MohammadHossein Jamshidi

PhD Candidate in Physics — Gravitation & Cosmology

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RESEARCH INTERESTS

Cosmic microwave background (CMB) anomalies and statistical isotropy; Doppler aberration and boosting of CMB; weak lensing; computational tools for CMB data analysis; numerical and computational physics, including numerical methods, non-linear dynamics and simulation of physical systems.

EDUCATION

Ph.D. Candidate, Physics — Gravitation & Cosmology · Shahid Beheshti University Sep 2021 – present
Research: large-scale anomalies in cosmic data (mainly the CMB).

M.Sc., Physics — Soft Condensed Matter · Sharif University of Technology Sep 2016 – Sep 2018
Thesis topic: defect structures in liquid crystals.

B.Sc., Physics, minor in Mathematics · Sharif University of Technology Sep 2011 – Jul 2016

PUBLICATIONS & TALKS

On the (Higher Multipoles) Variance Asymmetry in the Cosmic Microwave Background Aug 2024
M. Jamshidi, A. Banihashemi, N. Khosravi. *The Astrophysical Journal* 972(1), 77. doi:10.3847/1538-4357/ad68ff

- Analysed tiled CMB variance maps at several smoothing scales, with stripes along the dominant dipole direction; confirmed prior findings on the dipole's significance.
- Found that some higher multipoles reach significance comparable to the dipole depending on smoothing scale; evaluated against the look-elsewhere effect.

Talk: Higher multipole anomalies in the CMB Jul 2023
DSU2023 – The Dark Side of the Universe, Kigali, Rwanda (10–14 July 2023)

SCHOOLS & WORKSHOPS

The Dark Side of the Universe (DSU) 2023 · ICTP & EAIFR, Kigali, Rwanda Jul 2023 · in person

Michigan Summer School of Cosmology · University of Michigan Jun 2023 · remote

Summer School of Cosmology 2022 · ICTP, Abdus Salam International Centre Jul 2022 · in person

RESEARCH SOFTWARE & DATASETS

patch_cosmic_parameters Jul 2026
Python package and notebooks fitting cosmological parameters to Planck TT, TE and EE power spectra on the full sky and on 12 separate sky patches.

cosmic_projection_and_aberration Sep 2026
Adds Doppler aberration to HEALPix maps and projects maps (area-weighted resampling to standard HEALPix grids, gnomonic patch cutouts, optional GPU backend).

CosmicBlenderNodes Dec 2023
Blender Geometry Nodes for HEALPix sphere and CMB data: Doppler boost, Mollweide projection, weak lensing, spherical harmonics.

cmb_anomaly_detection Mar 2022
Notebooks and utilities for detecting the directional CMB anomaly: local variance at higher multipoles, local skewness and kurtosis, galactic foreground model.

INTERACTIVE SCIENTIFIC TOOLS

Web apps I designed; implementation was AI-assisted (TypeScript, three.js).

CMB Power Spectrum emulator – TT/EE/TE spectra of a flat ΛCDM universe redrawn from six parameters. CAMB run offline on 5,625 models, compressed with PCA and Chebyshev regression into a 270 KB model that runs in the browser in milliseconds; validated against 200 CAMB runs (error 0.02–0.07% for ℓ>30).

CMB Map – Planck temperature map and mask on a HEALPix sphere (Nside 16–256, up to 786,432 pixels) with sphere, observer and Mollweide views; own HEALPix implementation.

Spherical Harmonics explorer – Real and imaginary $Y_{\ell m}$ up to degree 512 evaluated on the GPU by stable recursion, verified against closed forms for $\ell \leq 3$ and orthonormality.

COMPUTATIONAL PHYSICS EXPERIENCE

Physics Programmer · FeelPhysics (personal) `Oct 2018 – present`
Real-time solver for mechanical systems, rotation of solid-filled objects and force fields, with math and geometry libraries, for an educational game of interactive physics experiments.

Tool Developer · Freelance `Sep 2021 – Nov 2023`
PhysX-based physics-posing and animation add-ons for custom Blender rigs (Physirig).

Technical Animator · Cable Termination Simulation (VR) `Nov 2020 – Apr 2021`
Compute-shader mesh deformer simulating flame effects (shrinking, temperature distribution, burning); wire-bandage tool with collision detection.

Personal physics projects `ongoing`
Relativistic shapes of fast-moving objects; compute shaders for massive classical systems; muqarnas shapes and volumes with L-systems; simulations of historical physics models.

AWARDS

Silver Medal · National Astronomy Olympiad `2010`

WRITING & PRESS

- **Blender.org user story**, "Cosmology with Geometry Nodes" – use of Geometry Nodes to compute, visualize and debug CMB analyses (Feb 2026); also covered by **80.lv** (Feb 2026) and **BlenderNation** (Mar 2026).
- **Tutorial:** "How-to use Blender's geometry nodes for visualizing CMB" – HEALPix meshes with healpy, Planck Commander maps as mesh attributes (Mar 2023).

SKILLS

SCIENCE	General physics and mathematics, numerical methods, non-linear dynamics, computational geometry, linear algebra, data analysis.
COSMOLOGY & DATA	HEALPix/healpy, CAMB, Planck maps and power spectra, spherical harmonics, parameter fitting, PCA, polynomial regression, statistical anomaly detection.
PROGRAMMING	Python, C++, C#, HLSL/GLSL; Bullet, PhysX, Rapier.
SOFTWARE	Blender, Git, Jupyter, LaTeX.