PHELIPE D'ARC

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EDUCATION

Universidade Federal do Rio de Janeiro (UFRJ)   **Jan 2017 - Oct 2021**
Bachelor's degree in Physics

Centro Brasileiro De Pesquisas Físicas (CBPF)   **Mar 2022 - Aug 2023**
Master's of science in Physics

Centro Brasileiro De Pesquisas Físicas (CBPF)   **Sep 2023 - Present**
Ph.D. in Physics

PUBLICATIONS

- Multi-Wavelength Analysis of Kilonova Associated with GRB 230307A: Accelerated Parameter Estimation and Model Selection Through Likelihood-Free Inference, P.Darc et al. - Extended Abstract NeurIPS 2024

- Kilonova Spectral Inverse Modelling with Simulation-based Inference: An Amortized Neural Posterior Estimation Analysis, P.Darc et al. 2024

- The S-PLUS Transient Extension Program: Imaging Pipeline, Transient Identification, and Survey Optimization for Multi-Messenger Astronomy, A. Santos et al. 2023

- A Dark Standard Siren Measurement of The Hubble constant following LIGO/Virgo/KAGRA O4a, C. R. Bom et al. 2024

- Photometric redshifts probability density estimation from recurrent neural networks in the DECam local volume exploration survey data release 2, G. Teixeira et al. 2024

RESEARCH

CBPF - Lab-IA   **Mar 2022 - Present**
PhD Candidate

- Developed simulation-based inference algorithms for kilonova spectral energy distribution (SED) modeling, incorporating Amortized and Sequential Neural Posterior Estimation (NPE) techniques.
- Applied Truncated Sequential Neural Posterior estimation and Neural Likelihood Estimation to Multi-Wavelength modelling of a Kilonova Associated with the GRB 230307A.
- Employed Learnt Harmonic Mean Estimator to enable efficient Bayesian model comparison across multiple afterglow and kilonova emission models applied to Gamma-Ray Bursts.
- Conducted an optical follow-up study on GW event S231206cc, a binary black hole (BBH) mergers detected by LIGO/Virgo.
- Investigated the hypothesis that BBH merger remnants produce observable optical flares when interacting with AGN disks, fitting candidates to analyze potential signals.
- Applied P-Cygni absorption-emission spectral feature and blackbody modeling to fit kilonova spectra.
- Employed $H\beta$ and $H\alpha$ line profile fitting in AGN spectra to estimate the mass of supermassive black holes using PyQSOFit.
- Designed and implemented a spectrum classifier to distinguish between Supernovas Type I and II. Employed interpolation and standardization techniques, integrated one-dimensional convolutional layers for feature extraction, and utilized bidirectional LSTM for enhanced performance.
- Created a Random Forest classifier for supernova identification, and built a comprehensive tutorial detailing image pre-processing, training, hyperparameter tuning, and the generalization process for a binary classification problem.
- Assisted collaborators in producing light curves of flares resulting from Binary Black Hole mergers in Active Galactic Nuclei (AGN) disk environments - Kimura et al 2021 scenario + Rodrigues-Ramirez et al 2024.

RESEARCH

FINK (Alert Broker) Brazil   **Oct 2023 - Present**
PhD Candidate
- Actively developing an API for the CBPF Alert Transient Search (CATS) Light Curve Broad Classifier.
- Engineered a script capable of classifying 100,000,000 LSST alerts on GPUs in less than 12 minutes for the *ELAsTiCC* dataset.

NEWFIRM Infrared Survey for Transients Collaboration   **Mar 2024 - Present**
PhD Candidate
- Observed and conducted Near-Infrared transient searches at the NEWFIRM telescope.

DESGW collaboration   **Mar 2023 - Present**
PhD Candidate
- Developed a Convolutional Neural Network (CNN) model to identify optical Gravitational Wave (GW) counterparts, effectively removing artifacts generated during the difference imaging process.
- Integrated the Convolutional Neural Network (CNN) into the DESGW pipeline, uploading the scores to the website.
- Assisted the DESGW team in the real-time classification of candidates during O4 (Observing Run 4) events.

S-PLUS Collaboration   **Jun 2022 - Present**
PhD Candidate
- Developed and implemented DeepSTEP, a Deep Learning tool for identifying Astrophysical Transients in the S-PLUS Transient Extension Program (STEP). Created a robust image processing pipeline from scratch, encompassing tasks like cleaning, contrast adjustment, and normalization.
- Conducted visual inspection of transient candidates obtained from the S-PLUS Transient Extension Pipeline.
- Conducted observations using the T80s telescope.

Laboratório Nacional de Computação Científica + Lemobs   **Jan 2022 - Aug 2023**
Intern
- Designed an advanced algorithm utilizing the state-of-the-art BERTimbau model, a variant of BERT, for classifying phrases describing medical conditions. Achieved accurate identification of health issues including asthma, diabetes, and cardiovascular diseases.
- Developed a customized script employing Google APIs and the Regex library to save, process, and filter data from YouTube comments.

UFRJ   **Jan 2018 - Aug 2021**
Undergraduate Research Assistant
- Explored the utilization of Supernovae Ia as standard candles for estimating cosmological parameters through the application of Markov Chain Monte Carlo (MCMC) and SALT2.
- Investigated the application of Quasars as standard candles by exploring a non-linear relation between X-ray and UV emission. Acknowledged with the "Best Presentation" prize at the XLII Jornada Giulio Massarani de Iniciação Científica, Tecnológica, Artística e Cultural (JICTAC 2, UFRJ) for this research.
- Worked at IFFablab, the prototype manufacturing laboratory at the Institute of Physics, UFRJ. Constructed a Kater's pendulum and conducted measurements to determine the gravitational constant.

TALKS

São Paulo Advanced School on Multi-Messenger Astrophysics, May 2023
DeepSTEP: A Deep learning tool for identification of Astrophysical Transients in S-PLUS Transient Extension Program (STEP)

LNCC XVI Computational Modeling Conference, Jun 2022
Astronomical Transient identification using CNNs

Dark Energy Survey Fall Collaboration Meeting (DESGW Workshop), Oct 2023
A Deep Learning approach to transient detection in DESGW search and Discovery pipeline

CBPF Annual Academic Meeting, Nov 2024
Multi-Wavelength Analysis of Kilonova Associated with GRB 230307A: Parameter Estimation Through Likelihood-Free Inference

CBPF Artificial Intelligence workshop, Dec 2023
Simulation-Based Inference of BNS Kilonova Properties

FINK Brazil, May 2024
An introduction to Simulation-Based Inference of BNS Kilonova Properties

POSTERS

XLVI Reunião Anual da Sociedade Astronômica Brasileira, Oct 2023
DeepSTEP: A Deep learning tool for identification of Astrophysical Transients in S-PLUS Transient Extension Program (STEP)

37th conference on Neural Information Processing Systems (NeurIPS), Dec 2023
Simulation-Based Inference of BNS Kilonova Properties: A Case Study with AT2017gfo

38th conference on Neural Information Processing Systems (NeurIPS), Dec 2024
Multi-Wavelength Analysis of Kilonova Associated with GRB 230307A: Accelerated Parameter Estimation and Model Selection Through Likelihood-Free Inference

TEACHING

Universidade Federal do Rio de Janeiro, UFRJ   **2019 - 2021**
Teacher Assistant
- Laboratory of instrumentation in contemporary physics and digital processing. (Mar. 2021 - Jun. 2021)
- Taught physics classes to high school students visiting the LADIF (Laboratório Didático do Instituto de Física da UFRJ), and visited schools introducing to the students science experiments (Mar. 2019 - Mar.2021)

Science Outreach Events   **2024 - Now**
Science Communicator

- **Semana Nacional de Ciência e Tecnologia (SNCT)** – Science Communicator - Brasilia, Distrito Federal, November 2024
  - Represented the Centro Brasileiro de Pesquisas Físicas (CBPF) in an event organized by the Ministry of Science, Technology, and Innovation (MCTI).
  - Conducted hands-on experiments for public engagement, including demonstrations of superconductivity, cosmic ray detection, and AI applications in astrophysics.
- **Sociedade Brasileira para o Progresso da Ciência (SBPC)** - Science Communicator - Belém do Pará, PA - July 2024
- **LITCOM-AI/Lab-IA** (Instagram) - Produced and recorded educational science videos. - December 2024

ADDITIONAL SKILLS

- **Deep Learning:**

Keras-Tensorflow, Pytorch, CNN, LSTM, GPU- Paralellism

- **Python:**

Pandas, Numpy, Regex, Matplotlib, seaborn, jupyter

- **Machine Learning:**

Sckit-Learn, Random Forest, SVM, xgboost

- **Bayesian Inference:**

MCMC, Simulation-based inference (SNPE, ANPE, NLE...)

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