

Sarthak Choudhary

Astroparticle Physicist

📍 Warsaw, Poland

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Personal Profile

I am an experimental astroparticle physicist. I have had a dynamic career, ranging from writing a novel algorithm for analyzing data from a lunar orbiter to working on a Monte Carlo Simulation code for an ultrasensitive deep underground particle detector. While my career in astroparticle physics has been rewarding, I am now seeking to transition into a field where I can directly witness the impact of my work.

Achievements

- Contributed to development of python based analysis tool for DEAP-3600 dark matter detector. This tool will become a part of standard software suite used by the DEAP-3600 collaboration.
- Worked-out an analytic model which could be used to guide sophisticated full physics Monte Carlo Simulation codes for liquid Argon particle detectors. When I joined this project, the initial idea was to use symbolic computation. However, I demonstrated that with appropriate approximations, this task could instead be accomplished with high school mathematics. Poster publication for comparison with simulations: Cenk Türkoğlu et al 2021 J. Phys.
- While studying optical characteristics of Silicon Photo-Multipliers, I found presence of anti-reflection coating which was not disclosed by the manufacturer. This additional information allowed us to significantly improve agreement between our experimental data and simulations.

Education

PhD: Astroparticle physics

2021-Present

AstroCeNT, Nicolaus Copernicus Astronomical Center of Polish Academy of Sciences, Warsaw, Poland

MTech: Astronomical Instrumentation

2017-2019

Indian Institute of Astrophysics, Bengaluru | University of Calcutta, Kolkata, India

BTech: Electronics, Instrumentation, and Control

2012-2016

YMCA University of Science and Technology, Faridabad, India

Certifications

Machine Learning Specialization

Jan 2024

Deeplearning.Ai | Stanford Online

Verify here: tinyurl.com/27zvtama

Experience

Doctoral Researcher

2021-present

AstroCeNT, Warsaw

- **PyTorch based code for performing Monte Carlo simulations**
Contributed to the development of Monte Carlo based Physics Simulation code for rare particle detector. Performed cross-checks and applied corrections to the mathematical foundation of the simulation model. Implemented new features for improving code diagnostics and modularity. I also implemented DEAP-3600 detector specific physics in this code.
- **Pipeline for monitoring and reporting physics parameters in DEAP-3600 detector**
Developed a python based analysis tool which will be employed as part of an automated data analysis pipeline for generating weekly reports on detector performance for eminent scientists who oversee the operation of DEAP-3600 detector.
- **Analytic Model for Estimation of Light Yield (AMELY) for liquid Argon detectors**
Worked-out an analytic formula to do a quick estimation of the amount of light detected. Implemented the code in form of a jupyter notebook. This tool assisted in developing more sophisticated physics simulations for an experiment designed by our research group. It also facilitated the discovery of certain

relations between detector design parameters and its sensitivity. If this exercise were performed using Monte Carlo simulations, it would have been relatively more compute-intensive.

- **Characterization of fluorescent materials at cryogenic conditions**

Collaborated on multiple experiments for characterization of fluorescent materials under irradiation from radioactive sources at cryogenic temperature. Contributed to the project by operating the experiments with onsite teams, managing data, and performing data analysis. Coordinated meeting between pan Europe teams for campaign at CERN.

- **Calibration of Silicon Photo-Multipliers (SiPM)**

A custom experimental setup was commissioned for characterization of fluorescent material on illumination by Argon scintillation light. The SiPM employed for recording fluorescence flashes turned out to be noisier than expected. I had to come up with an algorithmic way of rejecting noisy data to improve signal to noise. I wrote code for automating the data analysis. The algorithm makes use of Autoregressive Moving-Average (ARMA) filter for finding signals in time series data.

- **Personal project: Sentiment analysis using machine learning**

Employed a machine learning approach for classifying negative movie reviews. I used NLTK's Naive Bayes classifier to train on IMDb movie review data set.

- **Personal project: Machine Learning based particle classifier**

Used a Machine Learning algorithm Random Forest for binary classification of particles either as "Pions" or "not-Pions".

Outreach Coordinator

2022-2024

DEAP-3600 collaboration, Canada

- Organized an online MasterClass on Direct Dark Matter detection which was attended by about 75 undergrad students.

Junior Research Fellow

2019-2020

Indian Institute of Astrophysics, Bengaluru

- Collaborated on a novel algorithm for analysis of solar flare data recorded by first Indian lunar mission, Chandrayaan-1.
- Contributed to the research & development for hardware and software for X-ray astronomy.

Publications

- Cryogenic setup for the characterization of wavelength-shifting materials for noble element radiation detectors. S. Choudhary et al 2024 JINST 19 C05019
- The optical simulation model of the DarkSide-20k Veto detector. Cenk Türkoğlu et al 2021 J. Phys.: Conf. Ser. 2156 012236
- Direct comparison of PEN and TPB wavelength shifters in a liquid argon detector. Eur. Phys. J. C 81, 1099 (2021)
- SiPM cross-talk in liquid argon detectors. Front. Phys., Sec. High-Energy and Astroparticle Physics, Volume 11 (2023)

Conferences

- Presentation titled "Direct Dark Matter Search in Liquid Argon Detectors" at Conference of Doctoral Students of Polish Academy of Sciences held in Krakow, Poland.
- Presentation on Monte Carlo Pulse Shape Discrimination model and fitter for liquid Argon dark matter detectors in LIDINE-2022 conference held in Warsaw, Poland.

Skills

- **Scientific Computing:** Data analysis, mathematical modelling, Monte Carlo simulations, statistical methods, parameter estimation
- **Programming Language:** Python (NumPy, SciPy, pandas, scikit-learn, PyTorch), Cython
- **Tools:** VS Code, JupyterLab, Slurm workload manager
- **Version Control:** Git

