MagEIS High Rate (aka sample mode, burst mode) User's Guide

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1. Summary

MagEIS High Rate (HR) mode data is a high-angular resolution electron data product. For example, normal mode MagEIS data is recorded in anywhere from 20 to 64 angular sectors per spacecraft spin, where the number of sectors is configurable via ground command (since 27 June 2014, normal mode MagEIS data has been output at the highest possible angular resolution of 64 sectors per spacecraft spin). In addition to normal mode data, the low energy ("LOW" 20-200 keV) and medium energy ("M35" or "M75" ~200-1000 keV) MagEIS units can also be commanded into HR mode, at the expense of the histogram data (which means that background corrections are not possible when a unit is in HR mode). In HR mode, MagEIS data is recorded in anywhere from 20-2048 sectors per spin. Typical operations only record data from one unit (usually LOW-A) above L=4 (so background corrections are still possible in the inner zone) at 500 sectors per spin. There are select periods where multiple units are in HR mode simultaneously; where even higher angular sampling is available (1000-2000 sectors per spin); and where HR data is recorded in the inner zone. The HIGH unit (1-4 MeV) cannot go into HR mode (only LOW and MED), so ~1 MeV is the highest energy available. See mageis_instrument_mode.pdf for the specific times when the various MagEIS units are in HR mode.

2. Level 3 Data Files/Variables

The following variables in the level 3 (L3) HR data files should be used for analysis:

Epoch: Time array in CDF_EPOCH format.
FEDU_Energy: Channel number from 0-7. Note that this is not the energy centroid – it is simply a number that ranges from 0 to 7 (see below for the actual energy channel definitions). There are 8 possible HR channels but typically fewer than 8 channels are recorded (e.g., 3, 5, or 7).
HighRate_Alpha360: Instantaneous, full-spin pitch angle (0-360 degrees) for each sector. There are 2048 possible HR sectors but typically fewer than 2048 sectors are recorded (e.g., 500, 1000, or 2000). The pitch angle is given at the center of each angular sector. The array dimensions are ntime x 2048 so that, for a fixed time index, the first value corresponds to pitch angle at the center of the first sector in the spin, the second value corresponds to pitch angle at the center of the second sector in the spin, and so on.
HighRate: Count rate in each energy channel and each angular sector (see below for the conversions to flux). The array dimensions are ntime x 2048 x 8 (e.g., ntime x nsectors_max x nchannels_max). If less than 8 channels are recorded, then the count rates from the unused channels are set to fill. If less than 2048 sectors are recorded, then the count rates from the unused sectors are set to fill.

3. Energy Channel Definitions and Flux Conversions

The MagEIS team has produced energy channel definitions and flux conversion factors based on bow-tie calculations, given below. However, these have not been validated and users that need to convert count rates to flux should (1) consult the MagEIS team and (2) compare with the normal mode data to validate the conversions given below. To convert to flux, take the count rates ("HighRate") and divide by the G0dE value (=epsilon*G*dE) to get the flux. G0dE is determined via bow-tie analysis, where epsilon is the efficiency, G is the geometric factor and dE is the energy channel width. The conversion factors for each unit are given below. Please pay particular attention to the "DATES USED" field, as different look-up tables have been used throughout the mission, which results in different energy channel definitions and conversion factors. In the listing of conversion factors below, the energy

channel centroids, low, and high bounds are given by E0, Elow, and Ehigh, respectively.

4. Comparisons with Normal Mode Data

The MagEIS team has conducted a VERY preliminary initial comparison for a selection of the LOW unit bowtie flux conversion factors given below (see mageis_compare_highrate.pdf). In general, the HR and normal mode pitch-angle distributions show similar shapes and similar intensity levels. However, one important finding is that there is often considerable counting statistics error in the HR data. This is visible as the scatter in the HR fluxes and the discretization levels (e.g., the one, two, three,... count levels), which is clearly seen in some of the plots.

5. Energy Channel Definitions and Flux Conversion Factors

UNIT: LOW-A
LUTID: 16899 (Uses 7 channels, instead of 3)
DATES USED: 2013/07/12 to present
BOWTIE FILENAME: rbsp_mageis_low_101_1065_HR_16899_bowtie.txt
E0 (keV)=[34,54,78,108,143,182,223];
G0dE (keV cm^2 sr)=[4.13E-2,5.73E-2,6.056E-2,6.88E-2,7.35E-2,6.90E-2,5.98E-2];
Elow (keV)=[29,46,68,95,126,164,206];
Ehigh (keV)=[41,66,92,126,164,204,247];

UNIT: LOW-A
LUTID: 16898
DATES USED: 2013/04/04 to 2013/07/11
BOWTIE FILENAME: rbsp_mageis_low_101_1065_HR_16898_bowtie.txt
E0 (keV)=[34,62,129];
G0dE (keV cm^2 sr)=[3.77E-2,0.112,0.208];
Elow (keV)=[29,46,95];
Ehigh (keV)=[40,92,247];

UNIT: LOW-A
LUTID: 16897
DATES USED: 2012/12/23 to 2013/04/03
BOWTIE FILENAME: rbsp_mageis_low_101_1065_HR_16897_bowtie.txt
E0 (keV)=[36,62,128];
G0dE (keV cm^2 sr)=[5.93E-2,0.120,0.190];
Elow (keV)=[29,46,95];
Ehigh (keV)=[46,95,236];

UNIT: LOW-B
LUTID: 18947 (Uses 7 channels, instead of 3)
DATES USED: 2013/07/12 to present
BOWTIE FILENAME: rbsp_mageis_low_102_1020_HR_18947_bowtie.txt
E0 (keV)=[32,51,74,101,132,168,208];
G0dE (keV cm^2 sr)=[4.33E-2,5.41E-2,5.926E-2,6.605E-2,6.460E-2,6.23E-2,5.96E-2];
Elow (keV)=[27,43,63,88,117,152,193];
Ehigh (keV)=[39,63,88,117,150,188,231];

UNIT: LOW-B
LUTID: 18946

DATES USED: 2013/04/03 to 2013/07/11
BOWTIE FILENAME: rbsp_mageis_low_102_1020_HR_18946_bowtie.txt
E0 (keV)=[32,58,121];
G0dE (keV cm^2 sr)=[4.56E-2,0.107,0.202];
Elow (keV)=[27,42,88];
Ehigh (keV)=[40,87,231];

UNIT: LOW-B
LUTID: 18945
DATES USED: 2012/12/23 to 2013/04/03
BOWTIE FILENAME: rbsp_mageis_low_102_1020_HR_18945_bowtie.txt
E0 (keV)=[35,60,117];
G0dE (keV cm^2 sr)=[4.72E-2,0.104,0.16];
Elow (keV)=[28,44,88];
Ehigh (keV)=[43,87,208];

UNIT: M35-A
LUTID: 20994 (Uses 7 channels, instead of 3)
DATES USED: 2015/09/16 to present
BOWTIE FILENAME: rbsp_mageis_med_201_HR_20994_bowtie.txt
E0 (keV)=[230,334,454,584,724,879,1031];
G0dE (keV cm^2 sr)=[0.308,0.322,0.324,0.307,0.2835,0.252,0.202];
Elow (keV)=[189,285,392,515,654,802,963];
Ehigh (keV)=[275,387,515,654,802,963,1116];

UNIT: M35-A
LUTID: 20993
DATES USED: 2013/04/04 to 2015/09/15
BOWTIE FILENAME: rbsp_mageis_med_201_HR_20993_bowtie.txt
E0 (keV)=[260,492,802];
G0dE (keV cm^2 sr)=[0.606,0.607,0.683];
Elow (keV)=[189,392,654];
Ehigh (keV)=[387,646,1116];

UNIT: M35-A
LUTID: 20992
DATES USED: 2012/12/23 to 2013/04/03
BOWTIE FILENAME: rbsp_mageis_med_201_HR_20992_bowtie.txt
E0 (keV)=[146,288,684];
G0dE (keV cm^2 sr)=[0.319,0.967,0.944];
Elow (keV)=[112,189,515];
Ehigh (keV)=[189,515,1116];

UNIT: M35-B
LUTID: 39426 (Uses 7 channels, instead of 3)
DATES USED: 2015/09/16 to present
BOWTIE FILENAME: rbsp_mageis_med_202_1030_HR_39426_bowtie.txt
E0 (keV)=[246,354,475,604,749,909,1066];
G0dE (keV cm^2 sr)=[0.333,0.339,0.325,0.309,0.2684,0.240,0.195];

Elow (keV)=[200,298,415,539,684,840,1007];
Ehigh (keV)=[298,410,539,677,821,985,1142];

UNIT: M35-B
LUTID: 39425
DATES USED: 2013/04/04 to 2015/09/15
BOWTIE FILENAME: rbsp_mageis_med_202_1030_HR_39425_bowtie.txt
E0 (keV)=[279,515,830];
G0dE (keV cm^2 sr)=[0.650,0.612,0.649];
Elow (keV)=[200,415,684];
Ehigh (keV)=[410,677,114];

UNIT: M75-A
LUTID: 25091 (Uses 5 channels, instead of 3)
DATES USED: 2013/07/14 to present
BOWTIE FILENAME: rbsp_mageis_med_301_1020_HR_25091_bowtie.txt
E0 (keV)=[238,346,465,646,952];
G0dE (keV cm^2 sr)=[0.323,0.327,0.328,0.571,0.449];
Elow (keV)=[196,295,405,533,821];
Ehigh (keV)=[285,401,533,821,1142];

UNIT: M75-A
LUTID: 25090
DATES USED: 2013/04/04 to 2013/07/13
BOWTIE FILENAME: rbsp_mageis_med_301_1020_HR_25090_bowtie.txt
E0 (keV)=[269,509,821];
G0dE (keV cm^2 sr)=[0.633,0.616,0.679];
Elow (keV)=[196,405,669];
Ehigh (keV)=[396,661,1142];

UNIT: M75-A
LUTID: 25089
DATES USED: 2012/10/09 to 2013/04/03
BOWTIE FILENAME: rbsp_mageis_med_301_1020_HR_25089_bowtie.txt
E0 (keV)=[272,509,821];
G0dE (keV cm^2 sr)=[0.687,0.647,0.712];
Elow (keV)=[196,405,669];
Ehigh (keV)=[405,669,1129];

UNIT: M75-B
LUTID: 27139 (Uses 5 channels, instead of 3)
DATES USED: 2013/07/13 to present
BOWTIE FILENAME: rbsp_mageis_med_302_1030_HR_27139_bowtie.txt
E0 (keV)=[243,350,470,654,941];
G0dE (keV cm^2 sr)=[0.330,0.333,0.321,0.561,0.387];
Elow (keV)=[200,298,415,539,840];
Ehigh (keV)=[292,405,533,821,1116];

UNIT: M75-B

LUTID: 27138
DATES USED: 2013/04/04 to 2013/07/12
BOWTIE FILENAME: rbsp_mageis_med_302_1030_HR_27138_bowtie.txt
E0 (keV)=[275,515,821];
G0dE (keV cm^2 sr)=[0.627,0.617,0.619];
Elow (keV)=[200,415,684];
Ehigh (keV)=[405,669,1116];

UNIT: M75-B
LUTID: 27137
DATES USED: 2012/12/23 to 2013/04/03
BOWTIE FILENAME: rbsp_mageis_med_302_1030_HR_27137_bowtie.txt
E0 (keV)=[275,515,821];
G0dE (keV cm^2 sr)=[0.679,0.638,0.628];
Elow (keV)=[200,410,684];
Ehigh (keV)=[410,677,1103];