MagEIS Level 2&3 Data Caveats: Data Release 04 ("rel04")

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I. Major updates between rel03 and rel04:

A. Considerable issues with the MagEIS proton measurements have been uncovered, including noise at the lower energies (~60-250 keV; item #6 below) and efficiency-of-detection issues at the higher energies (~250-1200 keV; item #7 below). These issues began in mid-2013. **After that time, the MagEIS proton data should only be used qualitatively and with extreme care.** We recommend using RBSPICE protons instead. Please consult the MagEIS team if you wish to use MagEIS proton measurements.

B. Electron and proton energy channels are no longer time varying in a given daily file. **This may break your data analysis and processing codes** (item #5 below).

C. Revised flux conversions and calibration factors for electrons. The electron energy channel definitions and flux levels have changed (item #7 below).

D. Revisions to the background correction algorithm for the electron data (item #8 below).

E. The electron and proton time tags should be more uniform in the merged/public L2 and L3 data files than was the case in the rel03 files.

F. MagEIS LOW-A data loss in Aug/Sep 2017: An anomaly on MagEIS LOW-A led to a loss of data from 2017/08/21 through 2017/09/25 (item 15 below).

II. MagEIS Summary

There are four MagEIS units on each spacecraft: LOW, M35, M75, HIGH. The LOW and MED (MED=M35 or M75) units are electron spectrometers and only measure electrons. The HIGH units house both an electron spectrometer and a ion telescope, which measures protons. The nominal electron energy ranges for each unit are: LOW=20-200 keV; MED=200-1000 keV; and HIGH=1000-4000 keV. The nominal proton energy range for the telescopes in the HIGH unit is ~60-1000 keV. Each LOW/MED unit contains nine electron detectors ("pixels"), from which the energy channels are obtained (typically seven to nine channels). The HIGH unit electron spectrometers contain four electron pixels, from which seven energy channels are obtained (one channel from the first pixel and two channels each from the remaining three pixels). The primary data products from the HIGH unit ion telescopes produce 20 proton channels from a singe detector. Three of the four MagEIS units on a given spacecraft, LOW, M75, and HIGH, all point 75 degrees with respect to the spacecraft spin-plane, biased in the anti-sunward direction. The fourth unit, M35, points 35 degrees with respect to the spacecraft spin-plane and data from this unit are not included in the public data files, as they are generally redundant with the M75 unit (data from the M35 can be made available upon request). The LOW and HIGH units are on one side of the spacecraft, while the M35 and M75 units are on the opposite side. Deadtime corrections have been performed on all of the electron and proton flux measurements in this release, along with background corrections on the electron data. Please note that background corrections are not always possible - see item #7 below.

Level 2 (L2) Data

The public (aka "merged") level 2 (L2) MagEIS data files combine electron data from three of the four MagEIS units on a given spacecraft: LOW, M75, and HIGH. There are no angular-resolved electron data in the public L2 files – only spin-averaged fluxes ("FESA"). The proton data contains both a spin-averaged ("FPSA") and angular-resolved ("FPDU") flux product. Please note that the angular resolved proton data in the L2 files is a function of spin-phase angle (aka "sector angle," 0-360 degrees), not pitch-angle. If you want to look at electron and/or proton angular distributions, please use the level 3 MagEIS data files, which contain the pitch-angle resolved fluxes. The spin-phase angle variable is called FXDU_Sector_Angle (where X={'E','P'} for electrons or protons) and the value is the spin-phase angle at the beginning of each sector. Background corrected electron fluxes are stored in the "FESA_CORR" variable. Background corrections are never possible on the MagEIS proton data.

Level 3 (L3) Data

The L2 to L3 conversion converts sector angle (e.g., spin-phase angle) into pitch-angle. The public level 3 (L3) MagEIS data files combine electron data from three of the four MagEIS units on a given spacecraft: LOW, M75, and HIGH (as described above for the L2 files). The angular resolved flux variables are called "FEDU" (electron) and "FPDU" (proton). These variables are binned into a fixed number of pitch-angle bins, N, such that $d\alpha = 180°/N$ and the pitch-angle bin edges are given by $\alpha_i = [\ (i\text{-}1)*d\alpha,\ i*d\alpha\ )$ for i=1,2,...,N. Omnidirectional data products ("FEDO" (electron) and "FPDO" (proton)) are not included in this data release but may be in a future data release. Background corrected electron fluxes are stored in the "FEDU_CORR" variables.

Level 2&3 data files from each individual unit, which contain the spin-phase-angle/pitch-angle resolved data, are not part of the publicly available data archive but can be made available upon request. These L3 data files also contain unbinned pitch-angle data (FXDU_Unbinned_*), where the instantaneous sector angle is converted to pitch-angle. Here, the pitch-angle value for each sector corresponds to the pitch-angle at the center of each sector. Half-spin (*_0to180) and full-spin (*_0to360) flux data variables are also available in these files. These unbinned/full-spin pitch-angle data are useful if one wishes to do their own pitch-angle binning, examine non-gyrotropic effects, etc...

III. Known issues and caveats with the L2&L3 data files in this release:

0. Data Quality Issues before January 2013: MagEIS electron data prior to 2012/12/21 should be used with an abundance of caution and only qualitatively. This is due to the large number of instrumental reconfigurations that were performed during commissioning (2012/09/08-2012/10/31) and also bias adjustments that were performed on the LOW/MED in mid-December 2012. The MagEIS electron intercalibrations (e.g., the flux agreement at the overlap energies between MED and HIGH, or between LOW and MED) and the MagEIS-REPT electron cross-calibrations are poor during this early period. After 2012/12/21, the LOW/MED electron data are of much better quality and have improved intercalibrations, whereas the HIGH unit electron data underwent another round of reconfigurations in July-Sept of 2013. This second round of reconfigurations further improved the quality of the HIGH unit electron data and the MagEIS-REPT cross-calibrations (see item #2 below).

1. Noise in LOW/MED Pixels 0 and 1: Pixel 0 and pixel 1 on the 6 LOW/MED units (LOW-A,B; M35-A,B; M75-A,B) are known to be noisy and do not produce valid electron data. This is also leads to a ~15 minute period oscillation in the fluxes from these two pixels, due to the thermal control system, which is purely an instrumental artifact. All data from pixel 0 and pixel 1 should be set to fill in the L2&L3 data files – if you encounter what you believe to be noisy data from pixel0 and pixel1, please contact the MagEIS team at the above email address.

2. Major Changes in HIGHe Logic: Extensive cross-calibration work by the MagEIS and REPT teams led to a major reconfiguration of onboard logic in these units. For the MagEIS HIGH electron data (~1-4 MeV energy range), these changes occurred between 2013/07/03 and 2013/09/26 (specific dates listed below). **MagEIS HIGH electron data acquired prior to the reconfiguration (before 2013/08/03) should be used only for qualitative purposes**. **Data acquired between 2013/07/03 and 2013/08/03 should be used with extreme caution.** These instrumental tunings led to a significant improvement in the MagEIS/REPT **cross-calibration.** We emphasize that extensive tuning was done during this time interval and that any step-function like changes in flux on these days are likely instrumental (non-physical) effects:

- 2013/07/03: HIGHe-A, HIGHe-B (threshold changes).
- 2013/07/18: HIGHe-A, HIGHe-B (threshold changes).
- 2013/07/25: HIGHe-B (threshold changes).
- 2013/07/26: HIGHe-A (threshold changes).
- 2013/08/03: HIGHe-A, HIGHe-B (threshold changes).
- 2013/08/14: HIGHe-A (threshold changes).
- 2013/08/14: HIGHe-A (coincidence window changed from 10 microseconds to 5 microseconds).
- 2013/08/21: HIGHe-A (threshold changes).
- 2013/09/26: HIGHe-A (threshold changes).

We also note that a variety of instrument tests were performed in late May and early June of 2014 on the MagEIS HIGHe units. These were simply instrument diagnostics and did not improve the quality of the data like the ones described above. However, there are some data gaps between 2014/05/23 and 2014/11/07 due to these diagnostic tests and/or invalid commanding:

- 2014/05/23: HIGHe-A, HIGHe-B (coincidence toggling). Coincidence off until 5/28.
- 2014/05/28: HIGHe-A, HIGHe-B (coincidence turned back on).
- 2014/05/29: HIGHe-A (bad threshold – resulted in noise until corrected on 5/31).
- 2014/05/29: HIGHe-B (bad heater set point – resulted in thermal oscillation in pixel 03. Not corrected until 9/18 – data from this detector is set to fill).
- 2014/05/31: HIGHe-A (bad threshold fixed).
- 2014/06/01: HIGHe-A, HIGHe-B (coincidence toggling).
- 2014/06/04: HIGHe-A, (coincidence toggling).
- 2014/06/05: HIGHe-A, HIGHe-B (coincidence toggling).
- 2014/08/06: HIGHe-A (bad heater set point? – thermal oscillation in pixel 01. Not corrected until 11/07 – data from this detector is set to fill).
- 2014/09/18: HIGHe-B (bad heater set point fixed pixel 03).
- 2014/11/07: HIGHe-A (bad heater set point fixed pixel 01).

3. Light Contamination in the HIGHp: When the proton telescopes see the sunlit Earth, it saturates the detectors and the fluxes drop to zero. This typically occurs at low L (L<2.5) and only over part of a spin. The angular-resolved L2 data (FPDU) can be examined to look for this feature. The L3 FPDU data contains a masking array to remove these light-contaminated portions of the orbit but this effect is not accounted for in the L2 FPDU data. These plots show an example of this feature in the MagEIS proton data (**link**).

4. Detector Bias: For instrument testing purposes, the MagEIS electron spectrometers have occasionally been operated in the “Bias Off” configuration for varying periods of time, which corresponds to a low-bias state. **When the bias is off the flux intensities are affected, but the data are not set to fill values, as the data can still be used for qualitative purposes.** The bias state is contained in a variable called BIAS_MODE (see item #9 below).

5. Time-varying Sectoring and Energy Channels: MagEIS energy channels in the L2&L3 files are time-varying, as new look-up-tables (LUTs) can be uploaded to the instruments to optimize the detector performance. In addition, the number of sectors per spin, which can be set via ground command, has changed often throughout the mission to optimize pitch-angle resolution (please

note the number of pitch-angle bins that are used to bin the L3 data should be fixed in time over the course of the mission). The user should be aware of these two features, especially when considering long time-intervals (e.g., months) of data at a time. **However, a major update between rel03 and rel04 is that, within a given daily file, there is now a fixed set of energy channels. The energy channels may change from day-to-day (the dates of such changes are given below), but for a given day the channel definitions are fixed (e.g., the variables FEDU_Energy and FPDU_Energy are no longer time-varying in an individual daily file). If you have a MagEIS data processing code that expects FEDU_Energy/FPDU_Energy to be time-varying, that code will likely break with the rel04 data files.**

The energy channel (LUT) and sectoring changes were much more frequent during the early portions of the missions. Changes in sectoring have occurred periodically throughout the mission, with major changes on:

- 2013/10/04-10 (MagEIS-A and MagEIS-B).
- 2014/06/27 (MagEIS-A and MagEIS-B).

There have not been any changes in the energy channels since August 2013. Changes in the energy channels occurred on the following dates (**link**):

- 2012/09/19 (MagEIS-A and MagEIS-B electrons).
- 2012/09/29 (MagEIS-A and MagEIS-B protons).
- 2012/10/04 (MagEIS-A and MagEIS-B electrons).
- 2012/10/17 (MagEIS-B electrons).
- 2012/10/24 (MagEIS-B electrons).
- 2013/02/24 (MagEIS-A and MagEIS-B electrons).
- 2013/03/31 (MagEIS-A and MagEIS-B electrons; MagEIS-A protons).
- 2013/08/03 (MagEIS-A and MagEIS-B electrons)

6. Noise in Low Energy Proton Channels: The HIGHp proton telescope has noise in the lowest energy channels on both spacecraft. This issue first manifests around 2013/03/17. At that time, a low level of noise is observed in proton channels 00, 01 and 02 (roughly 60, 70, and 80 keV) and this noise increases over time. The noise first appeared in channel 00, then moved into channel 01, and subsequently into channel 02 as time progressed from 2013/03/17 onwards. By October 2014, the noise has moved into the first six (00-05) proton channels. It is believed that the noise is due to radiation damage (ion implant) on the surface of the detector. It has spread and will continue to spread into the higher energy channels as the mission has progressed. **Proton data in the lowest channels (<150 keV) should only be used qualitatively after March 2013.** The MagEIS team has determined that the low energy proton data cannot be used even qualitatively after October 2014. Thus, the first 6 proton channels (~60-140 keV) are set to fill after 2014/10/15. Some plots showing the influence of the noise can be seen here (**link**).

7. Efficiency Decrease in High Energy Proton Channels: The HIGHp proton telescope has appears to have an efficiency decrease in the higher energy channels (e.g., 700-1200 keV). The reason for this decrease in efficiency is currently under investigation, but we believe it may be related to the ion implant damage noted above in item 6. This decrease in efficiency has been occuring for the entire mission on both spacecraft, where a slow steady decrease in proton intensity is observed in the higher energy channels. At this time, we do not believe this slow decrease in flux to be a real geophysical effect. An example of this effect can be seen here (**link**).

8. <u>New Bow-tie Energy Channel Definitions and Efficiency Factors:</u> As part of the on-going MagEIS intercalibration and cross-calibration efforts, the MagEIS team has completed a physics-based simulation of the LOW, M75 and HIGH electron spectrometers using GEANT4. This has resulted in a revised set of energy channels centroids, energy channel widths and efficiency factors for the LOW, M75 and HIGH electron data. **Thus, in rel04, both the flux levels and the energy channel locations have changed for the MagEIS electron data.** The changes are not insignificant. The GEANT4 and bow-tie calculations and are being documented; please consult the MagEIS team if you have immediate concerns and questions. Also, please note that rel03 electron data contained a minor bug in the HIGH unit electron flux conversion factors for all data prior to 2013/08/03. This has been corrected in rel04 and the changes in this regard are minimal. As noted in item #2 above, HIGH electron data prior to 2013/08/03 should only be used qualitatively.

9. <u>Background Contamination and Correction Algorithm:</u> Electron measurements from the MagEIS suite have been corrected for background, when possible. The background corrected variables are described below in item #10. Background arises from several sources, both external and internal to the instruments. Penetrating radiation that reaches the focal planes of the instruments will cause an "event" in the electronics system. This penetrating radiation includes galactic cosmic rays, energetic solar particles, inner zone protons, and bremsstrahlung from the interaction of energetic electrons with the spacecraft. Internal background results from electron backscatter from the silicon focal plane and other scattering events within the magnetic spectrometer itself. The level of instrumental background depends strongly upon several factors, including the intensity of the energetic particles in the radiation belts at a given time, and the location of the Van Allen Probes within the radiation belts. A good rule-of-thumb is that above about 900 keV, electron data in the inner proton belt is highly suspect and likely entirely contaminated by high energy protons. However, background influences all of the MagEIS data at various locations along the orbit. In particular, bremsstrahlung appears to be a major source of background contamination in the LOW/MED units, at energies ~30-500 keV, in regions of space where ~5 MeV electrons are present. Note that the MagEIS HIGH unit proton telescopes are a single parameter measurement and cannot be corrected for background. **It is important to remember the complexity of background removal and that the MagEIS data can never be blindly used.** Please consult *Claudepierre et al., JGR [2015] doi: 10.1002/2015JA021171* before you use background corrected MagEIS data and contact the MagEIS team if you have questions or concerns about how to use these data. **As described in the *Claudepierre et al.* paper, background corrections are not always possible on all of the MagEIS electron channels (for example, when the units are in high rate mode - see Section 5 in the paper for more details).** Finally, the MagEIS team has determined that in the rel03 data, the background correction algorithm was accumulating the background estimate over too long of an interval (10 minutes - see Section 3.3 of *Claudepierre et al.* paper for a discussion of this aspect of the technique). Due to the rapid spacecraft motion at low L, the 10 minute accumulation interval was determined to be too long and led to accumulation over too large of an L range. The accumulation window has thus been reduced to 2.0 minutes in data release rel04, which ensures that the correction algorithm has a resolution dL<=0.1 over the entire orbit. Note that, however, a shorter accumulation window results in a poorer performance of the correction algorithm in regions of space where the corrections are challenging (e.g., for 1 MeV electrons during the rapid transition from the slot region, where both the foreground and background signals are low, into the inner zone, where foreground is low but the background signal is high – see Section 5 in the *Claudepierre et al.* paper).

10. <u>Primary Data Variables</u>:

Level 2 (L2) Data Files:

- ***FESA/FPSA***: spin-averaged, differential electron/proton flux.
- ***FPDU***: unidirectional, differential electron/proton flux. These data are resolved by spacecraft spin-phase angle (e.g. "sector angle", ranging from 0-360 degrees) in the L2 data files (see above).
- ***FESA_CORR***: background corrected electron flux (spin-averaged).
- ***FEDU_Energy/FPDU_Energy***: Energy channel centroids for FESA/FPSA (electron/proton flux).
- ***FEDU_Energy_DELTA_plus/FEDU_Energy_DELTA_minus:*** Upper and lower bounds for the energy channel centroids for FESA (electron flux). Can be used to compute the channel widths.
- ***FPDU_Energy_DELTA_plus/FPDU_Energy_DELTA_minus***: Upper and lower bounds for the energy channel centroids for FPSA (proton flux). Can be used to compute the channel widths.
- ***FESA_CORR_ERROR:*** Percent error in the background corrected electron data (spin-averaged). See item #12.
- ***FESA_ERROR:*** Percent error in the uncorrected electron data (spin-averaged). See item #12.
- ***FPSA_ERROR:*** Percent error in the proton data (spin-averaged). See item #12.
- ***FPDU_ERROR:*** Percent error in the proton data (sector-angle resolved). See item #12.
- ***FESA_Quality:*** 3-value quality flag (spin-averaged electrons): 0=green, 1=yellow, 2=red. See item #11.
- ***FPSA_Quality:*** 3-value quality flag (spin-averaged protons): 0=green, 1=yellow, 2=red. See item #11.
- ***FPDU_Quality:*** 3-value quality flag (sector-angle resolved protons): 0=green, 1=yellow, 2=red. See item #11.
- The following housekeeping variables are only in the unit-by-unit (non-public) level 2 data:
    1. ***BIAS_MODE:*** Flag to indicate whether or not the electron detectors are in the normal-bias or low-bias state (0=low bias; 1=normal bias). In the low-bias state, the electron fluxes should only be used qualitatively, and with caution.
    2. ***INSTRUMENT_MODE:*** Flag to indicate the mode of the MagEIS instruments (0=maintenance; 1=science; 2=high rate). Only the LOW and MED (~20-1000 keV) can go into high rate mode. The HIGH unit (~850-4000 keV), can only be in maintenance or science mode. The most common reason why background corrections cannot be done (e.g. FESA_CORR, FEDU_CORR are fill) is when the LOW and/or MED units are in high-rate mode.
    3. ***COINCIDENCE_MODE:*** Flag to indicate whether or not the electron coincidence is enabled (0=disabled; 1=enabled). This variable is only defined for the HIGH unit (850-4000 keV), as this is the only MagEIS unit with coincidence. In the disabled coincidence state, the fluxes should only be used qualitatively, and with caution.

Level 3 (L3) Data Files:

- ***FEDU/FPDU***: unidirectional, differential electron/proton flux. These data are resolved by pitch-angle in the L3 data files (electrons and protons).
- ***FEDU_CORR***: background corrected electron flux (pitch-angle resolved).
- ***FEDU_Energy/FPDU_Energy***: Energy channel centroids for FEDU/FPDU (electron/proton flux).

- ***FEDU_Energy_DELTA_plus/FEDU_Energy_DELTA_minus:*** Half-way point (in log10(Energy)) between the centers of each channel for FEDU (electron flux). **NOTE** that these are **NOT** the upper and lower bounds for the energy channel centroids for FEDU, as is the case for the level 2 files and thus they **CANNOT** be used to compute the channel widths.
- ***FPDU_Energy_DELTA_plus/FPDU_Energy_DELTA_minus***: Half-way point (in log10(Energy)) between the centers of each channel for FPDU (proton flux). **NOTE** that these are **NOT** the upper and lower bounds for the energy channel centroids for FEDU, as is the case for the level 2 files and thus they **CANNOT** be used to compute the channel widths.
- ***FEDU_CORR_ERROR:*** Percent error in the background corrected electron data (pitch-angle resolved). See item #12.
- ***FEDU_ERROR:*** Percent error in the uncorrected electron data (pitch-angle resolved). See item #12.
- ***FPDU_ERROR:*** Percent error in the proton data (pitch-angle resolved). See item #12.
- ***FEDU_Quality:*** 3-value quality flag (sector/pitch-angle resolved electrons): 0=green, 1=yellow, 2=red. See item #11.
- ***FPDU_Quality:*** 3-value quality flag (sector/pitch-angle resolved protons): 0=green, 1=yellow, 2=red. See item #11.

11. Data Quality Flags: The L2 files contain a RED/YELLOW/GREEN data quality flags that the user should consult when undertaking any study using MagEIS data. The L3 files do not contain a data quality flag in this release. However, the L2 data quality flags can be used as a guide. These variables are called FESA_Quality* for the spin-averaged electron data; FPSA_Quality* for the spin-averaged proton data; and FPDU_Quality for the sectored-resolved proton data. There are three possible values:

    0) *GREEN: There are no known issues with the data.*
    1) *YELLOW: Data should be used with caution.* Examples include: background corrections could not be performed** (electrons only); low counts, large backgrounds (electrons only), or both; detector coincidence was disabled (HIGHe only); deadtime correction was not performed; calibration tunings.
    2) *RED: Data is highly suspect and should be used with extreme care*. Examples include: very low counts, very large backgrounds (electrons only), or both; detector bias was disabled (i.e., in the low-bias state); large deadtimes (>40%); noisy channels.

    *The spin-averaged RED/YELLOW/GREEN quality flag (e.g. FESA_Quality) takes the most frequently occurring value of the sectored RED/YELLOW/GREEN quality flag (e.g. FEDU_Quality) in a given spin. For example, if there are 4 sectors/spin, and FEDU_Quality = [0,0,1,2] in that spin, the FESA_Quality = 0 for that spin.

    **Background corrections cannot always be performed (e.g. the unit was in high rate mode – see Section 5 in *Claudepierre et al., JGR [2015] doi:10.1002/2015JA021171).*

12) Error Due to Counting Statistics: When the count rates are low there is of course a significant statistical uncertainty in the MagEIS measurements. There is a variable included in the L2&L3 files (FESA_ERROR/FEDU_ERROR for electrons; FPSA_ERROR/FPDU_ERROR for protons) that can be used to quantify this counting statistics error. The percent error due to counting

statistics is computed as (see *Claudepierre et al., JGR [2015] doi:10.1002/2015JA021171)*:

% error = 100 * [sqrt(1+C)/C].

where C is the counts accumulated over the integration time. Thus, the one count level corresponds to 141% error in the uncorrected error variables (FXSA_ERROR/FXDU_ERROR where X={'E','P'}). For the electron data, these percent error variables **are computed from the uncorrected data and they should not be confused with the percent error variables for the background corrected data** (FESA_CORR_ERROR/FEDU_CORR_ERROR), which also include error terms due to background contamination (see *Claudepierre et al., JGR [2015])*. FESA_CORR_ERROR/FEDU_CORR_ERROR can be considerably larger than FESA_ERROR/FEDU_ERROR due to backgrounds. If you are after the one count level for electrons, you must use FESA_ERROR/FEDU_ERROR , and not FEDU_CORR_ERROR.

13) Thermal Oscillation in HIGHe Data: The MagEIS-HIGHe data is sensitive to temperature, with the yoke temperature maintained by an active thermal control system. When the yoke temperature gets too low, the count rates dropout and are not valid. The reason for this is not fully understood. It appears to affect only some HIGHe pixels (likely related to the individual pixel threshold settings). There have been two long time intervals (noted above it item #2) where the temperature periodically dipped below the nominal range, resulting in brief (~5 minute) flux dropouts at the thermal control period (~60 minutes). These data are set to fill during these time intervals but can be made available upon request: HIGHe-B, pixel 03 (~3.2 and 4.0 MeV channels) from 2014/05/29-2014/09/18; HIGHe-A pixel 01 (~1.2 and 1.5 MeV channels) on the following: 2014/08/06-2014/11/07; 2016/11/26-2016/12/06; 2017/10/04-2017/10/12; 2017/12/27-2018/01/03; 2018/03/24-2018/04/11.

14) Detector Failure on HIGHe-A: At ~1125 UTC on 2013/10/02, pixel 00 failed on HIGHe-A. Post-failure analysis revealed a slow buildup of noise that occurred over ~6 months preceding the failure. The root cause has yet to be determined. This failure results in the loss of the ~1 MeV channel from HIGHe-A after this time. This channel is redundant with the highest energy channel on the MED units, thus the impact is minimal.

15) MagEIS LOW-A data loss in Aug/Sep 2017: On 2017/08/21, MagEIS LOW-A (20-210 keV) suffered an anomaly that prevented proper commanding of the unit. The anomaly was believed to be due to a single-event upset (SEU) that was ultimately cleared by rebooting the instrument. The impact of the anomaly on the commanding resulted in a full loss of the science mode data from 2017/09/05 through 2017/09/25. There is intermittent (but sparse) science mode data from 2017/08/21 through 2017/09/04.

IV. Abbreviations

LOW	The MagEIS low energy electron (~20-200 keV) spectrometers (e.g. LOW-A and LOW-B)
MED	The MagEIS medium energy electron (~200-1000 keV) spectrometers (e.g. M35-A, M35-B, M75-A and M75-B).
HIGH	The MagEIS high units (e.g. HIGH-A and HIGH-B). Each unit contains both an electron spectrometer and a proton telescope.
HIGHe	The MagEIS high energy electron (~1000-4000 keV) spectrometers.

HIGHp	The MagEIS proton telescope (~60-1000 keV).
FESA/FPSA	Spin-averaged, differential electron/proton flux.
FEDU/FPDU	Unidirectional, differential electron/proton flux. These data are resolved by spacecraft spin-phase angle (e.g. “sector angle”, ranging from 0-360 degrees) in the L2 data files (protons only – see above), and resolved by pitch-angle in the L3 data files (electrons and protons).
FEDO/FPDO	Omnidirectional, differential electron/proton flux. Not available in this data release.