Testing the low energy hadronic models used in AIRES with Caprice98 results.

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July 5, 2007

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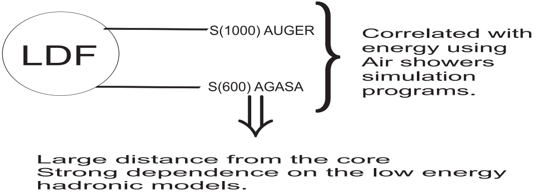
Outline of the talk:

- Introduction
  - Why important to test the low energy hadronic model ?.
- CAPRICE98 experiment and data.
- Air shower simulation program AIRES.
  - Improve low energy hadronic model (new experimental version).
  - Simulating the CAPRICE98 atmospheric fluxes.
- Results
  - Comparison between the two Aires version with CAPRICE98 data.
- Conclusion.

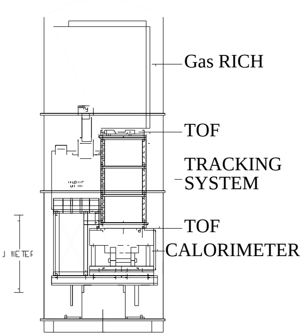
Why important to test the low energy hadronic model ?:

- UHECR surface detectors used Air shower simulation programs to reconstruct the energy.



- Hybrid detectors show disagreement between the results of the two techniques.
- Discrepancy in the particle production due to the different hadronic models. The discrepancy is in the high and low energy hadronic models.
- Collider experiment show difficulties in the measurement of the diffractive cross section since they do not register particles into the forward direction.

Caprice98 experiment



Caprice98 data:

- particle measurement during balloon floating period,
- particle measurement during balloon ascending period, and
- particle measurement on ground.

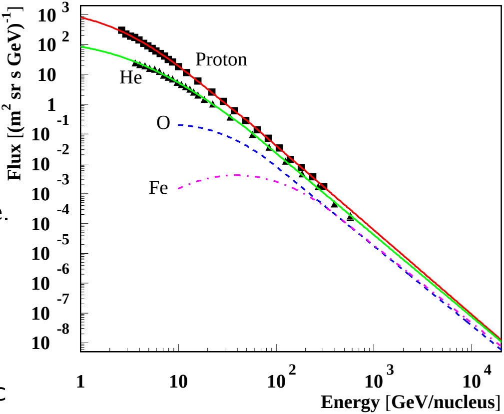
Particles	Proton	Helium	μ^+ and μ^-	e^- and e^+
	5.5 g/cm^2	5.5 g/cm^2	5.5 g/cm^2	13 g/cm^2
Average	23.5 g/cm^2	15.9 g/cm^2	22.6 g/cm^2	29 g/cm^2
	48.4 g/cm^2	48.4 g/cm^2	48.4 g/cm^2	61 g/cm^2
atmospheric	76.9 g/cm^2	111.4 g/cm^2	77 g/cm^2	99 g/cm^2
	104.8 g/cm^2		104 g/cm^2	169 g/cm^2
	136.6 g/cm^2		136 g/cm^2	420 g/cm^2
depth	165.1 g/cm^2		165 g/cm^2	885 g/cm^2
	218.9 g/cm^2		219 g/cm^2	
	312.2 g/cm^2		308 g/cm^2	
	467.2 g/cm^2		462 g/cm^2	
	687.8 g/cm^2		704 g/cm^2	
	885 g/cm^2		885 g/cm^2	

AIRES simulation:

- The AIRES program is a Monte Carlo simulator where the majority of the processes that undergo the shower particles are taken into account.
- We will compare the results of two versions of AIRES code:
  - A1: AIRES 2-8-4a distributed publically
  - A2: Same AIRES version but including an experimental low energy hadronic model.
- The high energy collision are processed invoking the external package SIBYLL. (The influence of the high energy hadronic model is minimal).

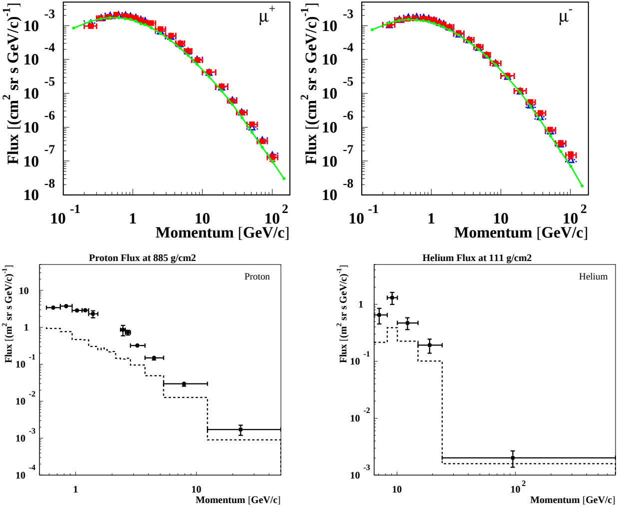
Simulating the flux:

- Input flux:
  H (protons and deuterium)-
  He (He^3 and He^4)
  (obtained by CAPRICE98);
  C, N, O, Ne, Mg, Si, and Fe.
- Geomagnetic fields:
  IGRF model
  (inside de atmosphere).

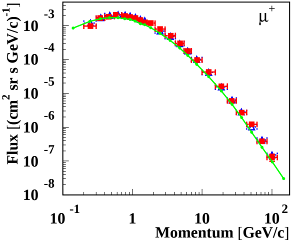


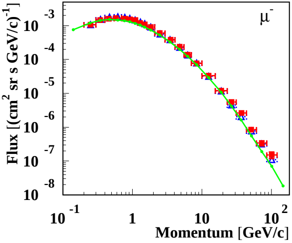
- Experimental geomagnetic transmission function (to simulate the geomagnetic cutoff).
- Only particles reaching the observing level with an inclination less than 20^o where considered.
- The selected particles are binning using the moment intervals of the experimental data.

Comparison Aires version A1 and CAPRICE98 data:

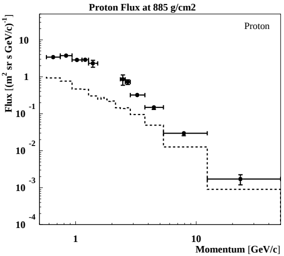


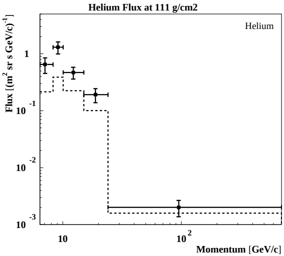
Comparison Aires version A1 and CAPRICE98 data:





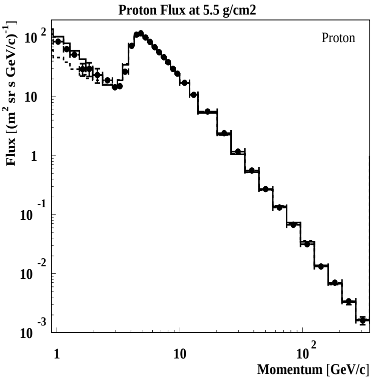
Fit the data!!!

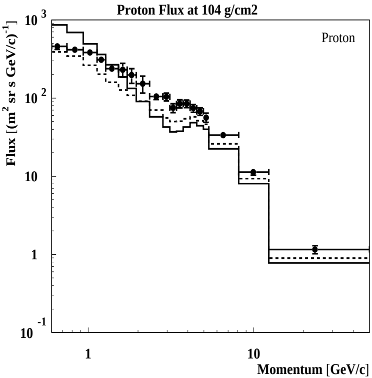




Do not fit the data!!!

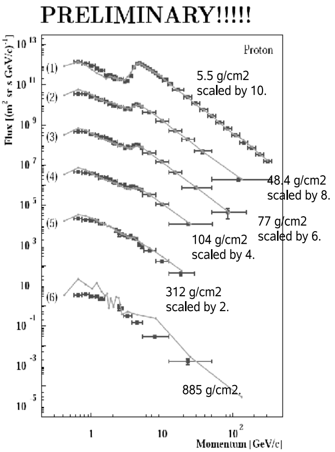
Comparison Aires version A1-A2 and CAPRICE98 data:

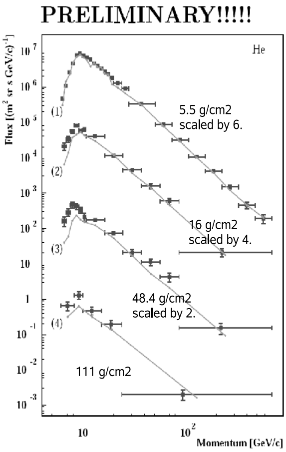




Version A1: dashed line
Version A2: solid line

Hadronic model URQMD fits proton and helium data:





Conclusion:

- Measure the fluxes of particles at different altitudes in the atmosphere provide an important way of checking the low energy hadronic models.
- We show that the low energy hadronic model EHSA is not reproducing apropiate the experimental results.
- This discrepancy between simulation and data can affect the estimation of the energy in the UHECR surface detectors.