User Guide for Analysis of

FAST Mass Spectrometer (TEAMS) 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

TEAMS IDL routines fall into five general categories: get routines, routines for plotting data, moments routines, low-level calibration routines, and summary plot routines.

Get Routines:

The keywords for these routines are similar to the keywords for the ESA get routines (see document fast_esa_da_guide.doc)

get_fa_t??.pro

The first ? stands for data type: s for survey, b for burst, and p for pole. The second ? stands for species: p for protons, a for alphas (He++), h for He+ , and o for oxygen. These are the general-purpose get routines. For example, to get the first sample of burst oxygen data in SDT (time must be defined in advance; it can be initialized to 0.D):

oburstsamp = get_fa_tbo(time, /start)

get_fa_ts?_eq.pro

The ? stands for species, as above. These routines process survey data from the anodes nearest the spin plane into a 2-D format (48 energies * 16 angles) compatible with the structures returned by the ESA IDL routines (fast_esa_da_guide.doc). Use these routines if you want pitch angle or distribution function plots. For example, the next sample of spin-plane survey He+ data is obtained thus:

nexteqsamp = get_fa_tsh_eq(time, /advance)

get_fa_ts?_sp.pro

The ? stands for species, as above. These routines produce spin averaged data, which differ from the generic data only for H+ /O+ at maximum resolution.

get_fa_ts?_eq_sp.pro

The ? stands for species, as above. These routines produce spin averaged data from the anodes nearest the spin plane, as with the *_eq.pro routines. They are used to produce the pitch angle panels in TEAMS summary plots and CDF's and are obsolete for all other purposes.

get_fa_th_3d.pro

This is the get routine for the HiMass data product. Note that the structure has additional components corresponding to the mass per charge. Unfortunately, the possibility of selecting a particular mass range for energy or pitch angle spectrograms or for moments was not forseen.

get_fa_tb_hdr.pro, get_fa_th_hdr.pro, get_fa_tpah_hdr.pro, get_fa_tpop_hdr.pro, get_fa_tsah_hdr.pro, get_fa_tsop_hdr.pro

These routines extract header information from the following respective TEAMS data packets: burst, HiMass, pole (He), pole (H+/O+), survey (He), and survey (H+ /O+).

Routines for Plotting Data:

Note that because TEAMS survey and high mass resolution data are at much lower time resolutions than ESA data, you should set the GAP_TIME keyword to ensure that slow survey data are correctly plotted. Adequate values are 30 for H+ /O+ survey data, 60 for He survey data, and 120 for high mass resolution data.

get_en_spec.pro

Plots an energy spectrogram. Can be called with any TEAMS get routine. See the ESA help page <fast_esa_help.html> for more information. Remember to specify four angles (theta min and max, phi min and max) if you set the ANGLE keyword when calling with 3-D survey data. For example, to plot an energy spectrogram of alpha pole data in differential energy flux units, type:

get_en_spec, 'fa_tpa', units = 'eflux', gap_time = 60

get_pa_spec.pro

Plots a pitch angle spectrogram. Call only with the *_eq.pro get routines. See the ESA help page <fast_esa_help.html> for more information. For example, to plot a pitch angle spectrogram of protons below 1 keV, type:

get_pa_spec, 'fa_tsp_eq', energy = [1, 1000], gap_time = 30

get_tms_hm_spec.pro

Plots a mass spectrogram. Call only with get_fa_th_3d.pro. Keywords are the same as for get_en_spec.pro and get_pa_spec.pro. The simplest calling sequence is:

get_tms_hm_spec, 'fa_th_3d', gap_time = 120

conv_units.pro

Function to change the units of your data structure to something more convenient. For example, if you want differential number flux, call:

fluxdat = conv_units(dat, 'flux')

Moments Routines:

There are routines **n_3d.pro, j_3d.pro, ...** which are analogous to the 2-D moment routines for ESA data. Call as in the following example:

get_2dt, 'n_3d', 'fa_tsp'

which gives the proton density. It is also possible, but not recommended for reasons given in the Pitfalls and Limitations <#probs> section, to call:

get_2dt, 'n_2d', 'fa_tsp_eq'

Do not attempt to take 2-D moments of 3-D data, 3-D moments of 2-D data, or any moments of pole or burst data--this puts garbage in and you will get garbage out.

Low-level Calibration Routines:

Most users will not need to know anything about these routines other than to leave them in the FAST IDL directory.

convert_tms_units.pro, convert_tms_units2.pro

One of these procedures is called when converting data between any two of counts, 'ncounts' (counts corrected for geometric factor), rate (counts per second), 'nrate' (rate corrected for geometric factor), energy flux, number flux, or distribution function. Usually called from conv_units.pro.

fa_ts_eff.pro

Function to calculate survey efficiencies. Calls FA_TTOF_CALIBRATION and takes into account the fact that two different anodes contribute to each angle bin at different times.

fa_ttof_calibration.pro

Function to apply the calibration to TEAMS data. Called from FA_TS_EFF for survey data and directly from the get routines for burst, HiMass, and pole data.

Summary Plot Routines:

The following routines deal with summary plots and CDF's: gen_fa_k0_tms_gifps.pro, load_fa_k0_tms.pro, and plot_fa_k0_tms.pro.