

# Sarthak Choudhary

## Experimental Physicist

📍 Warsaw, Poland

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 [LinkedIn](#)

 [Projects](#)

## Personal Profile

I am an experimental 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 radiation detector.

## Achievements

- Developed a python based analysis module 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 optical raytracing model to guide and verify sophisticated full physics Monte Carlo Simulation codes for liquid Argon radiation detectors: [C. Türkoğlu & SC, J. Phys.: Conf. Ser. 2156 012236 \(2021\)](#)
- While studying optical characteristics of Silicon Photo-Multipliers, I discovered an anti-reflection coating which was not disclosed by the manufacturer. This was a key ingredient for improving our simulations: [M. G. Boulay et al. Eur. Phys. J. C 81, 1099 \(2021\)](#)
- Commissioned and calibrated an optical cryostat for studies of fluorescent materials: [SC et al. JINST 19, C05019 \(2024\)](#)
- Successfully applied to Teacher Training Call by Open Astronomy School of the International Astronomical Union. Awarded 10 amateur telescopes for conducting this event.

## Education

### PhD: Astroparticle physics

**2021-2024**

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

\*Defense to be completely by end of March 2025.

### 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 | Standford Online

Verify here: [tinyurl.com/27zvtama](https://tinyurl.com/27zvtama)

## Summer Schools

### Graduate Instrumentation & Detector School

**June 2024**

TRIUMF, Vancouver, Canada

### INFN School On Underground Physics

**June 2021**

Remote

## Experience

### Doctoral Researcher

**2021-2024**

AstroCeNT, Warsaw

- **PyTorch based code for performing Monte Carlo simulations**  
Contributed to the development of Monte Carlo based Physics Simulation code for radiation detector. Performed cross-checks and applied corrections to the mathematical foundation of the simulation model. Implemented new features for improving code diagnostics and modularity. Liaised between experimentalists and computer scientists for efficient implementation of necessary features. 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 module 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. Pipeline fetches data from a *CouchDB* server, does data processing, packs processed data as ROOT files and saves plots as pdf files.

- **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.

- **Study of wavelength shifting properties of fluorescent materials**

Collaborated on multiple experiments for characterization of fluorescent materials under Argon scintillation light (128 nm) 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 experiment conducted at CERN.

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

I commissioned custom experimental setup 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".

## **Volunteering: Delivery Quality Assurance Analyst**

**2024-current**

Statisticians Without Borders

- Statisticians Without Borders (SWB) contributes to the common good by providing pro bono statistical, data science, and analytical services. As the Delivery Quality Assurance analyst, I ensure compliance with SWB standards throughout the duration of the project.

## **Outreach Coordinator**

**2022-2024**

DEAP-3600 collaboration, Canada

- Managed the public [website](#) and [twitter](#) account of DEAP-3600 collaboration.
- Co-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.

## **Participation in projects**

- Polish National Science Center OPUS 24: PhD student
- [European Commission Horizon 2020 Twinning "DarkWave"](#), consortium with Italy, France and Germany: team member
- Foundation for Polish Science [International Research Agenda Programme AstroCeNT](#): PhD student

## **Publications**

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

## **Conference Contributions**

- Presentation titled [Quality Control of PEN wavelength shifters for DarkSide-20k veto](#) in LIDINE-2024 conference held in São Paulo, Brazil.
- Co-authored poster titled [Development & Characterization of a PEN-based Wavelength Shifting Reflector](#) at LIDINE-2023 held in Madrid, Spain.

- Presentation on Monte Carlo Pulse Shape Discrimination model at DEAP-3600 collaboration meeting held in Sudbury, Canada.
- 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](#) at 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)
- **Tools:** VS Code, JupyterLab, Slurm workload manager, Latex, Bash
- **Version Control:** Git

## References

- Prof. Marcin Kuźniak, PhD thesis advisor and Group leader, Astrocent, NCAC PAS, Poland: [mkuzniak@camk.edu.pl](mailto:mkuzniak@camk.edu.pl)
- Prof. Piotr Gawron, Group leader, Astrocent, NCAC PAS, Poland: [gawron@camk.edu.pl](mailto:gawron@camk.edu.pl)
- Dr Michela Lai, postdoctoral researcher, UC Riverside: [michelal@ucr.edu](mailto:michelal@ucr.edu)