

User Guide for Analysis of FAST Plasma (ESA) Data

Introduction

Before proceeding, please read the following document for an overview of FAST Data Analysis:

http://sprg.ssl.berkeley.edu/fast/scienceops/docs/fast_da_overview.doc

IDL Routine Overview

Below is a summary of the FAST ESA IDL programs. These programs allow extraction of ESA data from SDT into IDL memory, and provide tools to plot data or to calculate properties of these data.

General:

- "get_" routines that return a data structure of particle data.

* **get_fa_ees.pro, get_fa_ies.pro, get_fa_ses.pro**

- standard survey data

* **get_fa_eeb.pro, get_fa_ieb.pro, get_fa_seb.pro**

- standard burst data

* **get_fa_seb1.pro, get_fa_seb2.pro, ... , get_fa_seb6.pro**

- standard burst data

* **get_fa_ees_sp.pro, get_fa_ees_sp.pro**

- spin average survey

* **get_fa_eeb_c.pro, get_fa_ieb_c.pro, get_fa_seb_c.pro** -

- use with get_en_spec.pro

* **get_fa_ees_hdr.pro, get_fa_eeb_hdr.pro, ...**

- use to get header data

Example:

```
t=str_to_time('98-1-1/12:00:00')
```

```
dat=get_fa_ees(t)
```

```
dat=get_fa_ees(t,/ad)  
help,dat,/st
```

Advice/Warnings: Use the "_c" versions of the programs when running time series routines such as "get_en_spec.pro" or "get_2dt.pro" -- they are much faster. Ignore the "_ts" versions of the programs -- they are no longer needed.

Moment functions that operate on a data structure to calculate a reduced quantity:

```
* n_2d_fs.pro, j_2d_fs.pro, je_2d_fs.pro
```

- Always use these, they are fast and accurate:

```
* n_2d.pro, j_2d.pro, je_2d.pro, ....
```

- Test routines, slow, don't handle beams:

```
* n_2d_b.pro, j_2d_b.pro, je_2d_b.pro
```

- Routines called by the "_fs" versions.

Example:

```
t=str_to_time('98-1-1/12:00:00')  
dat=get_fa_ees(t)  
print,n_2d_fs(dat)  
print,n_2d_fs(dat,energy=[100,30000],angle=[-90,90])
```

Advice/Warnings: Only use the "_fs" versions -- they handle field aligned beams correctly, work with survey or burst data, and are written without "for" loops for speed. The code may be difficult to follow -- see me for an explanation. The program "p_2d_fs.pro" still doesn't seem to work right for field aligned beams - don't trust it.

Plotting routines that operate on data structures:

```
* spec2d.pro, pitch2d.pro, contour2d.pro, fu_spec2d.pro
```

Example:

```
t=str_to_time('98-1-1/12:00:00')  
dat=get_fa_ees(t)  
spec2d,dat,/label  
contour2d,dat,ncont=25,/label,/polar,/vel  
fu_spec2d,'n_2d_fs',dat,/integ_f,/integ_r
```

Advice/Warnings: Check out all the keywords, there are lots of options to get the plot to look correct.

Fitting routines that operate on data structures:

- * `funct_fit2d.pro`
- * `gaussian_1.pro`, `maxwellian_1.pro`, `maxwellian_2.pro`

Example:

```
t=str_to_time('98-1-1/12:00:00')
```

```
dat=get_fa_ees(t)
```

```
funct_fit2d,dat
```

Advice/Warnings: Program was never finished. Currently works for the default function of an accelerated Maxwellian. Was meant to be a general fitting routine where you could write your own function. Still needs work.

Time series routines that generate data structures for plotting by "tplot":

- * `get_2dt.pro`, `get_en_spec.pro`, `get_pa_spec.pro`

Example:

```
t1=str_to_time('98-1-1/12:00:00')
```

```
t2=str_to_time('98-1-1/12:10:00')
```

```
get_2dt,'j_2d_fs','fa_ees',name='Je',t1=t1,t2=t2,energy=[100,30000]
```

```
get_en_spec,'fa_ees',units='eflux',name='el',retrace=1,t1=t1,t2=t2
```

```
tplot,['Je','el']
```

Advice/Warnings: Check out the example crib sheet to get better plot labels.

Summary Plot routines:

- * `load_fa_k0_ies.pro`, `load_fa_k0_ies.pro`, `plot_fa_k0_ies.pro`, `plot_fa_ies.pro`

- * `load_fa_k0_ies_day.pro`, `load_fa_k0_ies_day.pro`

Example:

```
load_fa_k0_ies, orbit=1804
```

```
plot_fa_k0_ies
```

Advice/Warnings: Environment variables must be set to point to summary plot directories.

Misc. programs:

- * `angle_to_bin.pro`, `angle_to_bins.pro`, `energy_to_ebin.pro`,
`convert_esa_units2.pro`
- * `omni2d.pro`, `fpar2d.pro`

Example:

```
t=str_to_time('98-1-1/12:00:00')
dat=get_fa_ees(t)
odat=omni2d(dat)
spec2d,odat
pdat=fpar2d(dat)
spec2d,pdat
```

Advice/Warnings: `fpar2d.pro` needs testing.

IDL Crib

Once you are familiar with the above programs and functions, try using our example crib:

http://sprg.ssl.berkeley.edu/fast/scienceops/docs/fast_esa_idl_demo.doc
http://sprg.ssl.berkeley.edu/fast/scienceops/docs/fast_esa_idl_demo.pdf