

Experimental Techniques in Particle Physics and Astrophysics

Master in Astrophysics, Particle
Physics and Cosmology

P. Bordas, X. Luri, C. Marin



Institute of Cosmos
Sciences



UNIVERSITAT DE
BARCELONA

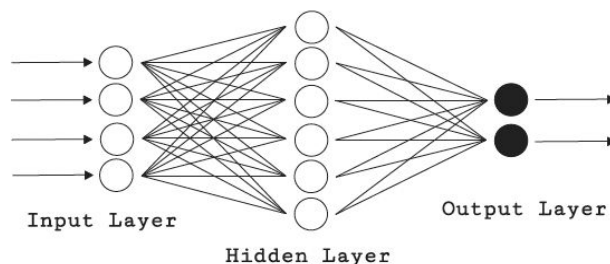
Content

Instrumentation



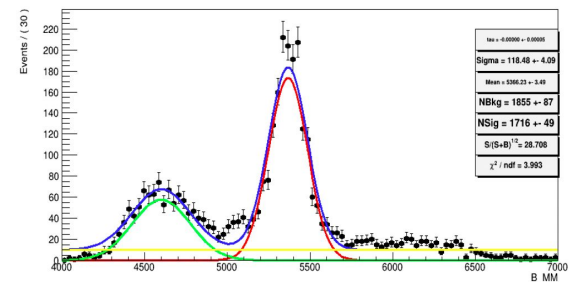
Joan Oro telescope (CAM)

Machine learning



Credit: V. Costa

Data analysis



Credit: A. Santander

General information

- Optional subject (2nd semester), joint astro & particle & cosmology
 - 6 credits = 150h
 - Lectures: 15h (first weeks)
 - Practical sessions and exercises: 20h
 - Workshops: 25h
 - Supervised project: 50h
 - Independent learning: 40h

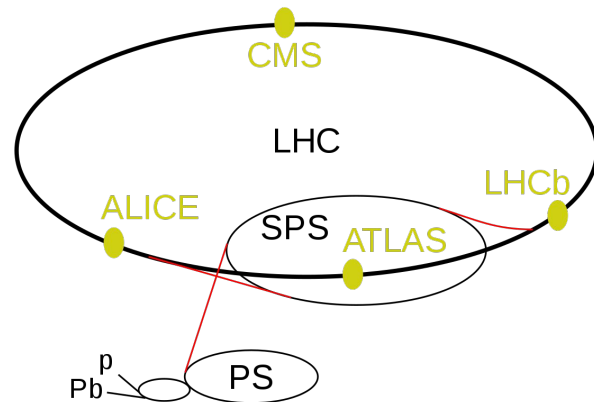
- Professors
 - Astrophysics: P. Bordas and X. Luri
 - Particle physics: C. Marin



Lectures

First weeks (15h):

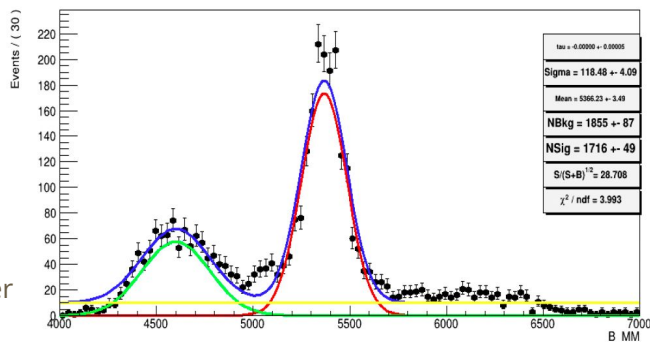
1. Requirements of particle physics experiments
2. Particle accelerators
3. Detection techniques
4. Design of high energy physics experiments
5. Requirements of astrophysical observations
6. Astrophysical instrumentation
7. Astrophysical observation techniques
8. Data acquisition and processing



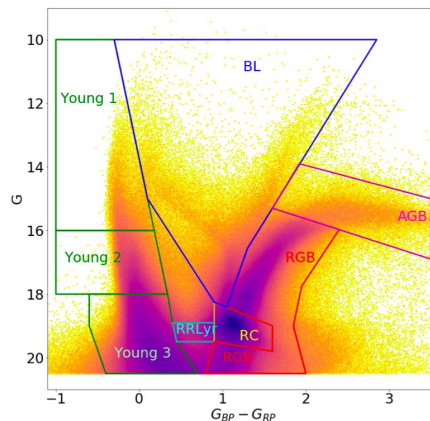
Practical sessions

During all the course (20h):

- Machine learning and fitting techniques using LHCb data
- Cloud computing using Gaia data
- X-rays using Chandra and XMM-Newton data
- High-Energy gamma rays using Fermi-LAT data
- Very high-energy gamma rays using CTA data



Credit: A. Santander



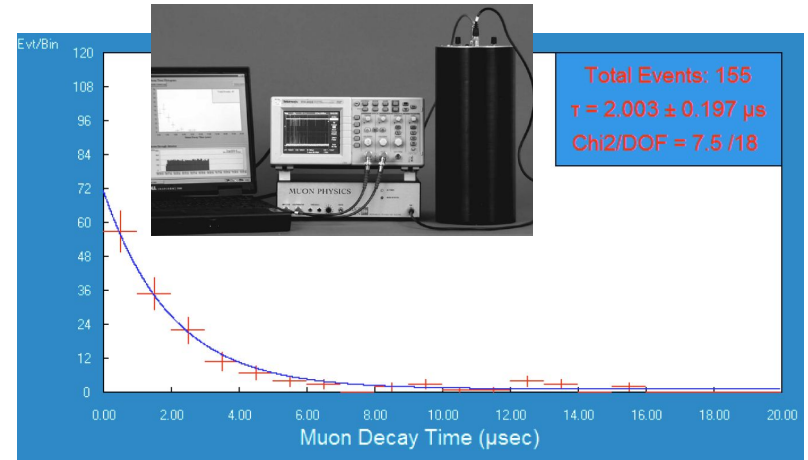
Workshops (1)

During all the course (25h):

ALBA synchrotron beam emittance



Muon lifetime



Credit: J. R. Stocchetti

Workshops (2)

During all the course (25h):

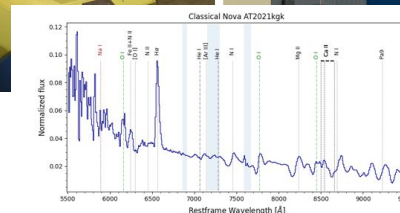
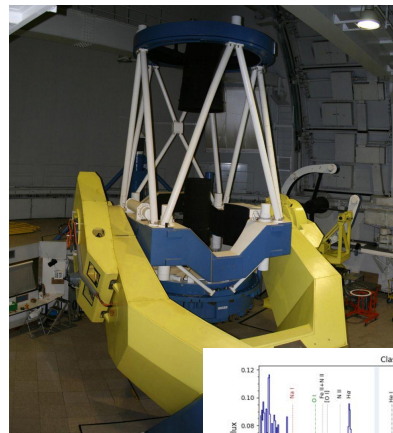
Observation at

Observatori Astronòmic del Montsec



Proposal and observation at

Calar Alto Astronomical Observatory



Extinction-corrected spectrum of the galactic nova AT2021kgk obtained with instrument CAFOS attached to the 2.2 m Zeiss reflector of Calar Alto, in observing time of the Calar Alto Academy program assigned to practical work for the University of Barcelona. Credits: Nadia Blagrodovna.

Supervised project

To be submitted at the end of the course (start early!) (50h):

Related to a topic of the subject or to your TFM project (extension)

Topic examples:

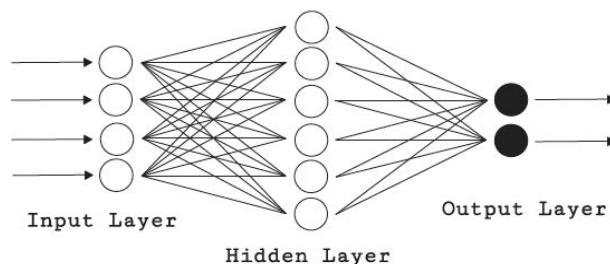
- related to site testing, instrument characterisation or telescope setting up
- Calibration or time alignment of detectors
- LHCb, Fermi satellite, MAGIC telescope or Gaia data analysis
- Trigger: queuing simulation
- radio interferometric observations
- *Study of the leptoquark mass with astrophysical neutrino flux from IceCube observatory*
- *Study of the structure of the Large Magellanic Cloud using RR Lyrae stars and Clustering analysis*

Summary

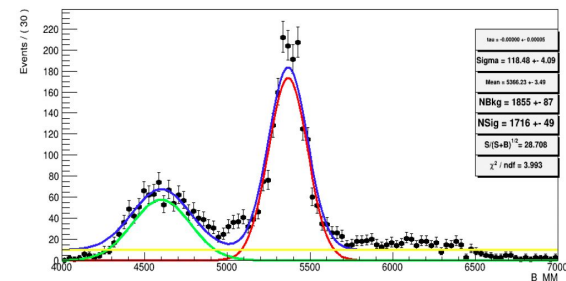
Unique opportunity to access instrumentation and data from ongoing Particle Physics and Astrophysics experiments!



Joan Oro telescope (CAM)



Credit: V. Costa



Credit: A. Santander

Thanks for the attention

Questions?

Comments?