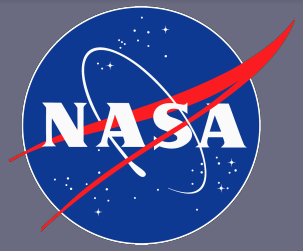
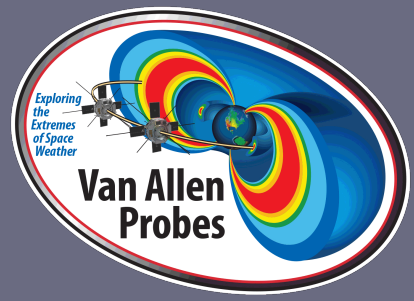




SEP Calibration Results

REPT analysis & preliminary inter-calibration:

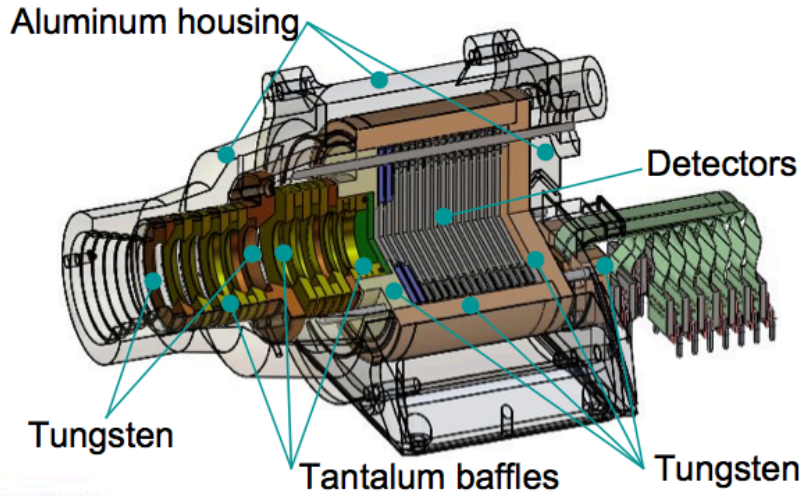
Jan 2014 SEP events

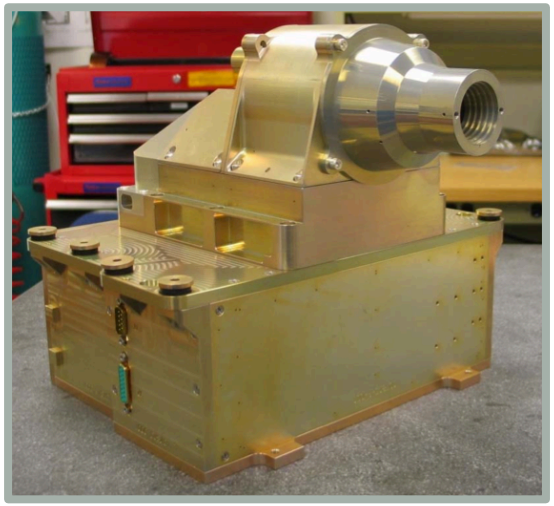
A. N. Jaynes[1] --- allison.jaynes@lasp.colorado.edu
D. N. Baker[1], X. Li[1], S. G. Kanekal[2]
[1]LASP CU-Boulder, [2]NASA Goddard

REPT instrument – Van Allen Probes

REPT protons

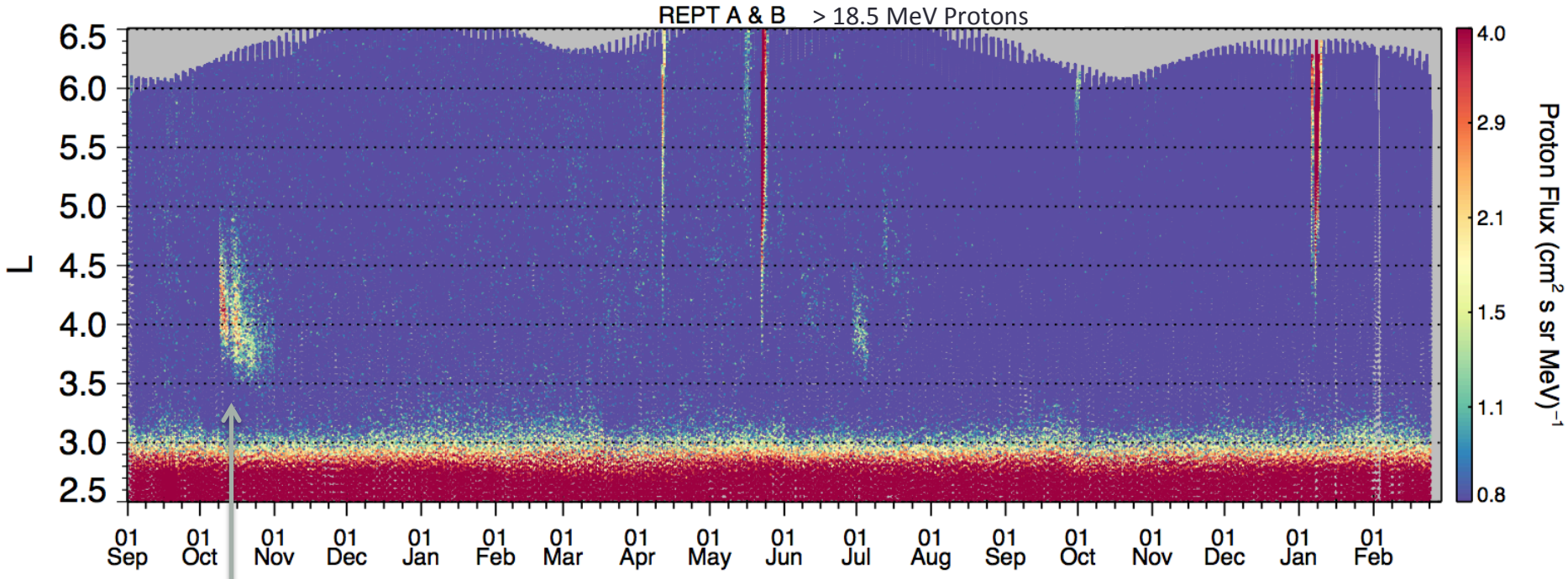
Bin	Center energy	Low bound	High bound
0	21.25 MeV	18.5 MeV	24.0 MeV
1	27.6 MeV	24.0 MeV	31.2 MeV
2	35.9 MeV	31.2 MeV	40.6 MeV
3	46.7 MeV	40.6 MeV	52.8 MeV
4	60.7 MeV	52.8 MeV	68.6 MeV
5	78.9 MeV	68.6 MeV	89.2 MeV
6	102.6 $MeV_{(integral)}$	89.2 MeV	*** MeV
7	208.0 $MeV_{(integral)}$	116.0 MeV	*** MeV





- Identical instruments on both Van Allen Probes satellites
- Excellent differential proton measurements for a full 19 months
- Several SEP events seen, though none have been very strong
- Jan 2014 – best event so far

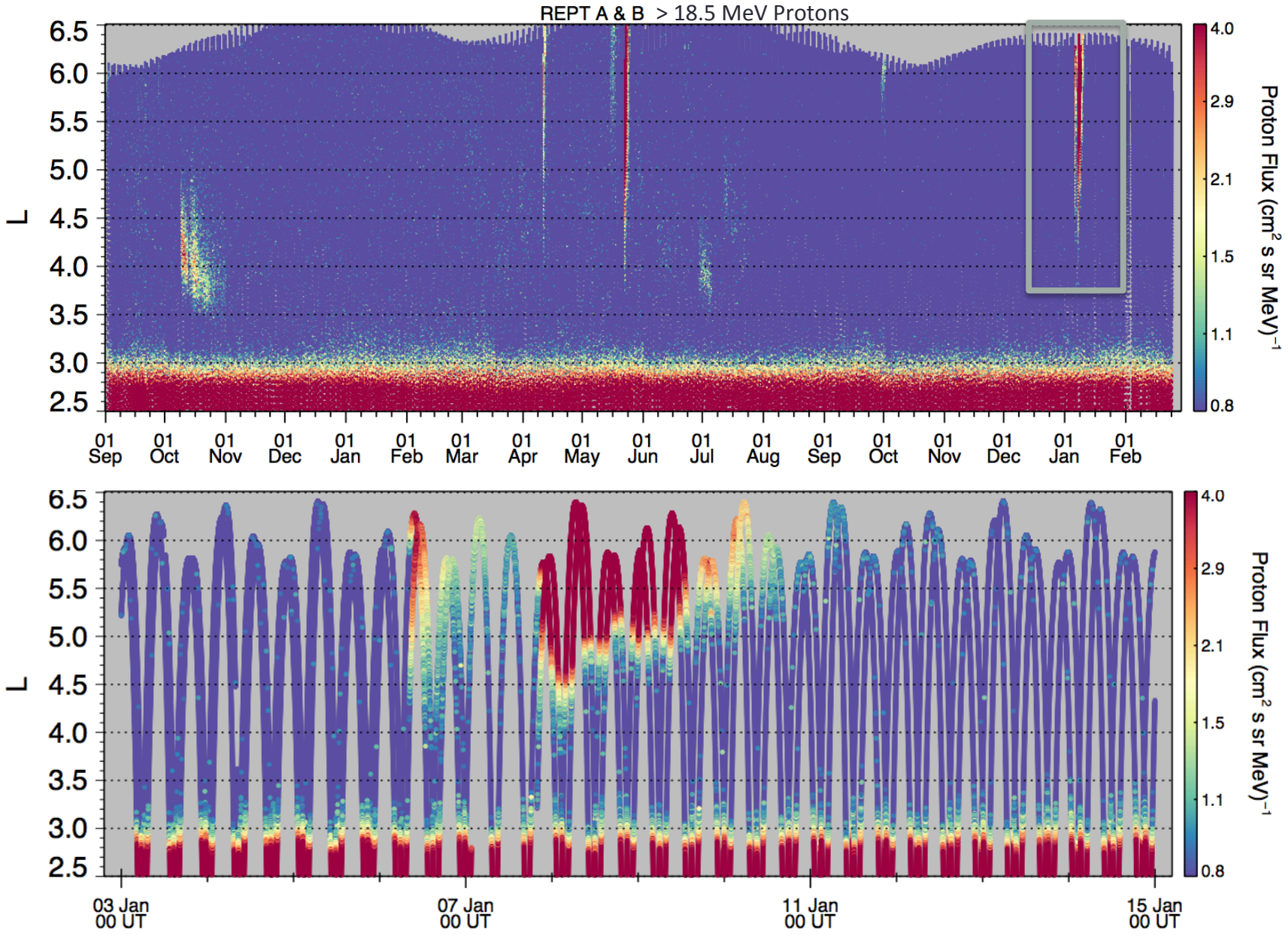
REPT instrument – SEP events



Contamination of proton channels by MeV electrons; hope to improve by logic changes

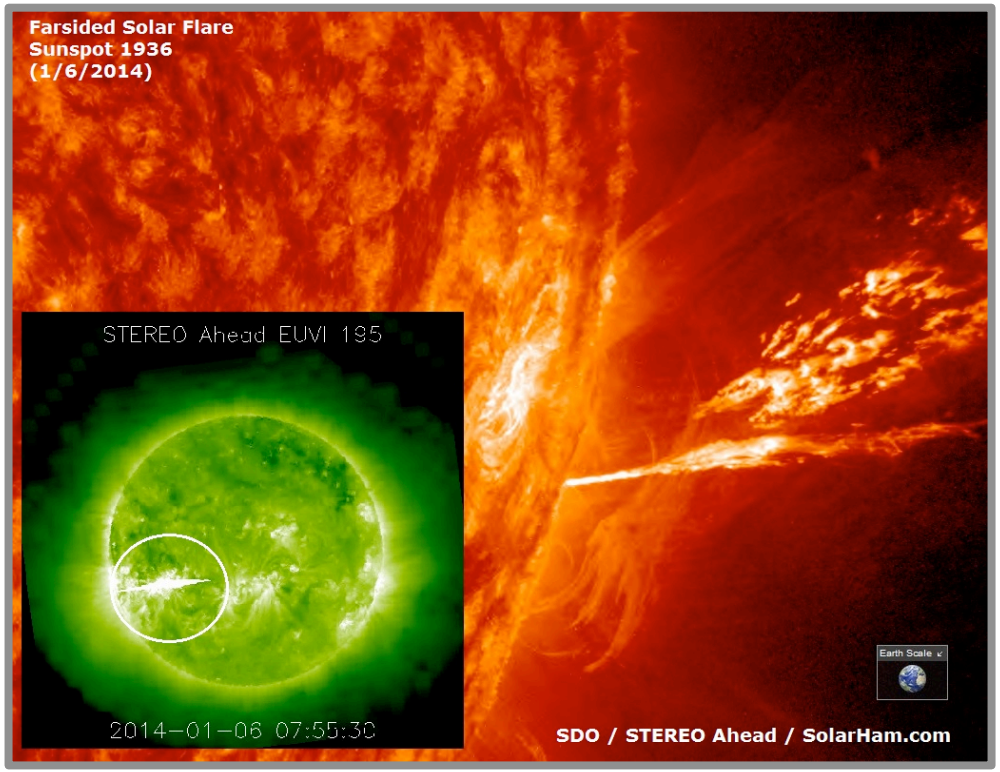
4 to 5 nice SEP events observed throughout mission so far!

REPT instrument – SEP events



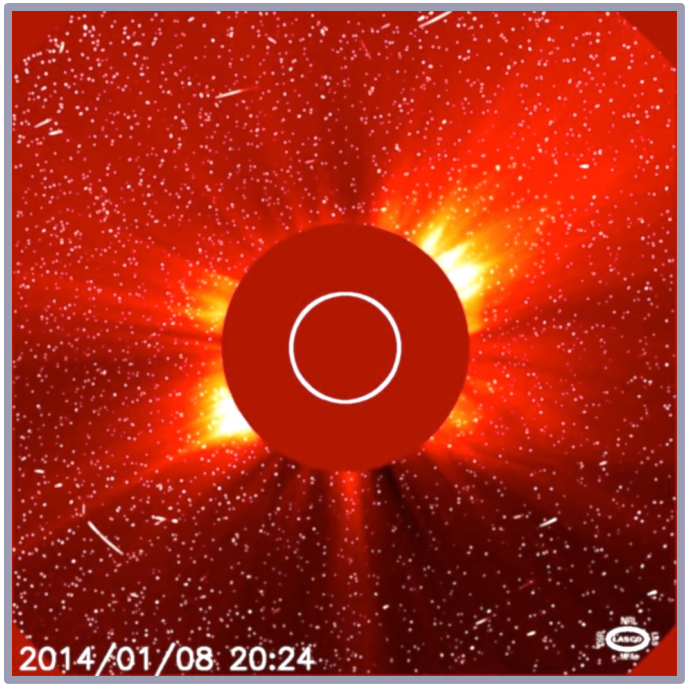
January 2014 SEPs

- Flare eruption on 06 Jan 2014
- Caused the smaller SEP that lasted for a short time



SDO STEREO – 06 Jan 2014 SEP

- X1-class flare erupted on 07 Jan from "giant sunspot" – along with associated coronal mass ejection (the CME that wasn't)
- Larger SEP event that persisted for several days
- More intense and harder spectrum

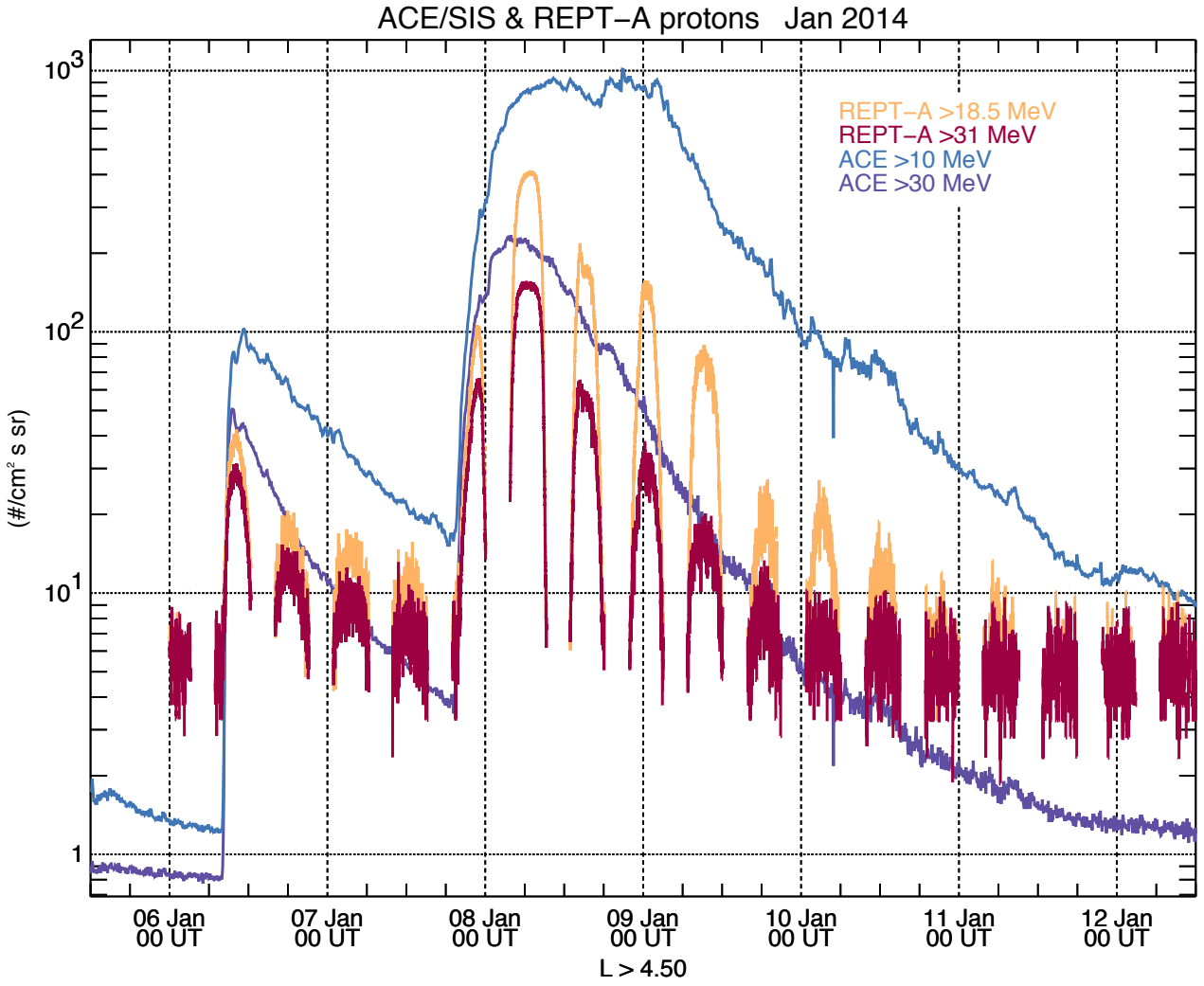


SOHO LASCO – 08 Jan 2014 SEP

REPT-A & ACE

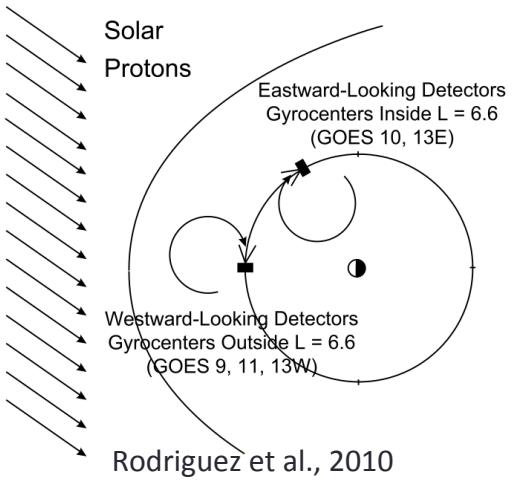
- ACE Solar Isotope Spectrometer (SIS) measures protons for E > 10 MeV and E > 30 MeV
- False integral channels for REPT to create analogous energy range
- ACE located at L1 point (~230 R_E)
- Expect higher counts at L1 than at RBSP within the magnetosphere

- REPT measurements are indeed lower at apogee (L~6.3) than at ACE (L1)
- GCR 'background' can easily be seen in REPT data (more later)
- (B s/c looks the same)

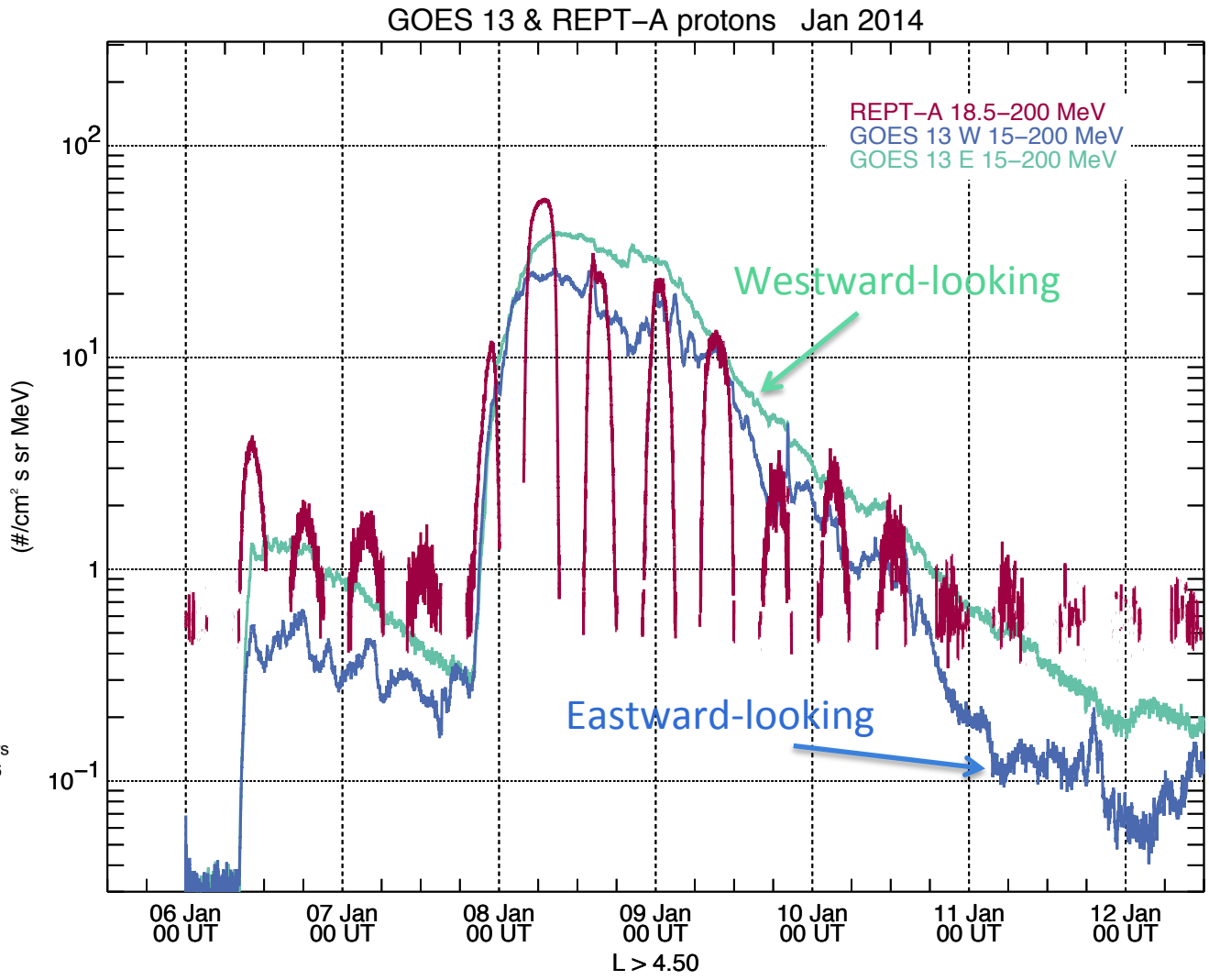


REPT-A & GOES 13

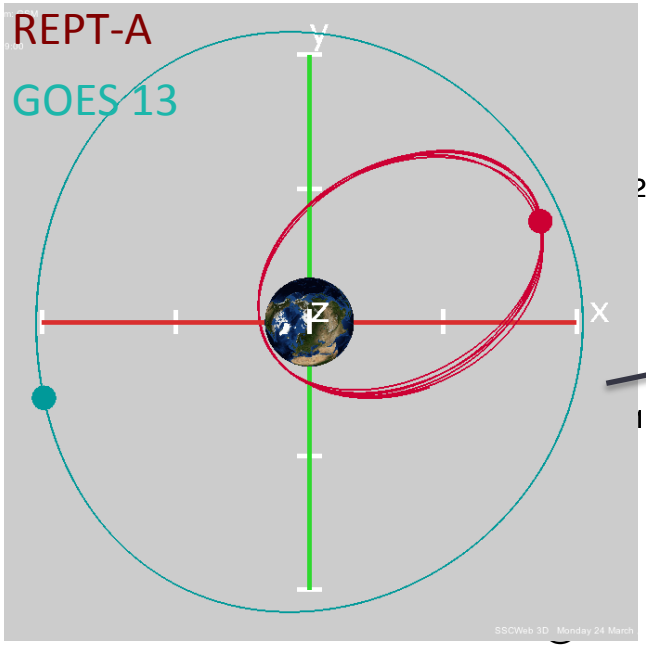
- REPT measurements higher on average than GOES at GEO at peak of SEP – probably due to s/c location
- Clear East-West anisotropy seen in GOES [*Rodriguez et al.*, 2010]
- Expect REPT to match more closely with Eastward-looking

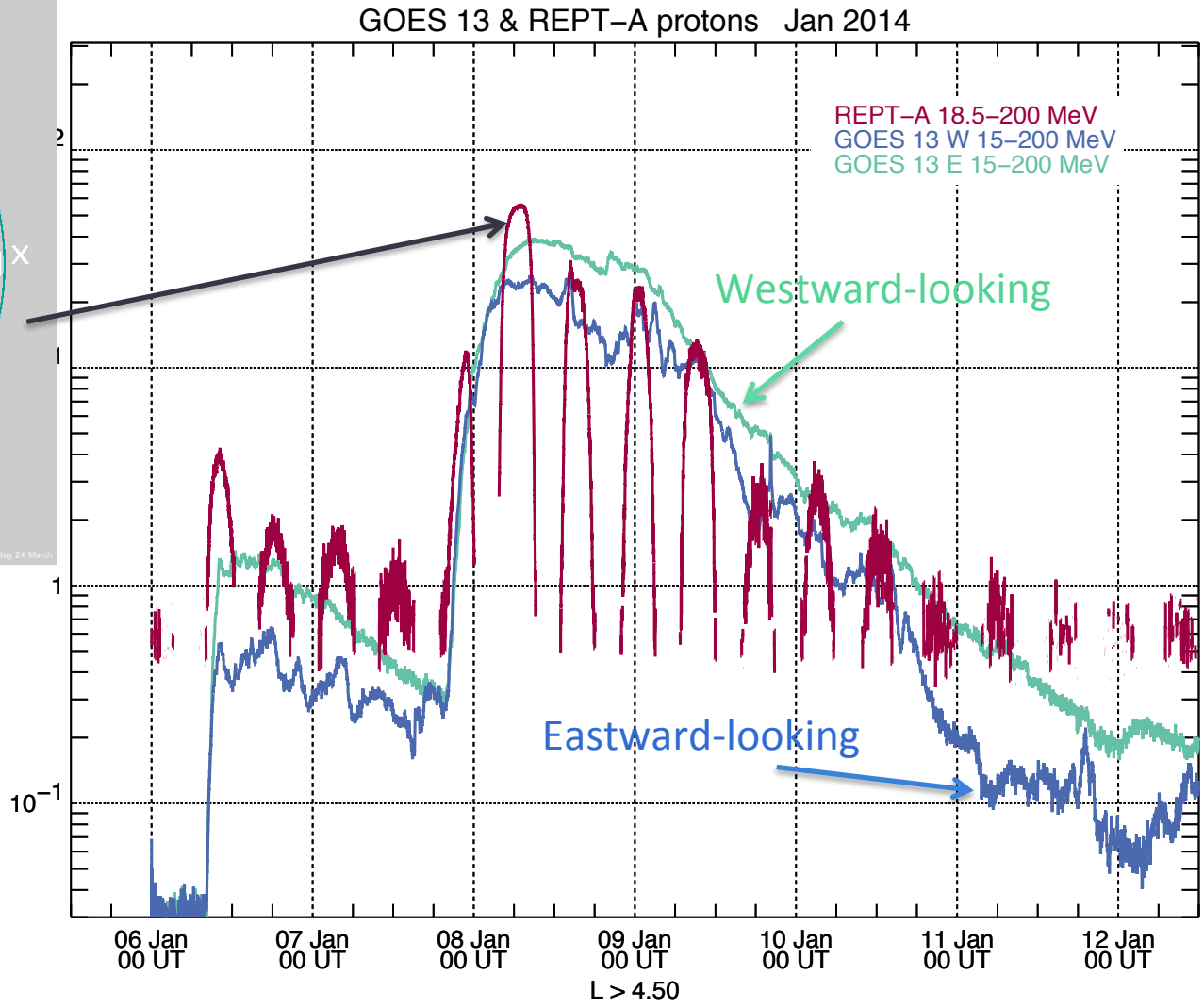


Rodriguez et al., 2010

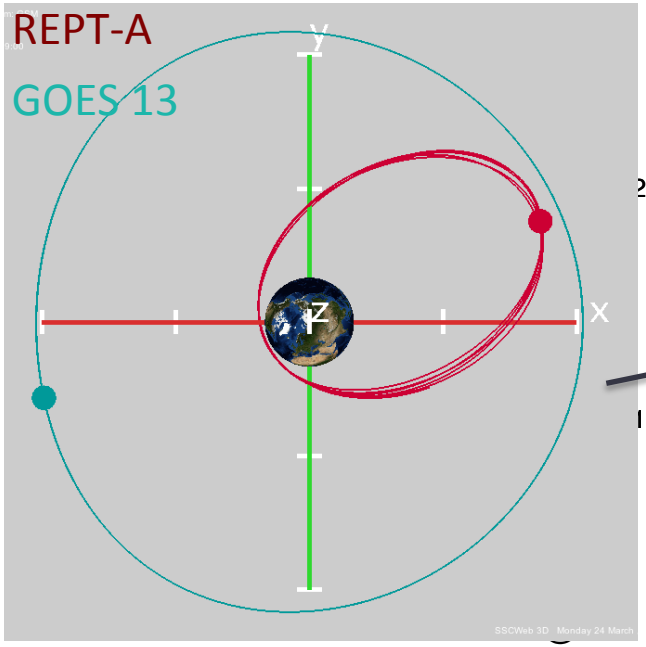


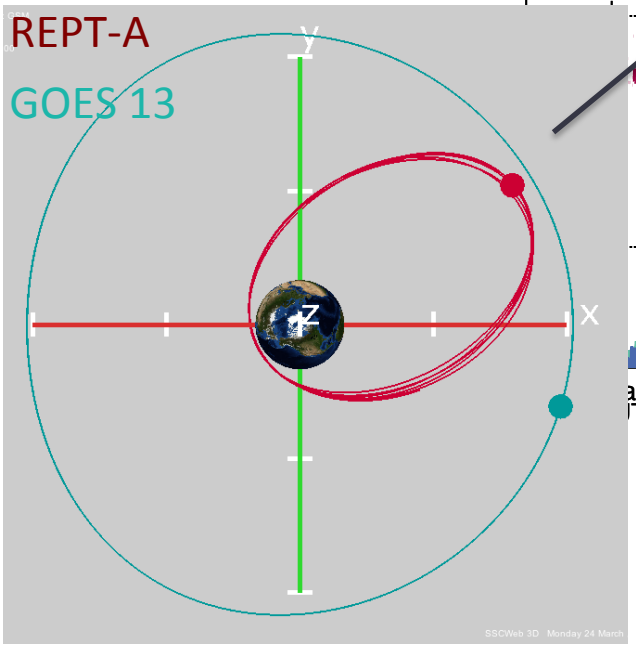
REPT-A & GOES 13

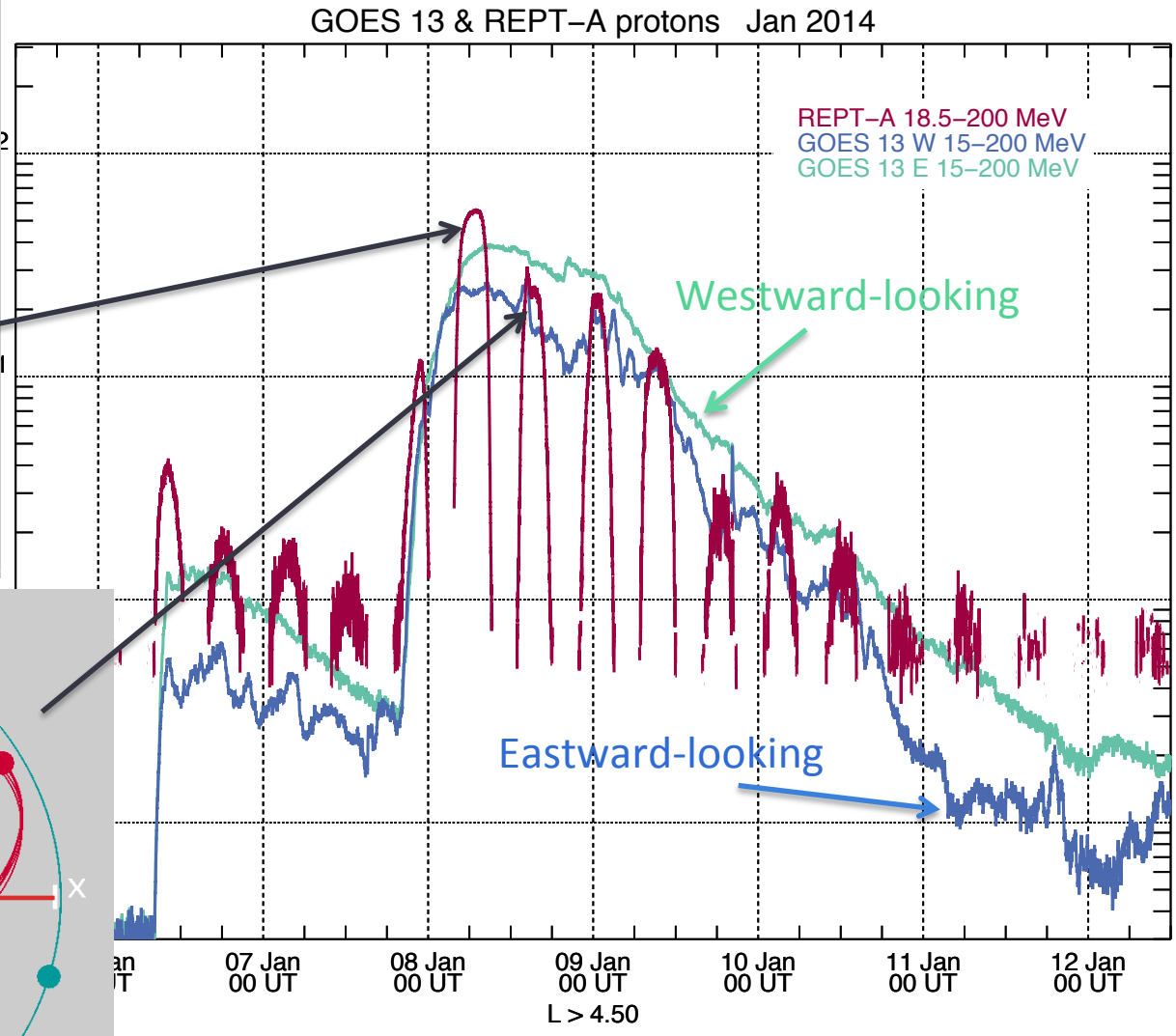




REPT-A & GOES 13







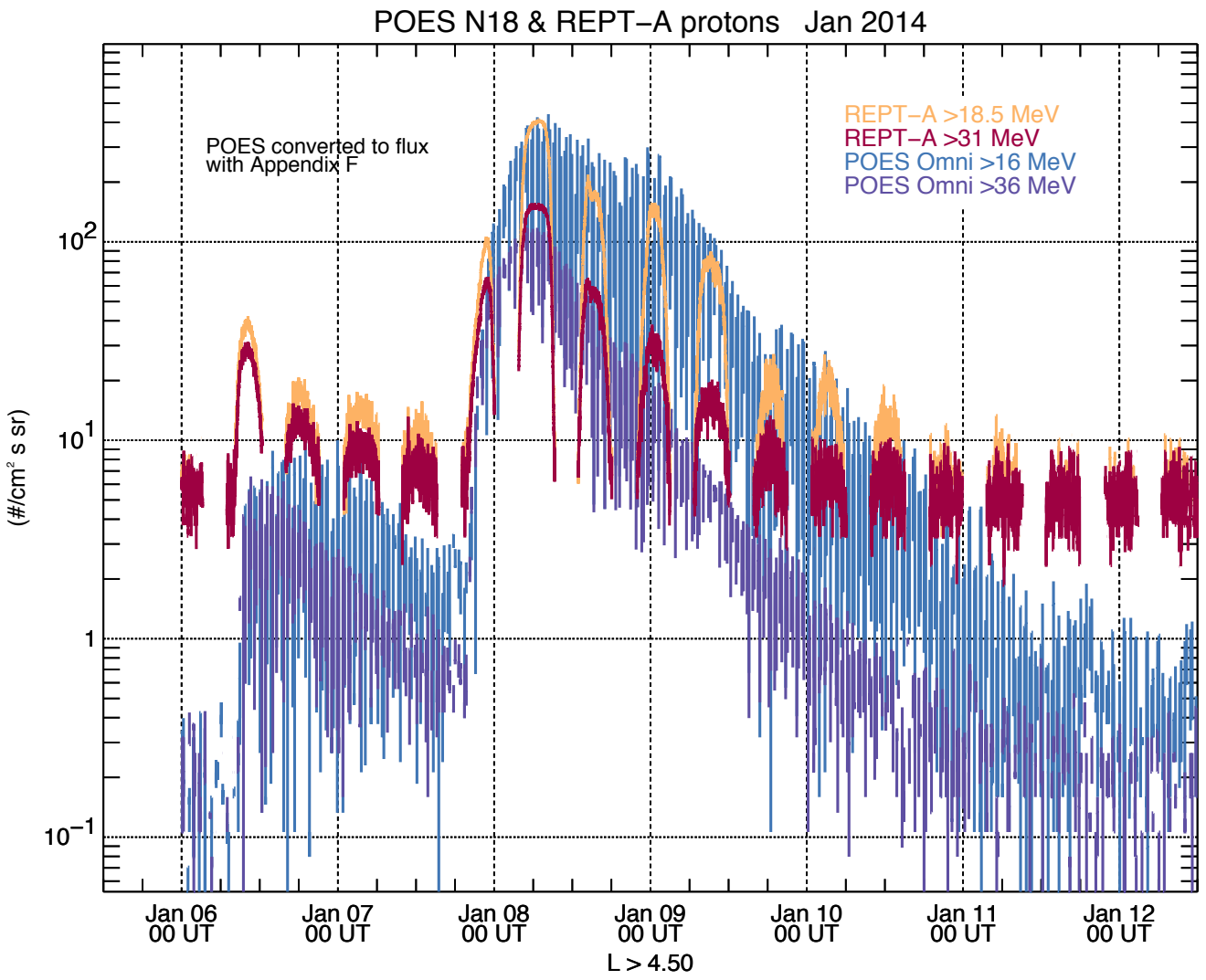
Discrepancy may be accounted for by MLT location

REPT-A & POES NOAA 18

- Lowest energies agree very well!
- **REPT/POES = 0.96** at peak intensity

- Higher energy is off more, but energy ranges are less similar at this steeper part of the spectrum
- REPT/POES = 1.4

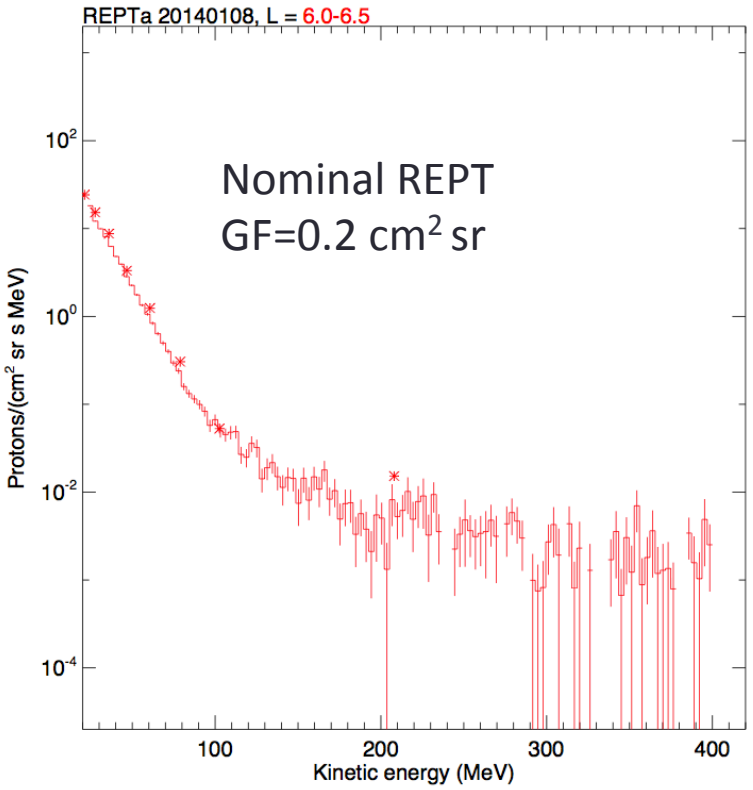
- POES cts/s were converted to flux using method in SEM-2 Appendix F for an angular distribution common to solar particle events (Case 2)

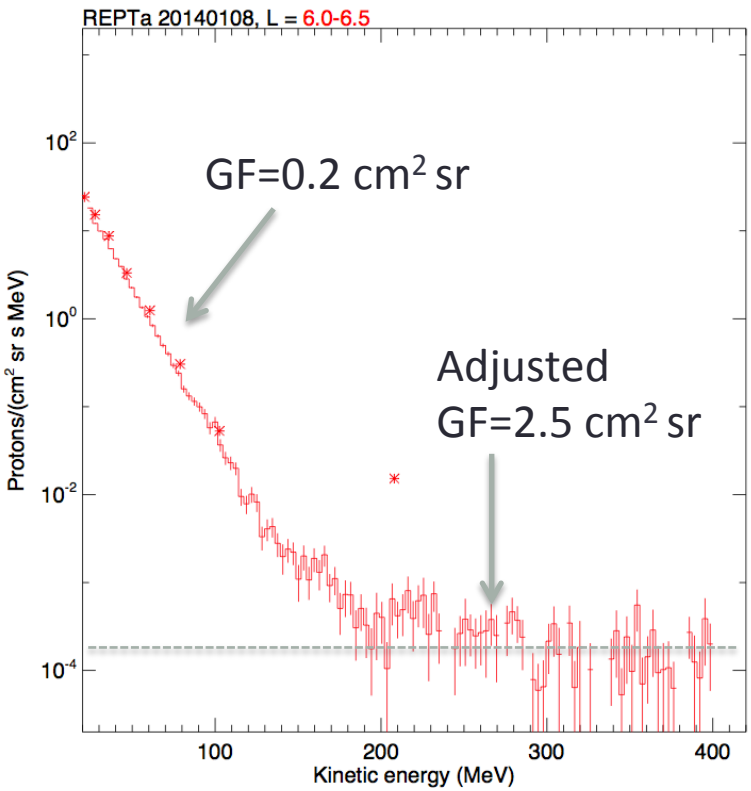


L<6.4

REPT PHA data analysis

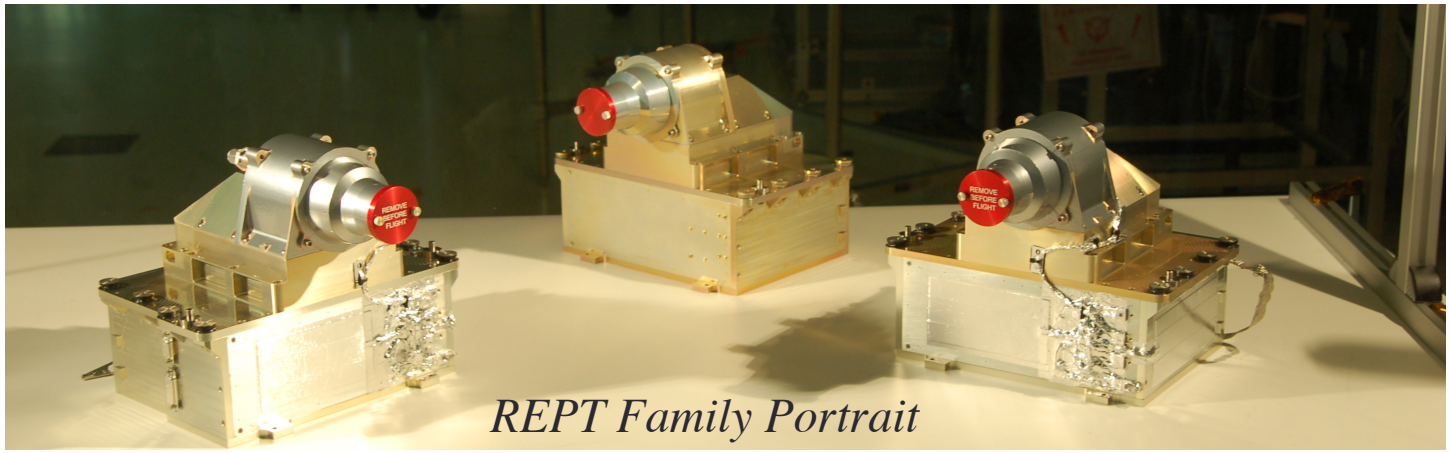
- REPT began to receive increased PHA data rate in July 2013 with re-allocated telemetry
- Effort led by Richard Selesnick (AFRL) to analyze raw PHAs for calibration purposes
- Energy spectrum near apogee of proton measurements, binned into equal width energy "channels" (histogram) compared to onboard binned differential proton measurements (asterisks)
- Left plot uses current geometric factor (one for entire detector stack)
- Right plot assumes high energy cross-cutters and uses adjusted (higher) geometric factor for E>200 MeV
- Resulting high-energy background is consistent with galactic cosmic ray (GCR) intensity of ~10^{-4} /(cm^2 s sr MeV)





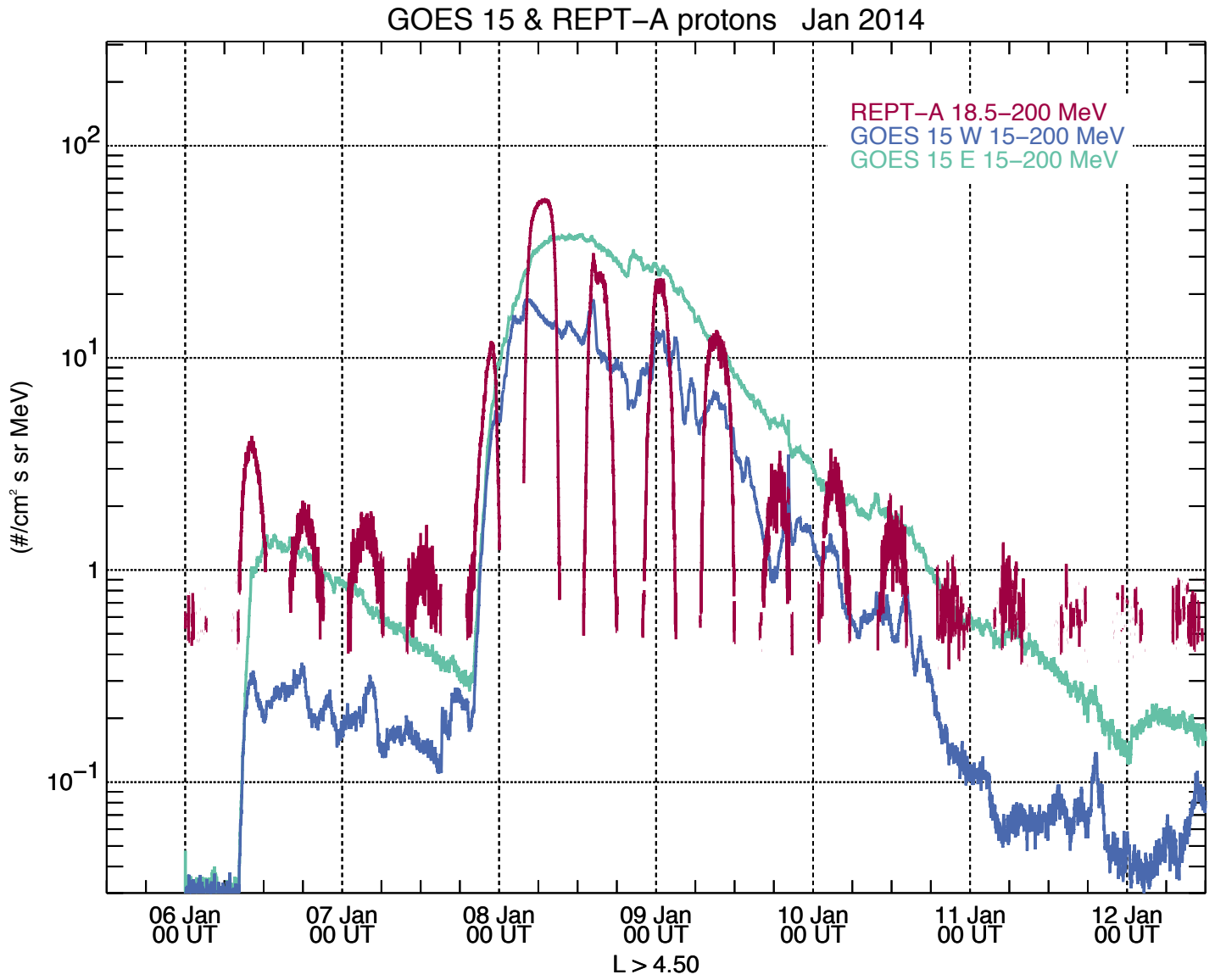
Takeaway message

- REPT solar proton measurements show good agreement with both GOES and ACE during SEP events
  - Factor of 0.5 *higher* than GOES at peak of SEP
  - Factor of 0.3 *lower* than ACE at peak of SEP
  - Factor of 0.04 *lower* than POES at peak of SEP
- REPT team has undertaken extensive efforts to calibrate and characterize the instrument response, as well as cross-calibrate with other measurements on the Van Allen Probes payloads
- This presentation represents just a broad overview of inter-cal possibilities, and will hopefully serve as starting point for more detailed analysis

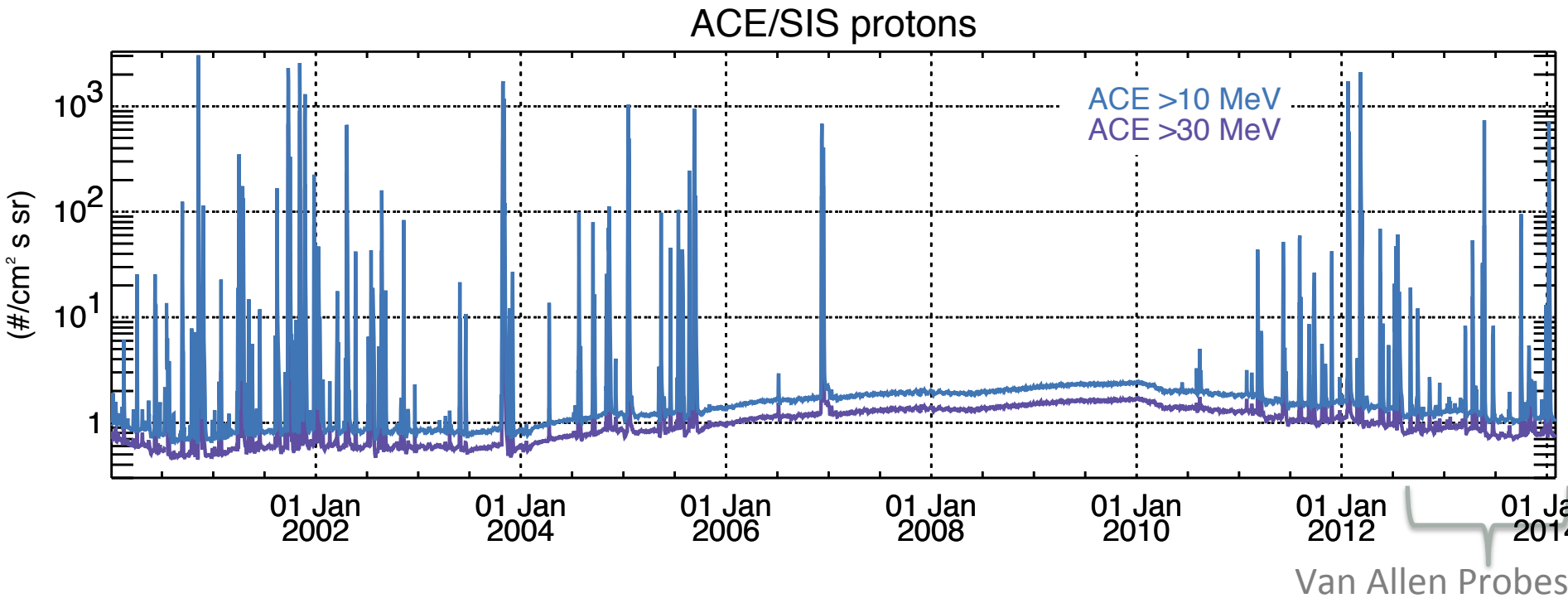


REPT Family Portrait

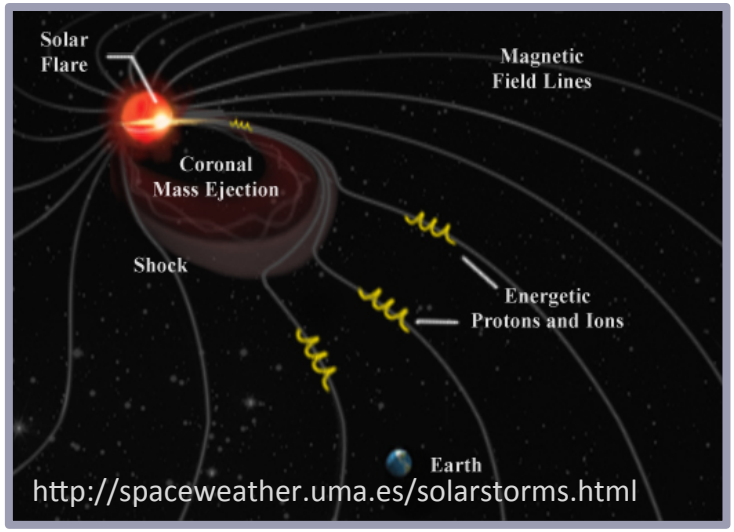
REPT-A & GOES 15



ACE proton measurements – 2000-Current

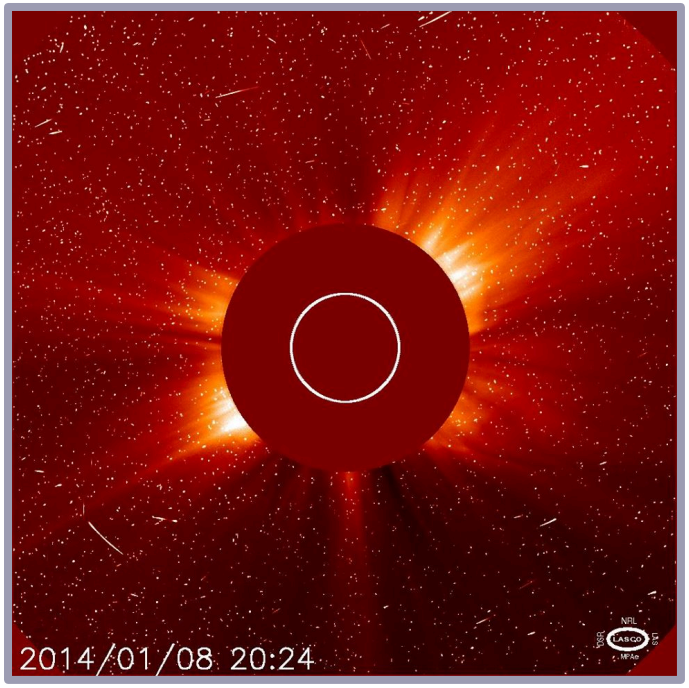


Solar Energetic Proton events



- Protons can be accelerated to very high energies due to solar eruptions
- Follow IMF lines to Earth
- Can reach Earth within a few hours of leaving the Sun
- Enter the magnetosphere and precipitate at the poles, causing problems for Earth-orbiting spacecraft and high-latitude airplane traffic

- Sometimes useful for determining if a CME is Earth-directed since arrival time is much faster than the associated electrons
- Flux seen at Earth will increase over several hours, then decay back to background over days



SOHO LASCO – 08 Jan 2014 SEP