Study of the Solar Magnetic Field influence on the cosmic ray Sun shadow

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Outline

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- 2. Sun Shadow Modeling and the Solar-terrestrial Magnetic Field affection
- 3. Influences of Different CMF's Models on the Sun Shadow
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1. Introduction



Interplanetary Magnetic Field: ARGO-YBJ probes the IMF using Sun shadow at 5 TeV.



ApJ, 729:113 (2011)

The structure of the IMF estimated using Sun shadow is consistent with the satellite measurement.

Coronal Magnetic Field: Tibet ASy evaluates two models using Sun shadow at 10 TeV.



The CSSS model is more consistent with the Sun shadow measurement.

Energy dependent: ARGO-YBJ's Result



ARGO-YBJ have detected Yearly rigidity dependence of Sun shadow.

LHAASO's expectation of 2-day Sun shadow observations



Wu, et al. Astroparticle Physics 103 (2018) 41-48

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2. SUN SHADOW MODELING AND THE SOLAR-TERRESTRIAL MAGNETIC FIELD AFFECTION

Simulation of the Sun Shadow

• Back forward method

tracing the anti-particle from earth to Sun.

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- Component: proton
- Energy range: TeV PeV
- Number of events: $\sim 10^7$

The Solar-terrestrial Magnetic Field



Influence of Large-scale CMF on the Sun Shadow



Influence of Large-scale CMF on the Sun Shadow





Influence of IMF on the Sun Shadow

Seasonal dependence





we expect the seasonal dependence of the extension of the Sun shadow.

3. INFLUENCES OF DIFFERENT CMF'S MODELS ON THE SUN SHADOW

Influences of Different CMF's Models on the Sun Shadow

Solar minimum



E< 10TeV,

the CSSS and low height of Rss of the PFSS increase the extension! the deficit ratios of different models are the same! Different results from ASγ.

At 10TeV,

Influences of Different CMF's Models on the Sun Shadow

Solar maximum



To explore more about the CMF, we need the experimental data and more simulation!

4. Summary

- The CMF and the IMF affect the deficit and the extension of the Sun shadow, respectively.
- From our simulation, we expect the seasonal dependence of the extension of the Sun shadow.
- Also, current models and parameters give a different expectations on Sun shadow. Both of them need data to confirm.

THANK YOU!