Curriculum vitae

PERSONAL INFORMATION

Ambra Di Piano

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Date of birth 5 November 1992 | Nationality Italian

RESEARCH TOPICS

I am interested in the study of the transient and variable sky at very-high energy, via space-born and ground-based (i.e., Cherenkov technique) observations of gamma-rays. A special focus is on the real-time analysis and time-domain astrophysics, which is becoming ever more relevant for the efforts of multi-wavelength and multi-messenger astronomy. Deep Learning techniques used for classification and identification of transients have shown successful results, allowing to overcome statistical issues that are inherently present in standard analysis (i.e., the low count rate).

Projects and Collaborations

• **CTA Consortium.** CTA is a Cherenkov facility that will observe the gamma-ray sky in the 20 GeV - 300 TeV energy range, the first to operate as an observatory.

○ *Science Alert Generation work group* – Study of the state-of-the-art high-level Cherenkov data analysis tools in the context of the real-time analysis of the Cherenkov Telescope Array, which will perform the automated analysis during observations. Definition of strategies for identification of transient events and science alerts. Definition of data quality triggers and strategies.

○ *Science/Transients/Multi-wavelength work-groups* – Collaboration with the gravitational wave and gamma-ray burst working groups for the development of an analysis pipeline of related top level science cases. In particular, the implementation of a source localisation in the GW-GRB analysis pipeline and the development of a source visibility tool.

○ *Analysis and Simulation work group* – Coordinator of level-A instrument response functions degradation work-group. Study of detection methods at very-short exposure times.

• **LST Consortium.** – The Large Size Telescope (LST) is one of three classes of telescopes comprising the Cherenkov Telescope Array (CTA). The prototype of the LST, called LST-1, is currently in the commissioning phase. Member of the consortium and the real-time analysis team. Development of high-level analysis scientific analysis pipelines for science monitoring and alert generation. Operator shifter at the LST-1 telescope.

• **AGILE Team.** – AGILE is an Italian space mission for gamma-ray astrophysics. Member of the Flare Advocate team that provides daily monitoring of the transient sky seen by the satellite. Preparation of a synthetic GRB population for the training and validation set for deep learning methods for AGILE detection of GRBs. Analysis of AGILE observations in conjunction with other instruments (i.e., Fermi-LAT).

• **ASTRI Team.** ASTRI Mini-Array is a Cherenkov telescope array for ground-based very-high energy science. Member of the INAF/OAS Bologna team.

• **COSI Team.** COSI is a Compton telescope sensitive in the 0.2 - 5 MeV energy range and with polarization capabilities, selected for the NASA's SMEX program. Member of the work group for the real-time analysis of COSI data.

• **GAMMA-MOON Team.** This project propose an instrumentation for High Energy Astrophysics to be installed on the Moon's surface, with X-ray and γ-ray energy coverage. Member of the science team.

PROFESSIONAL EXPERIENCE

January 2022 – Present

PhD student in Industrial Applications of ICT

Università degli Studi di Modena e Reggio Emilia.
Modena, via Pietro Vivarelli 10/1, 41125, Italy.
INAF - Osservatorio di Astrofisica e Scienza dello Spazio di Bologna.
Bologna, via Gobetti 93/3, 40129, Italy.

Deep learning in real-time on the astrophysical data obtained from the Cerenkov CTA Observatory. Tutor: Domenico Beneventano. Co-Tutor: Andrea Bulgarelli.

March 2022 – April 2022

Onsite operator of LST-1 Cherenkov Telescope

LST-1 Collaboration, Roque de los Muchachos Observatory.
Santa Cruz de Tenerife, 38728, Spagna

Onsite shifter, telescope operator.

November 2020 – December 2021

Young graduate trainee fellowship

INAF - Osservatorio di Astrofisica e Scienza dello Spazio di Bologna.
Bologna, via Gobetti 93/3, 40129, Italy.

Study of innovative algorithms for the real-time analysis of the Cherenkov Telescope Array (CTA) and other projects for ground-base and space-born gamma-ray astronomy, with focus on multi-messenger and multi-wavelength astronomy. Scientific supervisor: Andrea Bulgarelli.

March 2019 – March 2020

Master thesis internship

Alma Mater Studiorum, Università degli Studi di Bologna.
Bologna, via Zamboni 33, 40126, Italy.
INAF - Osservatorio di Astrofisica e Scienza dello Spazio di Bologna.
Bologna, via Gobetti 93/3, 40129, Italy.

Detection of short gamma-ray bursts with CTA through real-time analysis. Supervisor: Cristian Vignali. Co-Supervisors: Andrea Bulgarelli, Valentina Fioretti.

EDUCATION

2022 – Present

PhD student in Industrial Applications of ICT

Università degli Studi di Modena e Reggio Emilia.
Modena, via Pietro Vivarelli 10/1, 41125, Italy.
INAF - Osservatorio di Astrofisica e Scienza dello Spazio di Bologna.
Bologna, via Gobetti 93/3, 40129, Italy.

Project: **Deep learning in real-time on the astrophysical data obtained from the Cerenkov CTA Observatory.**

Tutor: Domenico Beneventano. Co-Tutor: Andrea Bulgarelli

2016 – 2020

Master Degree in Astrophysics and Cosmology

101/100

Alma Mater Studiorum, Università degli Studi di Bologna.
Bologna, via Zamboni 33, 40126, Italy.

Dissertation: **Detection of short gamma-ray burst with CTA through real-time analysis.**

Supervisor: Cristian Vignali. Co-Supervisor: Andrea Bulgarelli, Valentina Fioretti.

2011 – 2016 **Bachelor Degree in Astronomy** 98/110

Alma Mater Studiorum, Università degli Studi di Bologna.
Bologna, via Zamboni 33, 40126, Italy.

Dissertation: **Ottica geometrica e ondulatoria, e applicazioni astrofisiche.**

Supervisor: Daniele Dallacasa.

PRIZES AND AWARDS

July 2022 **Hack The Science 2022**

Università degli Studi di Milano-Bicocca.
Piazza dell'Ateneo Nuovo 1, 20126, Milano.

1st Place Award: **Challenge *"Hack The Planet".***

1st Place Award: **Challenge *"Hack And Explore The Latent Space".***

Organiser: NEANIAS H2020 project

PERSONAL SKILLS

Mother tongue: Italian

Other languages

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
International English Language Testing System (IELTS) C1					

Levels: A1 and A2: Basic user – B1 and B2: Independent user – C1 and C2: Proficient user
Common European Framework of Reference for Languages

Computer skills

- Programming languages: Python; academic use of Fortran; basics of HMLT and CSS.
- Development tools: git, GitHub, GitLab, Docker, Jenkins, SonarQube.
- Machine learning: TensorFlow, Keras, ScikitLearn.
- Science tools: ctools, gammapy, fermipy, agilepy, astropy, scipy, pandas; academic use of DS9, fv, IRAF, CASA, CIAO, XSPEC.
- IDE: Visual Studio Code, PyCharm, jupyter notebook, gedit, notepad++.
- OS: Linux/Ubuntu, MacOs, Microsoft Windows.
- Others: LaTeX.

Soft skills

- Communication: I know how to effectively deliver a presentation by calibrating the content for the targeted audience, and structuring a coherent and cohesive speech. I can discuss weaknesses of my work and follow-up on suggestions and feedback.
- Interpersonal: I am well versed in teamwork and I find collaboration a powerful tool to create a flourishing and validating environment.
- Intercultural: I am used to international settings and I can easily engage in conversations with respect and curiosity in diverse environments.

OUTREACH

February 2020 **2nd Edition, Women of CTA** talk

Invited talk, *Localizzazione di Gamma-Ray Bursts ed analisi in real-time con CTA*, https://www.cta-observatory.org/women-cta-meeting-2/.
Bologna, Italy.

CONFERENCES AND SEMINARS

September 2022 **PHYSTAT-2022** attendance

Statistical methods for data analysis: high energy gamma-ray astronomy in a multi-wavelength context.
Online.

July 2022 **Hack The Science 2022 Award Ceremony** talk

A. Di Piano, L. Baroncelli, A. Addis, *Hack the planet through hacking the latent space.*
Online.

Jun 2022 **Very-High Energy INAF@OAS** talk
A. Di Piano et al., *Real-time analysis for the LST-1.*
Bologna, Italy.

March 2022 **Machine Learning JOurnal Club** talk
A. Di Piano et al., *Cherenkov data reconstruction with deep learning.*
Online.

July 2021 **37th International Cosmic Ray Conference** proceeding
A. Di Piano et al., *Detection methods for the Cherenkov Telescope Array at very-short exposure times.*
Berlin, Germany.

April 2021 **UniBo DIFA, Weekly PhD Seminars** talk
Invited talk, *Detection methods for the real-time analysis of the Cherenkov Telescope Array.*
Online.

February 2021 **INAF OAS Bologna, Astrophysics Talk** talk
Invited talk, *Real-time analysis detection methods for the Cherenkov Telescope Array.*
Online.

May 2019 **1st CTA Symposium** poster
G. Stratta et al., *CTA Real Time Analysis output from the follow-up of a short GRB.*
Bologna, Italy.

WORKSHOPS AND SCHOOLS

September 2022 **ml.astro** workshop
Workshop on Machine Learning for Astroparticle Physics and Astronomy.
Online.

July 2022 **ESCAPE Summer School** school
Data Science for Astronomy, Astroparticle and Particle Physics.
Annecy, France.

Jun 2022 **Hack The Science 2022**
Member of OASBO participant team, challenge *"Hack The Planet"* and *"Hack And Explore The Latent Space"*.
Milano, Italy.

May 2022 **CTA General Consortium Meeting** LOC
Attendance and part of the local organisation committee.
Bologna, Italy.

February 2022 **18th Advanced School on Parallel Computing** school
School on Quantum Computing.
CINECA, online.

November 2021 **CTA General Consortium Meeting** talk
Di Piano et al., *SAG-SCI: DL3 analysis wrapper.*
Bologna, Italy.

May 2021 **CTA General Consortium Meeting** talk
Di Piano et al., *Characterising detection methods for CTA at very-short exposure times.*
Online.

November 2020 **Gammapy Co-Working Week** workshop
Kick-starting of the gammapy implementation in the real-time analysis of CTA.
Online.

May 2020 **CTA General Consortium Meeting** talk
Di Piano et al., *Real-time analysis detection pipelines.*
Online.

October 2019 **CTA General Consortium Meeting** LOC
Attendance and part of the local organisation committee.
Bologna, Italy.

March 2019 **Introduction to Parallel Computing with MPI and OpenMP** workshop
Attendance.
CINECA, Bologna.

PROJECT MEETINGS

2019 – Present **CTA Project Meetings**
Interface with CTA working groups and presentation of updates on behalf of the ACADA-SAG work group.
Online.

- GW Consortium Paper: regular attendance.
2021.04.19 - Studies on detection methods for the real-time analysis;
2019.07.24 - Blind-search and real-time analysis pipeline
- GRB Consortium Paper: regular attendance.
2021.04.14 - ctools pipeline refactoring comparison with gammapy;
2021.03.24 - ctools pipeline refactoring status;
2020.11.13 - ctools pipeline refactoring kick-start meeting;
2019.07.08 - Blind-search and real-time analysis pipeline
- Analysis and Simulation: regular attendance.
2021.05.12 - Characterising detection methods for CTA at very short exposure time;
2021.03.03 - Detection at very-short exposure times;
- Transients/MWL: regular attendance.
- Real-Time Analysis for LST1:
2021.09.14 - RTA-SCI: DL3 analysis wrapper;
- Gammapy implementation:
2022.07.01 - Real-time analysis and gammapy: status update;

PUBLICATIONS

Refereed papers

April 2022 **N. Parmiggiani et al.**, *The RTApipe framework for the gamma-ray real-time analysis software development* , Astronomy and Computing, 10.1016/j.ascom.2022.100570.

February 2022 **A. Ursi et al.**, *The Second AGILE MCAL Gamma-Ray Burst Catalog: 13 yr of Observations*, The Astrophysical Journal, 10.3847/1538-4357/ac3df7.

July 2021 **F. Verrecchia et al.**, *AGILE Observations of Fast Radio Bursts*, The Astrophysical Journal, 10.3847/1538-4357/abfda7.

Jun 2021 **N. Parmiggiani et al.**, *A Deep Learning Method for AGILE-GRID GRB Detection*, The Astrophysical Journal, 10.3847/1538-4357/abfa15.

Proceedings of Science

October 2021 **N. Parmiggiani et al.**, *Preliminary Results of a Deep Learning Anomaly Detection Method to Identify Gamma-Ray Bursts in the AGILE Anticoincidence System*, abstract accepted at ADASS2022 conference.

July 2021 **A. Di Piano et al.**, *Detection methods for the Cherenkov Telescope Array at very-short exposure times*, poster, ICRC2021, 10.22323/1.395.0694.

July 2021 **A. López-Oramas et al.**, *Prospects for Galactic transient sources detection with the Cherenkov Telescope Array*, talk, ICRC2021, 10.22323/1.395.0784.

July 2021 **A. Bulgarelli et al.**, *The Science Alert Generation system of the Cherenkov Telescope Array Observatory*, poster, ICRC2021, 10.22323/1.395.0937.

July 2021 **B. Patricelli et al.**, *Searching for very-high-energy electromagnetic counterparts to gravitational-wave events with the Cherenkov Telescope Array*, talk, ICRC2021, 10.22323/1.395.0998.

July 2021 **N. Parmiggiani et al.**, *The Online Observation Quality System for the ASTRI Mini Array*, poster, ICRC2021, 10.22323/1.395.0692.

July 2021 **N. Parmiggiani et al.**, *The AGILE real-time analysis pipelines in the multi-messenger era*, poster, ICRC2021, 10.22323/1.395.0933.

November 2020 **A. Bulgarelli et al.**, *Agilepy: A Python framework for scientific analysis of AGILE data*, poster, ADASS2021, https://arxiv.org/abs/2105.08474.

November 2020 **L. Baroncelli et al.**, *rta-dq-lib: a library to perform online data quality analysis of scientific data*, poster, ADASS2021, https://arxiv.org/abs/2105.08648.

Technical Reports

August 2022 **A. Bulgarelli**, *Detailed Design of the Science Alert Generation of the of the ACADA System*, CTA ACADA Coordination, CTA-TRE-COM-303000-0005, issue 1, rev. B.

July 2022 **A. Di Piano**, *ACADA/SAG Wobble Analysis for LST-1*, CTA ACADA Coordination, CTA-TRE-ACA-307000-0001, issue 1, rev. A.

Theses

March 2020 **A. Di Piano**, *Detection of short gamma-ray burst afterglows with CTA through real-time analysis*, Master Thesis, 13 March 2021, http://amslaurea.unibo.it/19962/.

March 2016 **A. Di Piano**, *Ottica geometrica e ondulatoria, e applicazioni astrofisiche*, Bachelor Thesis, 17 March 2016, http://amslaurea.unibo.it/9834/.