

# SPEDAS / PySPEDAS

Mini-GEM Workshop, December 11, 2022

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# Overview

- Recent IDL Updates
- IDL Examples
- Recent Python Updates
- Python Examples

# Recent IDL Updates

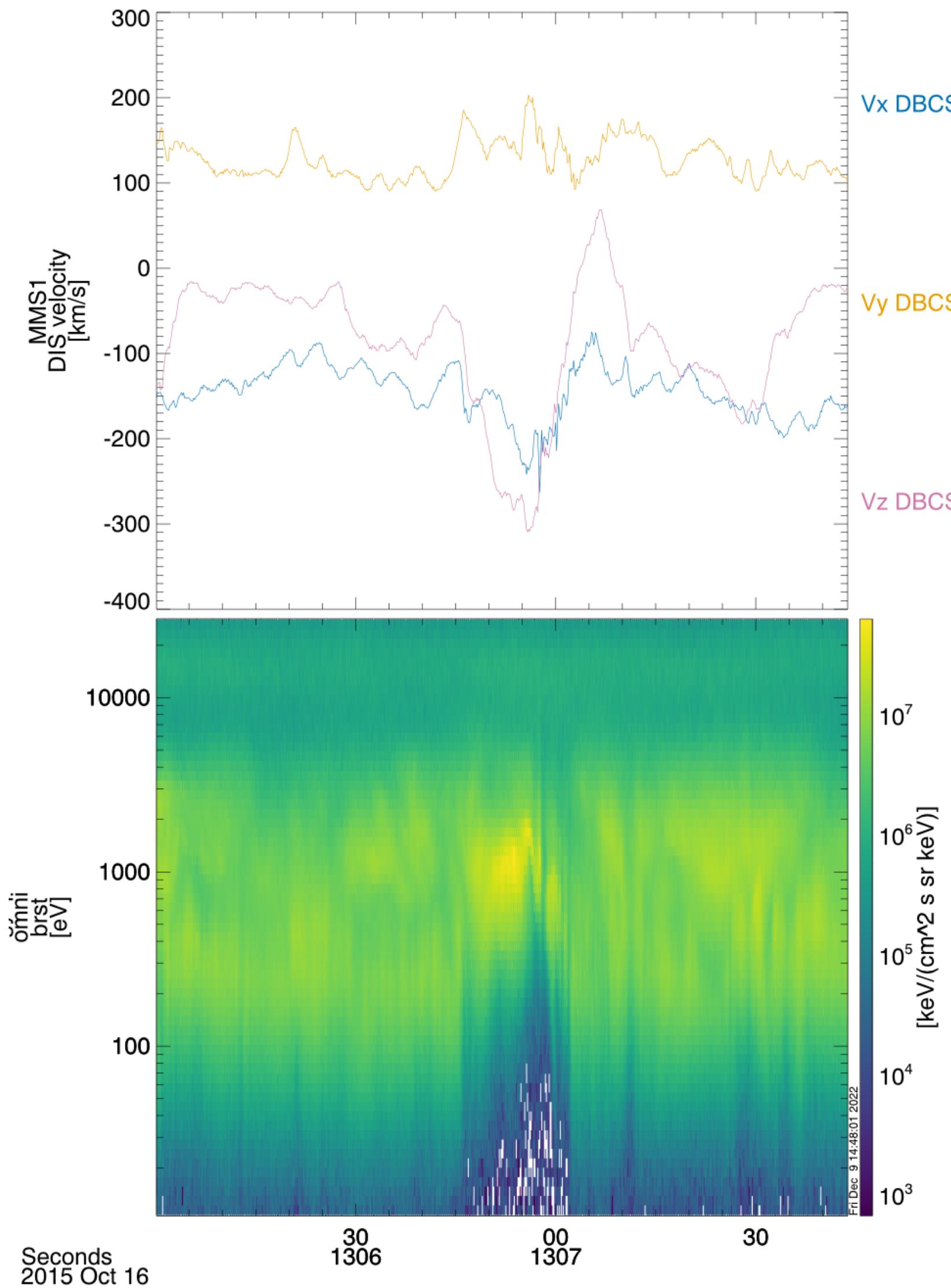
- Added support for recent Tsyganenko magnetic field models (TA 15 / TA 16)
- Improved support for color blind friendly color tables
- Added postscript support for multi-axis tplot figures
- Numerous updates to the SPEDAS GUI for high resolution displays
- Numerous updates to PSP, MAVEN, ELFIN, THEMIS, MMS plug-ins
- For a full list of updates, please see:

<https://spedas.org/changelog/>

# IDL Examples

```
5 ; load some data for the figures
6 mms_load_fpi, trange=['2015-10-16/13:06','2015-10-16/13:08'], probes=[1, 2, 3, 4], datatype='dis-moms', data_rate='brst', /time_clip
7
8 ; example of new colorblind-friendly color tables (1075-1080)
9 options, 'mms1_dis_energyspectr_omni_brst', 'color_table', 1080
10 tplot, 'mms1_dis_energyspectr_omni_brst'
11 stop
12
13 ; change the default line colors to a colorblind-friendly scheme
14 ; color table suggested by https://www.nature.com/articles/nmeth.1618 except for reddish purple
15 ; see also: line_clrs=7 and 8
16 loadct2, 43, line_clrs=9
17 tplot, 'mms1_dis_bulkv_dbcs_brst'
18 stop
19 |
```

# IDL Examples



See the crib sheet for more:

[projects/mms/examples/basic/mms\\_colorblind\\_friendly\\_colors.pro](#)

# Recent Python Updates

- Added support for particle calculations from distribution function data (calculating energy and angular spectrograms, moments, as well as 2D slices)
- Added MMS FPI angle-angle, angle-energy, energy-pitch angle plots
- Added support for several more projects: Akebono, ST5, DE2, LANL plasma analyzers, C/NOFS, Swarm, as well as VirES data
- Added support for querying the available datasets for plug-ins that load data from CDAWeb
- Improved post-processing support (RBSP, PSP, MMS, etc)

# Recent Python Updates

- Added support for several neutral sheet models
- Continuing development of matplotlib version of pytplot
- Recently made significant improvements to plotting times in pytplot (100x faster)
- Added numerous plotting features: annotate, highlight, support for matplotlib styles, etc.
- Added Jupyter notebooks with several plotting examples:

[https://github.com/spedas/pyspedas\\_examples/tree/master/  
pyspedas\\_examples/notebooks](https://github.com/spedas/pyspedas_examples/tree/master/pyspedas_examples/notebooks)

# Recent Python Updates

- Added support for GOES orbit data
- Added support for accessing the MMS burst events database
- Added support for MMS data rate bars, FPI compression/errorflags bars
- Added notebook showing quaternion transformations with SpacePy
- Documentation improvements: HTML docs now have simple copy+paste examples for every instrument
- Numerous test suite improvements

# Recent Python Updates

- PySPEDAS paper(s)

Grimes EW, et al. (2022) The Space Physics Environment Data Analysis System in Python. *Front. Astron. Space Sci.* 9:1020815. doi: 10.3389/fspas.2022.1020815
- Numerous other updates! Follow along on our GitHub page:

<https://github.com/spedas/pyspedas>

# Python Examples

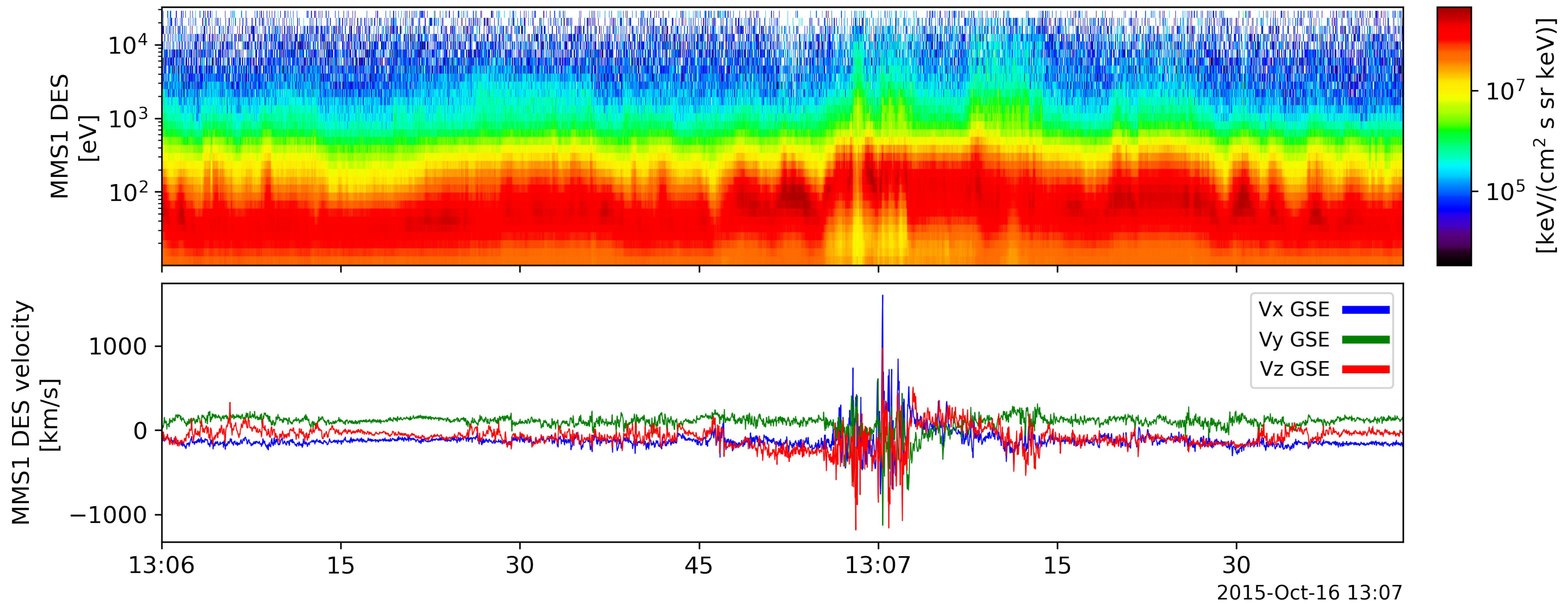
```
import pyspedas

pyspedas.mms.fpi(trange=['2015-10-16/13:06', '2015-10-16/13:08'],
                  probe=1,
                  data_rate='brst',
                  datatype='des-moms',
                  time_clip=True)
```

```
from pytplot import tplot

tplot(['mms1_des_energyspectr_omni_brst', 'mms1_des_bulkv_gse_brst'],
      save_png='simple_ex',
      dpi=300)
```

# Python Examples

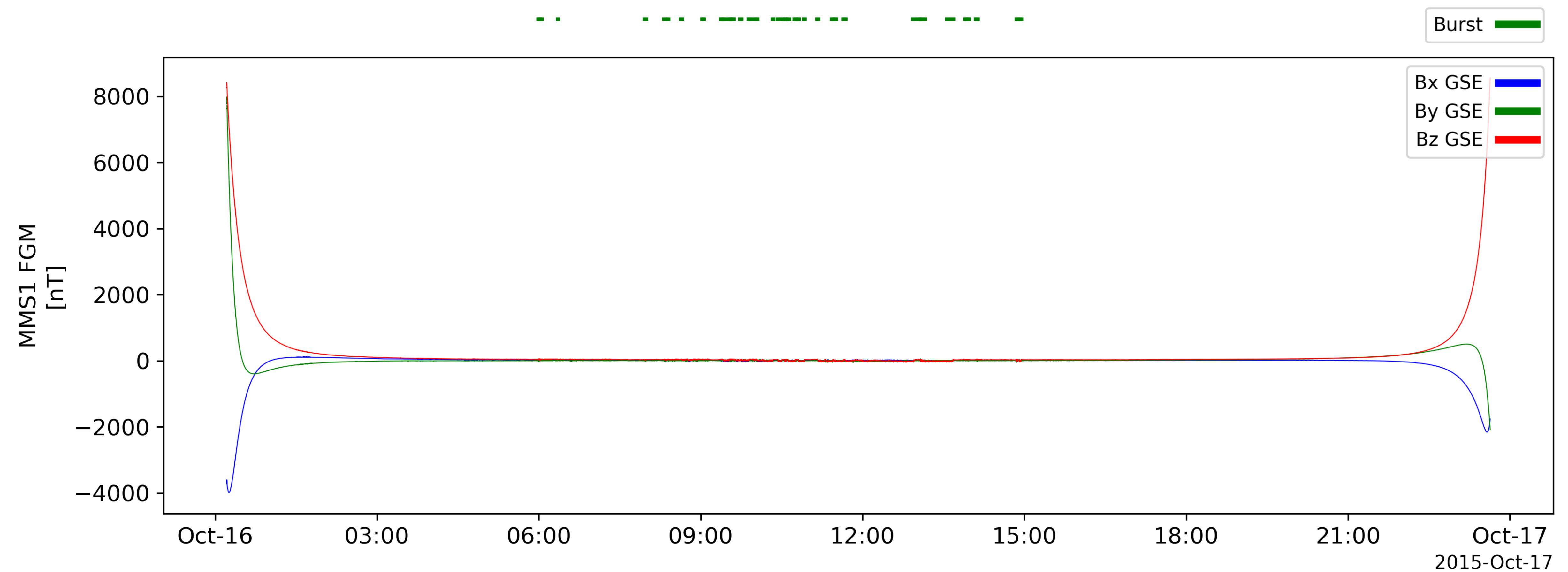


# Python Examples

```
pyspedas.mms.bss(trange=['2015-10-16', '2015-10-17'])  
pyspedas.mms.fgm(trange=['2015-10-16', '2015-10-17'])
```

```
tplot(['mms_bss_burst',  
       'mms1_fgm_b_gse_srvy_12_bvec'],  
      save_png='burst_bar',  
      dpi=300)
```

# Python Examples

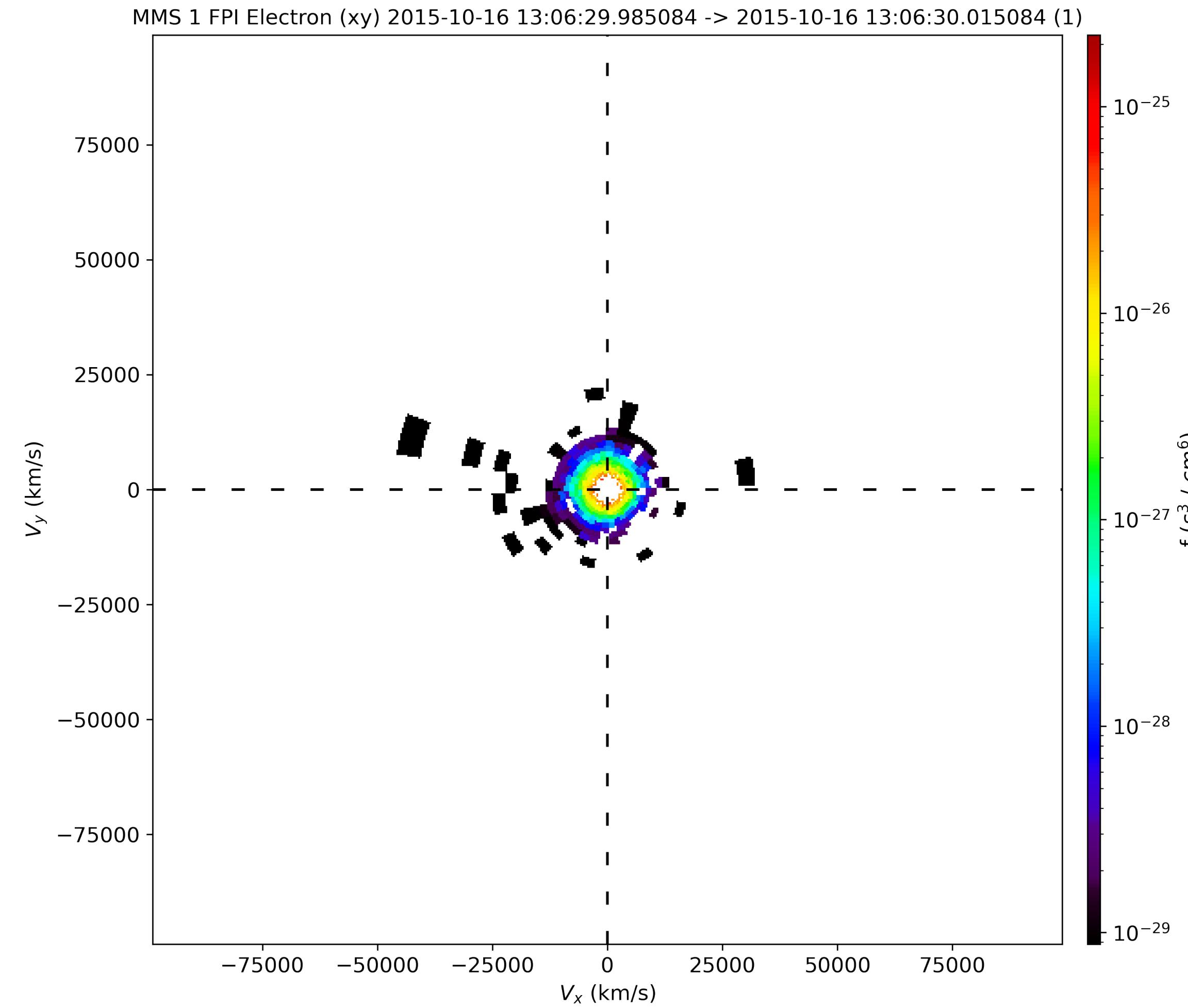


# Python Examples

```
from pyspedas.mms.particles.mms_part_slice2d import mms_part_slice2d

mms_part_slice2d(time='2015-10-16/13:06:30',
                  instrument='fpi',
                  probe=1,
                  species='e',
                  data_rate='brst',
                  save_png='2dslice',
                  dpi=300)
```

# Python Examples



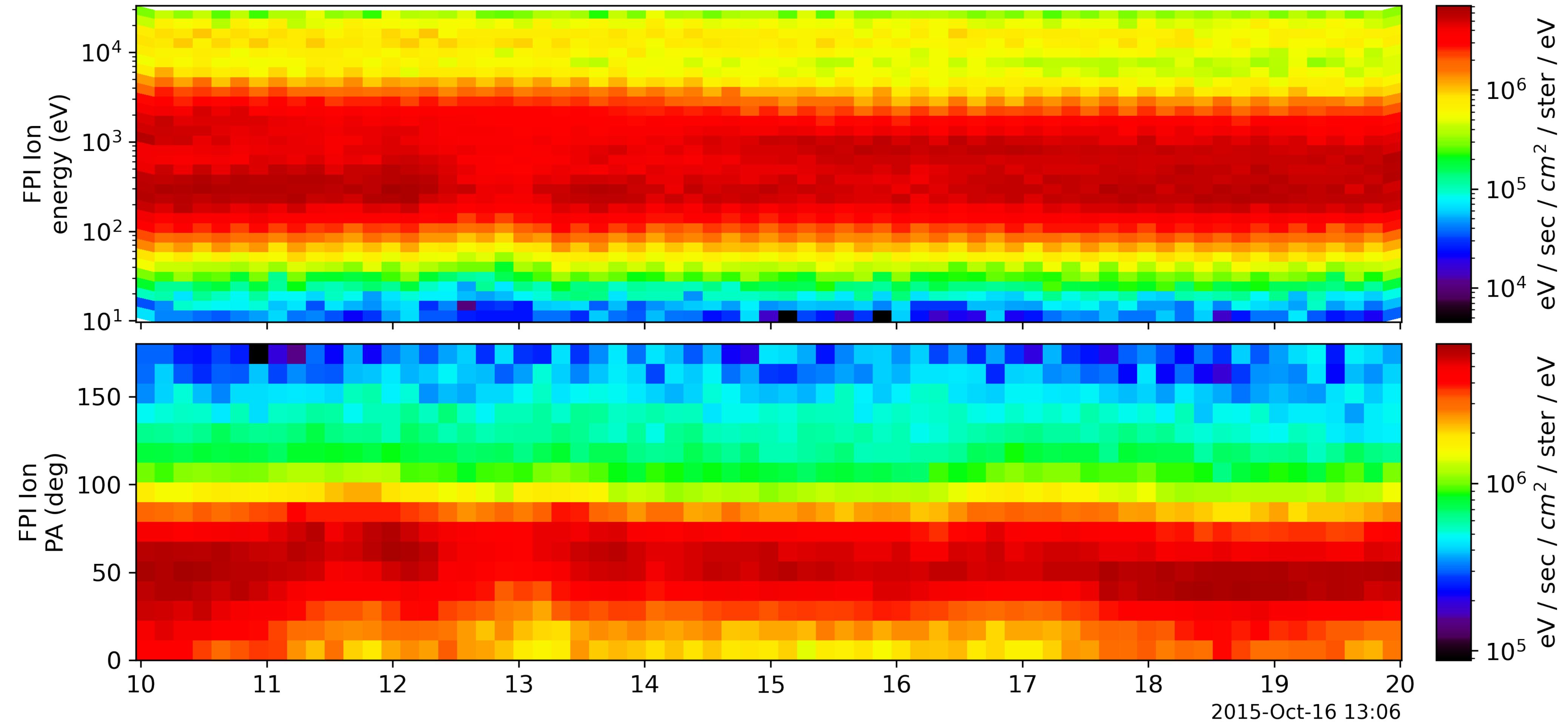
# Python Examples

```
from pyspedas.mms.particles.mms_part_getspec import mms_part_getspec

mms_part_getspec(trange=['2015-10-16/13:06:10', '2015-10-16/13:06:20'],
                  instrument='fpi',
                  species='i',
                  probe=1,
                  data_rate='brst')
```

```
tplot(['mms1_dis_dist_brst_energy',
       'mms1_dis_dist_brst_pa'],
      save_png='getspec',
      dpi=300)
```

# Python Examples

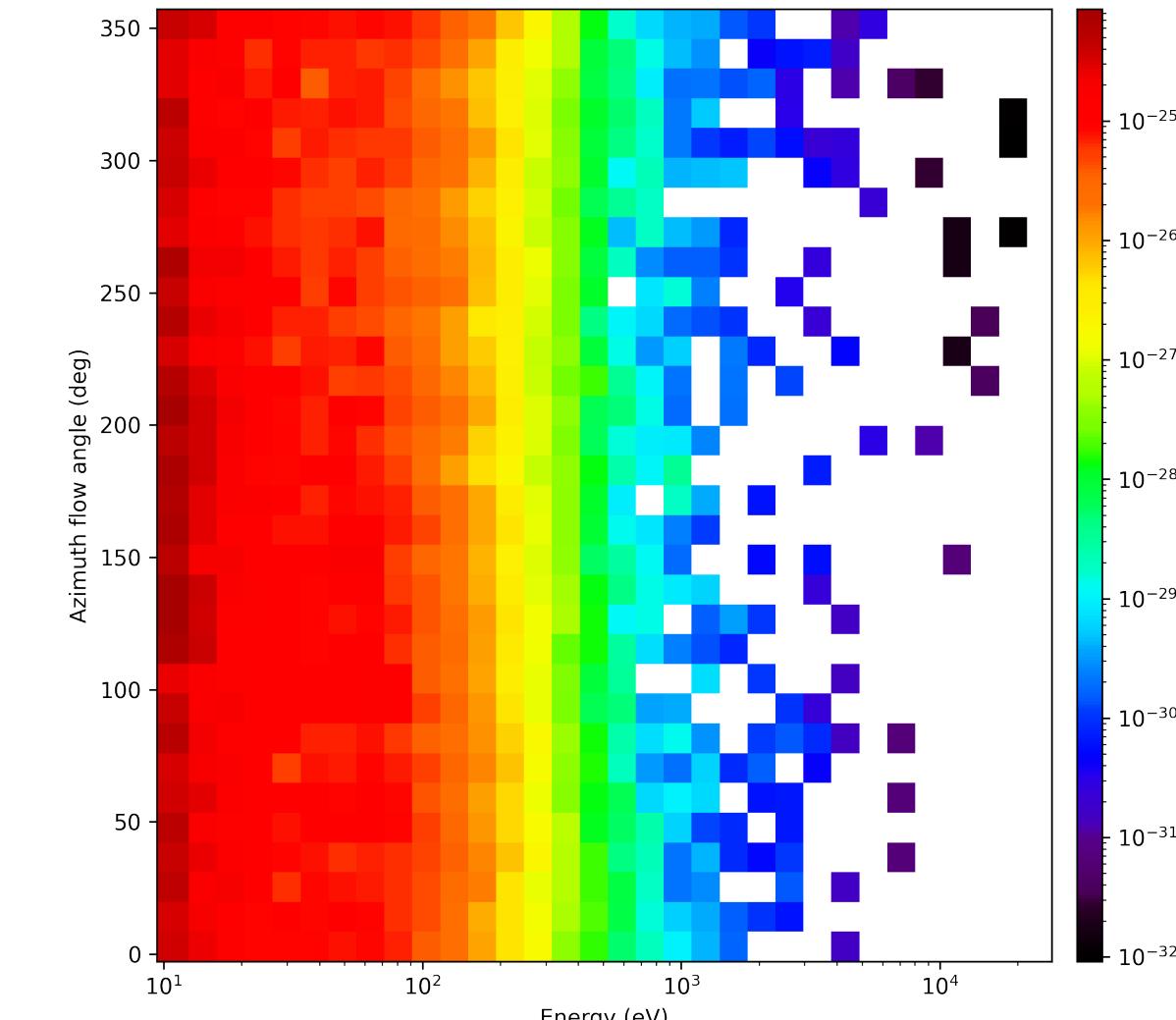
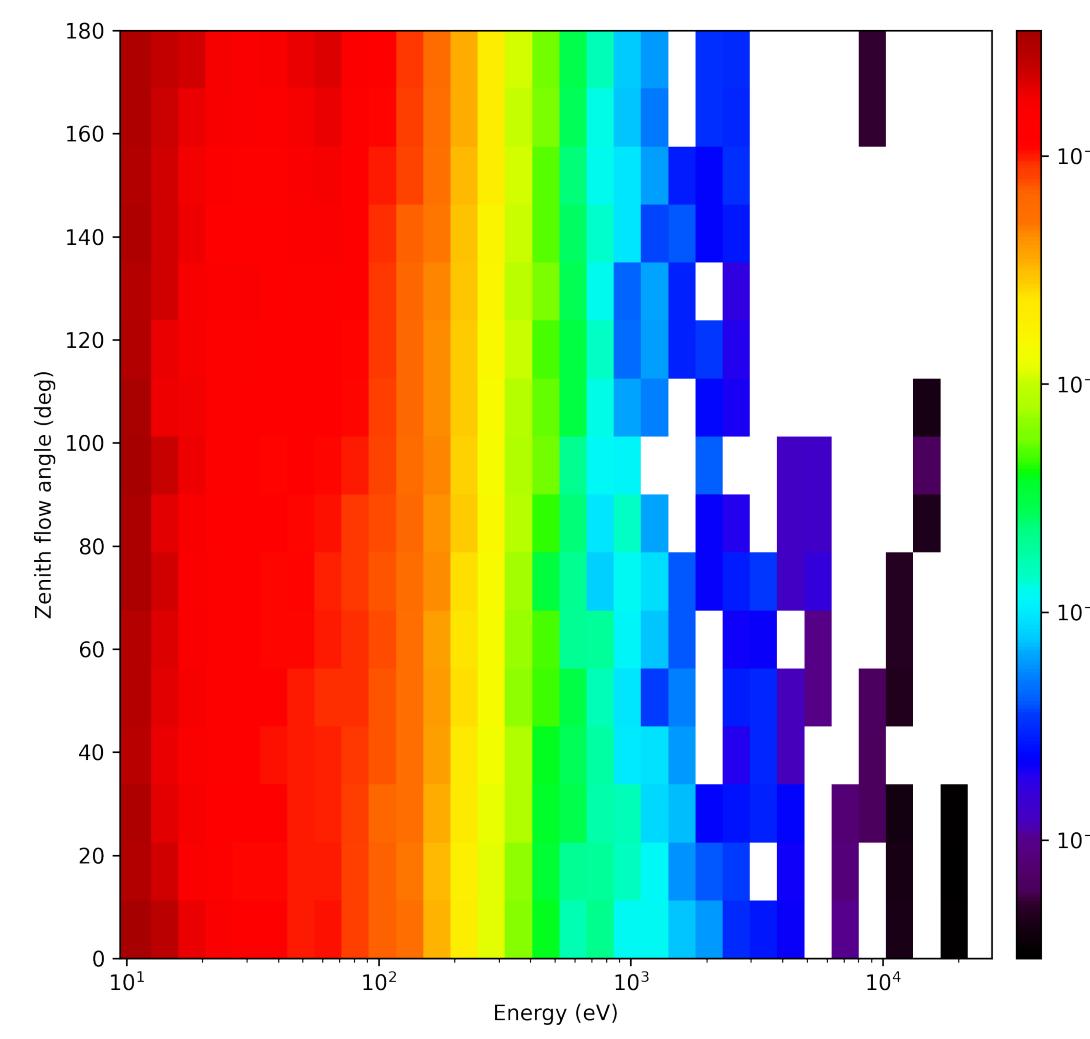
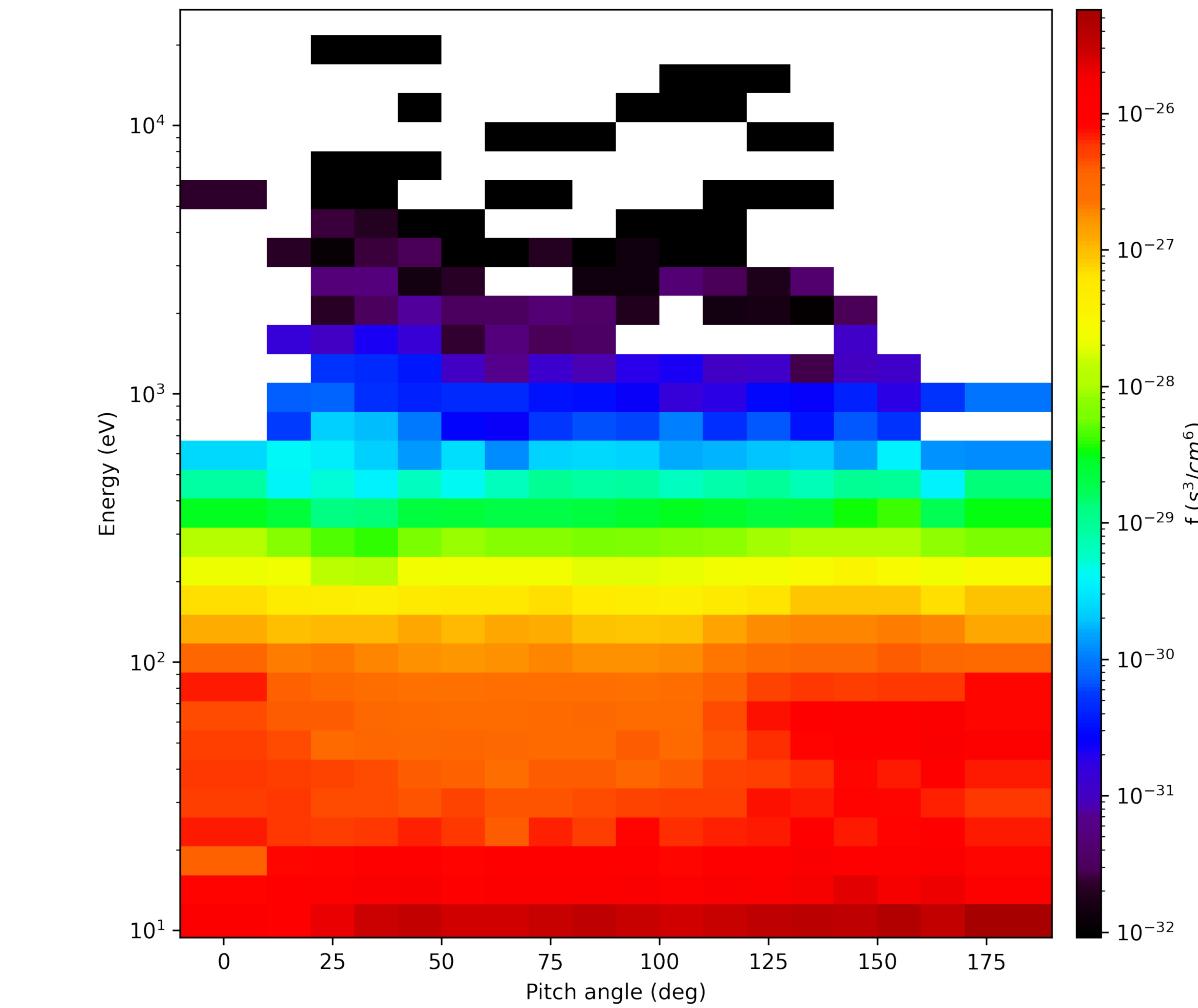
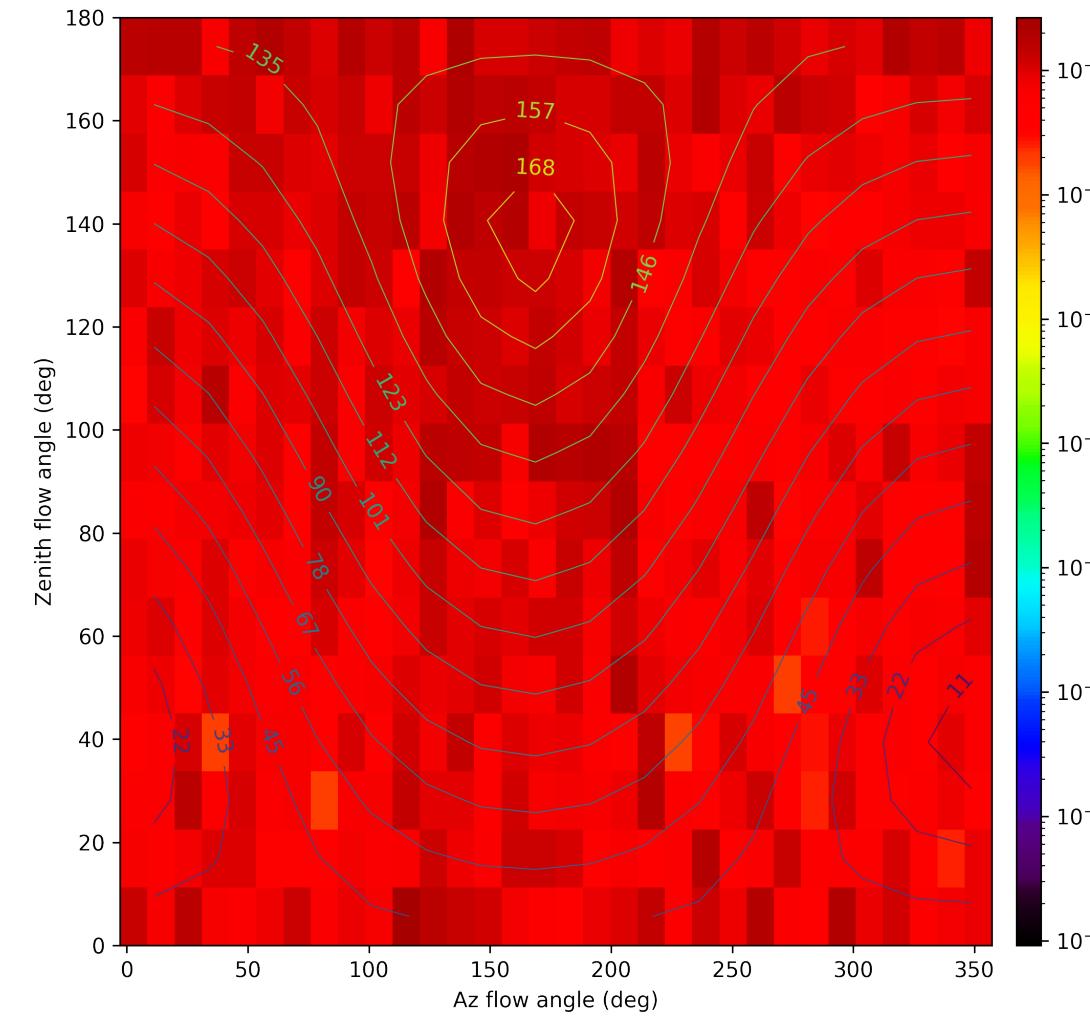


# Python Examples

```
from pyspedas.mms.fpi.mms_fpi_ang_ang import mms_fpi_ang_ang

mms_fpi_ang_ang('2015-10-16/13:06:59.985',
                  probe='1',
                  species='e',
                  data_rate='brst',
                  save_png='mms1_',
                  dpi=300)
```

# Python Examples



# Python Examples

```
[17] pyspedas.solo.datasets('epd')

SOLO_L2_EPD-EPT-ASUN-BURST-ELE-CLOSE: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Anti-Sun direction, High Energy Telescop
SOLO_L2_EPD-EPT-ASUN-BURST-ION: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Anti-Sun direction, Ion Telescop
SOLO_L2_EPD-EPT-ASUN-HCAD: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Anti-Sun direction, HCAD Telescop
SOLO_L2_EPD-EPT-ASUN-RATES: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Anti-Sun Direction, Rates Telescop
SOLO_L2_EPD-EPT-NORTH-BURST-ELE-CLOSE: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, North direction, High Energy Telescop
SOLO_L2_EPD-EPT-NORTH-BURST-ION: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, North direction, Ion Telescop
SOLO_L2_EPD-EPT-NORTH-HCAD: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, North Direction, HCAD Telescop
SOLO_L2_EPD-EPT-NORTH-RATES: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, North Direction, Rates Telescop
SOLO_L2_EPD-EPT-SOUTH-BURST-ELE-CLOSE: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, South direction, High Energy Telescop
SOLO_L2_EPD-EPT-SOUTH-BURST-ION: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, South direction, Ion Telescop
SOLO_L2_EPD-EPT-SOUTH-HCAD: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, South direction, HCAD Telescop
SOLO_L2_EPD-EPT-SOUTH-RATES: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, South Direction, Rates Telescop
SOLO_L2_EPD-EPT-SUN-BURST-ELE-CLOSE: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Sun direction, High Energy Telescop
SOLO_L2_EPD-EPT-SUN-BURST-ION: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Sun direction, Ion Telescop
SOLO_L2_EPD-EPT-SUN-HCAD: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Sun direction, HCAD Telescop
SOLO_L2_EPD-EPT-SUN-RATES: Solar Orbiter, Level 2 Data, Energetic Particle Detector, Electron Proton Telescope, Sun Direction, Rates Telescop
SOLO_L2_EPD-HET-ASUN-BURST: Solar Orbiter, Level 2 Data, Energetic Particle Detector, High Energy Telescope, Anti-Sun direction, Burst Telescop
SOLO_L2_EPD-HET-ASUN-RATES: Solar Orbiter, Level 2 Data, Energetic Particle Detector, High Energy Telescope, Anti-Sun direction, Rates Telescop
SOLO_L2_EPD-HET-NORTH-BURST: Solar Orbiter, Level 2 Data, Energetic Particle Detector, High Energy Telescope, North direction, Burst Telescop
```

# Python Examples

```
from pyptplot import get_data, store_data, options
from pyspedas import tkm2re

pyspedas.mms.mec(probe=1, trange=['2015-10-16', '2015-10-17'])
tkm2re('mms1_mec_r_gsm')

pos_data = get_data('mms1_mec_r_gsm_re')

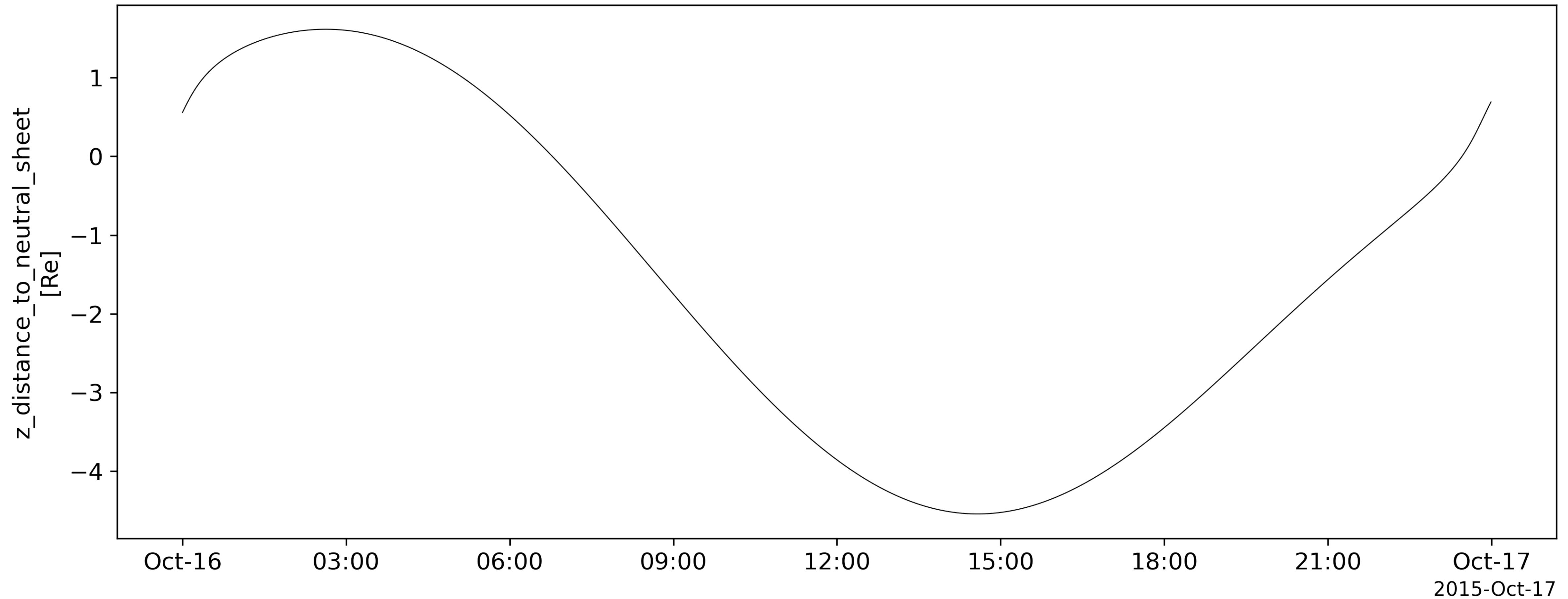
from pyspedas.analysis.neutral_sheet import neutral_sheet

z2NS = neutral_sheet(pos_data.times, pos_data.y, model='lopez', sc2NS=True)

store_data('z_distance_to_neutral_sheet', data={'x': pos_data.times, 'y': z2NS})
options('z_distance_to_neutral_sheet', 'ysubtitle', '[Re]')

tplot('z_distance_to_neutral_sheet', save_png='neutral_sheet', dpi=300)
```

# Python Examples



# Finding More Examples

- Examples of loading data for most instruments can be found at:  
<https://pyspedas.readthedocs.io/>
- More general plotting and analysis examples can be found at:  
[https://github.com/spedas/pyspedas\\_examples](https://github.com/spedas/pyspedas_examples)
- Mission examples can be found in the mission repositories, e.g.  
<https://github.com/spedas/mms-examples>