTS & SPACES LAB | SAMANTHA PORTER GROUP (MINNEAPOLIS, MN)
[\[FEBRUARY 2020 – MAY 2020\]](#)

- Developed 3D modeling techniques & imaging hardware for photogrammetry systems (low-cost single-shot **static 3D scanning** & image stitching).
- Collaborated with small staff team on 3D virtual reality (VR) content for low-cost supply integration.

RESEARCH ASSISTANT • UNIVERSITY OF MINNESOTA • QUANTUM DEVICES & MATERIALS LAB | VLAD PRIBIAG GROUP | PHYSICS DEPT. (MINNEAPOLIS, MN)

[JUNE 2017 – AUGUST 2017]

- Optimized the process development of (III-V) InSb **Majorana nanowire devices** (100 nm spin-valves) for studies on **Majorana Fermion quasiparticles** & topological quantum logic gates.
- Wrote recipes for e-beam lithography development, planarization, & plasma etching calibration based on extracted data. Operated & **qualified on semiconductor fab equipment** in the Minnesota Nano Center.

ELECTRIC VEHICLE RESEARCHER (VOLUNTEER) • UTAH STATE UNIVERSITY • ELECTRIC VEHICLE & ROADWAY TEST TRACK FACILITY | REGAN ZANE GROUP | ECE DEPT. (LOGAN, UT)

[JANUARY 2017 – APRIL 2017]

- Volunteered time in the Electric Vehicle & Roadway (EVR) Research Facility and Test Track.
- Tested/ inspected +60 kW electric vehicle subsystems (ex. J1772 charging networks, sub-pavement in-motion wireless power transfer systems, **3-phase motor controls**, **powertrain**, etc.).

STEM LAB ASSISTANT • UTAH STATE UNIVERSITY-EASTERN • ENGINEERING LAB | CURTIS FRAZIER GROUP (BLANDING, UT)

[OCTOBER 2016 – DECEMBER 2016]

- Incorporated an unfinished electric vehicle project that was initially volunteered upon in the previous semester.
- Led & directed the design, wiring, fabrication, field testing, & demonstration of functional **system hardware projects** based on experience (5-kilowatt-hour **all-terrain electric vehicle (e-ATV)**, 3-kilowatt-hour battery system, custom **LEGO/ VEX robotics**, high-powered photovoltaic array, & configuration of a **modular solar charging network**).
- As vice president for American Indian Science & Engineering Society chapter, outreached to the local community on the capabilities of robotics hardware, electric vehicles, & renewable energy via **public demonstrations**.

STEM MENTORSHIP RESEARCH ASSISTANT • UTAH STATE UNIVERSITY • COLLEGE OF SCIENCE (LOGAN, UT)

[MAY 2016 – JUNE 2016]

- Provided **data labeling**, extraction, & analysis services on **Zr microcrystal** structures, atmospheric **gravity waves**, & Lycaeides Idas butterflies using Microsoft Excel spreadsheets.
- (Uranium-Thorium)/ Helium ((U-Th)/ He) thermochronology, IR CCD astroimaging, SEM, & digital microscopy were sources of fresh/ raw data.
- Presented new learnings on **instrumentation techniques** for **data extraction** at the USU research **symposium**.

EDUCATION

DOCTOR OF PHILOSOPHY - Ph.D., ELECTRICAL ENGINEERING, [QUANTUM HARDWARE/ SPINTRONICS FOCUSED]

UNIVERSITY OF MINNESOTA-TWIN CITIES (MINNEAPOLIS, MN)

June 2022 – April 2027

BACHELOR OF SCIENCE - B.S.Md.S., MULTIDISCIPLINARY STUDIES

UNIVERSITY OF MINNESOTA-TWIN CITIES (MINNEAPOLIS, MN)

August 2018 – December 2021

ASSOCIATE OF SCIENCE - A.S., GENERAL STUDIES, PHYSICS

UTAH STATE UNIVERSITY-EASTERN (BLANDING, UT)

August 2014 – December 2016

DIPLOMA: GENERAL STUDIES, RANK: #1

RED VALLEY/ COVE HIGH SCHOOL (RED VALLEY, AZ)

August 2010 – May 2014

ASSOCIATED CERTIFICATIONS

IBM GROWTH BEHAVIORS

International Business Machines Corporation (IBM)

08/2024

QUANTUM CHEMISTRY, WITH VARIATIONAL QUANTUM EIGENSOLVER

International Business Machines Corporation (IBM)

06/2024

QUANTUM BUSINESS FOUNDATIONS

International Business Machines Corporation (IBM)

06/2024

IBM CERTIFIED QUANTUM DEVELOPER – QUANTUM COMPUTATION USING QISKIT V0.2X [PROFESSIONAL]

International Business Machines Corporation (IBM)

02/2022

Full List of Onri's 67 Completed Training Programs & MOOCs: (z.umn.edu/OJB-Certifications)

PUBLICATIONS & PAPERS

1. **Benally, O.J.**, Lyu, D., Zink, B., Lv, Y., Mkhoyan, K.A., Khanal, P., Wang, W., Shoup, J.E., Hoskins, B., Gopman, D.B., and Wang, J.P., 2023. Magnetic random-access memory (MRAM) for embedded quantum computing hardware. *GOMACTech* [Submitted Abstract]. – Contributions: main author, designed the quantum hardware architecture.
2. Zhang, D., Jiang, W., Yun, H., **Benally, O.J.**, Peterson, T., Cresswell, Z., Fan, Y., Lv, Y., Yu, G., Barriocanal, J.G. and Swatek, P.W., and Wang, J.P., 2023. Robust negative longitudinal magnetoresistance and spin-orbit torque in sputtered Pt₃Sn and Pt₃Sn_xFe_{1-x} topological semimetal. *Nature Communications*, 14(1), p.4151. – Contributions: co-author, microdevice patterning.
3. Zhou, B., Khanal, P., **Benally, O.J.**, Lyu, D., Gopman, D.B., Enriquez, A., Habiboglu, A., Warrilow, K., Wang, J.P., and Wang, W.G., 2023. Perpendicular magnetic anisotropy, tunneling magnetoresistance and spin-transfer torque effect in magnetic tunnel junctions with Nb layers. *Scientific Reports*, 13(1), p.3454. – Contributions: co-author, nanodevice patterning.
4. Sheng, P., Zhao, Z., **Benally, O.J.**, Zhang, D., and Wang, J.P., 2022. Thermal contribution in the electrical switching experiments with heavy metal/antiferromagnet structures. *Journal of Applied Physics*, 132(7). – Contributions: main author, microdevice patterning.
5. Swatek, P.W., Hang, X., Fan, Y., Jiang, W., Yun, H., Lyu, D., Zhang, D., Peterson, T.J., Sahu, P., **Benally, O.J.**, Cresswell, Z., and Wang, J.P., 2022. Room temperature spin-orbit torque efficiency in sputtered low-temperature superconductor δ -TaN. *Physical Review Materials*, 6(7), p.074206. – Contributions: co-author, microdevice patterning.
6. Liu, J., Fan, Y., Zhang, D., **Benally, O.J.**, Bainsla, L., Peterson, T., and Wang, J.P., 2022. Element doping enhanced charge-to-spin conversion efficiency in amorphous PtSn₄ Dirac semimetal. *arXiv preprint arXiv:2202.01384*. – Contributions: co-author, microdevice patterning.
7. Lyu, D., Zhang, D., Gopman, D.B., Lv, Y., **Benally, O.J.**, and Wang, J.P., 2022. Ferromagnetic resonance and magnetization switching characteristics of perpendicular magnetic tunnel junctions with synthetic antiferromagnetic free layers. *Applied Physics Letters*, 120(1). – Contributions: co-author, microdevice patterning.
8. Zink, B.R., Zhang, D., Li, H., **Benally, O.J.**, Lv, Y., Lyu, D., and Wang, J.P., 2022. Ultralow current switching of synthetic-antiferromagnetic magnetic tunnel junctions via electric-field assisted by spin-orbit torque. *Advanced Electronic Materials*, 8(10), p.2200382. – Contributions: co-author, microdevice patterning.
9. Lyu, D., **Benally, O.J.**, Zhang, D., Lv, Y., Zhao, Z., Gopman, D.B., and Wang, J.P., 2021. Fabrication of Magnetic Tunnel Junctions with Synthetic Antiferromagnetic Free Layer with Bulk Perpendicular Materials. *EIPBN*. [Abstract] – Contributions: co-author, nanodevice patterning.

PROJECTS

Full list of +16 hardware projects: (tinyurl.com/OJB-Projects-001)

[Side projects included]

ASSOCIATED ONLINE PROFILES

Google Scholar (z.umn.edu/OJB-Google-Scholar)

ORCID (orcid.org/0000-0002-8391-9105)

GitHub (github.com/OJB-Quantum)

Credly (credly.com/users/onri-jay-benally)

VOLUNTEER ACTIVITIES

2024 UMN CSE Major Exploration Volunteer (Minneapolis, MN)

2024 IBM Impact, Covenant House International Volunteer – Created a career readiness kit for the youth, made one for hardware engineering path. (Yorktown Heights, NY)

2023 UMN CSE Major Exploration Volunteer – Provision of a custom-made, [3D-Printed Mini Quantum Computer](#) (Minneapolis, MN) – [Contains real quantum chips & programmable radio control components for public display]

2015 & 2016 USU STEAM EXPO Volunteer (Blanding, UT)

2014-to-2017 Lily of the Valley Tabernacle Hammond B3 Organist/ Musician (Red Valley, AZ)

2013 & 2014 Chuska Challenge Mountain Bike Race Volunteer (Red Valley, AZ)

2012-to-2013 Red Valley/ Cove High School Leadership Recognition (Red Valley, AZ)
(+35) hours of school leadership & service

ASSOCIATIONS

2024 Arizona State University (ASU) Quantum Collaborative Steering Committee Member

2023 Minneapolis Quantum Association (MQA) – Member

2022 QuantumGrad – Mentor & Lecturer

2022 IBM Quantum Researchers Program Member/ Group Administrator (ibm-q-research-2)

2021 IEEE Quantum & IEEE UMN (Tech Sub-Committee)

2016 American Indian Science & Engineering Society (AISES) Chapter Vice President at Utah State

LEADERSHIP

2023 IBM Qiskit Fall Fest Extension Event main host & organizer, co-hosted by UMN IEEE & MQA

2021 PhD student research mentor

2019 Nanofabrication instructor for new PhD research students in the cleanroom

2016 American Indian Science & Engineering Society (AISES) Chapter Vice President

2012-to-2014 Red Valley/ Cove High School Student Council President

2010-to-2014 Red Valley/ Cove High School Class President

2007 U.S. President George W. Bush Award for Educational Excellence

COMMUNICATION

2023 Quantum Collaborative Summit 2023 - Keynote Speaker (San Antonio, TX)

2010-to-Present Public speaker/ oral presenter to academic/ public audiences on STEM topics related to research experiences/ work

2016 Mathematics conference instructor - LEGO robotics - White Horse High School, (Montezuma Creek, UT)

AWARDS & RECOGNITION

- 2024 [IBM Media Recognition](#) (*Life @ IBM*, Global)
- 2024 [National Science Foundation Graduate Research Fellowship](#) [Prestigious]
- 2023 Global Quantum Scholarship – (Womanium Quantum, STEM Entrepreneurship Program)
- 2022 Departmental Fellowship/ Assistantship – (UMN ECE Dept.)
- 2021 [Raith GmbH Media Recognition](#) (World Leading Nanofabrication Instrumentation Manufacturer, Germany)
- 2021 [Robotics Education & Competition Foundation Media Recognition](#) – Native American Profiles in STEM
- 2021 [International Booklet/ Magazine Feature](#) (*Readers' Club Bulletin*, Page 19-20, National Book Trust, India)
- 2021 [UMN Media Recognition](#) – Hardwired for Science
- 2021 Thank-a-Teacher Award, (UMN Center For Educational Innovation)
- 2021 Dean's List (UMN)
- 2020 IBM Quantum Full Sponsorship – (Qubit by Qubit)
- 2019 [Front Cover of National Magazine](#) (*Winds of Change*, USA)
- 2018 [University Magazine Story Feature](#) (*Discovery*, USA)
- 2017 & 2018 National Science Foundation – Materials Research Science & Engineering-Centers (MRSEC) Fellowship – REU [Highly Competitive]
- 2016 Native American STEM Mentorship Award
- 2014 Presidential Scholar Award - Full Scholarship [Highest University Award]
- 2014-to-2017 Chief Manuelito Scholar Award – Navajo Tribe [Highest Tribal Award]
- 2014 Rank #1 of District, High School Valedictorian [Prestigious]
- 2013 Student Council Presidential Leadership Medal
- 2012 Award for Exceeding Arizona Instrument to Measure Standards
- 2010-to-2014 Honor Roll Award