The Global Data Assimilation System GDAS, for the astroparticle background flux estimation in the LAGO collaboration

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https://arxiv.org/abs/2006.01224

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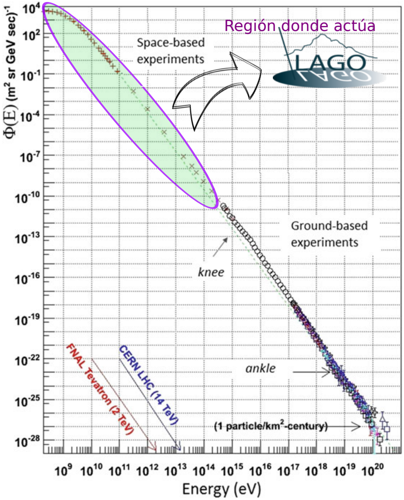
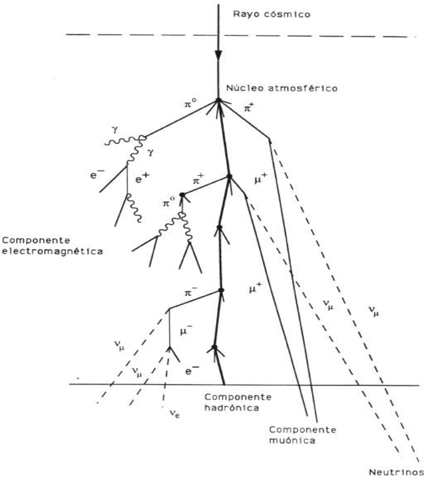
Escuela de Física

Astroparticles

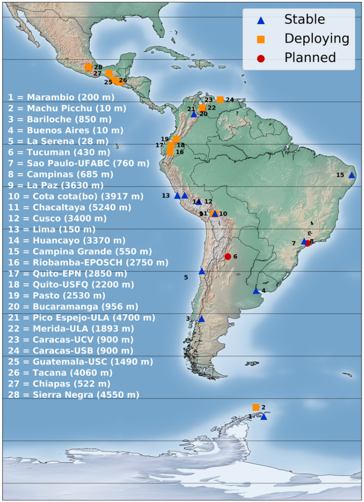


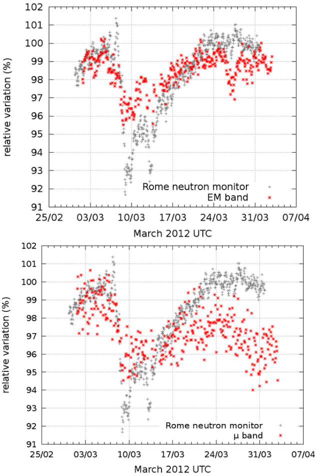


Patrignani, C., et al. *PDG, Review of Particle Physics*, 2016.

Ferrer et al.,2005

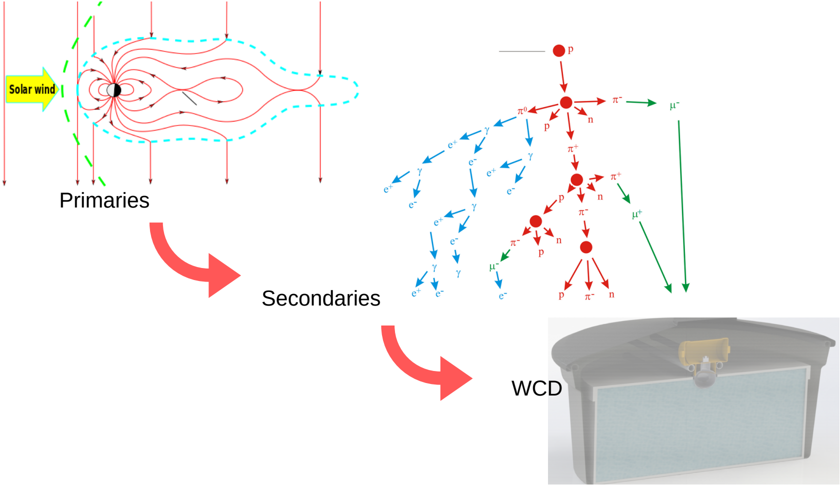
Solar phenomena





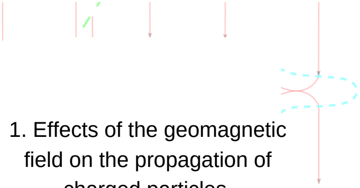
H. Asorey. The LAGO Space Weather Program, 2015

The LAGO simulation framework

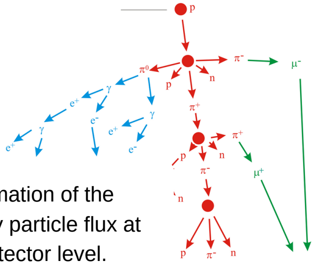


Sarmiento-Cano, C., et. al. Performance of the LAGO water Cherenkov detectors to cosmic ray flux. arXiv preprint arXiv:2010.14591.

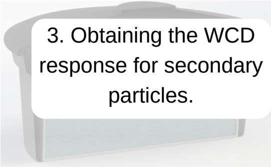
The LAGO simulation framework



1. Effects of the geomagnetic field on the propagation of charged particles.

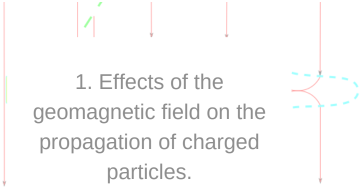


2. Estimation of the secondary particle flux at the detector level.



3. Obtaining the WCD response for secondary particles.

The LAGO simulation framework



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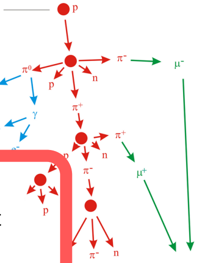
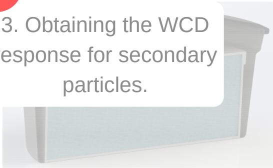


2. Estimation of the secondary particle flux at the detector level.

Study the effect of the atmosphere on the development of the Extensive Air Showers



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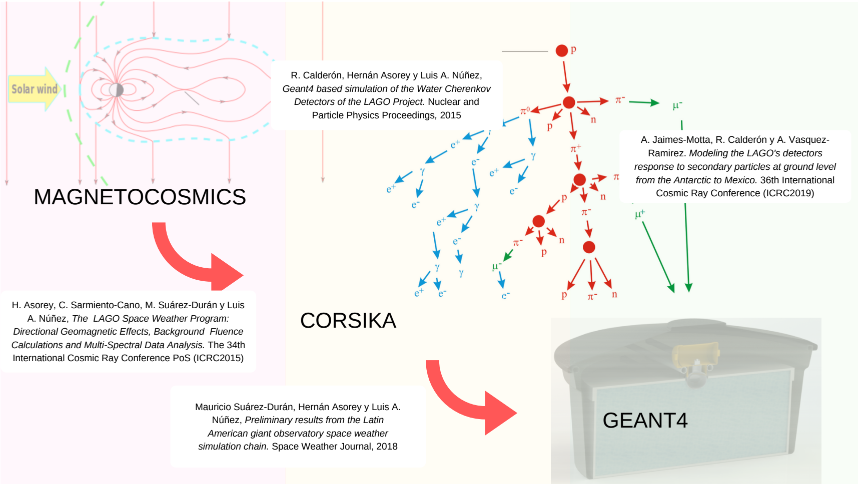
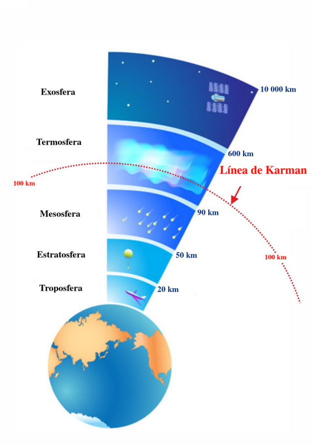
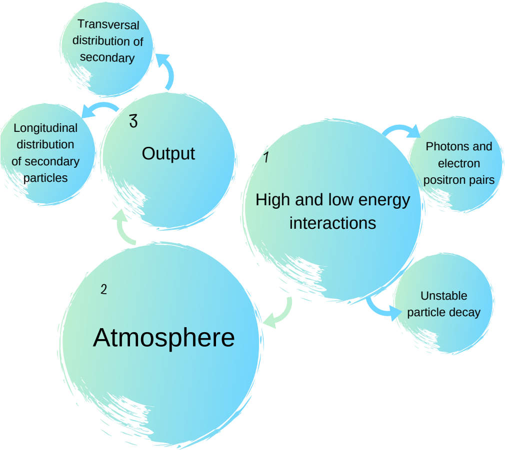


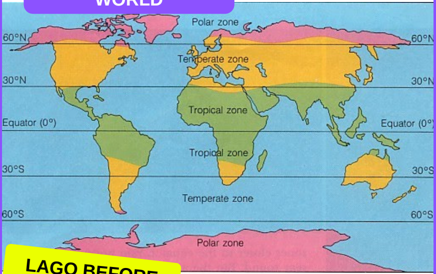
COsmic Ray SImulations for KAscade, CORSIKA. Fundamental structure





CORSIKA's Atmosphere

REGIONS OF THE WORLD



LAGO BEFORE

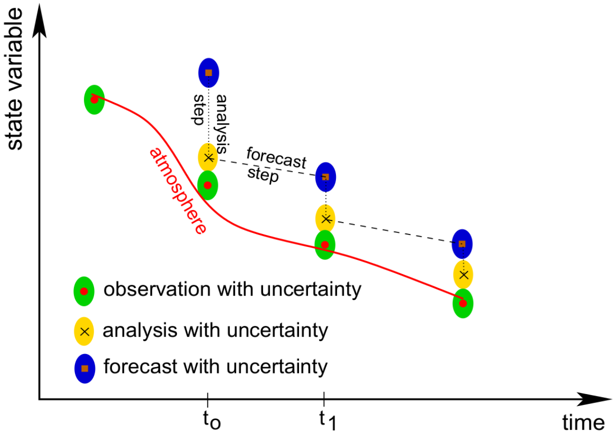
Atmospheric profiles built on the basis of weather balloons

LAGO NOW

CUSTOMIZED ATMOSPHERES

Profiles built based on **GDAS**, Gobal Data Assimilation System.

GDAS, *Global Data Assimilation System*



W. Wergen, 2002

Building our monthly profiles

One atmospheric profile per month

from:

2 Daily Atmospheric Profiles

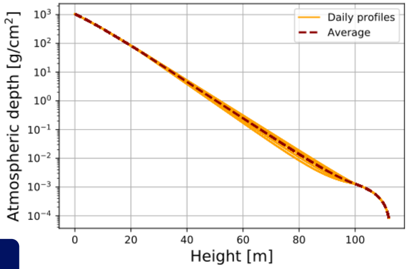
for:

5:00 UTC + 17:00 UTC

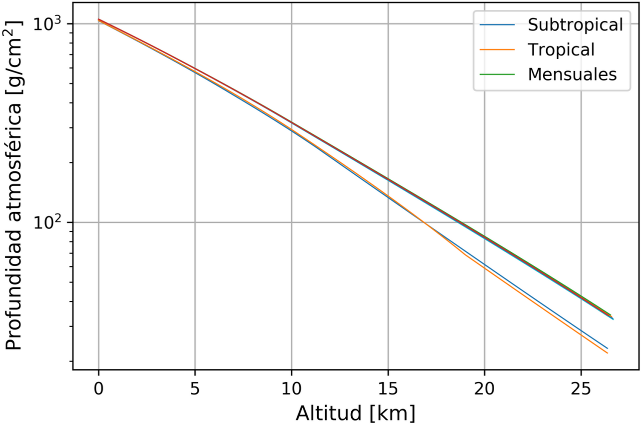
and 952 msnm

Year: 2018 → 12 Monthly Profiles

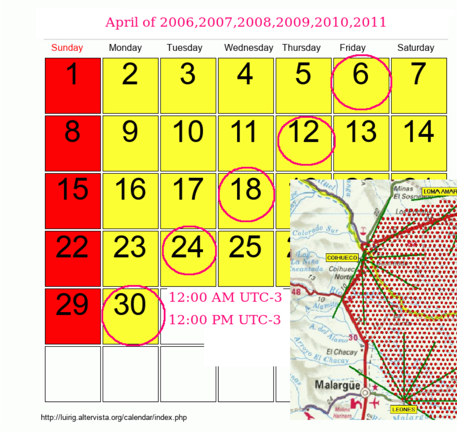
Profile:

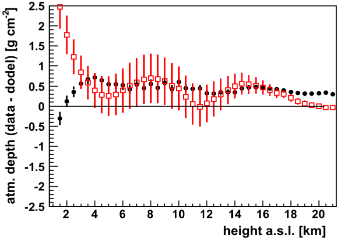


Comparison with default profiles

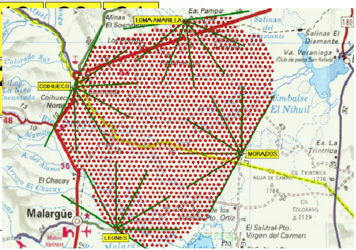


Validation with Pierre Auger models

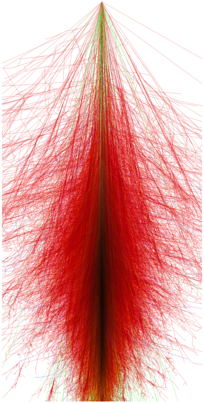


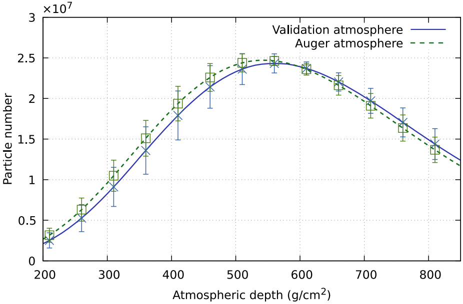


Abreu, 2012 *for Pierre Auger Colaboration*



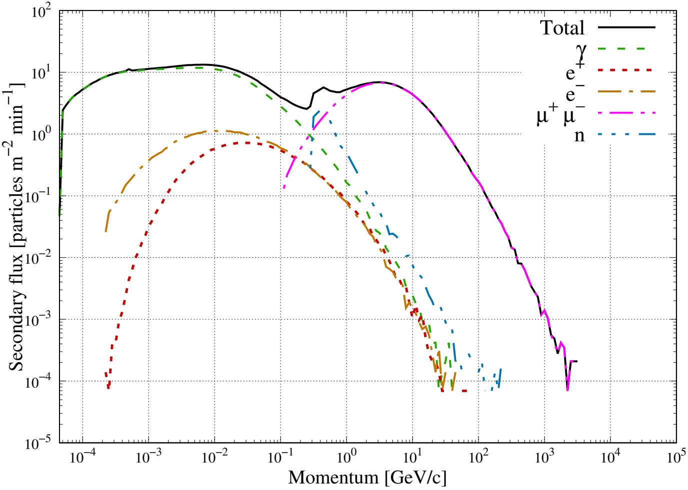
Reconstruction of a rain for a Fe with $1 \cdot 10^8$ GeV over Malargüe





Fabian Schmidt, University of Leeds, UK for KIT

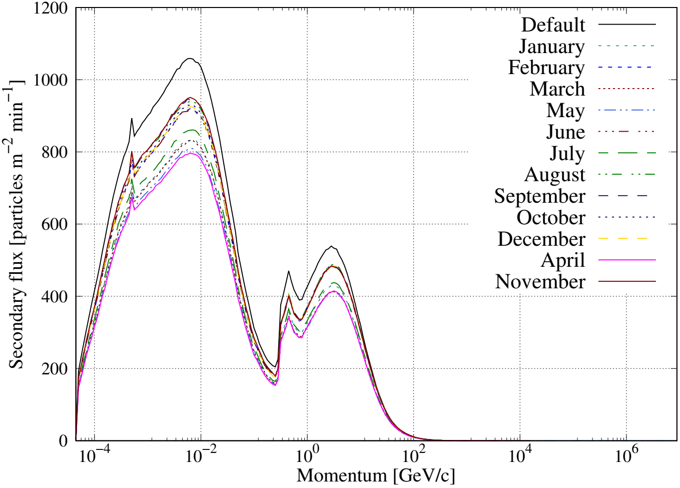
Secondary energy spectrum



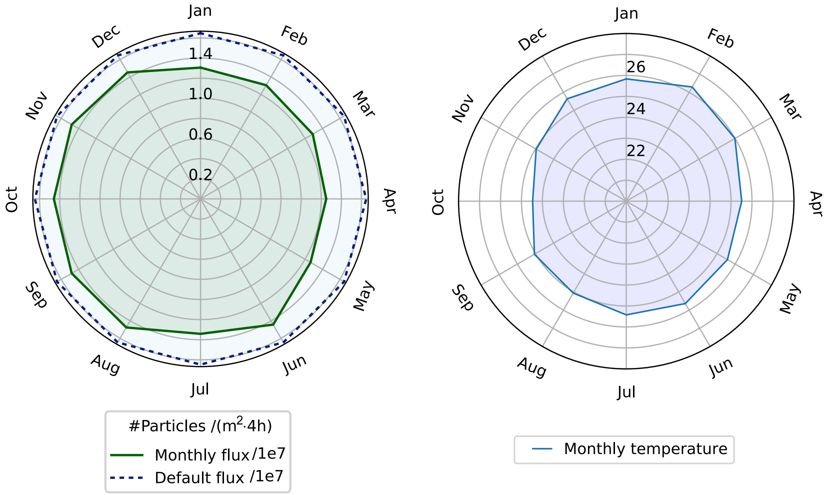
How do we get the flux?

1. Horizontal and vertical components of the Earth's magnetic field corresponding to 27.026 νT and 17.176 νT, respectively.
2. Observation level, 950 m a.s.l. for Bucaramanga.
3. Primary: Nuclei from Hydrogen to Iron
4. Energy range of primaries: from 5 GeV to 10^6 GeV.
5. Zenithal angle of incidence of the primaries: from 0° to 90°.
6. Flow time 4 hours = 14400 s.
7. Atmospheric profile: Default subtropical profile within ATMEXT routines, which is the one used so far for flow simulations over Bucaramanga, and the 12 monthly atmospheric profiles created from GDASTOOL.
8. Energy cuts: 0.0 GeV for hadrons and muons and 5×10^{-5} GeV for electrons and photons.

Variation throughout the year



Flux and temperature



Conclusions

- We have devised a methodology that enables to obtain a month-by-month averaged atmospheric profiles for any geographic location. This methodology, implemented using the GDASTOOL code available in CORSIKA.
- We have validated the methodology, building atmospheric profiles for the Pierre Auger Observatory, and contrasting them with the GDAS-based models currently used by the Observatory. The behaviour of the EAS obtained with the reconstructed atmosphere shows a difference of $\approx 2\,\%$ in the value of the maximum atmospheric depth, $Xmax$.

Conclusions

- We observed that the most significant differences in the total flux, between simulations with predefined profiles *vs* GDAS models, are between 10.22 % and 24.12 % and occur in November and April respectively. Similarly, for muons, these differences are between 9.58 % and 22.25 %.
- This work completes the sequence of simulations that the LAGO collaboration established, to study the phenomena related to the modulation that the solar wind makes to the flux of secondary that can be detected by a WCD in any geographic position and at any time of the year.

THANKS

Bibliografía

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