ISCRA 2019

Round table

“Nuclear-physical and cosmophysical approaches to CR investigations”

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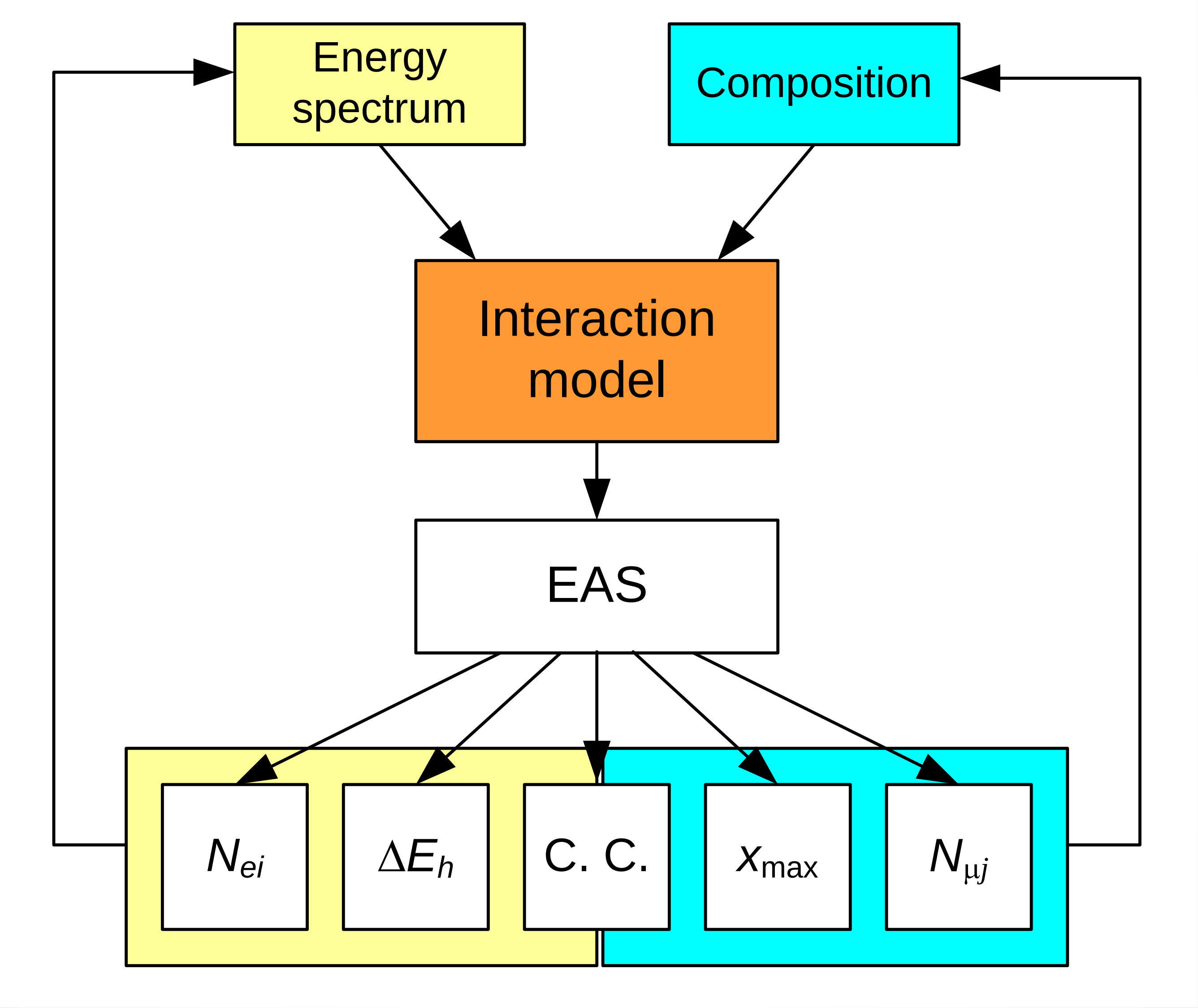
1. Nuclear-Physical Approach

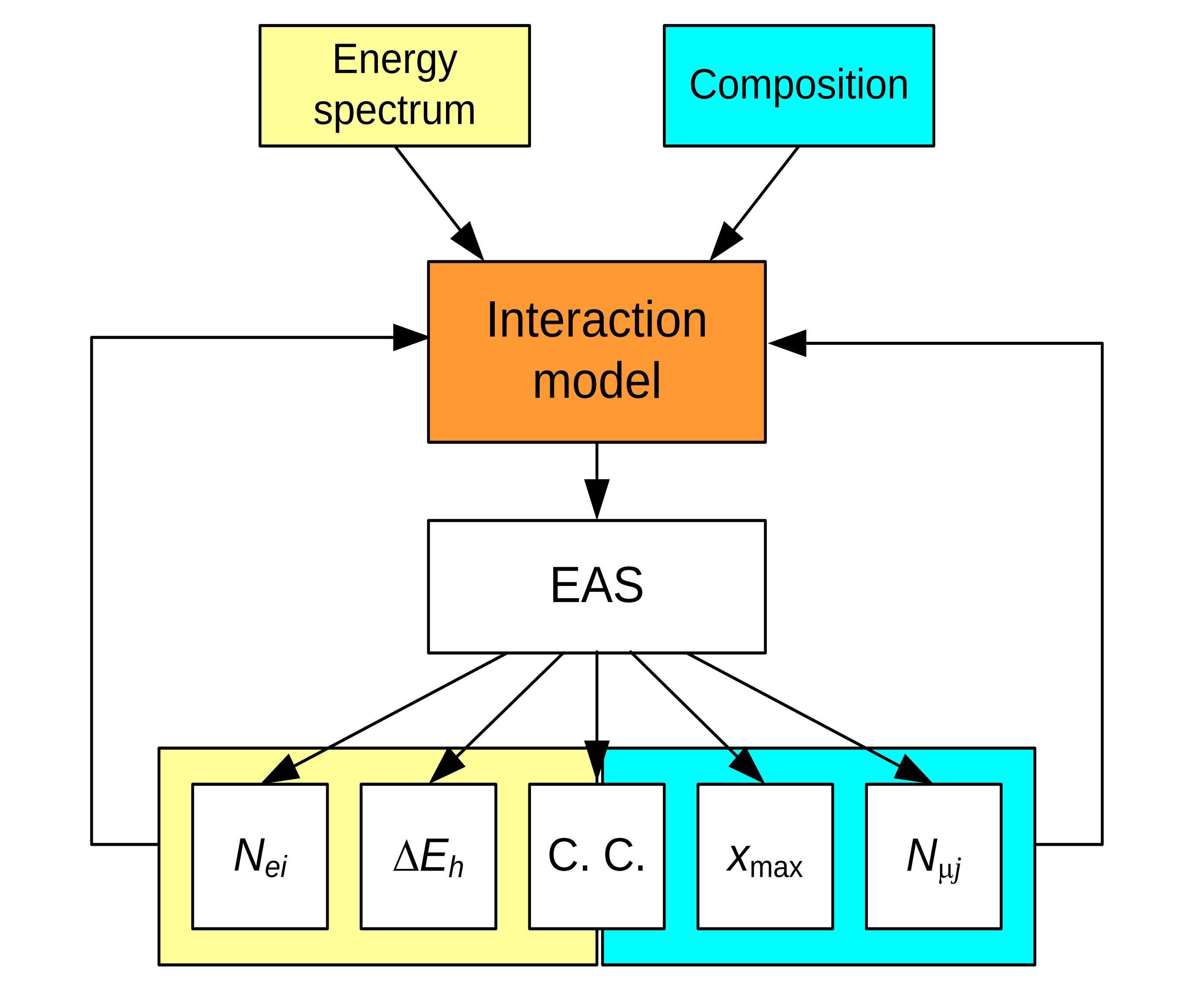
EAS study – the only possibility to get information about energy spectrum and composition of primary cosmic rays and their interactions at energies higher~ 10^{15} eV.

Approach	Energy spectrum and composition	Interaction model
Cosmo-physical	Unknown	Known
Nuclear-physical	Known	Unknown

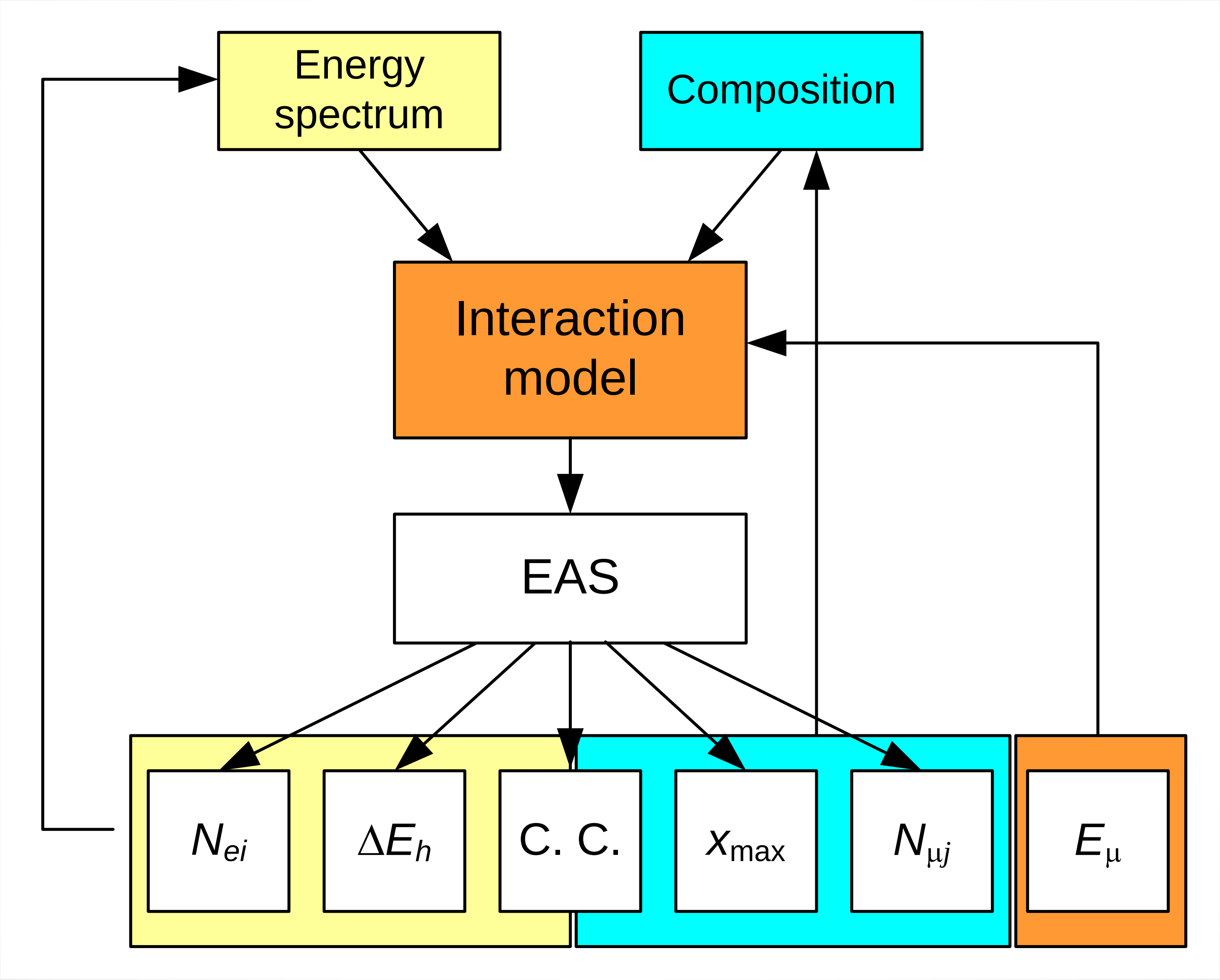
Cosmo-physical approach



Nuclear-physical approach

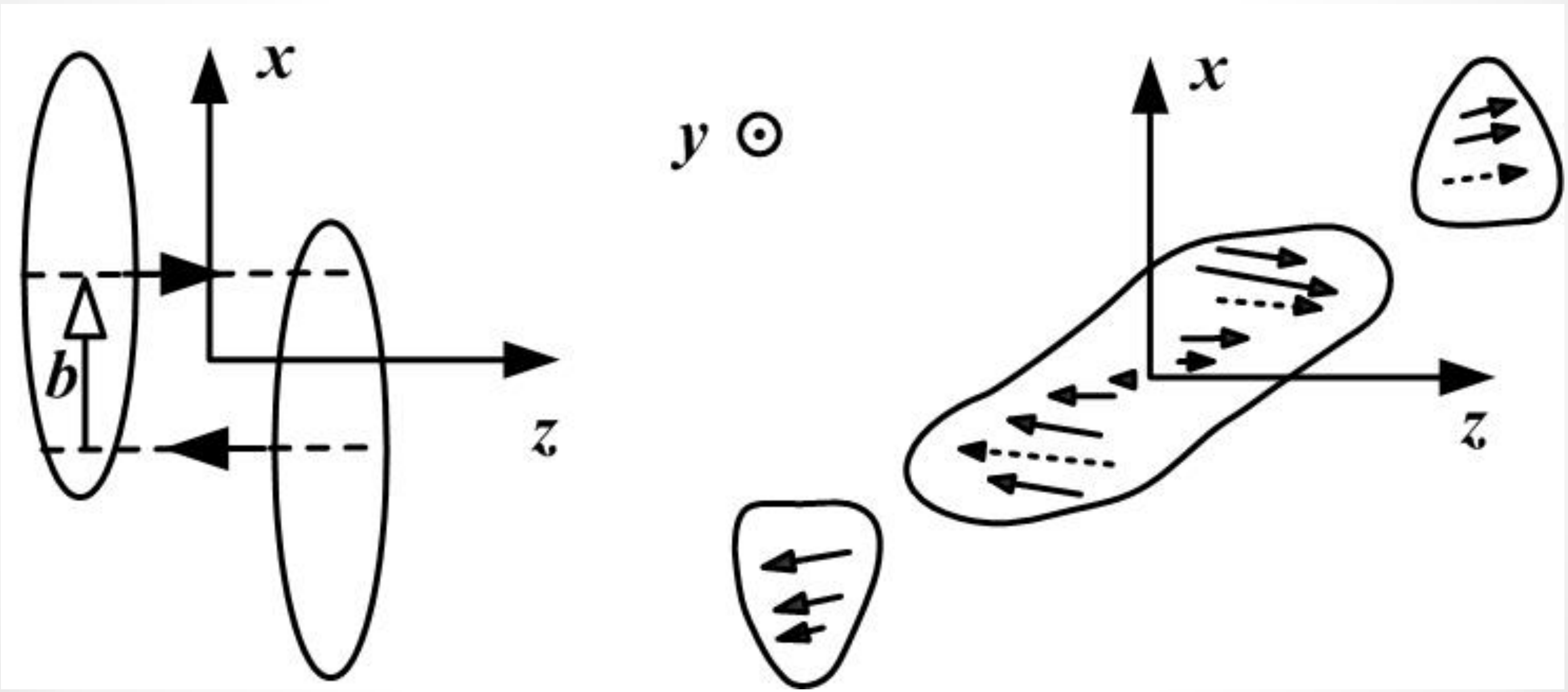


New approach to EAS analysis



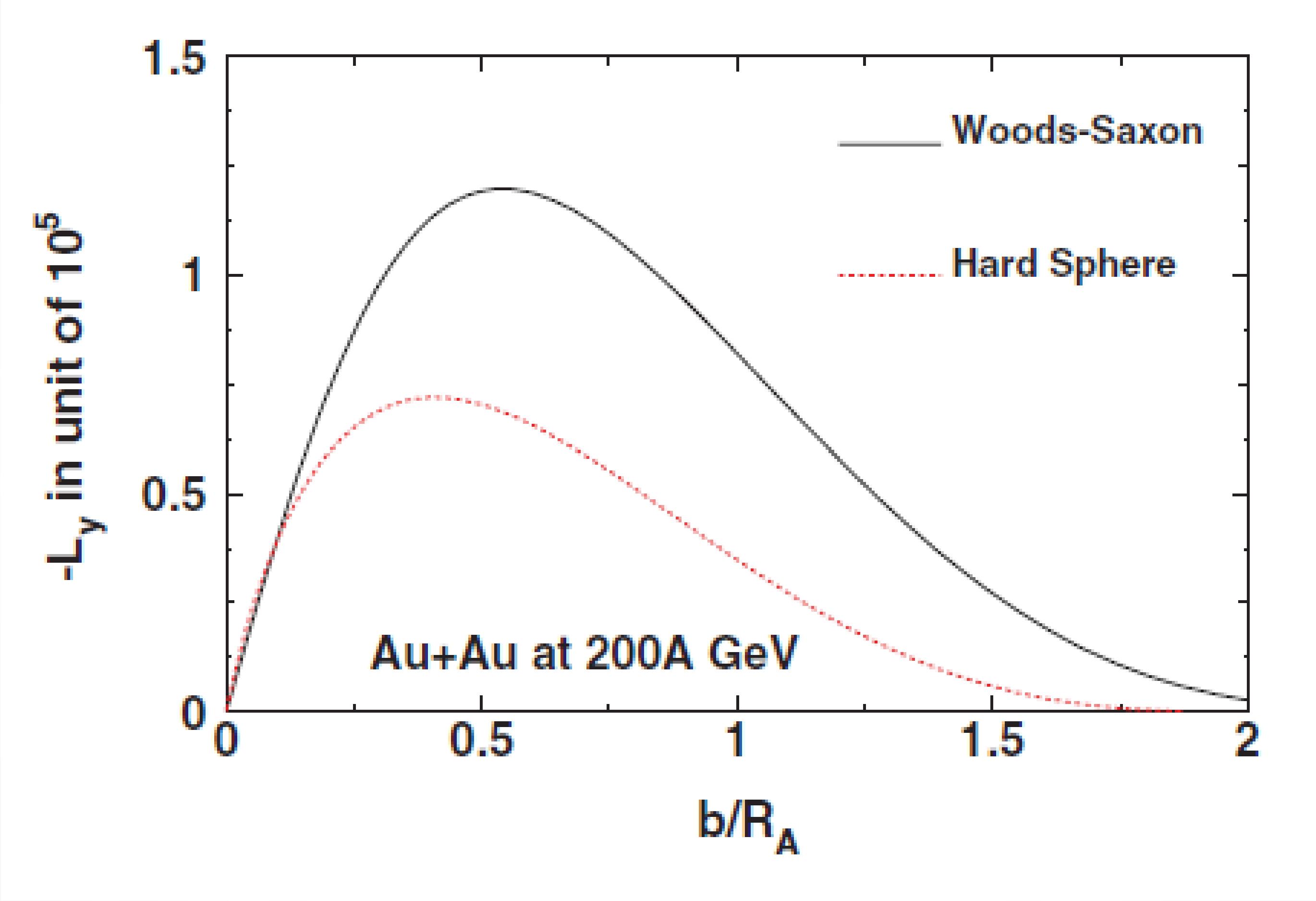
2. QGM blob with large orbital momentum

Zuo-Tang Liang and Xin-Nian Wang // PRL 94, 102301 (2005); 96, 039901 (2006)



The value of orbital angular momentum

Jian-Hua Gao et al., Phys. Rev. C 77 (2008) 044902



Total orbital angular momentum of the overlapping system in Au+Au collisions at the RHIC energy as a function of the impact parameter b.

Centrifugal barrier

A blob of a globally polarized QGM with large orbital angular momentum can be considered as a usual resonance with a large centrifugal barrier

$$V(L) = L^2 / 2mr^2$$

which will be large for light quarks but much less for top-quarks.

Though in interacting nuclei top-quarks are absent, the suppression of decays into light quarks gives time for the appearence of heavy quarks.

Produced $t\bar{t}$-quarks will decay $t(\bar{t}) \to W^+ (W^-) + b(\bar{b})$

In their turn *W*-bosons decay into leptons (~30%) and hadrons (~70%) and we can get muons and neutrinos with very high energies.

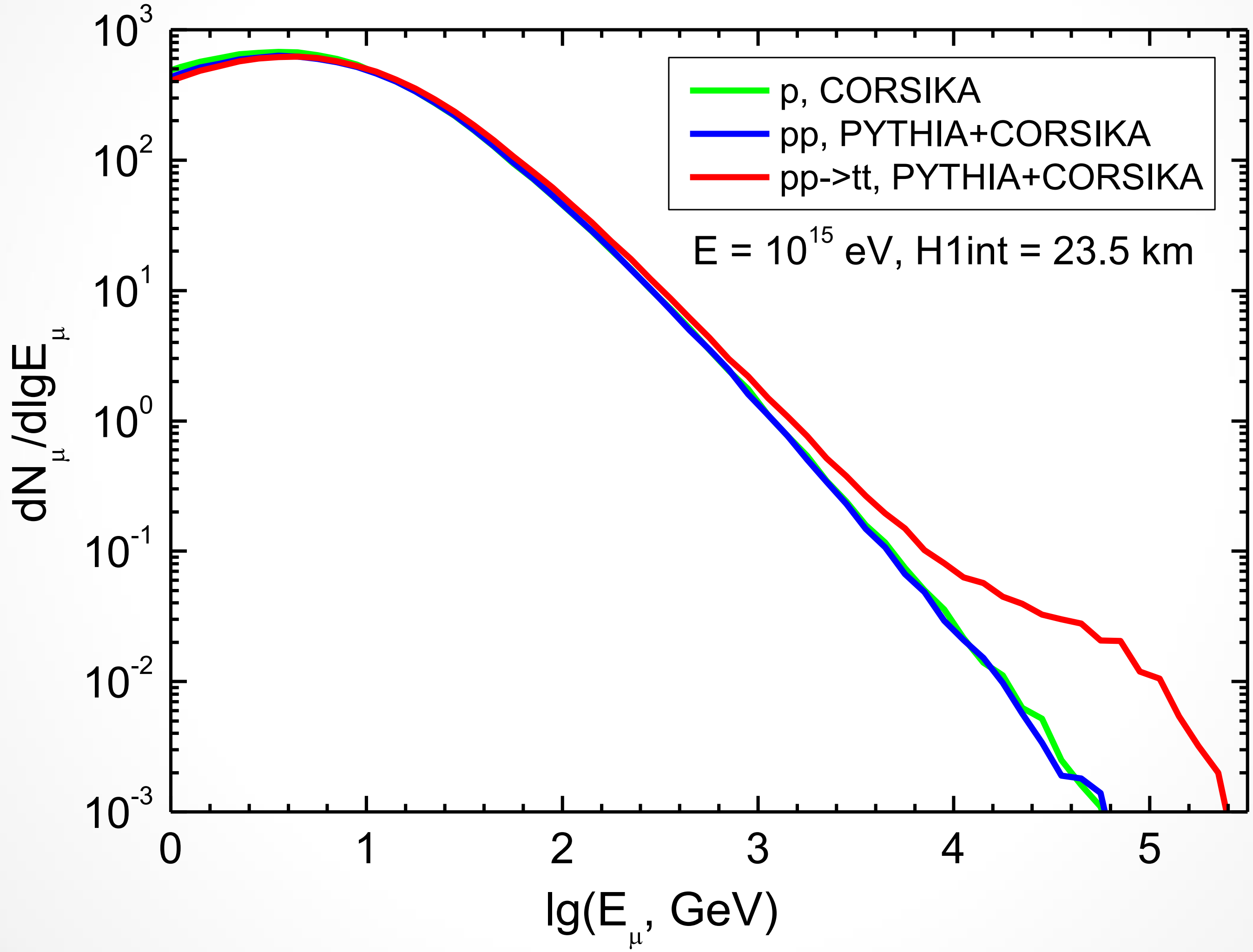
3. Ways of muon puzzle solution

There are two possibilities to check new interaction model:

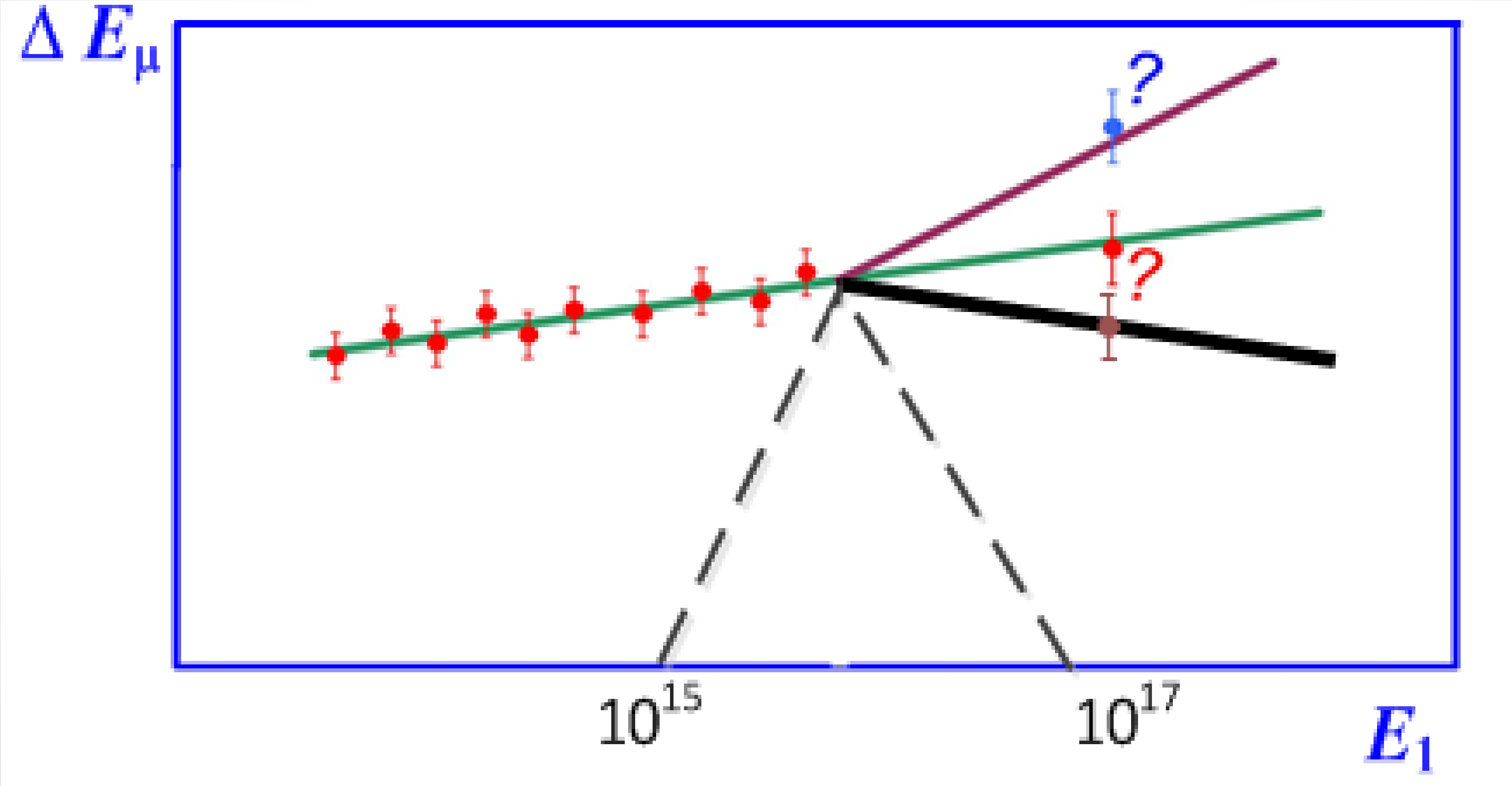
detailed measurements of inclusive muon energy spectrum near and above 100 TeV (for that, IceCube and other large detectors can be used);

measurements of the energy deposit of muon bundles and changes of its behavior with increasing PCR energy.

Predicted muon energy spectrum from W-boson decays



Expected results of muon energy deposit measurements



Thank you for your attention!