Karthik Reddy

karthik@asu.edu ❖ (443) 840-9390 ❖ Tempe, AZ

Multi-wavelength astronomer experienced in observational and computational research. Skilled in first-principle physics modeling, image processing, algorithm development, big data analysis, statistical modeling, and high-performance software development with C++ and CUDA. Seeking to leverage expertise and passion for high-performance computing in a dynamic research environment.

WORK EXPERIENCE

Arizona State University **Jul. 2022 – Present**
Postdoc *Tempe, Arizona*

- As a postdoc in radio astronomy, I lead the development of the world's first real-time full-sky radio camera.
  - Signal processor developed in CUDA, processing 14 Gb/s data from 256 radio antennas on a single GPU, yielding a 25000 FPS video of the full radio sky–the first astronomical facility to do so.
  - Automated image processing system, deployed in production, extracts and ingests over 54 million rows (over 1 TB) of time series data on transient radio sources into a distributed database daily.
- Developed DevOps solutions to commission radio cameras on a GPU cluster using Ansible and HashiCorp stack with a modular architecture, deployable on any array with minimal configuration changes.
- Collaborated with multi-university teams to develop strategies to detect and broadcast millisecond-scale cosmic events to the scientific community for rapid follow-up.
- Built an interactive web interface with Nuxt.JS, Vue.JS, FastAPI, and Postgres-based backends to explore live and archival spectrograms. Developed transient data exploration UI with PyQT for internal use.
- Built the imaging CUDA code to use only on-chip memory, resulting in a 50x increased throughput and 100x reduced VRAM usage.
- Built transient data processing pipeline in Python with gRPC and distributed Postgres database to process and store real-time imaging data.
- Maintain the epic-astronomy GitHub organization and its related projects and services.

University of Maryland Baltimore County & **Aug 2017 – Jun 2022**
Center for Astrophysics, Harvard-Smithsonian **Sep 2021 – Dec 2021**
Graduate Researcher *Baltimore, Maryland*

- Developed the first-ever Bayesian-based Monte-Carlo method to detect and localize extremely faint features in astronomical X-ray images.
  - Utilized it to perform the largest multi-wavelength study of kpc-scale outflows from AGN in the last two decades, revealing a critical flaw in the decades-old assumption about their X-ray emission mechanism with implications to structure formation in the universe.
  - Re-built the image processing code with SIMD intrinsics in C++ for a 4x reduced analysis time. Co-developed its Python package and parallel processing wrapper in R.
- Developed a suite of bash scripts to automate the pre-processing of astronomical X-ray images, reducing manual intervention by 90%.
- Developed a Python-based web dashboard to allow the high-energy community to interactively explore multi-dimensional data on X-ray jets from AGN.
- Successfully assisted in securing over $500k in research funding from NASA and observing times on facilities, including the Hubble Space Telescope and the Chandra X-ray Observatory.

National Remote Sensing Centre (Indian Space Research Organization) **Sep 2014 – Aug 2017**
Scientist *Hyderabad, India*

- Spearheaded the development of a high-performance multi-satellite image processing system, leading to its adoption by multiple teams across the organization, cutting compute and storage costs by over 40%.
- Built and maintained strategic partnerships with government stakeholders in four states and propelled them towards using geospatial and remote sensing technologies, leading to 50% faster decision-making.
- Managed a diverse team of more than 30 researchers, engineers, and ground staff from four universities nationwide and completed two pilot projects on time and within budget with zero safety incidents.
- Created and fostered a collaborative and respectful environment for a cross-functional team of six in modernizing a large geospatial web application, improving page load and API response times by 35%.
- Identified emerging geospatial technologies and advocated for their widespread adoption to senior management, presenting a comprehensive analysis of expected outcomes, ultimately resulting in a 20% increase in web development efficiency.
- Trained over 50 Central Water Works Commission engineers on using advanced runoff estimation software, reducing analysis times by 25%.
- Created annual reports on country-wide water spread data for the National Natural Resources Census.

EDUCATION

University of Maryland Baltimore County **June 2022**
Doctor of Philosophy in Astrophysics *Baltimore, Maryland*
Thesis: Morphological Clues to the X-ray emission from Astrophysical Jets

University of Maryland Baltimore County **May 2019**
*Master of Science in Astrophysics (*GPA: 3.8/4.0) *Baltimore, Maryland*

SKILLS

Programming: C++, CUDA, Python, Bash, Javascript, R, SIMD, OpenMP
Tools & Libraries: NVIDIA Nsight Systems & Compute, Git, CMake, FFMPEG, Nomad, Consul, Docker, Node.js, Ansible
Technical: Radio and X-ray Astronomy, HPC, Statistical Modeling, Image Processing, Algorithm Development, Big Datasets
Leadership: Project Management, Stakeholder Engagement, Conflict Resolution, Cross-functional team collaboration
Data: LWA, JVLA, ATCA, Chandra, HST, Fermi

GRANTS AND HONOURS

2024 Co-PI, Joint HST Proposal #17781, 3 Orbits, Cycle 32 / Chandra GO | Cycle 26, 90 ks, A superluminal jet in 3C264: the view at 30.
2024 Co-PI, HST Proposal #17783, 9 Orbits | Cyelc 32, HST Polarimetry and Proper Motions of the Pictor A Hotspot.
2023 Co-PI, Joint HST Proposal #17201 / Chandra GO | Cycle 24700496, $21k, 160 ks, Determining the High-Energy emission Mechanism in Jets with HST.
2021 PI, Chandra GO | Cycle 23 (#23700252), $51k grant, 50 ks, The curious case of a bent jet: Deciphering the X-ray emission from TXS 0833+585.
2021 Finalist for the Student Paper Competition, Joint Statistical Meetings 2021, Astrostatistics Interest Group.
2021 Co-PI, NuSTAR, 300 ks (#7295), The first hard X-ray measurement of a kpc-scale jet.
2020 Co-PI, NASA Astrophysics Data Analysis Program, $400k, Extragalactic Jets: Emission Mechanisms, Power, and Impact.
2020 Co-PI, JVLA, C/X/K/Ku A and B configs for about 200 jets (20B-356,21B-356), A Legacy VLA Survey of X-ray Emitting Jets.
2016 PI, $100k grant, Earth Observing and Monitoring projects, Indian Space Research Organization, Estimating water quality parameters using multi-spectral and hyperspectral satellite data.
2015-2017 Outstanding Employee

PUBLICATIONS

Reddy, K., Georganopoulos, M., Meyer, E. T., (2024), Surprisingly Brighter, Spectrally Harder, Spatially Disjoint: Powerful Extragalactic X-ray Jets in the Chandra Era, Universe (submitted).

Reddy, K., Bowman, J. D., Dowell, J., Taylor, G. B., Beardsley, A. P., & Taylor, C. (2024). Architecture and implementation of a 25000 FPS radio camera on the long wavelength array. In J. Ibsen & G. Chiozzi (Eds.), Software and Cyberinfrastructure for astronomy VIII (p. 131011C). SPIE.

Reddy, K., Bowman, J. D., Beardsley, A. P., *et al.* (2023), An optimized GPU kernel for real-time radio imaging. IEEE International Conference on High Performance Computing, 523–527.

Reddy, K., Georganopoulos, M., Meyer, E. T., *et al.* (2023). Offsets between X-Ray and Radio Components in X-Ray Jets: The AtlasX., The Astrophysical Journal Supplement Series, 265 (1), Article 8, 8.

Meyer, E. T., Shaik, A., **Reddy, K.,** *et al.* (2023). Extragalactic Jets from Radio to Gamma-rays, The Multimessenger Chakra of Blazar Jets Proceedings, IAU Symposium No. 375.

Meyer, E. T., Shaik, A., Tang, Y., Reid, N., **Reddy, K.,** *et al.* (2023). Variability of extragalactic X-ray jets on kiloparsec scales. Nature Astronomy, 7(8), 967-975.

Breiding, P., Meyer, E. T., Georganopoulos, M., **Reddy, K.,** *et al.* (2022). A Multi-Wavelength Study of Multiple Spectral Component Jets in AGN: Testing the IC/CMB Model for the Large-Scale-Jet X-ray Emission, Monthly Notices of the Royal Astronomical Society, 518(3), 3222-3250.

Donath, A., Siemiginowska, A., Kashyap, V., Burke, D., **Reddy, K.,** & Van Dyk, D. (2022). Pylira: Deconvolution of images in the presence of Poisson noise. Proceedings of the 21st Python in Science Conference, 98–104.

Keenan, M., Meyer, E. T., Georganopoulos, M., **Reddy, K.,** & French, O. J. (2021). The relativistic jet dichotomy and the end of the blazar sequence. Monthly Notices of the Royal Astronomical Society, 505 (4), 4726–4745.

Reddy, K., Georganopoulos, M., & Meyer, E. T. (2021). X-ray-to-radio offset inference from low-count X-ray jets. The Astrophysical Journal Supplement Series, 253 (2), 37.

Meyer, E. T., Iyer, A. R., **Reddy, K.,** Georganopoulos, M., Breiding, P., & Keenan, M. (2019). The origin of the x-ray emission in two well-aligned extragalactic jets: The case for IC/CMB. The Astrophysical Journal Letters, 883 (1), L2.

Vemareddy, P., Venkatakrishnan, P., & **Reddy, K.,** (2015). Flux emergence in the solar active region NOAA 11158: The evolution of net current. Research in Astronomy and Astrophysics, 15 (9), 1547.

PRESENTATIONS

SPIE Astronomical Telescopes + Instrumentation, Architecture, and Implementation of a 25000 FPS Radio Camera on the Long Wavelength Array (20 minutes)**.** **Jun 2024**
(Contributed)

NVIDIA GTC, A GPU-accelerated real-time all-sky radio camera (poster). **Mar 2024**

IEEE HPCC, Melbourne, Australia, An optimized GPU kernel for real-time radio imaging (15+5 minutes). **Dec 2023**
(Contributed)

LWA & Friends, Virtual, Deployment of a Real-Time All-Sky Imager on LWA-Sevilleta (40+10 minutes). **Nov 2023**
(Invited)

AXIS Seminar, Virtual, Characterizing the structure of X-ray Jets with AXIS telescope(20+5 minutes). **Feb 2023**
(Invited)

HEAD 19th Meeting, Pittsburgh, Pennsylvania, Morphological Clues to the X-ray Emission from Extragalactic Jets (15 minutes). **Mar 2022**
(Contributed)

CHASC Astrostatistics Seminar, Harvard-Smithsonian Center for Astrophysics, Astrophysical Jets with Astrostatistics: Using X-ray/Radio structural differences to understand their X-ray emission (60 minutes). **Nov 2021**
(Invited)

Mid-Atlantic Radio-Loud AGN Meeting, UMD, Maryland, Morphological Clues to X-rays from Extragalactic Jets (7+3 minutes). **Oct 2021**
(Contributed)

High Energy Seminar, Harvard-Smithsonian Center for Astrophysics, Morphological Clues to the X-ray emission from Extragalactic Jets (20+5 minutes). **Oct 2021**
(Invited)

Joint Statistical Meetings 2021, X-Ray-to-Radio Offset Inference from Low-Count X-Ray Jets (15+5 minutes). **Aug 2021**
(Invited)

American Astronomical Society 237th Meeting, X-Ray-to-Radio Offset Inference from Low-Count X-Ray Jets (7+3 minutes). **Jan 2021**
(Contributed)
Mid-Atlantic Radio-Loud AGN Meeting, Offsets between X-ray and Radio Emission (10+5 minutes). **Oct 2019**
(Contributed)

PROFESSIONAL MEMBERSHIPS

- American Astronomical Society
- American Statistical Association (+Astrostatistics Interest Group)
- International Astrostatistics Association
- Informatics and Statistics Science Collaboration (ISSC) of the Legacy Survey of Space and Time (LSST)
- International Indian Statistical Association

PEER REVIEW

- NASA/XRISM Guest Scientist panel service
- NASA/NuSTAR panel service
- NASA/ULTRASAT panel service