

Towards a Universality-based, mass-dependent anisotropy study

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Overview

Topic: the composition-dependent analysis on AD

- How: use Universality-reconstructed X max and R μ to obtain In A
- Method outline:
- 1. Universality data production on the MC library
- 2. Create a dataset that resembles measured data (match spectrum and composition)
- 3.Add AD information to mock data (**how?**) using AD from measured data **OR** from parameterized dipole
- 4. Perform In A-based selection of ~10-20% of lightest events **OR** bellow a threshold In A **OR** rigidity



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Mock data-set to evaluate method

Mock data-set should:

- Be of a mixed composition
- Follow E spectrum





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Mock data-set to evaluate method: Extended Auger mix



— Fitted ICRC 2017 and extended in energy

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Mock data-set to evaluate method: **Energy spectrum**



$$J(E) = J_0 \left(\frac{E}{10^{16} \text{ eV}}\right)^{-\gamma_0} \prod_{i=0}^{4} \left[1 + \left(\frac{E}{E_{ij}}\right)^{\frac{1}{\omega_{ij}}}\right]^{(\gamma_i - \gamma_j)\omega_{ij}}, \qquad j = i+1,$$

(ICRC 2021)

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Spectrum fit + extended Auger mix (10⁶ events)

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Mock data-set to evaluate method: p-He separation based on In A



In A reconstruction from library of MC events (~ 1:1:1:1 compo.)

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Spectrum + extended Auger mix

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Mock data-set to evaluate method: p-He separation based on ln A



In A reconstruction from library of MC events (~ 1:1:1:1 compo.)

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Mock data-set should:

- Be of a mixed composition
- Follow E spectrum
- Have a sample size similar to measured data
 - lg E in [18.9, 20.1]
 - θ in [0°, 50°]

~ 27300 events (up to 2020)

Summary & next steps

A pipeline is established to create a Universality-reconstructed mixed composition dataset. This can be used to estimate the potential for mass-enhanced

anisotropy studies.





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Summary & next steps

A pipeline is established to create a Universality-reconstructed mixed composition dataset.

This can be used to estimate the potential for mass-enhanced anisotropy studies.

Upcoming:





• Further tests on mock data-set; • Follow-up on Universality updates and monitor impact on In A reconstruction; • Prepare for analysis of measurements;

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Coming next

Upcoming: Stay in Bariloche Oct 26th - Mar 25th • Collaboration with Silvia Mollerach and Esteban Roulet

FIG. 4 (color online). Mean total dipole amplitude as a function of the energy for different injected nuclei and a density of sources $\rho = 10^{-5} \text{ Mpc}^{-3}$ (red solid lines) and $\rho = 10^{-4} \text{ Mpc}^{-3}$ (black dashed lines).

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0.1

0.01





PHYSICAL REVIEW D 92, 063014 (2015)

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Coming next

Stay in Bariloche Oct 26th - Mar 25th

 Collaboration with Silvia Mollerach and Esteban Roulet Upcoming:



• Dipole amplitude increases with mass? • Separate data in light and heavy components and reconstruct dipole info.;

• Keep in mind sample sizes should be similar;

• Select percentile of events? Select threshold value on In A?

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Coming next

label	InA_cut	N_light	N_heavy	p (%)	He (%)	O (%)	Fe (%)	p
А	-1.000000	5266	22032	23.623243	68.894797	7.406001	0.075959	6.7
В	-0.800000	5905	21393	22.235394	69.195597	8.501270	0.067739	6.6
С	-0.600000	6525	20773	21.195402	69.118774	9.609195	0.076628	6.4
D	-0.400000	7509	19789	19.416700	70.249034	10.227727	0.106539	6.4
Е	-0.200000	8281	19017	18.560560	70.136457	11.145997	0.156986	6.2
F	0.000000	9081	18217	17.740337	69.452703	12.652792	0.154168	6.1
G	0.200000	9903	17395	16.914066	69.271938	13.642331	0.171665	6.0
Н	0.400000	10804	16494	16.253240	68.780081	14.790818	0.175861	5.8
I	0.600000	11840	15458	15.726351	68.133446	15.920608	0.219595	5.6
J	0.800000	12737	14561	15.034938	67.802465	16.895658	0.266939	5.9
К	1.000000	13688	13610	14.428697	67.131794	18.139977	0.299532	5.

light population

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heavy population

Obrigada! Thank you for your attention

Suggestions & questions

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The 'above 8 EeV' bin



from library of MC events (~ 1:1:1:1 compo.)

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lightest 10% of Spectrum + extended Auger mix

Additional information The 'above 8 EeV' bin



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Universality sanity checks



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Issue resolved by Max Stadelmaier

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