Precision Measurement of low energy positron fluxes by AMS

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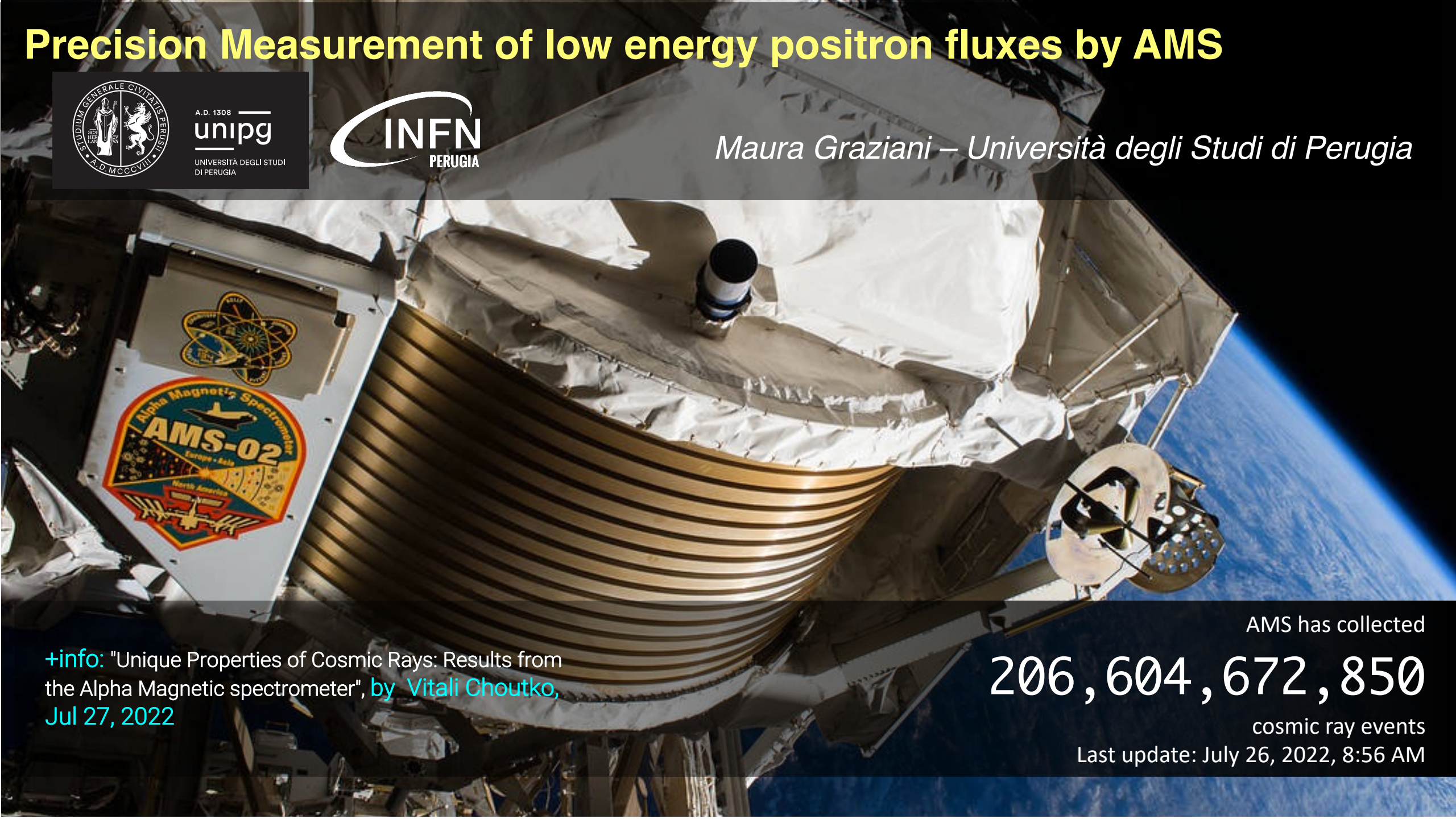


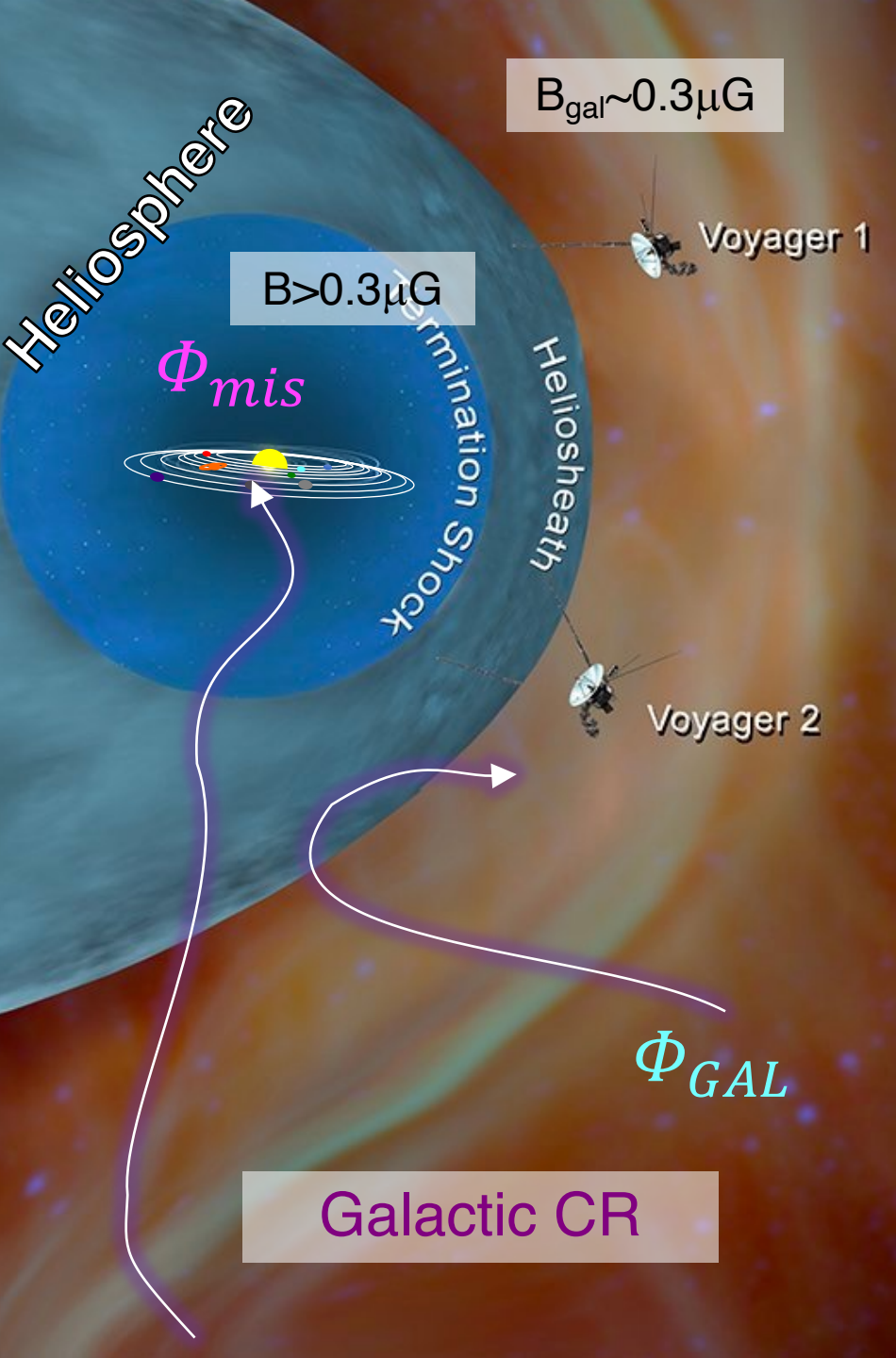
+info: "Unique Properties of Cosmic Rays: Results from the Alpha Magnetic spectrometer", by Vitali Choutko, Jul 27, 2022

AMS has collected

206,604,672,850

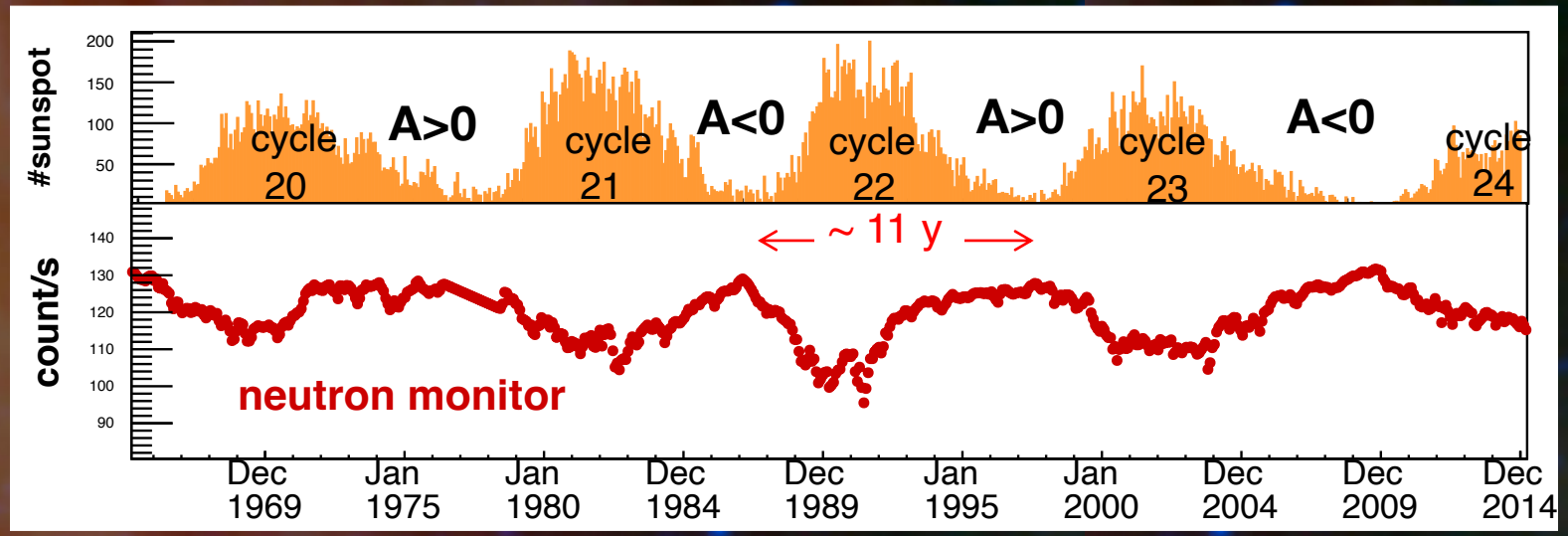
cosmic ray events

Last update: July 26, 2022, 8:56 AM



Low energies (E<30 GeV)

→ Solar Modulation of Cosmic Rays (CR)



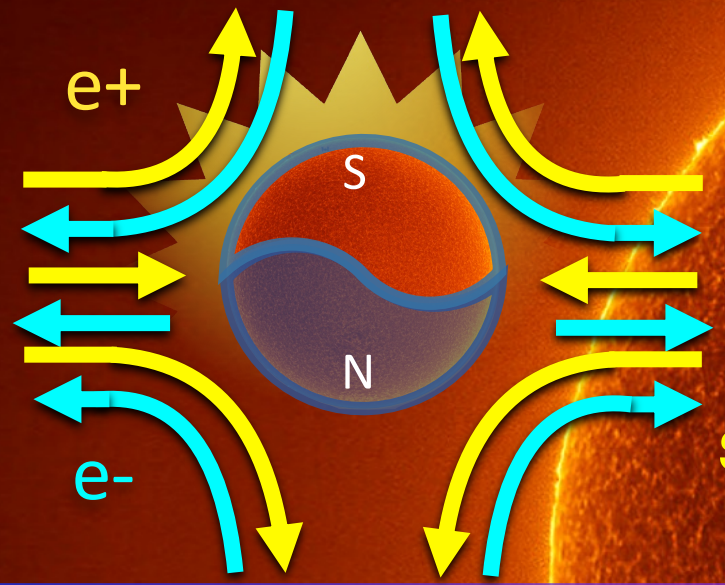
- Large time scale effect (~11 years);
- Small time scale effects (~days);
- Depends on CR mass, charge and energy;

Knowing the solar modulation of CR:

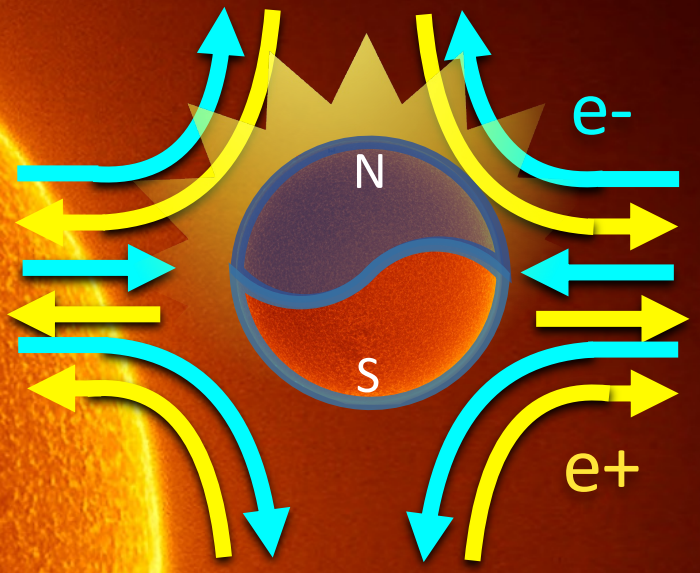
→ correct undesrtanding of galactic CR

→ Space weather

Why electrons and positrons?



DIFFUSION motion +
MAGNETIC drift



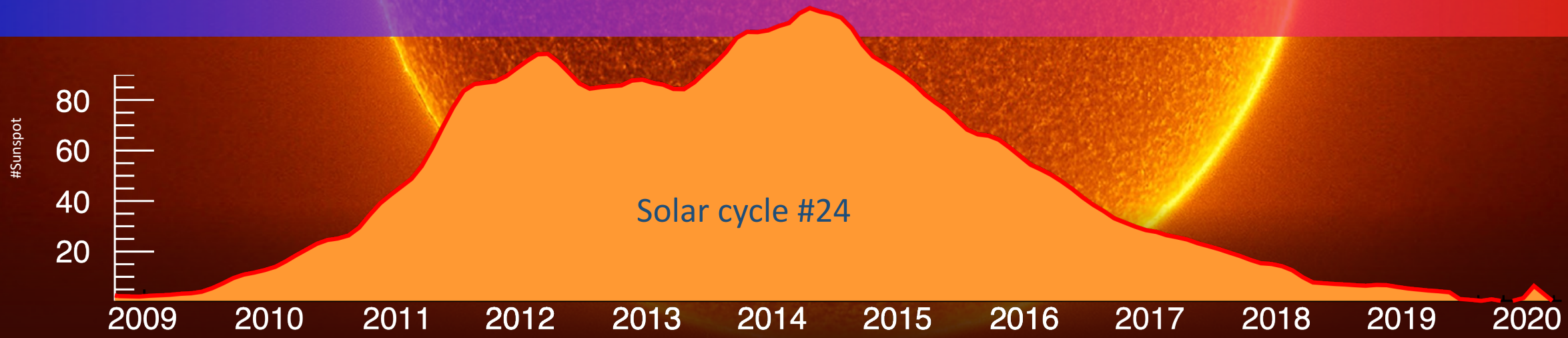
Studing of the charge-sign dependent effects

A<0

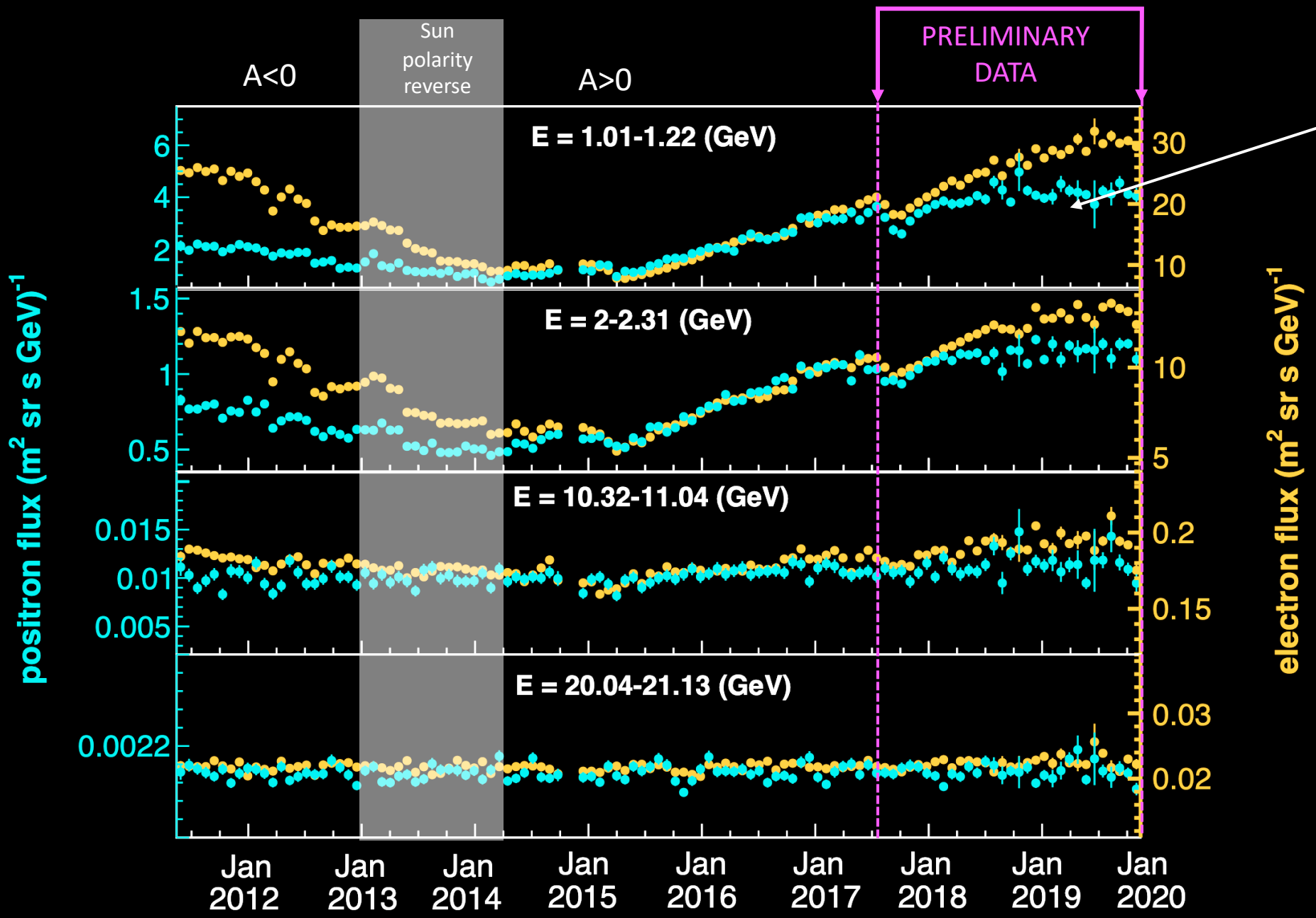
A??

Polarity reverse

A>0



Electron and Positron fluxes in time

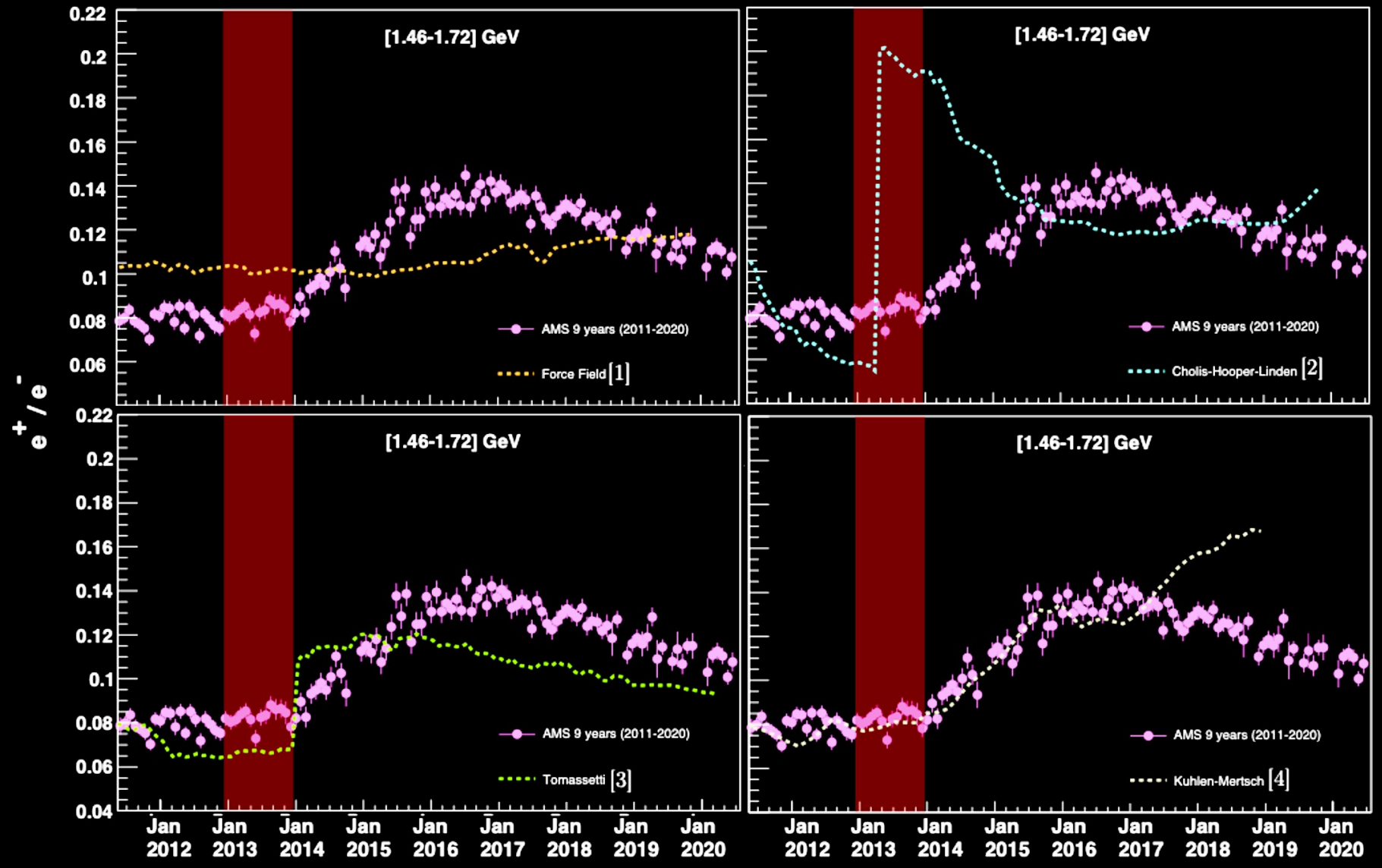


Δt = 27 days

Both fluxes exhibit profound short - and long - term variations.

The short-term variations occur simultaneously in both fluxes with approximately the same relative amplitude.

Charge sign-dependent effects



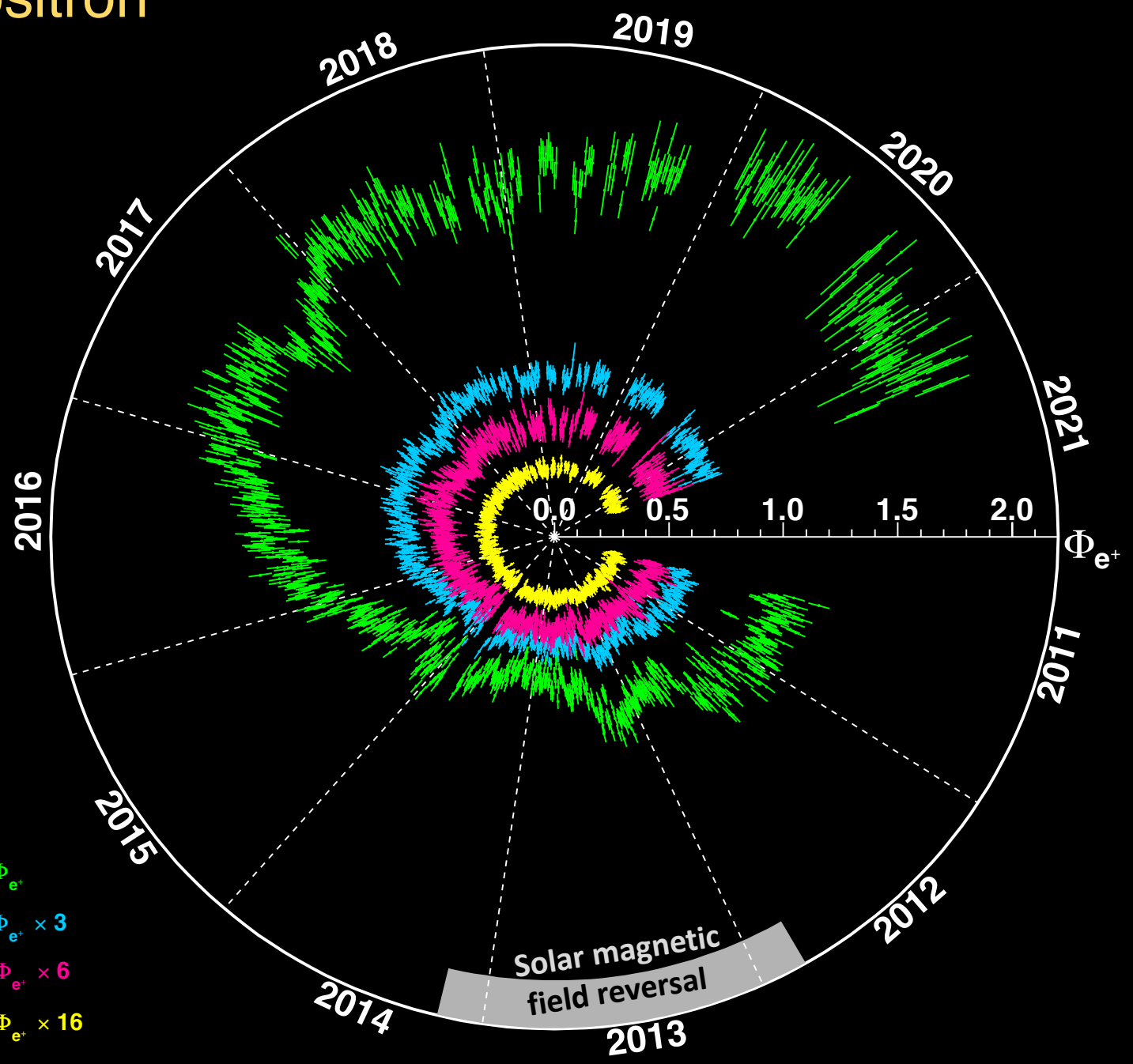
Δt = 27 days

All four models fail to reproduce the long term dependence of AMS positron ratio.

AMS-02 data provide novel information on the e^+ and e^- flux time dependences.

[1]: analytical model by Gleeson & Axford 1968. Modulation potential Φ from NM; e+/e- LIS from Bisschoff et al. Apj 2019
[2]: FF with charge sign dependent effect. e+/e- LIS from Bisschoff et al. Apj 2019. Solar Parameters constrained with AMS-02 p and antip
[3]: Solar Prop based 2D model from Tomassetti PRD 2015. e+/e- LIS from Bisschoff etal. Apj 2019. Solar Parameters constrained with p data
[4]: Semianalitical charge sign dependent 2D model from Kuhlen & Mertsh PRL 2019. Model constrained with AMS-02 data on e+/e- between 2011 and 2017

Daily Positron



[1.00–2.97] GV Φ_{e^+}

[2.97–4.88] GV Φ_{e^+} × 3

[4.88–5.90] GV Φ_{e^+} × 6

[7.09–11.0] GV Φ_{e^+} × 16

Update…

Δt = 27 days

↓

Δt = 1 days

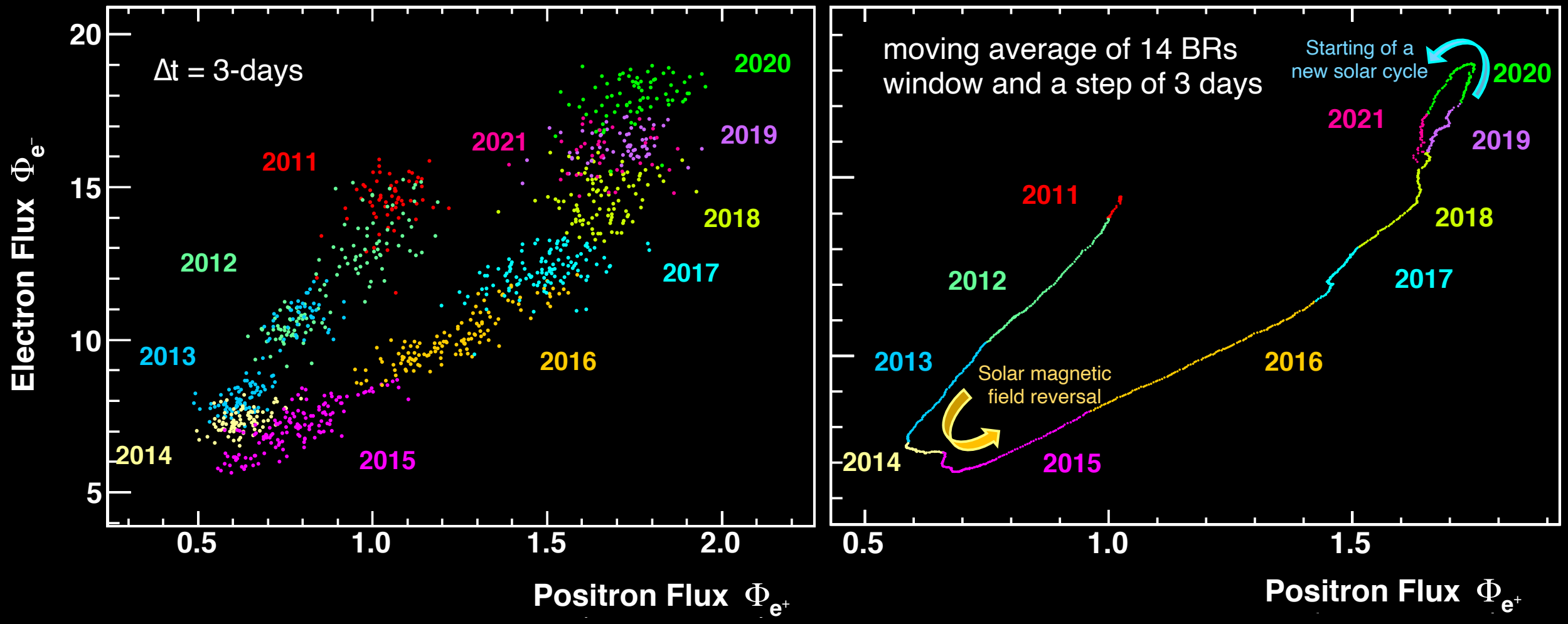
This will allow the short-time scale effects (~days)

Positrons Vs Electrons

→ Same mass, opposite charge = studying of charge-sign dependent effects

→ Hysteresis

1 - 2.97 GeV

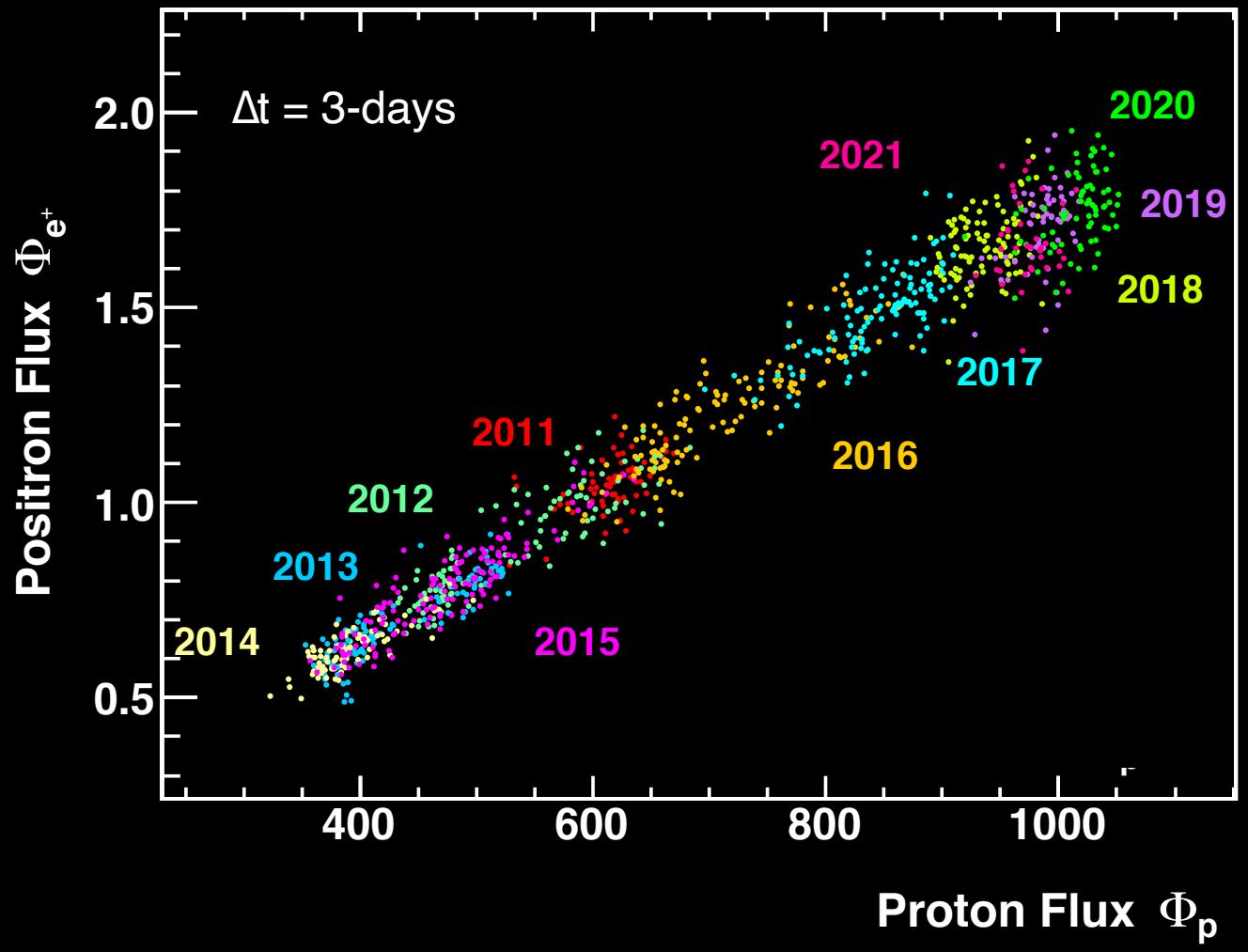


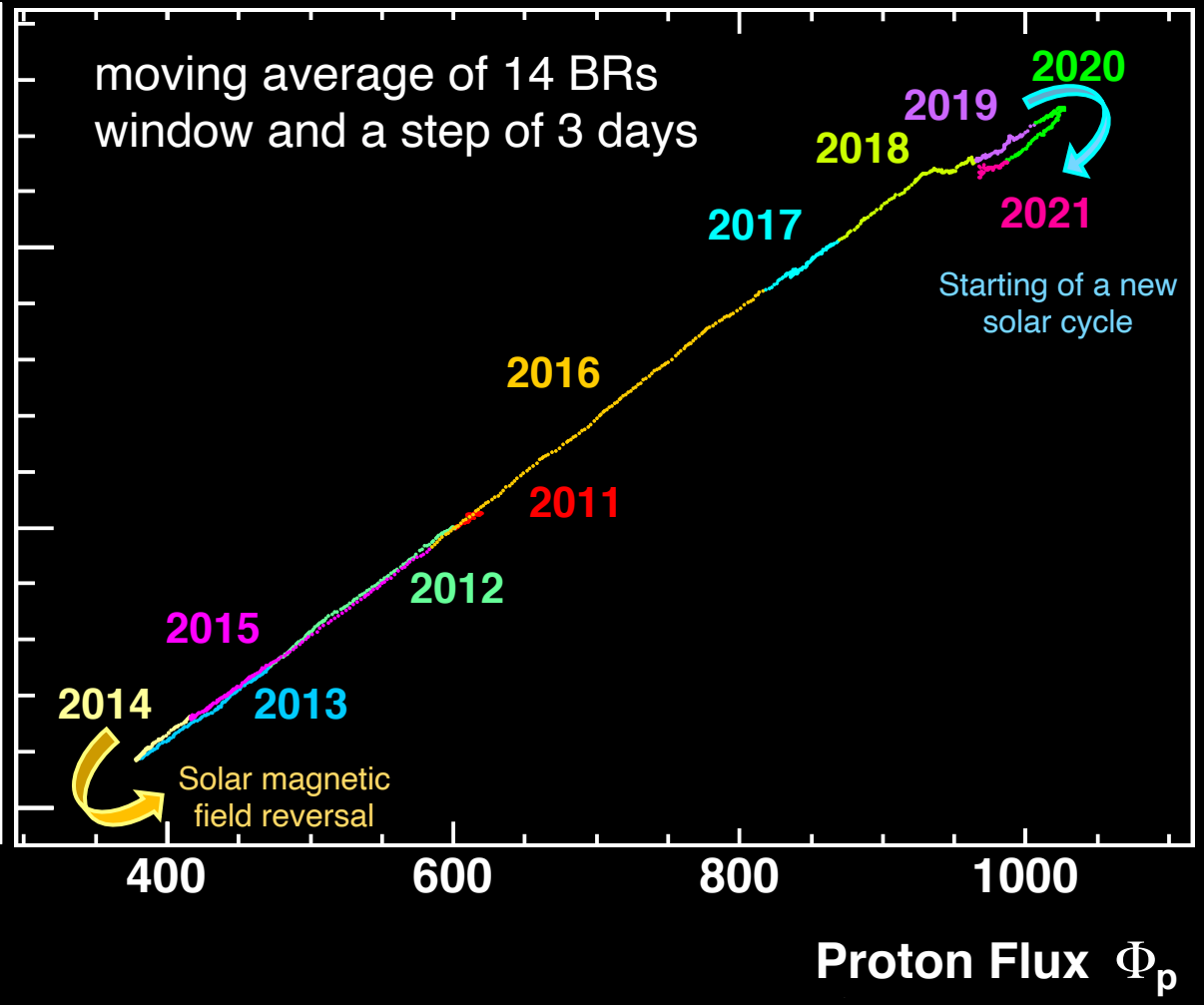
Positrons Vs Protons

→ Different mass, same charge = studying of mass dependent effects

→ ~ linear relation

1 - 2.97 GeV





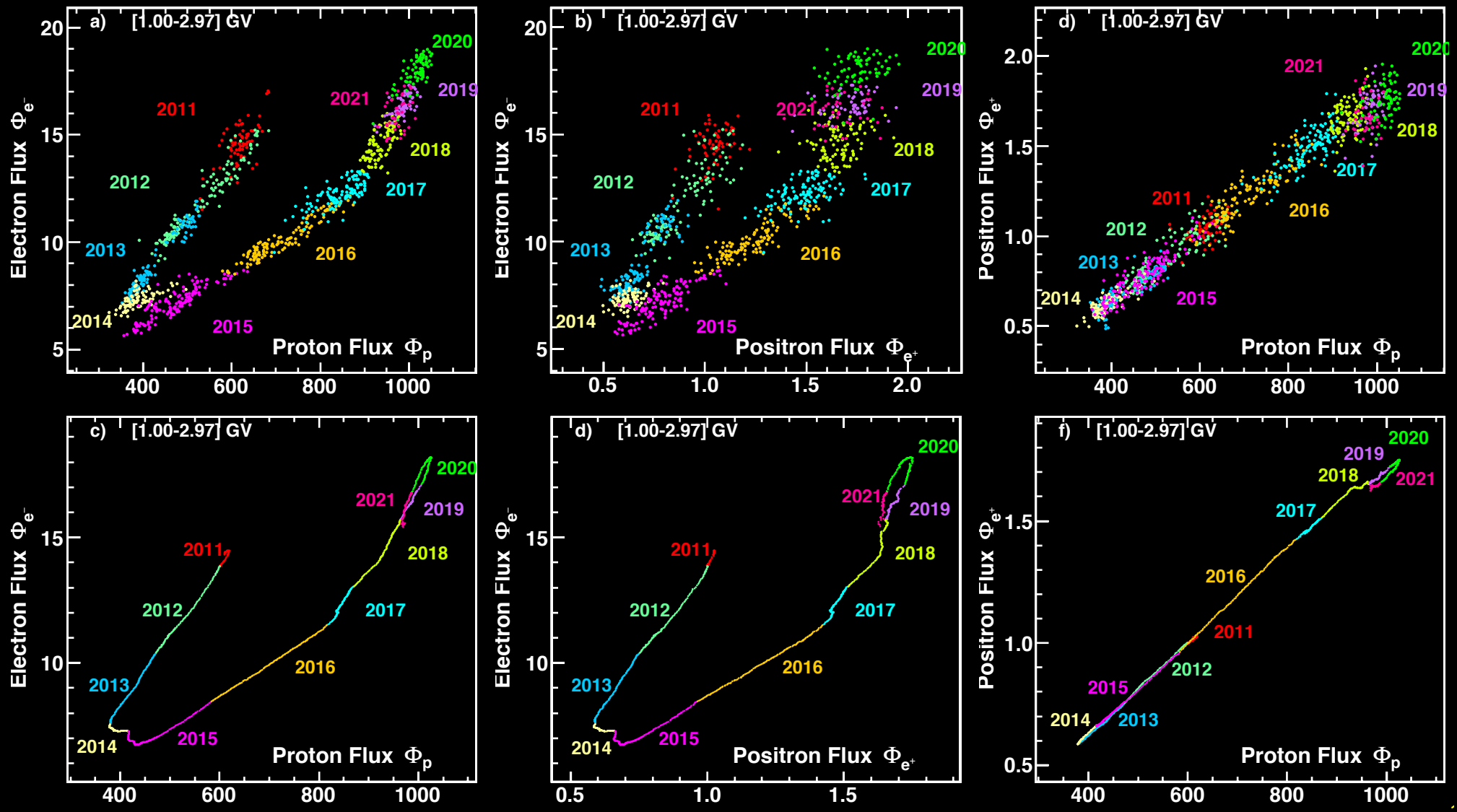
Summary

Comprehensive dataset to study propagation in the heliosphere of cosmic ray with **Z=1 …**

electron v.s. proton
Different mass, opposite charge

electron v.s. positron
Same mass, opposite charge

positron v.s. proton
Different mass, same charge



Maura Graziani
9/12

Summary

…and all the others charges

Already published…

PHYSICAL REVIEW LETTERS **121,** 051101 (2018)

Observation of Fine Time Structures in the Cosmic Proton and Helium Fluxes with the Alpha Magnetic Spectrometer on the International Space Station

p and *He*
Δt= 27 days

PHYSICAL REVIEW LETTERS **121,** 051102 (2018)

Editors' Suggestion

Observation of Complex Time Structures in the Cosmic-Ray Electron and Positron Fluxes with the Alpha Magnetic Spectrometer on the International Space Station

e^- and e^+
Δt= 27 days

PHYSICAL REVIEW LETTERS **127,** 271102 (2021)

Periodicities in the Daily Proton Fluxes from 2011 to 2019 Measured by the Alpha Magnetic Spectrometer on the International Space Station from 1 to 100 GV

p
Δt= 1 days

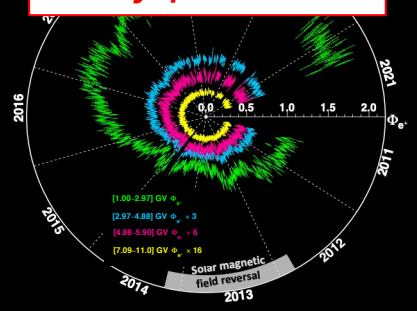
PHYSICAL REVIEW LETTERS **128,** 2311

Properties of Daily Helium Fluxes

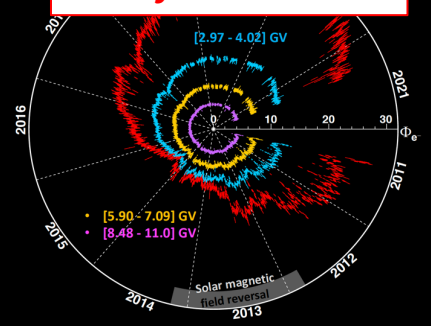
He
Δt= 1 days

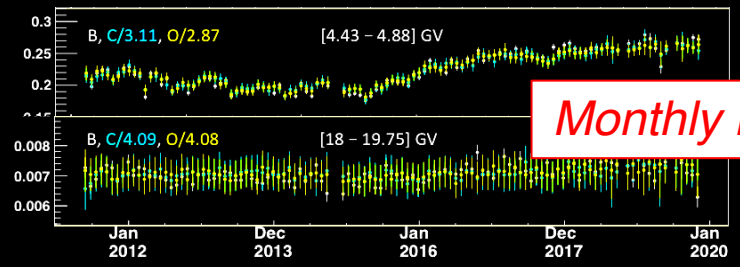
Work on going

Daily positrons



Daily electrons





Monthly B, C, O

For more details see:

Talk by Johannes Marquardt, Jul 26, 4:15 PM, "Precision Measurement of Periodicities in the Daily Proton Fluxes with the Alpha Magnetic Spectrometer"

Talk by Tong Su, Jul 26, 4:45 PM, "Precision measurement of daily electrons fluxes by AMS"

Talk by Behrouz Khiali , Jul 28, 3:00 PM, "Precision Measurement of the Monthly Proton, Helium, Carbon, and Oxygen Fluxes in Cosmic Rays with the Alpha Magnetic Spectrometer on the International Space Station"

By 2030, AMS will explore nearly two complete solar cycle…