7.0 Version Release Notes

Release 3.3.z

New Features

- Three variables to DIS moments files for background radiation estimates
    - dis_spectr_bg: Background differential energy flux by energy bin
    - dis_numberdensity_bg: Background number density
    - dis_pres_bg: Background pressure
- Added error flag (bit 13) if significant penetrating radiation
- Ability to process separate solar wind ROI
- Added global attributes to document whether low/high energy extrapolation is enabled
    - Low_energy_extrapolation
    - High_energy_extrapolation

Bug Fixes

- Low energy extrapolation for DIS has been disabled
- Updates to spacecraft potential correction

Release 3.2.z

New Features

- Processing of FPI slow survey data
- Spintone estimator for DES and DIS (burst and fast survey)
- **Compensation for DIS008 anomaly (MMS3) in burst and fast survey data
- Incorporate Phase 2B energy profiles and photoelectron models
- Add global attributes to enable reproducible moments

Bug Fixes

- Directional spectrograms now in flow direction
- Clarify particle direction in spectrogram metadata
- Fix CATDESC attribute for moments pressure/temperature variables
- Fix phi_delta values in distribution files
- Add DELTA_<PLUS|MINUS>_VAR attributes to DIS burst energy variable
- Add missing attributes to DEPEND_i variables in distribution files

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Release 3.1.z

Delta release to correct one inconsistency across data products

- imposed uniformity on the application of the energy sweep tables across all data types and products
    - As you know, each FPI data quantity supplied in our CDFs consists of contributions from eight spectrometers. The energy band sampled by each spectrometer at each step is a function of applied voltages (each with their own ground-calibrated error) and great care is spent in balancing the operation of each set of eight spectrometers to yield a uniform energy sweep for the ensemble. This release ensures all products and types are processed using the same tables, as updated for Phase 1B operations.
    - This fix should not affect data quality. Any differences between this and previous releases (e.g., v3.0z) should not be discernible within the error margins already inherent to the system. Please report instances that appear otherwise.

Previous Limitations Corrected

Some Phase 1A FPI L2 DES/DIS v 3.1.0 fast survey moments (des-moms and dis-moms) inadvertently did not include optimal spacecraft potential correction. These data have been replaced (as of 15Nov2016) and are designated as v. 3.1.1 files. The dates of the affected moments files are:

- 2016-01-01 - 2016-01-12
- 2016-02-01 - 2016-02-15
- 2016-03-01 - 2016-03-08

Known Limitations to be addressed in future data release

GSE-Referenced Directional Spectrograms: The data for the six directional spectrogram variables in the FPI DES/DIS v3.1.0 burst and fast survey moments files (des-moms and dis-moms) do not match their respective VAR_NOTES descriptions nor do they match the data standard released with the v2.1 CDF files. The issue is "plasma flow" direction versus "detector look" direction; that is, the VAR_NOTES descriptions and the FPI data standard set with v2.1 dictate flow direction, while the v3.1 spectrograms are detector look direction with respect to GSE. In order to maintain consistency with FPI v. 2.1 you may switch the _px (plus x) variable with that labeled _mx (minus x), _py with _my, and _pz with _mz, where px indicates the plus GSE x direction, mx indicates the minus GSE x direction and similiarly for py, my, pz, mz. This applies for Release 3.1.z only. These are less frequently used variables and will be corrected in release (v3.2). We thank Ali Varsani for bringing this to our attention. The affected variables are:

- energyspectr_px
- energyspectr_mx
- energyspectr_py
- energyspectr_my
- energyspectr_pz
- energyspectr_mz

Note that the pitch-angle distributions (*_pitchangdist_*) are ***not*** similarly affected.

Release 3.0.z

Second major release of research-grade L2 data products

New Features

- Added temp/pres matrices and bulkv/heatq vectors. Removed individual component variables.
- Adjust existing spectrograms to make them non-overlapping
- Addition of omni-directional differential energy flux variable
- Population of GSE coordinate variables to complement DBCS
- Population of CDF global attributes
- Increased compliance with MMS CDF Format Guide
- Record varying step energy tables
- Removal of spherical vectors (azimuth, elevation, bulkspeed, heat flux)
- Delta plus and minus variables for energies and angles
- Addition of density extrapolation values
- Properly set Z variable of CDF file version

Bug Fixes

- Fixed bit-11 of errorflags to properly reflect compression error. Noted in metadata.
- Fixed DES bursts occasional missing maps at end of segment
- Compression loss variable to properly reflect FPI-IDPU-SPEC-0008
- Capped relative moments statistical errors at 100%
- Ensure absolute moment statistical errors are positive
- Fixed DES burst phi targets
- Corrected tpara and tperp in fast survey DES moments occasionally appearing as all zeros
- Metadata corrections (units, SI conversion, valid min/max, variable description, etc.)
- Removal of coordinate system references for number density and bulk speed
- Properly interpolate spacecraft potential for DES burst
- Ensure that density extrapolation values are not negative

Release 2.1.z

Delta release to correct two errors in L2 data products

- The function converting counts to differential flux for the L2 spectrograms has been corrected.
- The occasional nonphysical density values resulting from the removal of the DES photoelectron signal has been resolved.

Known Limitations to be addressed in a future data release

- The temppara and tempperp fields in the DES Fast Survey files are set to zero. The temperature tensor fields (e.g., Txx, Txy, etc...) are unaffected. The tensor can be transformed into magnetic coordinates in order to recover estimates of temppara and tempperp.
- 'GSE' quantities are reported as zero. Use of 'DBCS' should be sufficient for scientific analysis as it differs by ~1-2deg from true GSE.
- Scalar quantities such as density and heatFlux have a coordinate system associated with them. These will be removed for the next release. The 'DBCS' quantity should be used.

Release 2.0.z

First release of research-grade L2 data products

New Features

- Data Quality Flags added
- L2pre Fields data are used for PAD spectrograms and field-aligned moment parameters
- Improvements to moment calculations:
    - spacecraft potential correction applied using L2 spacecraft potential data
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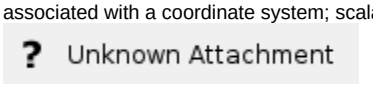
    - spurious DES photoelectron signal (internal) removed
    - NOTE: these are not applied to the skymap data product
- Updated, time-dependent spectrometer response correction tables
    - intra-spectrometer responses balanced
    - inter-spacecraft responses balanced
    - DES/DIS absolute density correction
- Statistical errors are provided for the moment quantities (systematic errors are not yet included).
- Significant development to CDF structures, metadata, attributes, and variable names
- Units of measure now compliant with MMS Units of Measure Standard
- Spectrogram data products are now in units of Differential Energy Flux (eV/cm^2 s sr eV).

Previous Limitations Corrected

- Missing 10s of burst at the end of burst CDFs has been addressed
- Directional energy-time burst spectrograms are now despun consistent with all other spectrograms

Known Limitations to be addressed in a future data release

- The unit field for spectrogram data products is blank and the var_notes in the CDF incorrectly states the unit is counts.
- Statistical errors are erroneously reported with signs. Until resolved, take the absolute value of the reported uncertainties.
- Burst compression status is currently listed as a 1 or 3 instead of a 1 or 0. Until resolved, consider 1 as lossless compression and 3 as lossy compression.
- The temppara and tempperp variables in the Fast Survey moments CDFs are set to zero. This issue does not impact the full temperature tensor. Users should manually project the full tensor onto the magnetic field to recover parallel and perpendicular temperatures from the 4.5 s Fast Survey maps.
- At very low DES densities, when the spurious photoelectron signal is removed, the resulting density value can be obviously nonphysical; do not use FPI density moments when the corresponding quality flag is 1. (Quality Flag bit 7).
- Not all SI conversions are populated in the metadata
- Not all planned Global Attributes are populated
- The bug remains that causes missing (≤5) DES skymaps at the end of some burst files
- The function that converts counts to differential flux for the L2 spectrograms was hard-coded for electron mass. The DIS numbers are therefore a factor of sqrt(1.67e-27/9.11e-31)^4 too high (~3360440 too high). Users of this data parameter will need to divide by this scale factor. This was corrected in v2.1.
- The moment values in GSE coordinates are not yet populated. The values are instead given in separate variables in a despun body coordinate system. True GSE values will be provided in the next data release. As MMS maintains the positive spin axis within ~3 degrees from ecliptic normal during science operations, DBCS may nominally be considered 'near GSE'. When this is corrected, only vector quantities will be associated with a coordinate system; scalar quantities will not, as would be expected.
- 

Release 1.1.z

Delta release to correct an error

- Fixed a bug in the calculation of heat flux in DES/DIS moments data
- Special corrections for 2015-Oct-16 fast survey and burst data
- Burst files are now packaged as single segments. Start date/time is in the file name.

Release 1.0.z

Improved, scientifically useful products; not research grade quality (no L2 products)

Changes/Updates:

- SITL FS: Corrected use of Epoch_FS in fpijob_fast_procsitl.pro line 209, which resulted in pseudo moments appearing saturated or as constants rather than varying in the expected manner.
- Correction table updates, including processing architecture for handling versioning and time-referenced tables
- Update file names and sizes
    - SITL and QL FS contains full ROI, breaking only at day boundaries
    - L1B and L2 FS are 2 hour files, beginning at even 2 hr boundaries
    - QL, L1B, and L2 bursts are 5 minute files, beginning at even 5 min boundaries
    - Modified L1B/L2 CDF file names to better match the SDC file storage structure. Modified other files not stored at SDC with same convention.
- Upgrade to CDF version 3.6
- "time_resolution" attribute values are corrected
- CDF structure changes – compliance with MMS / SPDF conventions
    - Add Energy and angle tables
    - Add the spacecraft potential (set to 0 for release #3) and the file it came from
    - Add Quality flags, including improvements to compression status word
    - Add Delta +/- ; for FPI Minus will be zero and Plus is the interval, 10 on SITL, 4.5 on FS
    - Add labels for units
- Implemented QL product for first time
    - Applied release #1 and #2 changes to QL codes
    - QL burst moments produced using Fast Survey accumulation times.
- Add antiparallel and parallel spectrograms; PAR (all within 30deg PA), ANTIPAR (all from 150-180 PA inclusive), PERP (all from 60-120 PA inclusive)
- Fix units for pressure moments
- Add statistical errors for sky maps
- Correct energy tables

Release 0.2.z

delta release to correct an error

- Deleted correction for spurious photoelectrons in DES/DIS Moment calculations – DID NOT AFFECT BURST PRODUCTS.

Release 0.1.z

First scientifically useful browse products; not research grade quality (no L2 products)

Cautions

- **Temporary correction for spurious photoelectrons in DES:** A temporary correction was applied to the electron moments: v0.1.0 cuts out energies below 100 eV for electrons but includes the point at zero, so that low energies are not completely excluded. The low energy contribution is represented as an interpolation from 100 eV to zero. For the plasma sheet this works well; for the magnetosheath, it introduces errors in the electron density and bulk velocity. The moments should not be interpreted as partial moments between 100 eV and the highest channel, due to the interpolation between [0, 100] eV and between [30, Infinity] keV. This correction was inadvertently applied to the ion moments as well.

Changes since last release

- Spectrometer-specific correction tables applied; corrections are based on in-flight data gathered during May-July special calibration orbits.
- Produces sky maps in near GSE with preliminary corrections (FS and Burst), including sun pulse offset correction
- Preliminary corrections incorporated into moments calculations (Burst, FS, and SITL), data below 100 eV excluded due to internally generated photo electrons
- Correct spacecraft name appears in all fields
- Table Parity field – bursts only
- Fast Survey epoch times agree between DES and DIS

Release 0.0.z

products for health and safety checks only, first viable SITL product, not scientifically valid data

Cautions

- **Corrections and Calibrations:** Version 0.0.x of the data files have only crude ground-testing calibrations/corrections applied. While the data may look quite ordered and the moment quantities somewhat reasonable, none should be used for scientific analysis.