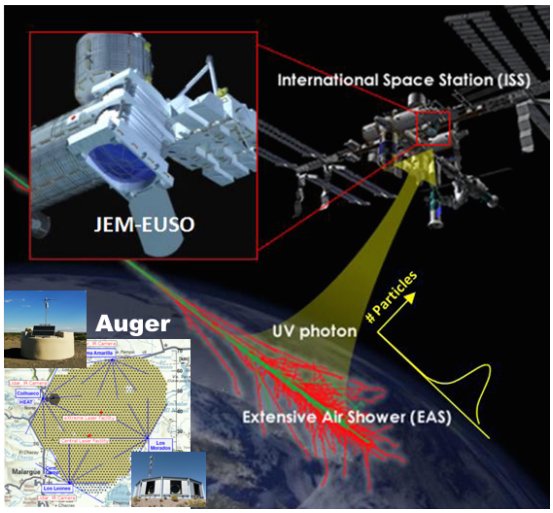
Modelling of space & ground-based observations of Ultra-High Energy Cosmic Rays



SUMMARY.
One of the key open questions in the field of astroparticle physics concerns the origin of the so-called Ultra-High Energy Cosmic Rays (UHECRs). They consist of protons and nuclei traveling through the universe with macroscopic energies, reaching 10^{20} eV and beyond, which makes them by far the most energetic particles known in the universe. However, their sources and acceleration mechanism(s) are still to be identified. A major challenge is the very low flux, namely about 1 particle per km^2 per millennium at the highest energies! For this reason, detectors with a huge field of view must be developed to study UHECRs with reasonable statistics. Objective of the METEOR is a full immersion in the topic of UHECRs, with lectures on cosmic rays science and detection tecniques. A significant fraction of the time will be devoted to conduct data analysis, simulation studies or experiments in the framework of the Pierre Auger Observatory or JEM-EUSO projects.

OBJECTIVES

- ***Knowledge***, *understand cosmic ray science, learn about astroparticle physics and observational methodologies*
- ***Skills*** *run numerical simulations, process AugerPrime or JEM-EUSO data*

INSTITUTE

- Department of Physics, University of Turin
- Institute URL
- Via P. Giuria 1, Turin, Italy

THEORY

by BERTAINA Mario Edoardo

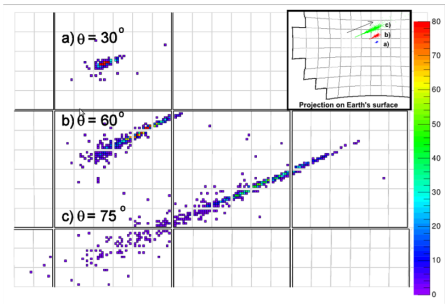
Explain the theoretical aspects covered in the METEOR and the observational methodology. Presentation of the cosmic ray observation techinques and the importance of cosmic ray studies in the framework of astroparticle science.

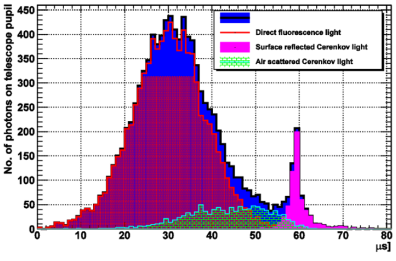
APPLICATIONS

by M. Bertaina

The trainee will use and possibly improve available numerical codes to analyze the data acquired by JEM-EUSO or AugerPrime projects as well as simulate the expected signals in the detector by UHECRs.

The figure shows an example of the signal generated in the atmosphere by the extensive air shower produced by an UHECR colliding with the atmosphere and detected by the JEM-EUSO space telescope





Example of the signal generated by an UHECR on the JEM-EUSO focal surface.

MAIN PROGRESSION STEPS

- `Week 1-2`: lectures on the covered topics and bibliographic studies
- `Weeks 3-8`: project
- `Week 9`: preparation of the final presentation and discussion

EVALUATION

The students will be examinated by means of a final presentation which will be delivered on the last week. This presentation should include all the items discussed in the following.

- `Theory grade [30%]`
  - 50%: theoretical questions, base calculus from lectures
  - 50%: critical spirit
- `Practice grade [30%]`
  - Project-related exercices (10%): thought-process and results
  - Project (90%): initiative, progress, analysis
- `Defense grade [40%]`
  - Oral and slides quality
  - Context
  - Project / Personal work
  - Answers to questions

BIBLIOGRAPHY & RESOURCES

Any reference or web page that students can read to have a better idea of the topic

- Bertaina-webpage
- JEM-EUSO-program
- JEM-EUSO-paper
- PierreAugerObservatory
- Auger-paper
- UHECR-science

CONTACT

Mario Edoardo BERTAINA
☎ +39.011.6707492
✉ marioedoardo.bertaina@unito.it