JAY AGARWAL

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Education

Birla Institute of Technology and Science, Pilani **Nov 2022 – Aug 2027**
M.Sc. Physics and B.E. Computer Science | *CGPA 8.11/10* *Pilani, India*

- Physics coursework: Quantum Mechanics I & II, Statistical Mechanics, Classical Mechanics, Electromagnetic Theory I & II, Nuclear & Particle Physics, Theory of Relativity, Group Theory & Applications, Computational Physics.
- Computer Science coursework: Deep Learning, Introduction to Large Language Models, Quantum Information & Computing, Design & Analysis of Algorithms, Probability & Statistics.

Research Interests

ML for High-Energy Physics, Mechanistic Interpretability, Interpretable ML, Mathematical Structures in Neural Networks

Publications & Preprints

- **How Far Can Foundation Models Be Distilled for Efficient Jet Tagging? J. Agarwal**, S. Khare, D. Kumar. Preprint, 2026; under review. arXiv:2610.29439
- **What Do Lorentz-Equivariant Jet Taggers Learn? J. Agarwal**, S. Khare, D. Kumar. AI4Physics Workshop, ICML 2026. arXiv:2606.21790

Research Experience

Visiting Researcher – KEK Theory Center **Aug 2026 – Present**
Host: Prof. Mihoko Nojiri *Tsukuba, Japan*

- Funded research visit as part of my thesis on machine learning for high-energy physics, applying symbolic regression and interpretability methods to high-energy physics problems.

Undergraduate Researcher – PhantomGrad Lab **Oct 2025 – Present**
Advisor: Prof. Dhruv Kumar *Pilani, India*

- Distilled six jet-tagging teachers, including two foundation models, into small students; a 20k-parameter student outperformed every published tagger trained from scratch at a fraction of the inference cost.
- Studied what Lorentz-equivariant jet taggers learn internally, using equivariance tests, linear probes and ablations to identify which physical features they rely on.

Collaboration Member – TAMBO Neutrino Observatory **Apr 2026 – Present**
Advisor: Prof. Tommaso Dorigo *INFN Padova (Remote)*

- Working on differentiable optimization of TAMBO detector geometry and instrumentation, including design-space analysis and surrogate modelling of expensive simulations.

Research Intern – Solid State Physics Lab, DRDO **May 2024 – Jul 2024**
Supervisor: Dr. Poornendu Chaturvedi | *Quantum Sensing Group* *Delhi, India*

- Simulated coherent population trapping, supported atomic-clock cavity experiments, and developed a Python spectra tool validated against measurements and adopted by the group.

Industry Experience

Quantitative Analyst Intern – Wells Fargo **May 2026 – Jul 2026**
Causal Inference Team *Bengaluru, India*

- Automated marketing model development and diagnostics with a reproducible, extensible workflow, reducing manual setup and analysis turnaround.

Selected Projects

Laser-Assisted Radiative Recombination in Intense Laser Fields **Aug 2025 – Dec 2025**

Design Project – Advisor: Prof. Amol R. Holkundkar

- Compared quantum and semiclassical recombination spectra in intense laser fields; parallelized complex integrals for carrier-envelope phase sweeps, reproducing spectral cutoffs and phase-dependent asymmetries.

Detecting Quantitative Spatial Inconsistencies in Vision-Language Outputs **Feb 2026 – Apr 2026**

Course Project – Deep Learning

- Refined VLM-predicted object distances with a graph neural network and geometric consistency-weighted message passing, reducing error against a Qwen2-VL-7B baseline on Spatial457.

Beating Hallucinations via Uncertainty-Conditioned Attention Gating **Jan 2026 – May 2026**

Course Project – Introduction to Large Language Models

- Developed an inference-time framework for detecting and mitigating LLM hallucinations using semantic-entropy probes, attention-based grounding signals, and adaptive attention-head gating; evaluated across four QA and summarization benchmarks.

Monte Carlo Methods in Physics **Oct 2024 – Nov 2024**

Course Project – Computational Physics

- Validated Metropolis–Hastings sampling of boosted-muon neutrino spectra against analytic results; generated correlated Gaussians using Box–Muller and Cholesky decomposition.

Technical Skills

- **Programming & tools:** Python, C++, C, Linux, Git
- **ML & scientific computing:** PyTorch, JAX, NumPy, SciPy, Scikit-learn, Pandas

Honors and Awards

Learn2Design Competition (NeurIPS 2026): Ranked 1st in Round 1; 11th of 110 in the final round **2026**

Reviewer, AI4Physics Workshop (ICML 2026) **2026**

Amazon ML Challenge 2025: Ranked 372nd overall among 5,000+ teams **2025**

Extracurricular Activities

Coordinator – Peer Mentorship Program, BITS Pilani **2025 – 2026**

- Led 150 volunteers supporting 1,200+ incoming students; coordinated with the Chief Warden's office and MPower.

President – Kalipatnapu AR-VR Lab, BITS Pilani **2024 – 2025**

- Expanded the lab from 25 to 60 members and supervised R&D across 10+ projects.

Student–Faculty Council, Department of Physics **2025 – 2026**

- Represented Physics students in departmental student–faculty discussions at BITS Pilani.

BITS Pilani Hockey Team **2023 – 2024**

- Won gold at InterBITS and represented the institute at BOSM.

The Debating Society, BITS Pilani **2022 – 2025**

- Participated in national-level tournaments and led outreach for QED '23 and BPPD '24.