

# Siddharth Maddali, Ph.D

## Computational scientist/engineer

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 siddharthmaddali



## Experience

- **Liminal Insights, Inc.** **Emeryville, CA, USA**
  - **Applied Physics/Machine Learning Consultant** Nov 2024 – present
    - Developing ultrasound characterization techniques for structural defects in lithium batteries.
    - Building physics-inspired ML models for deployment on ultrasound-based battery inspection equipment.
- **Independent** **Fremont, CA, USA**
  - **Scientific Consultant** Feb 2024 – Nov 2024
    - Provided technical consulting for investors in emerging semiconductor technologies.
    - Built an AI-powered tool for automated land area survey trained on drone-based multi-spectral images.
- **KLA Corporation (KLA-Tencor)** **Milpitas, CA, USA**
  - **Research Scientist** Nov 2022 – Jan 2024
    - Developed methods for sensitivity enhancement in semiconductor wafer inspection processes.
- **Argonne National Laboratory** **Chicago, IL, USA**
  - **Staff Scientist** Oct 2019 – Sep 2022
    1. Led the computational development and worked on the **first demonstration** of the X-ray MR-BCDI imaging technique.
    2. Led the design of future imaging experiments at DoE facilities with physics-based signal processing techniques.
    3. Built software libraries for 3D X-ray image reconstruction: `Phaser`, `mrbcidi`.
    4. Raised \$900k seed funding for computational R&D and novel microscopy infrastructure.
    5. Proposed, executed novel proofs of concept in materials research (US, France).
    6. Published work in high-impact scientific journals, mentored junior researchers, organized/chaired international workshops.
  - **Postdoctoral researcher** Jan 2017 – Sep 2019
    1. **First demonstration** of multi-scale, high-energy coherent diffraction imaging (HEDM) of 3D materials.
- **National Energy Technology Laboratory** **Pittsburgh, PA, USA**
  - **Postdoctoral Researcher: ORISE Fellow** May 2016 – Nov 2016
    1. Developed guidelines for machine learning-driven materials discovery of novel, function-optimized alloys.
- **Carnegie Mellon University** **Pittsburgh, PA, USA**
  - **Graduate teaching/research assistant** Aug 2009 – Feb 2016
    1. Dissertation on mining meso-scale materials physics from high-energy synchrotron data.
    2. Created `HierarchicalSmooth`: mesh smoothing software for physical interface networks.
    3. Taught mechanics & electromagnetism to undergraduate science majors.

## Education

- **Ph.D, & M.S., Physics** (Dissertation area: materials science) **Pittsburgh, PA, USA**
  - *Carnegie Mellon University* Aug 2009 – Feb 2016
- **M.Sc, Physics** **Chennai, TN, India**
  - *Indian Institute of Technology Madras (IIT-M)* Aug 2007 – May 2009
- **B.Sc, Physics, mathematics, electronics** **Bengaluru, KA, India**
  - *Bangalore University* June 2004 – May 2007

## Technical skills

- **Science & Engg.:** Geometric + Fourier optics, ultrasound/acoustic methods, microscopy, image formation (Hopkins, Abbe), diffraction gratings, X-ray science, condensed matter + materials physics, electromagnetics, mechanics, statistical physics, semiconductors, experimental design, quantum sciences
- **Math/computation:** Linear algebra, reconstruction, optimization, signal processing, control theory, inverse problems, simulations, statistics, probability, FDTD (meep), RCWA, computational geometry, differential equations
- **Software:** Python scientific stack (numpy, scipy, matplotlib, scikit-learn, pandas + more), Matlab, Linux, git, bash,  $\LaTeX$ , HPC + parallel computing (MPI), GPU development, PyTorch, Tensorflow, C++, Docker, Qiskit
- **AI/ML:** LLMs, retrieval augmented generation (RAG), data science, applied statistics, machine learning, deep learning for computer vision, CNNs, NeRF, structure for motion

## Awards & Grants

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1. ANL LDRD Research grant: *Coherence-enhanced dark-field X-ray microscopy* (Role: PI; \$930,000).
2. ANL LDRD Research grant: *detecting critical microstructural processes with AI* (Role: PI; \$100,000).
3. ANL LDRD Research grant: *COHED: Coherence for high-energy diffraction* (Role: postdoc)
4. Oak Ridge Institute for Science & Education (ORISE) post-doctoral fellowship (2016).
5. Indian Institute of Technology Madras Academic Merit Scholarship (2007 – 2009).
6. IIT Joint Admission to M.Sc (IIT-JAM) All-india rank 5 (out of  $\simeq 4000$ ) (2007).
7. Bangalore University undergraduate rank 5 (2007).

## Professional Activities & Outreach (link to full CV)

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- **Editorship:** *Crystals* special issue: Synchrotron Studies of Materials
- **Select invited talks:** The Minerals, Metals, Materials Society (TMS), Advanced Photon Source.
- **Society membership:** American Physical Society, Materials Research Society, TMS.
- **Select peer review:** US Department of Energy, American Physical Society, Optica.
- **Select workshop organization:** Advanced Photon Source User Meetings.

## Select publications (link to full CV)

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1. **Maddali, S.**, Frazer, T.D., Deegan, N. *et al*, *Concurrent multi-peak Bragg coherent x-ray diffraction imaging of 3D nanocrystal lattice displacement via global optimization*, **npj Computational Materials** 9, 77 (2023).
2. Wilkin, M., **Maddali, S.**, Hruszkewycz, S., Pateras, A., Sandberg, R., Harder, R., Cha, W., Suter, R., & Rollett, A. *Experimental demonstration of coupled multi-peak Bragg coherent diffraction imaging with genetic algorithms*, **Phys. Rev. B**, 103, 214103. (2021).
3. **Maddali, S.**, Allain, M., Cha, W., Harder, R., Park, J.S., Kenesei, P., Almer, J., Nashed, Y., & Hruszkewycz, S., *Phase retrieval for Bragg coherent diffraction imaging at high x-ray energies*, **Phys. Rev. A**, 99, 053838 (2019).
4. **Maddali, S.**, Park, J.S., Sharma, H., Shastri, S., Kenesei, P., Almer, J., Harder, R., Highland, M., Nashed, Y., & Hruszkewycz, S., *High-Energy Coherent X-Ray Diffraction Microscopy of Polycrystal Grains: Steps Toward a Multiscale Approach*, **Phys. Rev. Appl.**, 14, 024085 (2020).
5. Kandel, S., **Maddali, S.**, Allain, M., Hruszkewycz, S. O., Jacobsen, C., & Nashed, Y. S. G., *Using automatic differentiation as a general framework for ptychographic reconstruction*, **Opt. Express**, 27(13):18653–18672 (2019).

## Languages

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English (fluent), Hindi (fluent), Tamil (intermediate), Telugu (intermediate), Marathi (intermediate), Kannada (intermediate), French (beginner)