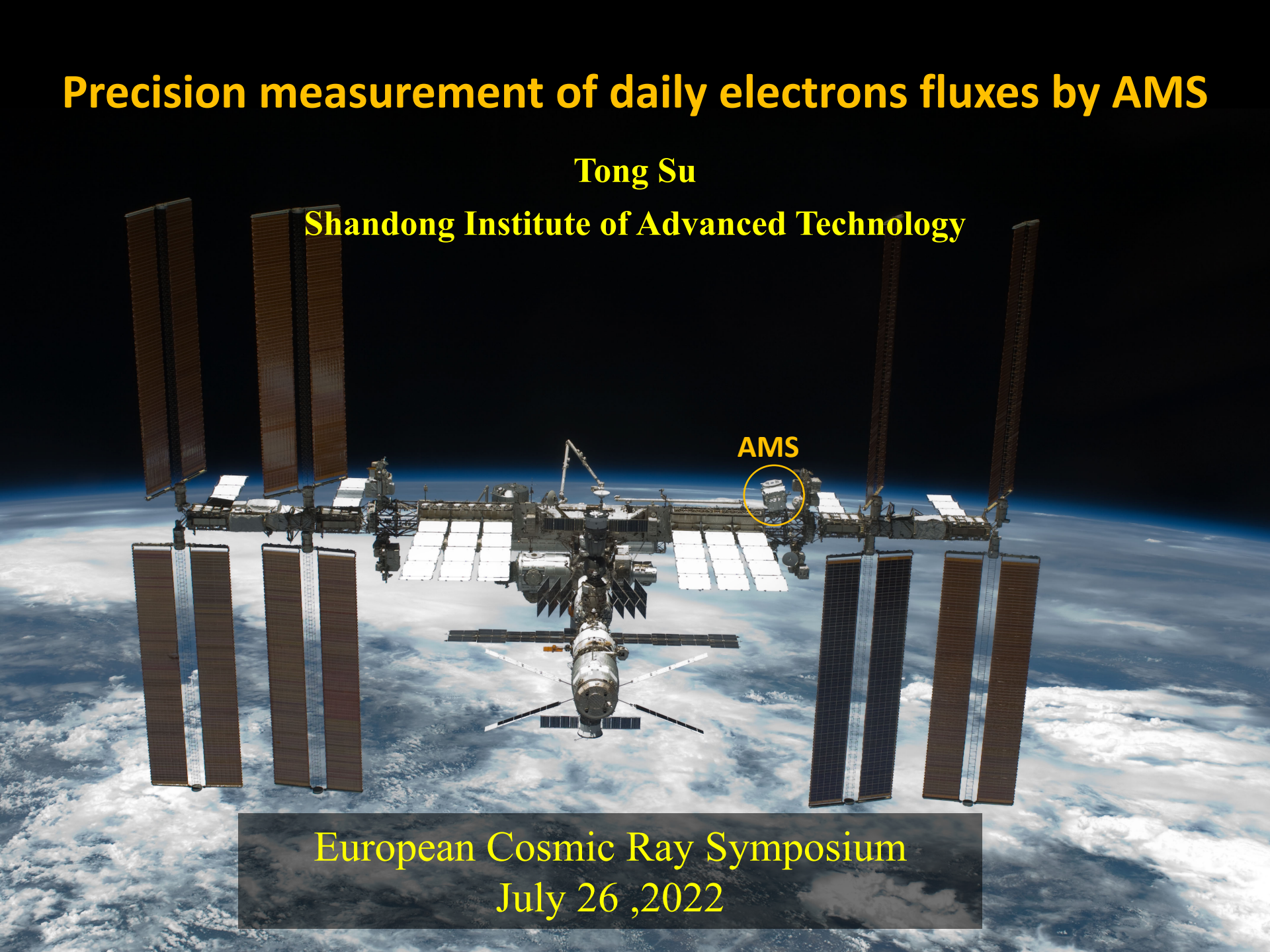
Precision measurement of daily electrons fluxes by AMS

Tong Su

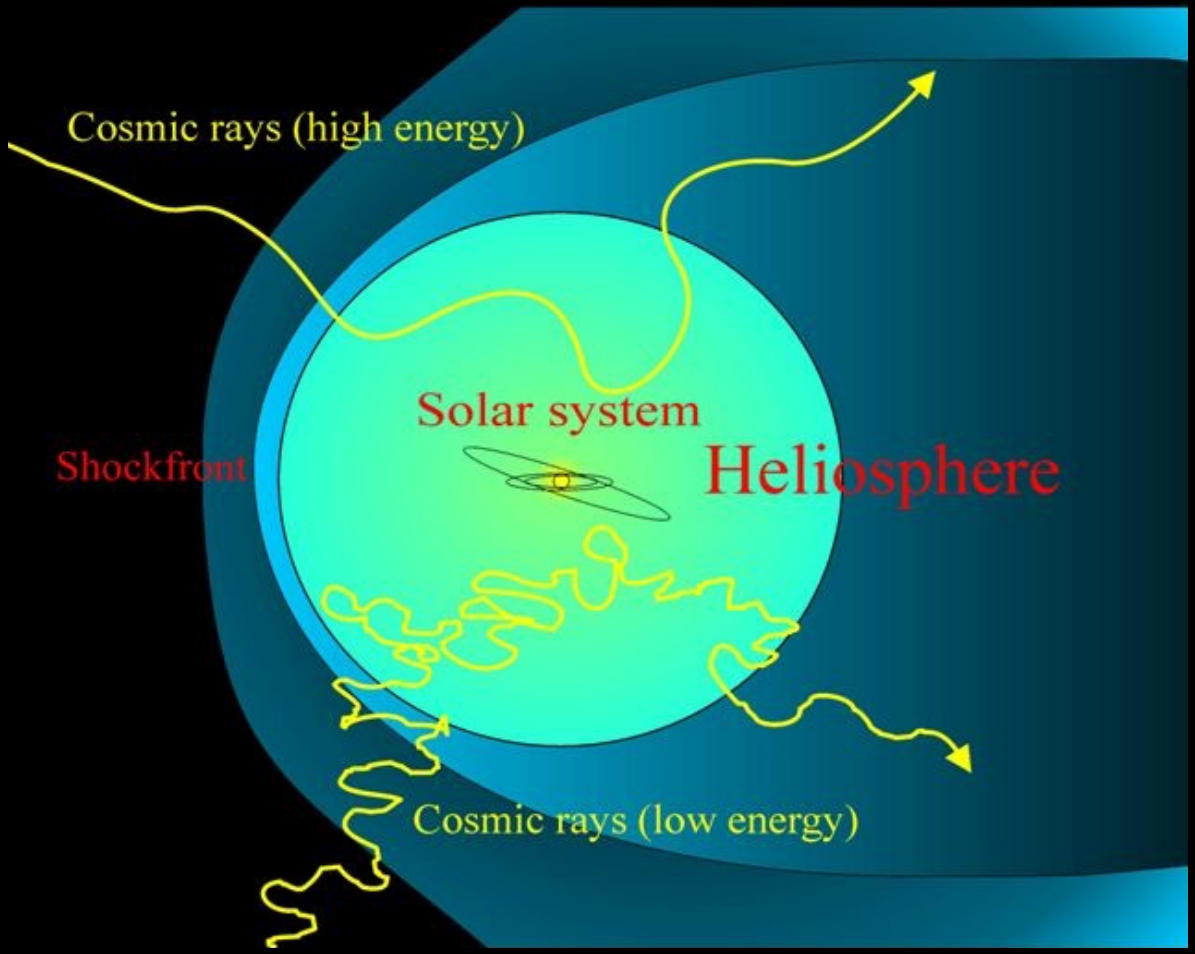
Shandong Institute of Advanced Technology



European Cosmic Ray Symposium
July 26 ,2022

Cosmic rays in the heliosphere

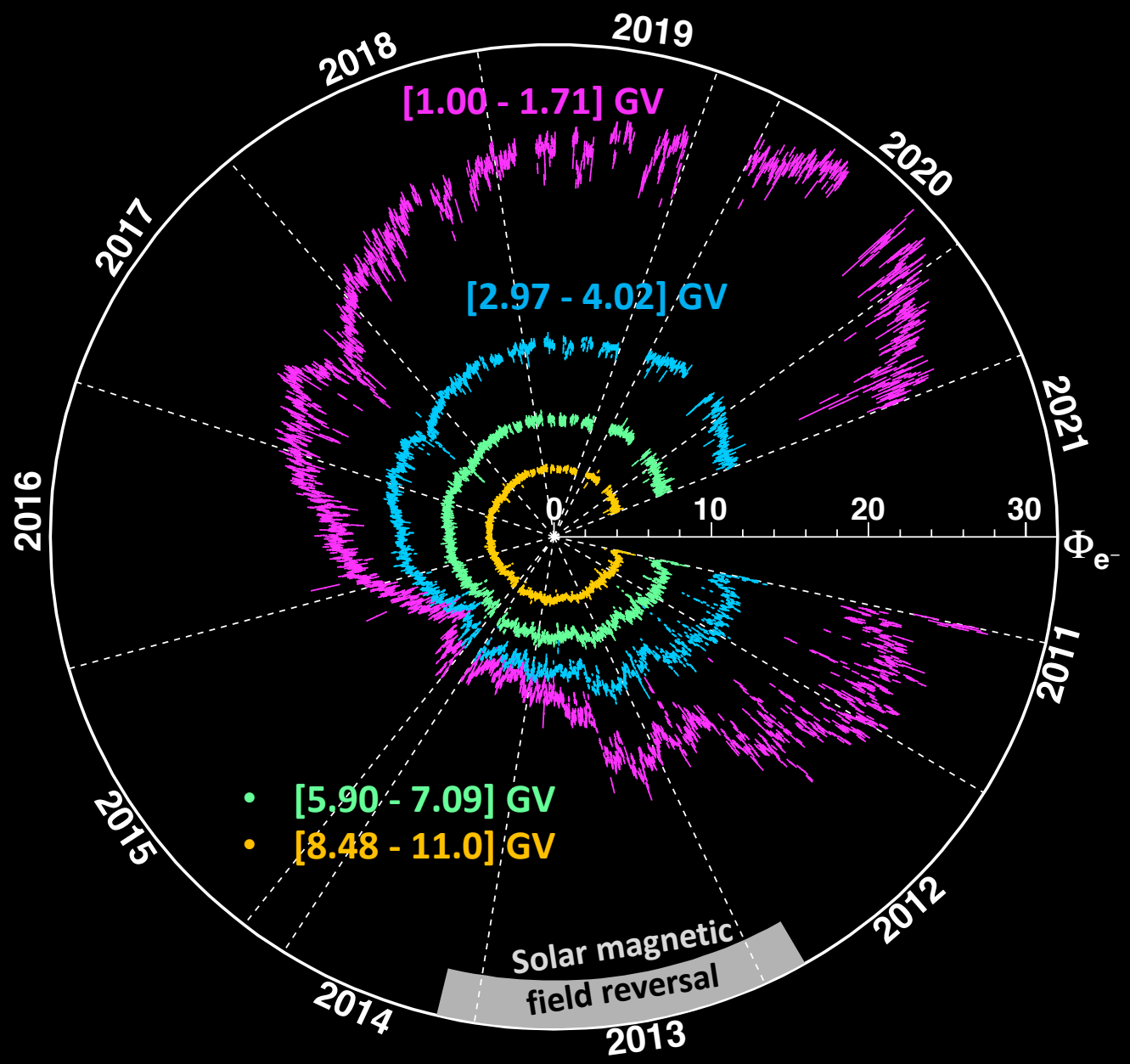
Modulation of cosmic rays in the heliosphere depends on their mass, charge, energy, and solar activities.



Electrons are the most abundunt negative cosmic rays.

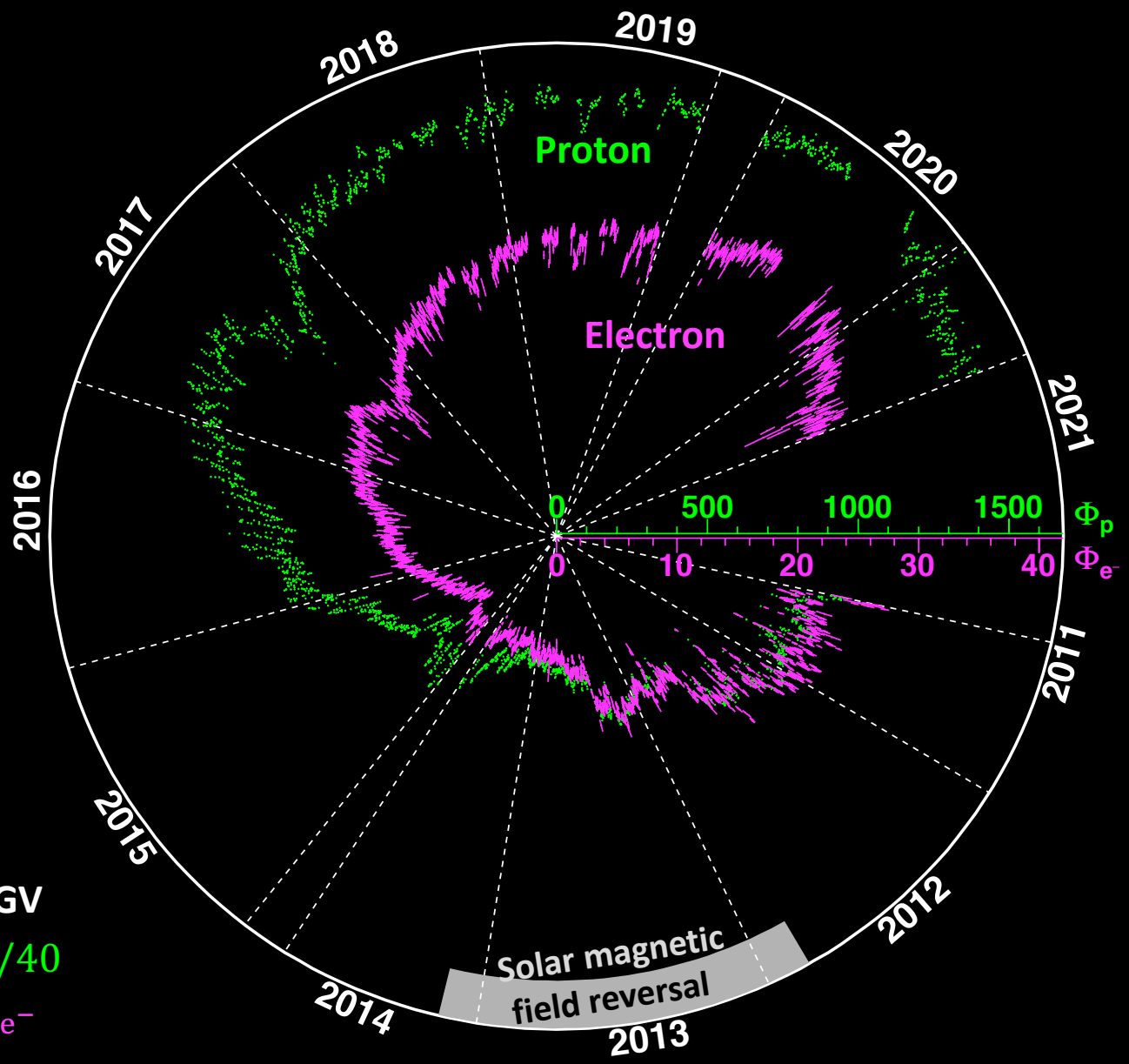
Positrons are positive cosmic rays with lightest mass.

Daily electrons over ten years



First daily electron fluxes over an extended period of time.

AMS daily electrons and protons:



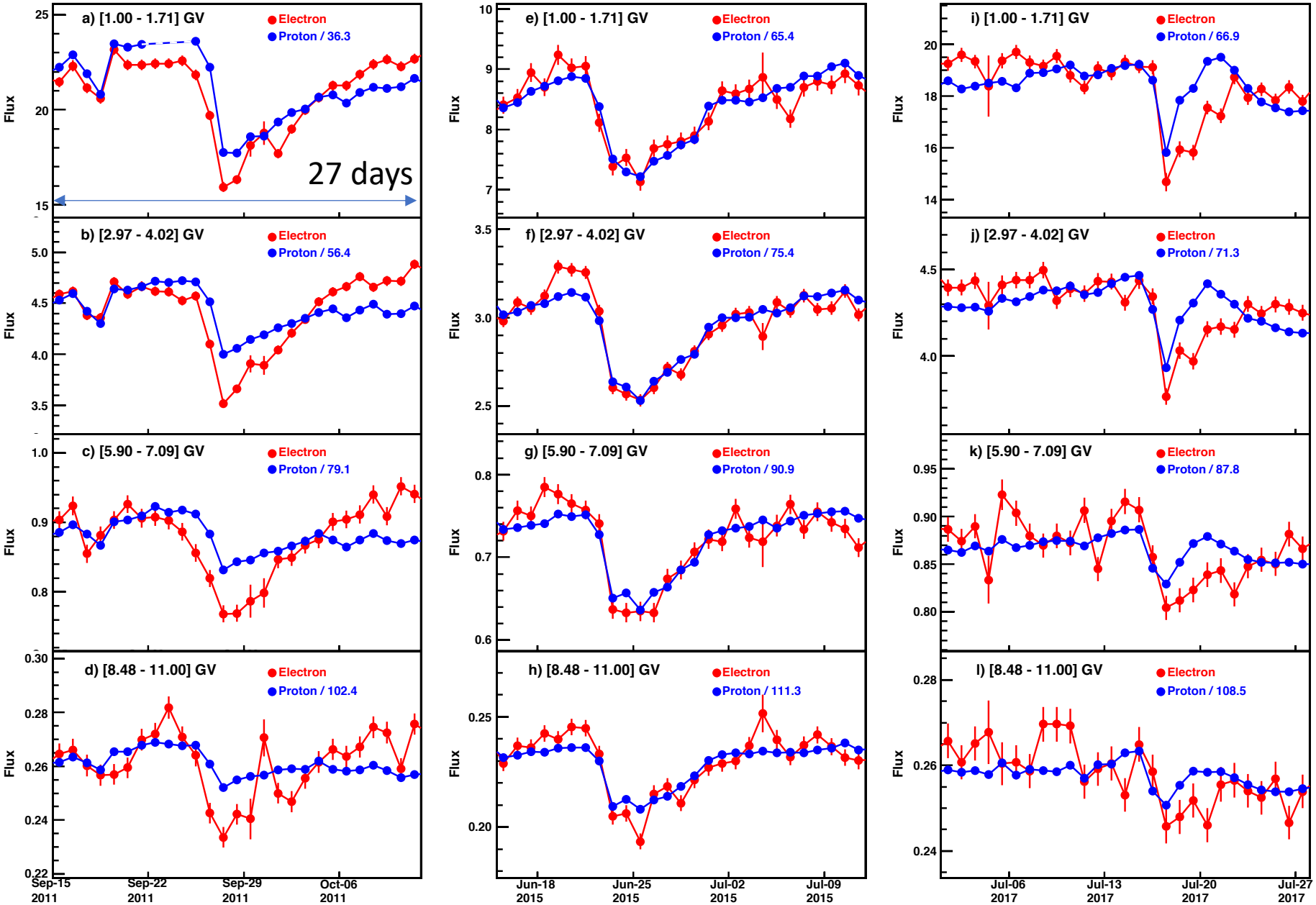
[1.00 - 1.71] GV

- Proton $\Phi_p/40$
- Electron Φ_{e^-}

Unique data to study charge-sign dependence on multiple time scales

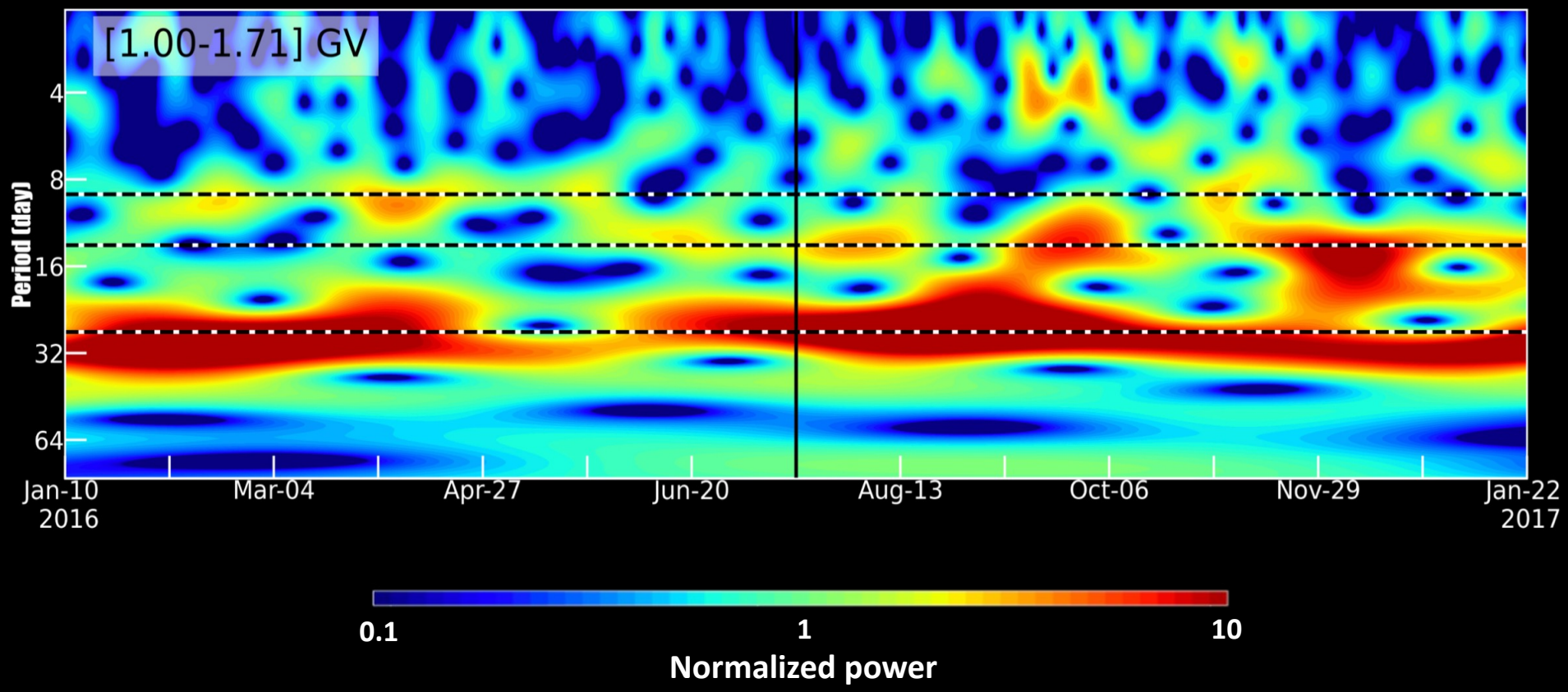
Non-recurrent variations of electron and proton fluxes

2011, A<0, lower solar activity | 2015, solar maximum | 2017, A>0, lower solar activity

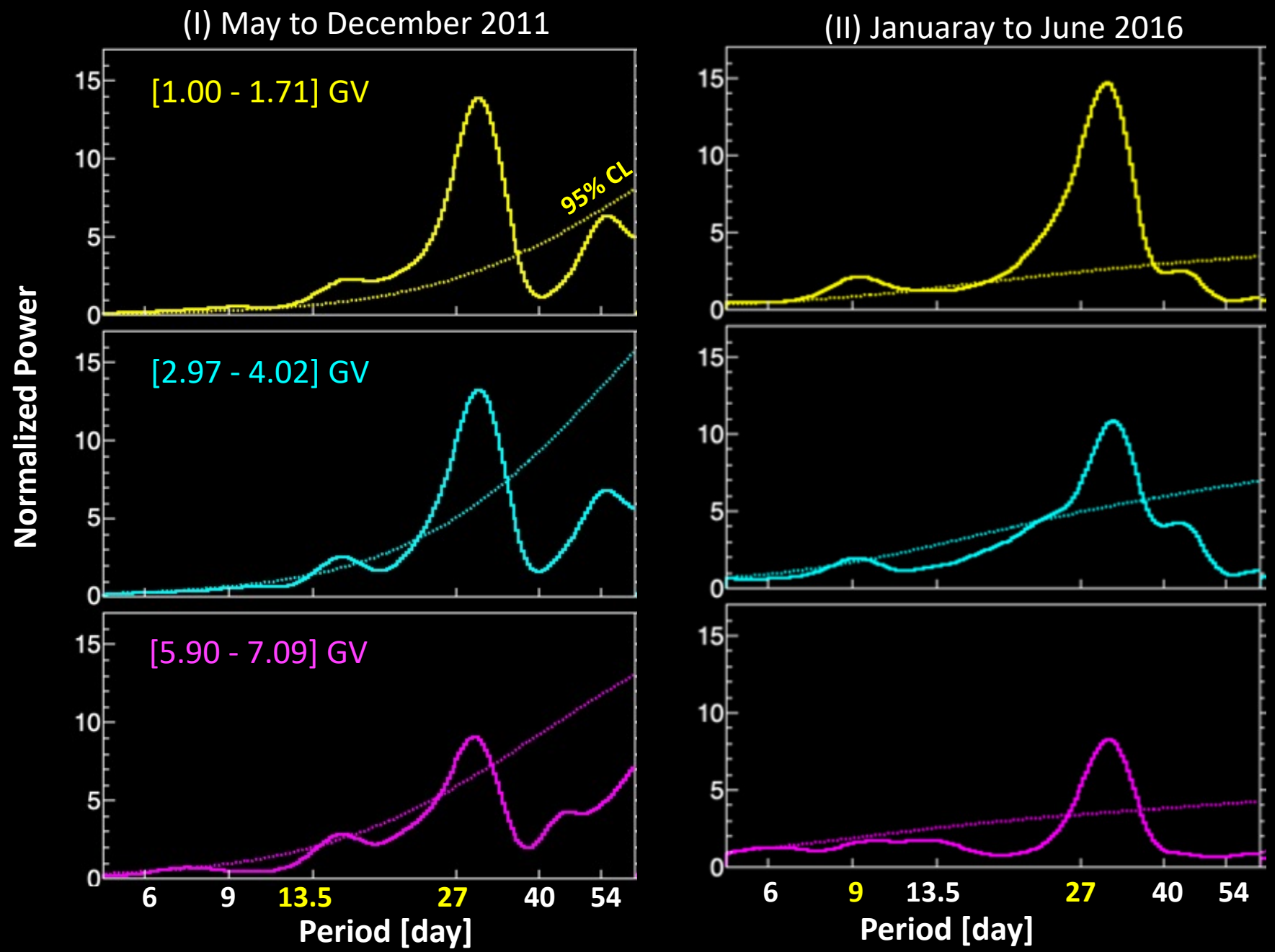


The Recurrent Variation in Electron Flux: Periodicity

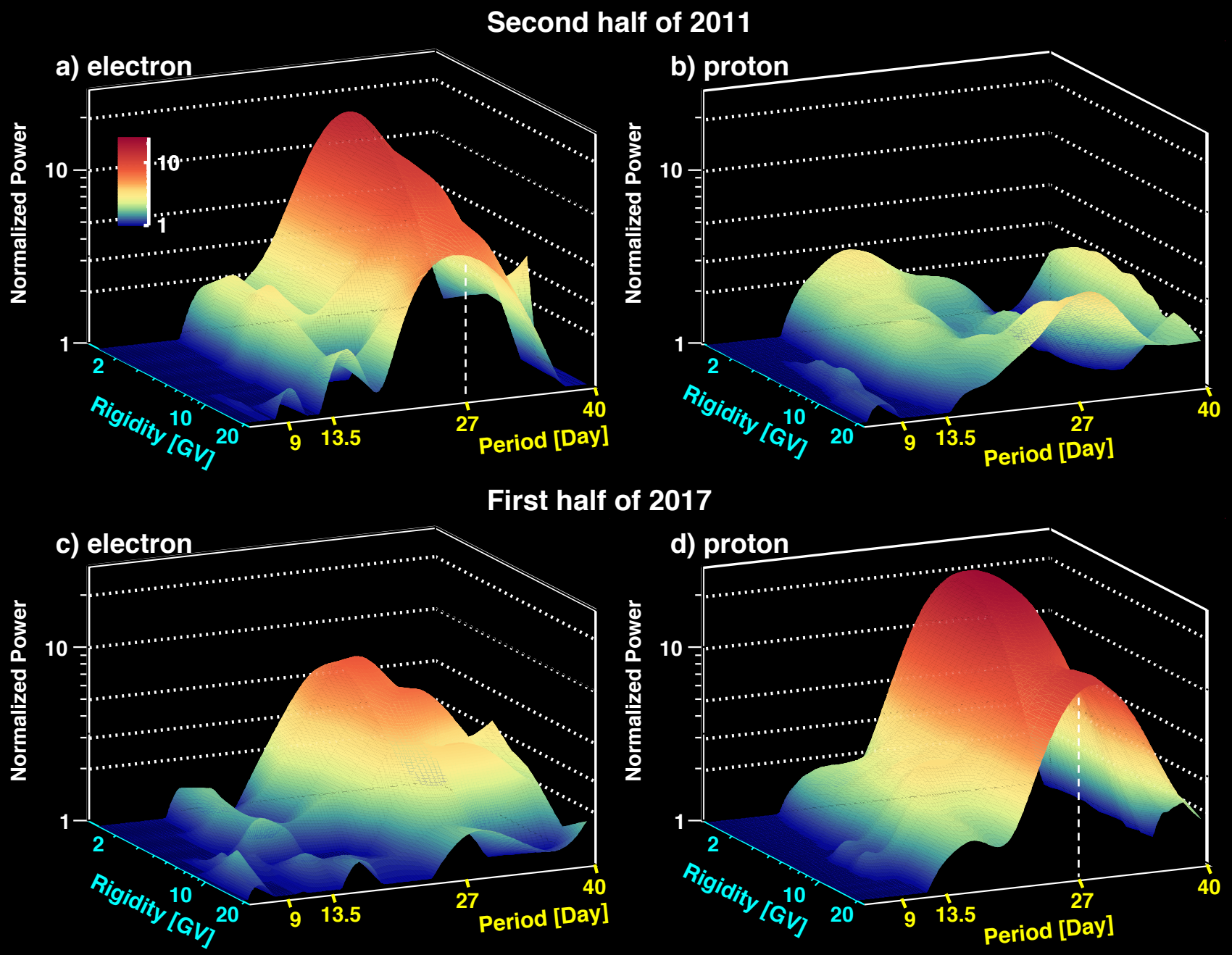
- **The wavelet analysis is used to study the periodicity in electron fluxes.**
- **Red-noise model is used to estimate the significance of the periods.**



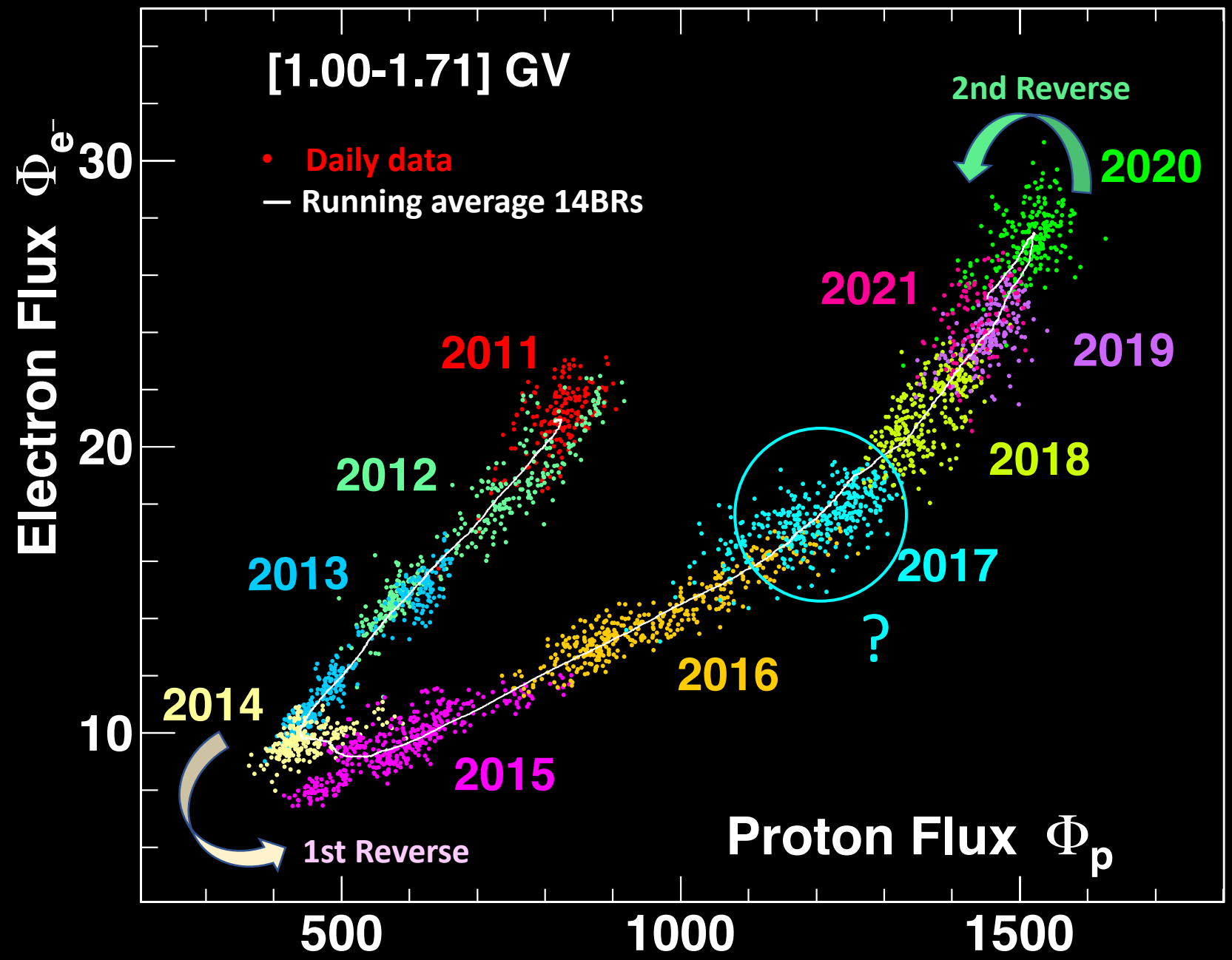
Significance of the Periodicity



Rigidity and Time Dependence of the Periodicity Strength

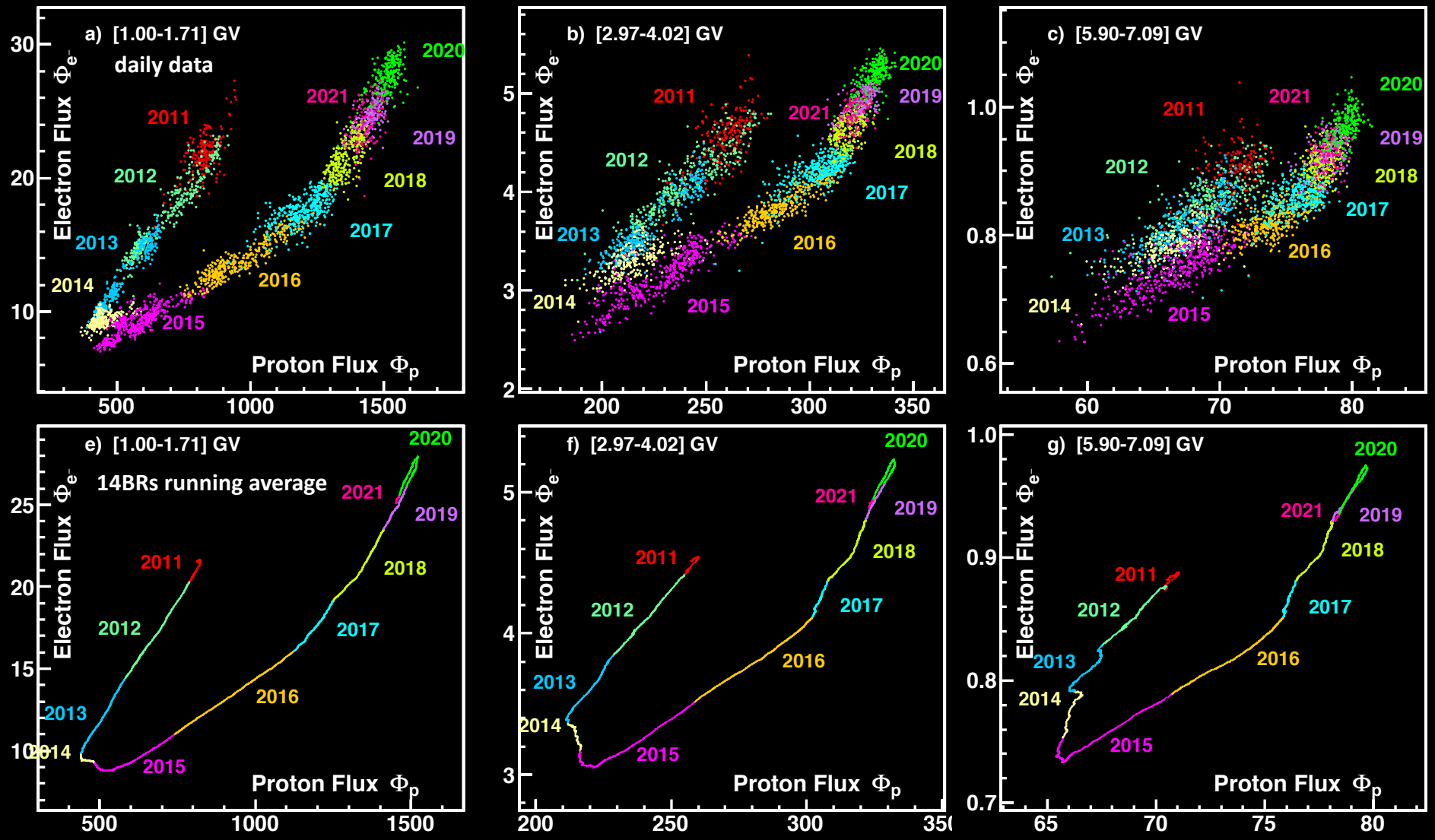


Hysteresis in the electron and proton flux

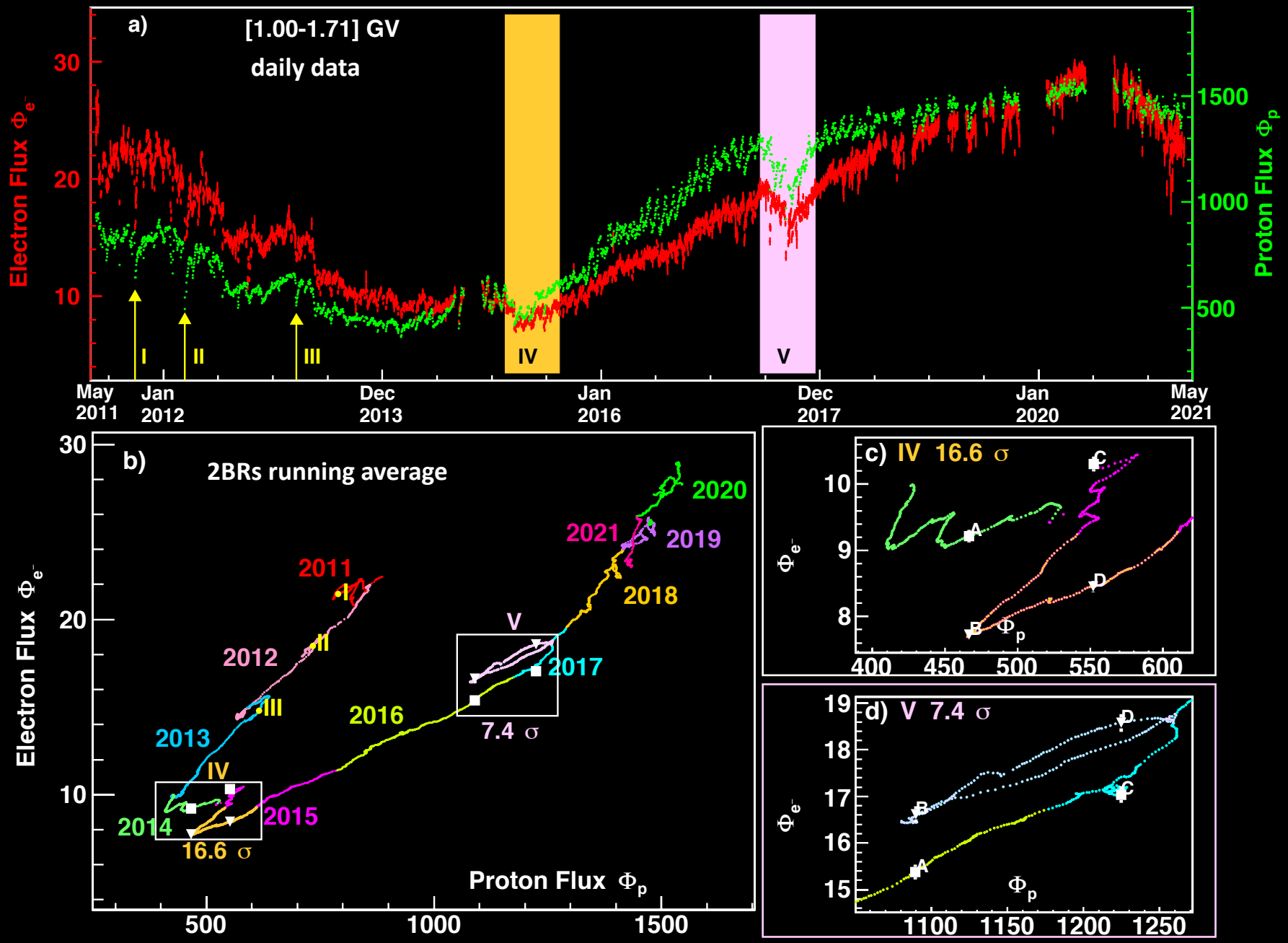


Hysteresis in the electron and proton flux

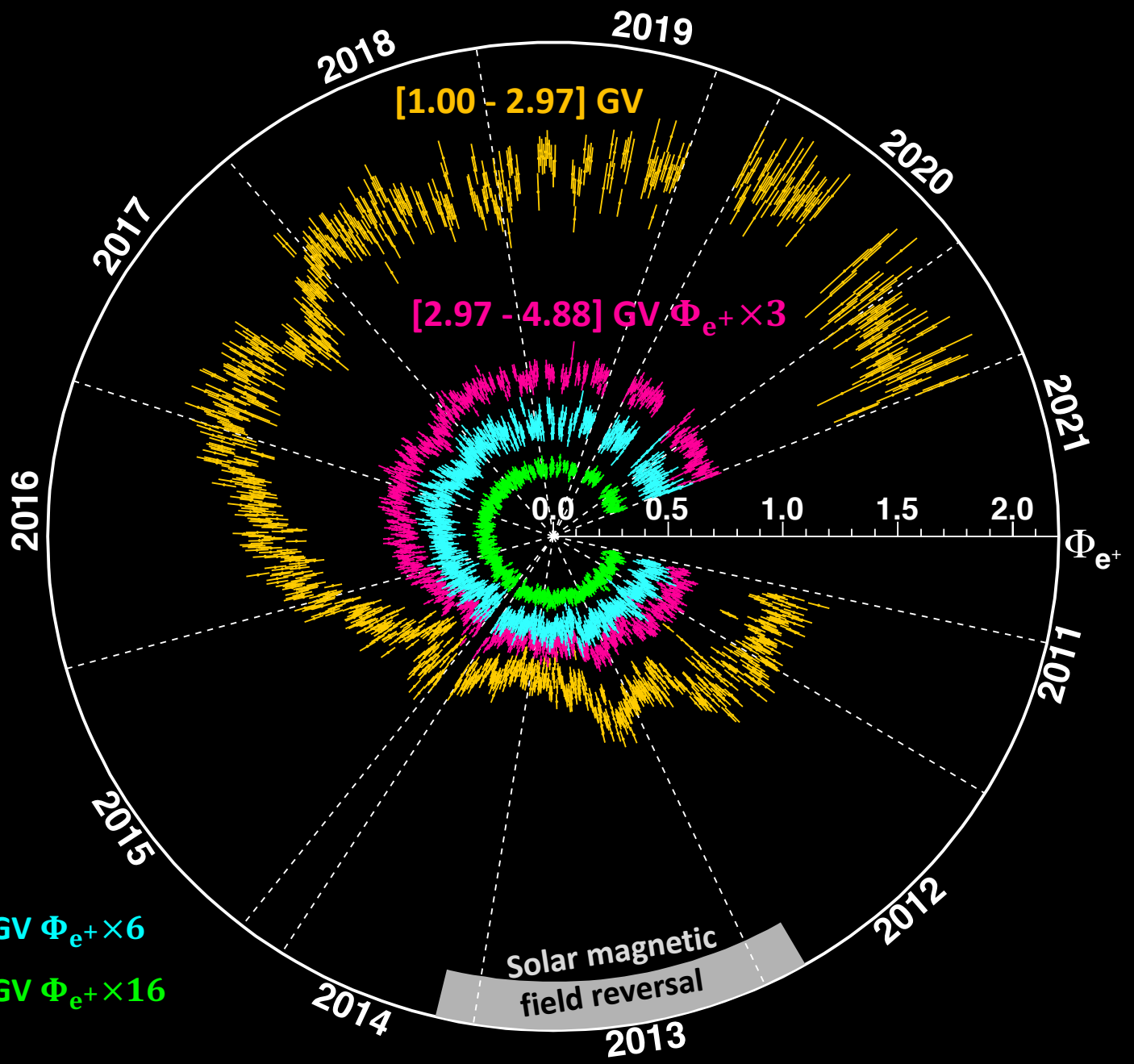
[1.00 - 1.71] GV [2.97 - 4.02] GV [5.90 - 7.09] GV



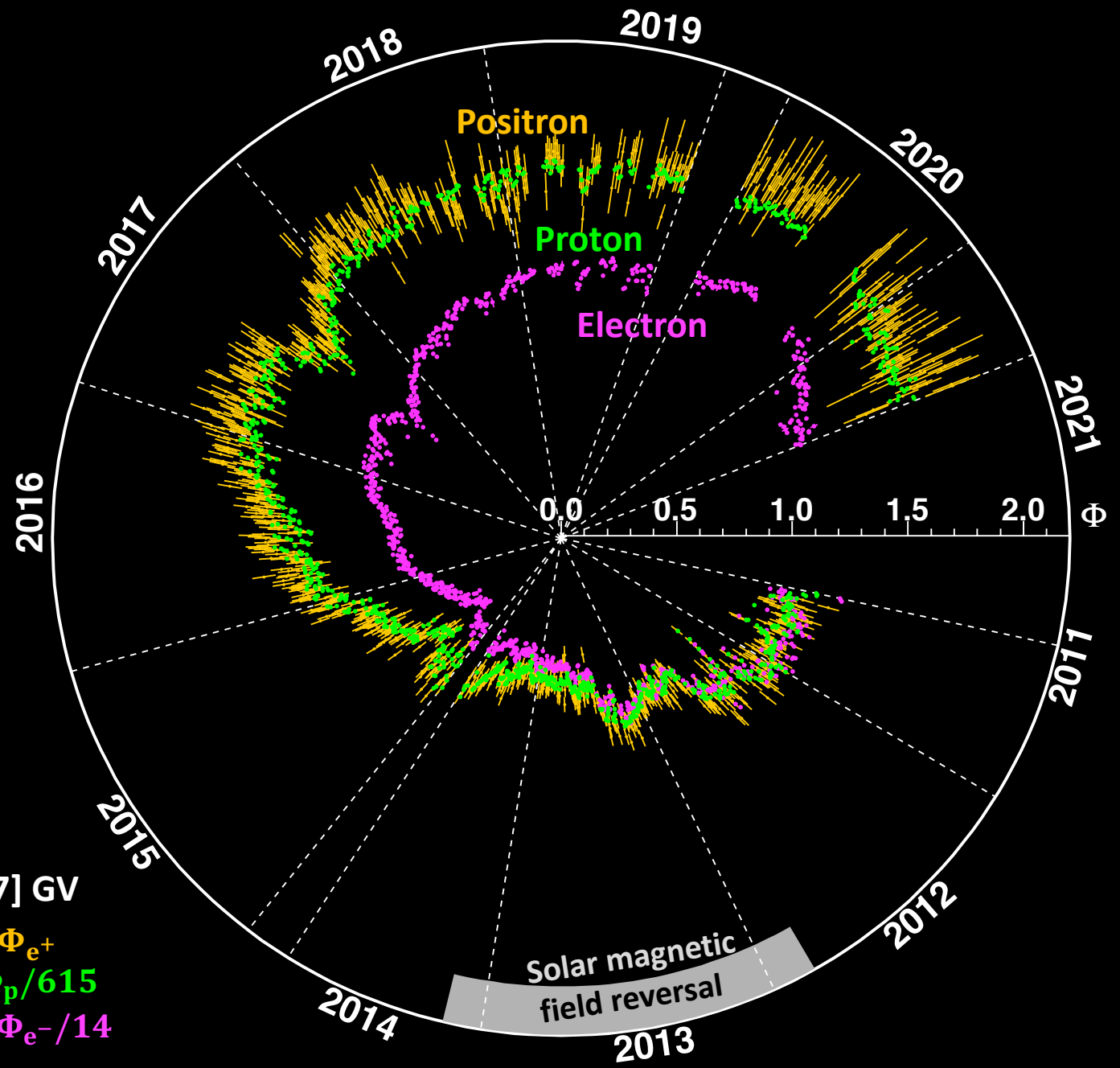
Structures in the Electron-Proton Hysteresis



Daily positrons over ten years



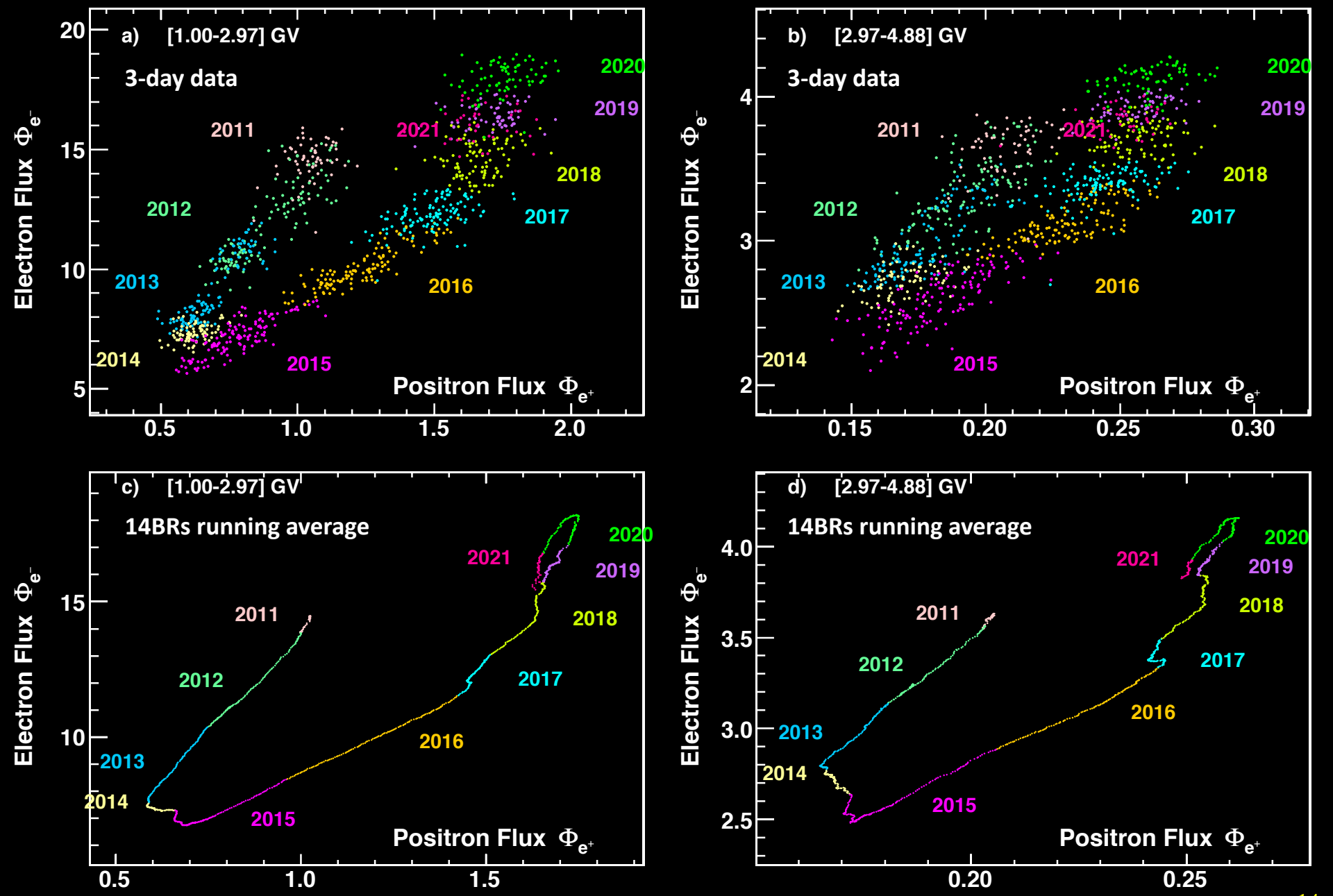
Comparison between positrons, protons, and electrons



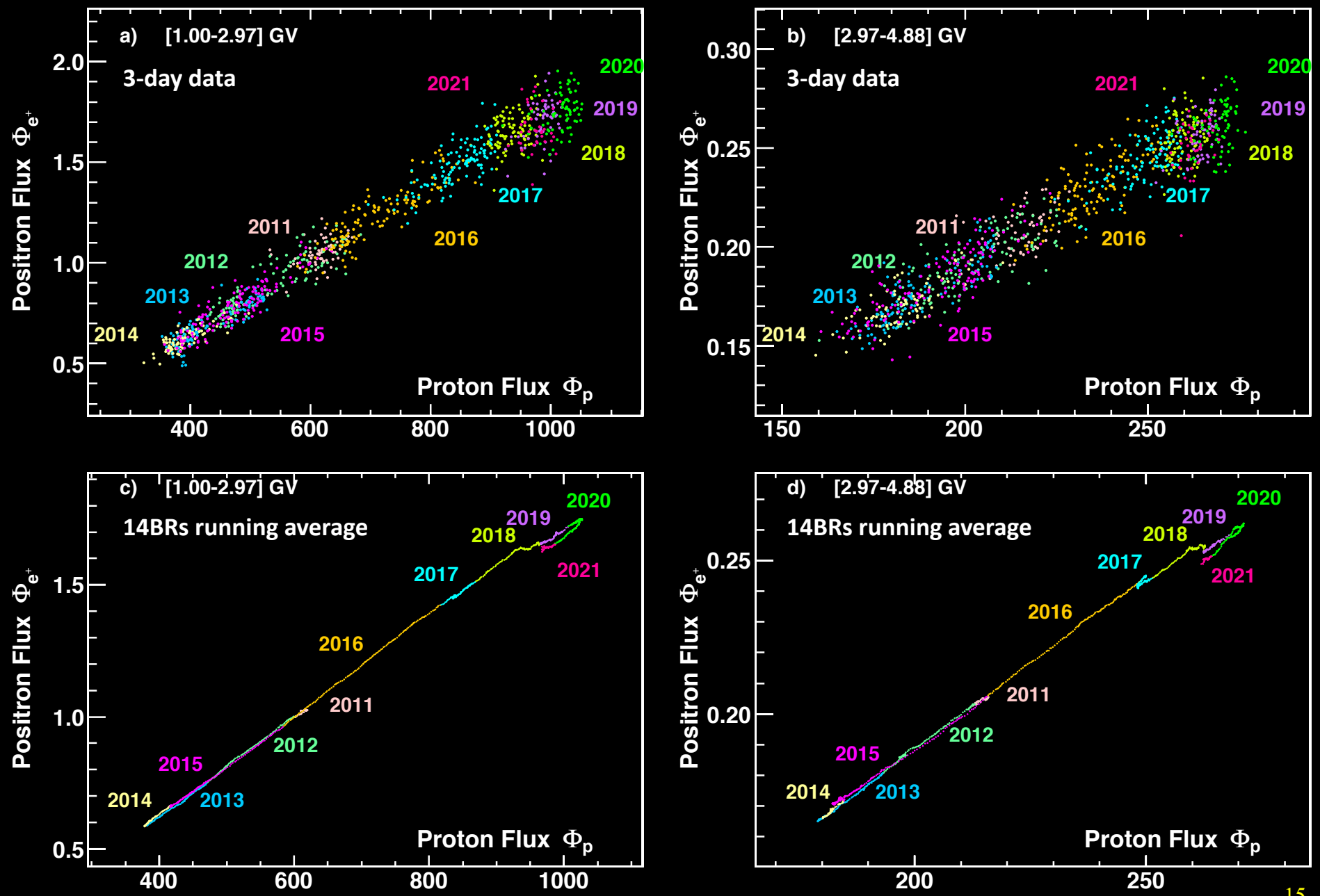
[1.00 - 2.97] GV

- Positron Φ_{e^+}
- Proton $\Phi_p/615$
- Electron $\Phi_{e^-}/14$

Positron-Electron Hysteresis



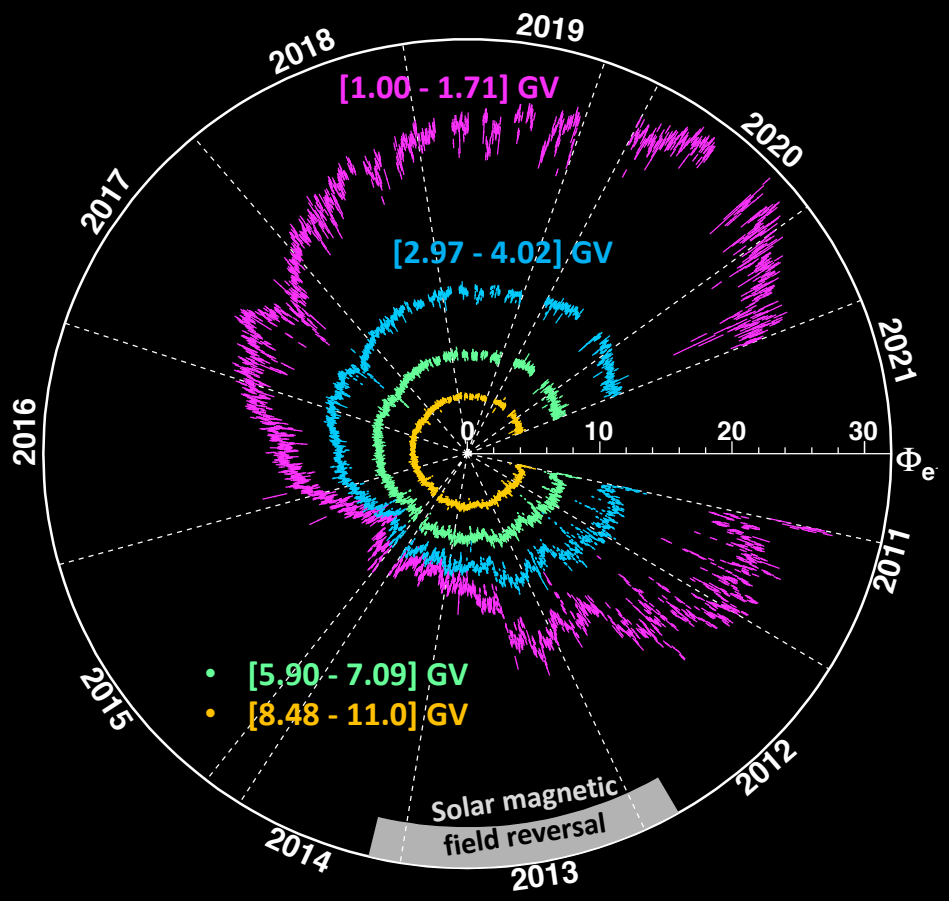
Approximately Linear Relation between Positron and Proton



Summary

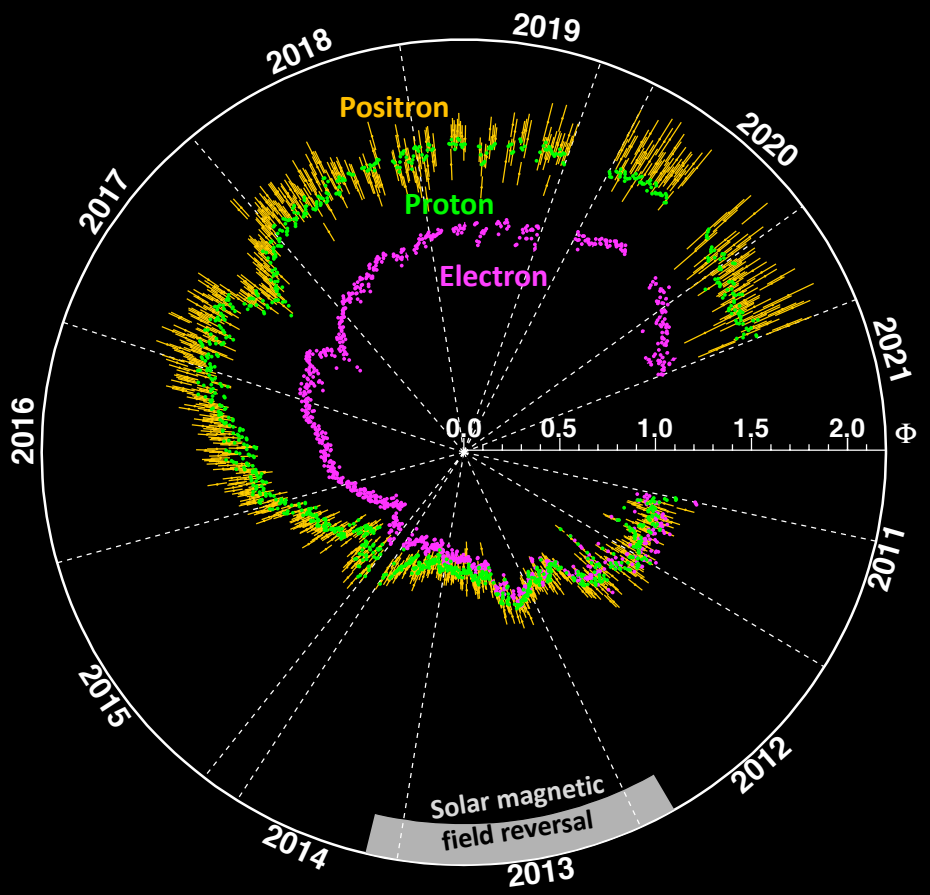
Daily electron positron fluxes are measured by AMS from May 2011 to May 2021.

Electron



daily

Positron, proton and electron

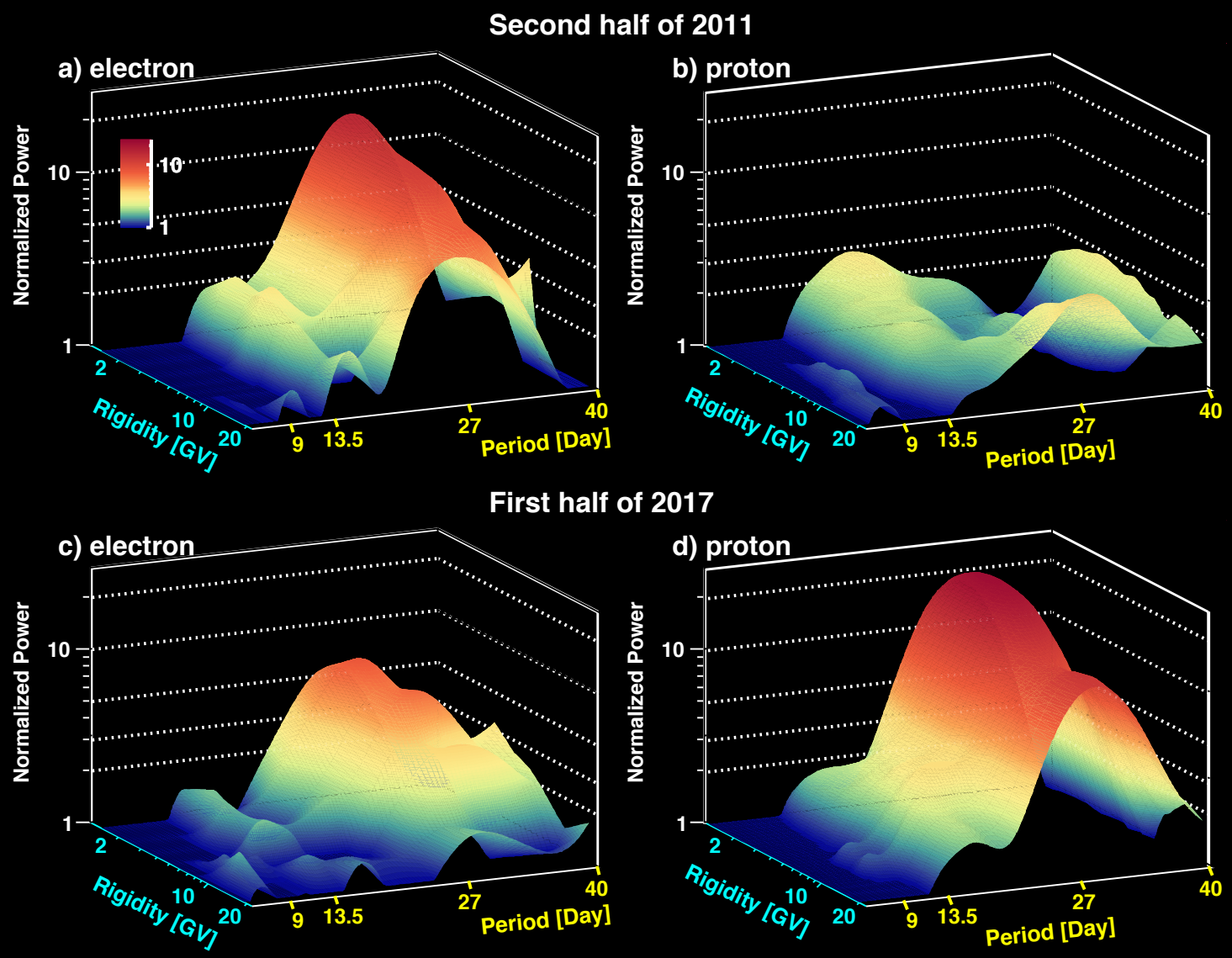


3-day

Summary

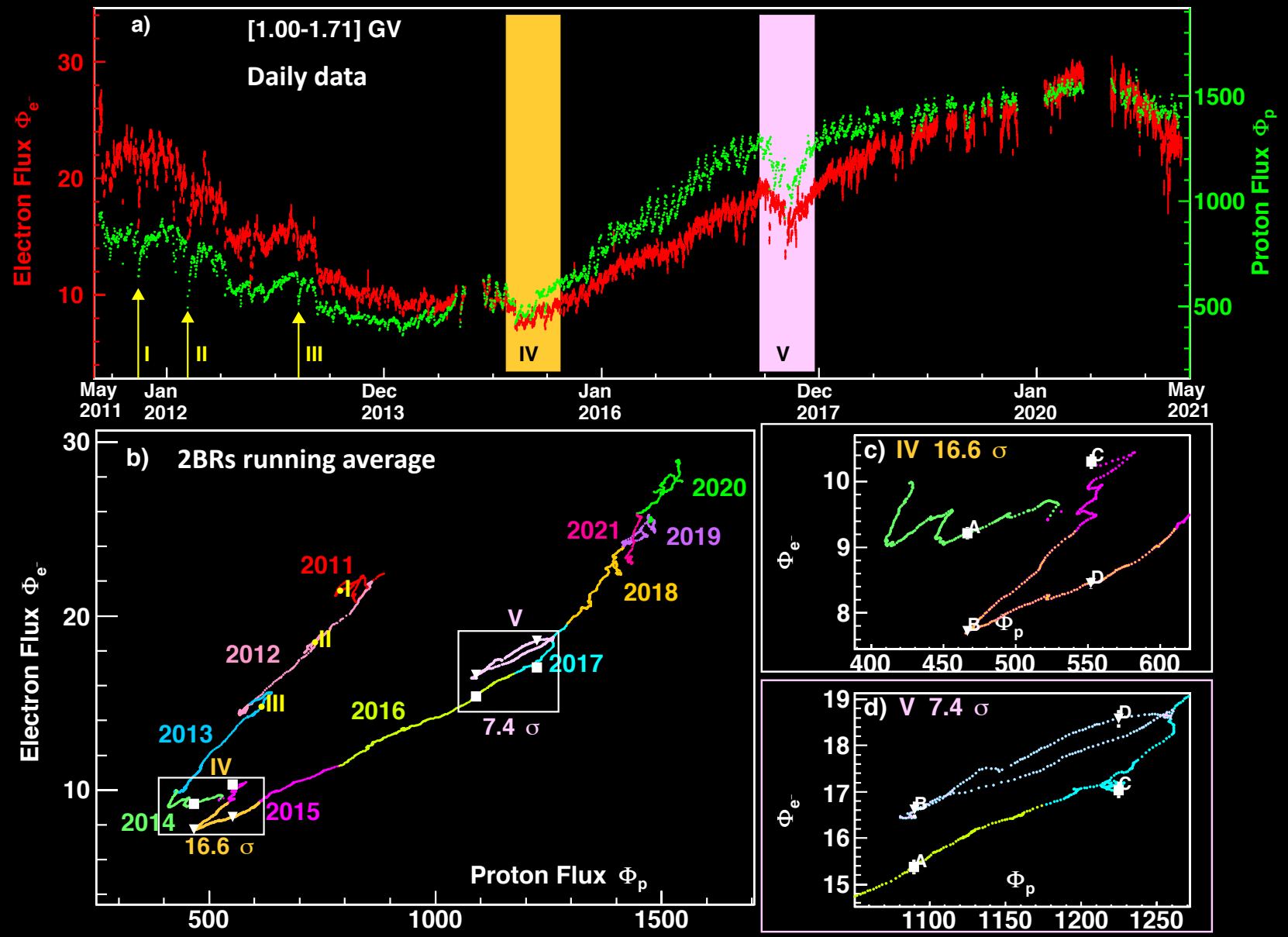
Electron fluxes exhibite recurrent variation with 9-, 13.5-, and 27-day periods.

The time and rigidity dependence of the electron periodicity is different from proton.



Summary

Electron-proton and electron-positron hysteresis show complex structures.



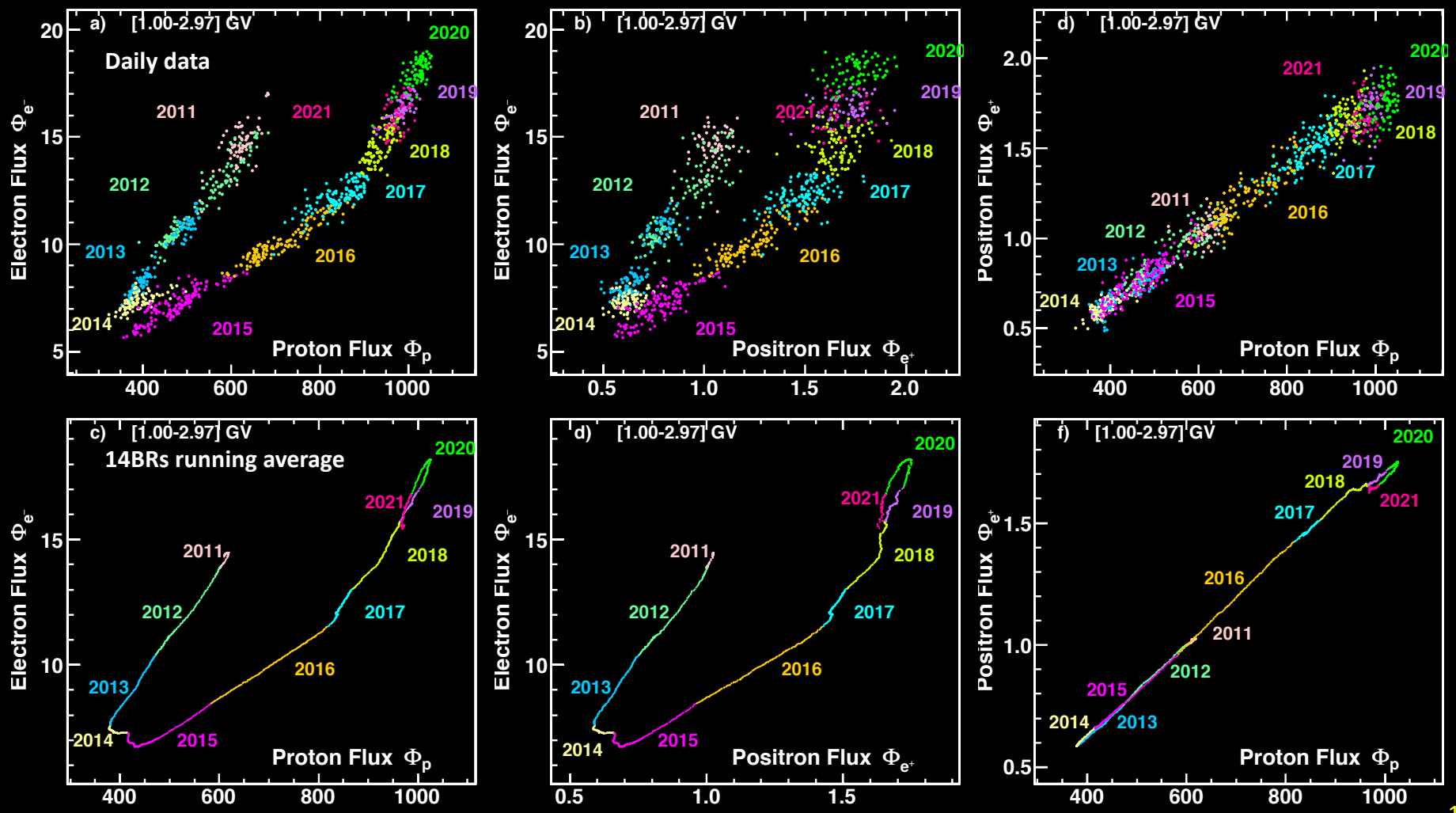
Summary

Comprehensive dataset to study cosmic ray propagation in the heliosphere

electron v.s. proton
Different mass, opposite charge

electron v.s. positron
Same mass, opposite charge

positron v.s. proton
Different mass, same charge



Conclusion

By 2030, AMS will explore nearly two complete solar cycle