



LABORATÓRIO DE INSTRUMENTAÇÃO  
E FÍSICA EXPERIMENTAL DE PARTÍCULAS  
*partículas e tecnologia*

# III LIP Summer Student Program / 2019

## Final Presentations Workshop

Lisbon - Coimbra - Braga  
September 4-5, 2019

[NUNO@CERN.CH](mailto:nuno@cern.ch)

# Thank you for taking part !



Foremost to You, **the Students**, for spending the summer engaging in research work with us.  
The **Supervisors** for designing the actual research projects and for mentoring them.  
Everyone at LIP involved in the **organisation** (inc. ECO, IT, directorate, secretariat, etc)



# INDUCTION TUTORIALS

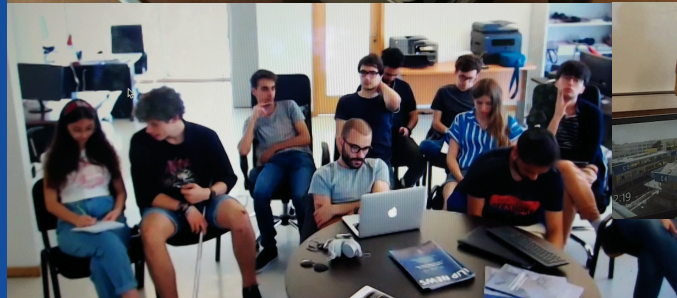
Introductory  
lectures

+

Thematic  
discussion

+

Hands-on  
exercises



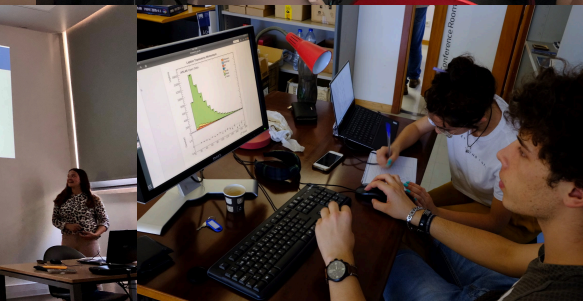
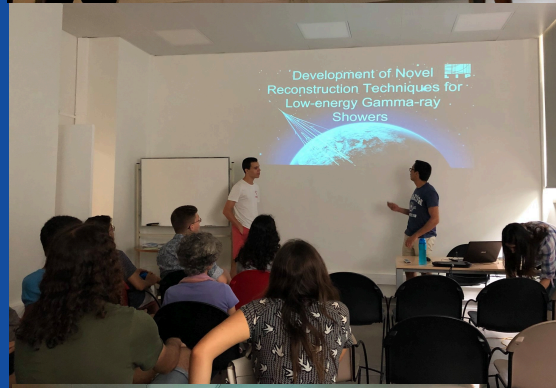
# MID-TERM ACTIVITIES

'August Chats'

## Student seminar weekly Sessions

(Students present to colleagues a  
problem they are addressing)

after-work party  
in the garden





# Final Workshop

- 2 days of presentations
- 8 sessions
- 1 report per project
- **15 min per report**
- +5 min discussion

- **Lisbon + Coimbra + Braga**
- sessions transmitted via videoconference

## Summer Student Program 2019 | Final Workshop

4 Sep 2019, 09:00 → 5 Sep 2019, 18:00 Europe/Lisbon

Auditorium (LIP 3is)

4 Sep 2019			5 Sep 2019		
AM	09:15	Welcome (Auditorium)	09:20	Session (until 10:40) ()	
	09:20	Session (until 10:40) (Auditorium)	09:20	Física Experimental de Partículas com os detectores ATLAS, LUX e LZ - <i>Ângelo Ferreira Tiago Azevedo André Silva</i> ()	
	09:40	Gamma-ray astrophysics with current and future detectors - <i>Wagner Blotz</i> (Auditorium)	09:40	Muões num balão: medidas do fluxo de muões até à estratosfera - <i>Pedro Leal João Parente Bárbara Matos</i>	
	10:00	Argon transparency to neutrons - <i>Leonardo Oliveira</i> (Auditorium)	10:00	Simulações de Monte Carlo para preparar a procura de matéria escura na experiência LZ - <i>Nuno Brito Frederico Simões</i> ()	
	10:20	(pre)supernova signals in SNO+ - <i>António Maschio Miguel Avilhez</i> (Auditorium)	10:20	Ampliação das funcionalidades de um visualizador gráfico 3D do Observatório Pierre Auger - <i>Leonardo Ramalho Luis Neto</i> ()	
	10:40	--- Coffee Break ---	10:40	--- Coffee Break ---	
	11:10	Session (until 12:30) (Auditorium)	11:10	Session (until 12:30) ()	
	11:10	Simulação e medida do fundo natural proveniente da terra e do céu - <i>José Nunes</i> (Auditorium)	11:10	Explorar os dados públicos do Observatório Pierre Auger - <i>Pedro Branco Pedro Passos Osvaldo Freitas</i> ()	
	11:30	Reações nucleares com feixes radioativos a energias relativistas - <i>Ricardo Pires</i> (Auditorium)	11:30	Pesquisa de nova física associada ao quark top usando dados de ATLAS - <i>Ana Oliveira José Abreu</i> ()	
	11:50	Preparation and characterization of a thin target for nuclear physics experiments - <i>Luísa Baptista</i> (Auditorium)	11:50	Pesquisa de nova física associada ao quark top usando dados de ATLAS - <i>Maria Portela Maria Neiva</i> ()	
			12:10	Pesquisa de nova física associada ao quark top usando dados de ATLAS - <i>Nuno Morujão Tomás Ferreira</i> ()	
	12:30	--- Lunch ---	12:30	--- Lunch ---	
PM	14:00	Session (until 15:20) (Auditorium)	14:00	Session (until 15:20) (Auditorium)	
	14:00	AMBER - Physics simulations for a new experiment at CERN - <i>Rita Silva</i> (Auditorium)	14:00	Exploring the Quark-Gluon Plasma - <i>Iris Silva Sérgio Carrão André Cordeiro Rafael Pinto</i> (Auditorium)	
	14:20	Performance of the ATLAS Trigger for the High Luminosity LHC era - <i>Filipe Cruz</i> (Auditorium)	14:20	Probing Quark Gluon Plasma with b-Jets - <i>Rodrigo Gazola Inês Rebanda</i> (Auditorium)	
	14:40	High-precision timing detectors for HL-LHC - <i>Vitor Cardoso Gonçalo Villa</i> (Auditorium)	14:40	Novel probes of the primordial QGP - <i>João Gonçalves Alexandra Pardal</i> (Auditorium)	
	15:00	Simulação das propriedades óticas de plásticos cintiladores para dosimetria de elevada resolução - <i>Catarina Pimenta</i> (Auditorium)	15:00	Quarkonia polarization method using a new fully unbinned fitting and background subtraction method - <i>Albergaia Francisco</i> (Auditorium)	
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	15:50	O plástico na física de partículas: cintiladores e fibras ópticas - <i>Hugo Miranda Francisco Laranjinha Ivan Muñoz</i> (Auditorium)	15:50	Development of novel reconstruction techniques for low-energy gamma-ray showers - <i>Luís Lourenço Hugo Ló</i> (Auditorium)	
	16:10	Selection of Helium nuclei using multivariate data analysis in AMS - <i>José Jesus David Lima</i> (Auditorium)	16:10	Exploring the Hidden Sector of Particle Physics at the SHIP experiment - <i>Beatriz Araújo</i> (Auditorium)	
	16:30	Efficient modeling of optical photon propagation in SNO+ - <i>Samuel Magalhães</i> (Auditorium)	16:30	Search for New Physics in exclusive processes at the LHC - <i>Miguel Guerreiro</i> (Auditorium)	
	16:50	Search for Supersymmetry with a machine-learning tool - <i>Arthur Oudot Timothée Cabos</i> (Auditorium)	16:50	Study of the Higgs couplings to quarks at ATLAS - <i>Gonçalo Fernandes Dmytro Ostapchuk</i> (Auditorium)	
	17:10	Desenvolvimento de um programa de simulação ótica de detetores de cintilação - <i>Rudnei Machado</i>			

LIP SUMMER STUDENT 2019

# Book of Abstracts

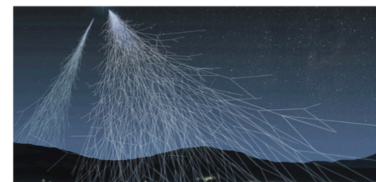
You are invited to prepare a  
terse summary of your project.

HOW MUCH: 0(200) WORDS  
WHEN: BY NEXT WEEK

## LIP Summer Students Programme 2018

Book of abstracts

Entre Julho e Setembro de 2018, decorreu a 2ª edição do Programa de Estudantes de Verão do LIP, dirigidos a estudantes universitários de Física, mas também de áreas relacionadas, como a Engenharia. Mais de meia centena de estudantes de licenciatura e mestrado participaram activamente em mais de 30 projetos de investigação, integrados em vários grupos de investigação nos três polos do LIP – Lisboa, Coimbra e Minho. O programa iniciou-se com uma semana de tutoriais e terminou com um workshop em que os estudantes apresentaram o seu trabalho. Nesta secção do Boletim, os participantes apresentam um breve resumo do projecto de investigação que desenvolveram.



### LATTES: Looking for astrophysical gammas with a next generation detector

**Students:** André Torcato, Melissa Serra, José Cordeiro, Sara Marques, José Jesus  
**Supervisors:** Ruben Conceição, Bernardo Tomé, Mário Pimenta

LATTES is a project that aims to build a gamma-ray ground-based experiment to survey the Southern sky. This wide field-of-view experiment is based on a hybrid detector concept (water Cherenkov detectors + resistive plate chambers) to effectively access with a good sensitivity an energy region that is not currently covered by any experiment of this type. While the proof-of-concept is done, this new experiment offers a new set of possibilities to observe the sky that are far from fully explored. This summer we explored some of these opportunities: investigate and optimize the shower core reconstruction of highly energetic events; build an artificial neural network to enhance the gamma (signal) / hadron (background) discrimination; assess the LATTES shower geometry reconstruction for different RPC time resolutions and array configurations. In all these tasks, possible improvement to the current LATTES reconstruction were found which might contribute to enhance its performance in the future.

### Development of a framework for multi-messenger observations

**Students:** Bernardo Dias and Nelson Eiró  
**Supervisors:** Sofia Andringa and Lorenzo Cazon

Cosmic rays, neutrinos, photons and gravitational waves are observed independently over the last years by different observatories around Earth. However, the detection of a single event can be observed by several observatories in different channels. Identification of such events is a challenging task, allowing to understand the physical processes that generate violent phases of the Universe (e.g. the merger of two black holes or the GW170817 and the GW150914 events). The objectives of the internship were the development of display tools of the instantaneous sky coverage of the Auger experiment (that can be consulted at <http://www.lip.pt/~ev117/galactic.html>) and the identification of relevant source candidates. Calculations of time of flight delay and deflection angles from different relevant sources were also achieved. The work culminated in a poster presented at ENAA – Encontro Nacional de Astronomia e Astrofísica.

### Rare beauty decays

**Student:** Maria Carolina Faria  
**Supervisors:** Ozlem Ozcelik, Nuno Leonardo

The rare meson decays  $B \rightarrow \mu\mu$  are amongst the most sensitive probes for physics beyond the standard model at the LHC. Following the Run 1 flagship observation by CMS and LHCb  $\rightarrow \mu\mu$ , the accumulation of data will allow detailed measurement of the  $B^0$  channel along with improved searches for the rare  $B^{\pm} \rightarrow \mu^{\pm}\mu^{\pm}$ . In this project, we estimate the sensitivity that will be attainable with the upgraded CMS detector during the high luminosity LHC (HL-LHC). Using detailed simulations of signal background processes, we determined expected improvements in mass resolution relative to the current detector. These were used to generate pseudo-experiments simulating the involved processes. With the sample of  $3ab^{-1}$  at 14 TeV that we expect to collect during HL-LHC, major improvements in the measurement will be enabled. In addition to allowing precise measurement of the  $B^0$  channel, including of its effective lifetime, a first observation of the  $B^{\pm}$  channel will be in reach, with a statistical significance in excess of 6 $\sigma$ .

### Measurement of $H \rightarrow 2$ tau with multivariate analysis tools

**Students:** Luis Sintra, Ricardo Cipriano, Tomás Alvim  
**Supervisor:** Pedrame Baggassa

One of the main goals of the CMS collaboration is the precise measurement of the properties of the Higgs boson. The coupling of Higgs to different Standard Model (SM) particles can give a precious hint to whether it belongs to the SM framework, or otherwise a gateway to physics beyond our present knowledge. The goal of the internship was to improve on the analysis results of  $H \rightarrow 2\tau$  performed with a multi-class neural network (NN) instead of the original cut-and-count approach used for the Higgs boson discovery. Our NN categorizes events in SM processes exploiting the separation between those processes in the multidimensional space of the chosen variables (e.g. missing transverse momentum). The signal of the Higgs signal is extracted from this category. To achieve a higher precision if the latter is selected, we explored two ways to improve the selection accuracy: by diminishing the background on the number of b jets; by optimizing the cut on the output of a NN trained for the purpose of maximizing the hints at an improvement of 11.1% of previous results.

### Di-Higgs searches with machine learning

**Students:** Miguel Bengala, Rodrigo Santo  
**Supervisors:** Giles Strong, Michele Gallinaro

With the proposed upgrades for the CMS detector in the High Luminosity LHC, it is wise to study what kind of results we are expecting to obtain and explore new paths for future analysis on our project. We took data produced via a Monte Carlo generator and used it to predict the expected discovery significance of resonant di-Higgs (HH) production for the upgraded detector. The methods and results were discussed in an analysis note that will be included in the Yellow Report. In the project, we explored

from last year's



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# Your Feedback

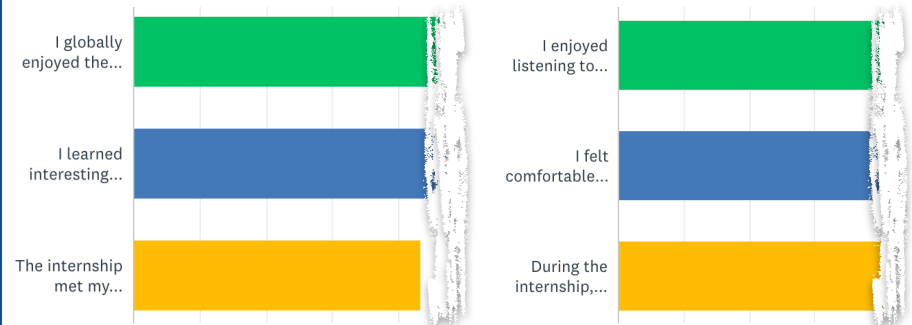
You shall receive shortly an invitation to fill in a survey to share with us your feedback on the program:

- what you think went well
- how it could be improved

Your feedback is important so we can improve on future editions of the program for your colleagues.



## Survey on the 2017 LIP Summer Student Program







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**CERTIFICADO**

Farewell &

2018 / **Summer Student  
Program**

**Certificates**  
of participation

Certifica-se que

*Student's Name*

concluiu com sucesso o programa

**"LIP - Estágios de Verão"**

que decorreu no LIP, entre Julho e Setembro de 2018,

organizado pelo

***Laboratório de Instrumentação e Física Experimental de Partículas (LIP)***

WILL BE HANDED IN TOMORROW

FOLLOWING THE FINAL SESSION OF THE WORKSHOP

# THE AGENDA

rules of engagement

15 min per report:  
try to keep within time

5 min discussion time  
do ask questions!

slides uploaded before  
start of session  
ask advisors to  
upload

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