FAST Fields Gotchas – November 2001

FAST Fields Help Page

- URL: `http://sprg.ssl.berkeley.edu/fast/scienceops/fast_fields_help.html`.
- Lots of details on known problems with FAST Fields Data Quantities.
- Tutorial content focuses on what can affect the fields measurements, rather than how to use the fields pros.
- A good place to look when you start using a new kind of Fields Data Quantity.

DSP/16k Burst Intercalibration

- When the standard calibration procedures are used, the spectral density estimates from the on-board DSP do not match those derived from 16k Burst data (or 1k FastSurvey data, for that matter).
  - DSP electric field (`V5-V8`, etc.) spectral densities are *high* by a factor of $\approx 10^{2.8} \approx 630$ relative to spectral densities derived from 16k Burst data.
  - DSP magnetic field (`Mag3ac`) spectral densities are *low* by a factor of $\approx 10^{3.5} \approx 3200$ relative to spectral densities derived from 16k Burst data.
  - The source of this discrepancy is not clear, but is assumed to reside in the DSP calibration, rather than the time series calibration (Survey or Burst).
- The `DSP_AUTOCAL` package is available to perform the DSP/Burst comparison for all bursts occuring in a given orbit (`ftp://apollo.ssl.berkeley.edu/pub/jbonnell/FASTsupport/DSP_AUTOCAL`).
- A change in the DSP `.cal` files will be made once the discrepancy can be shown to be non-mode-dependent.

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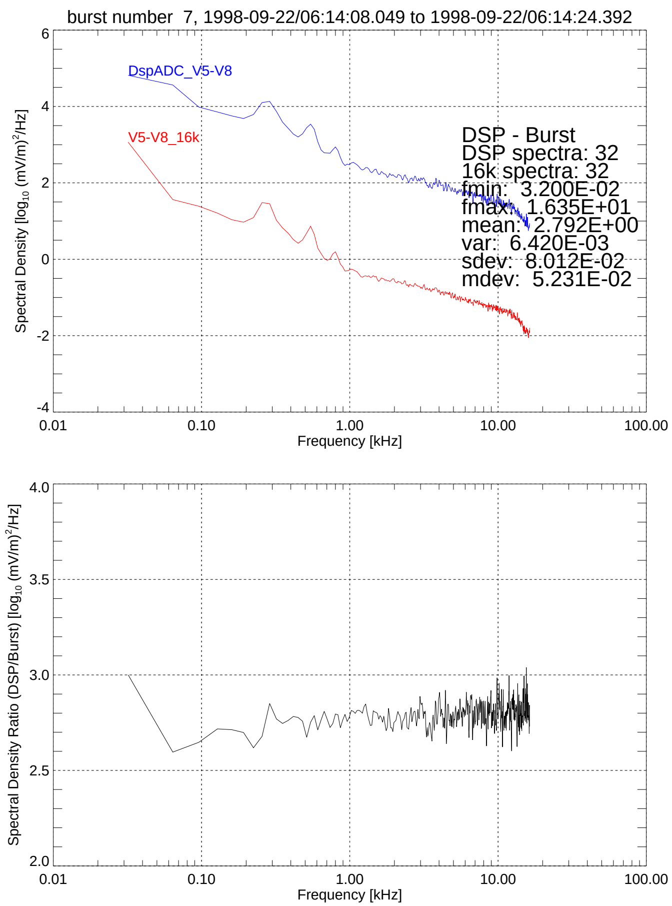
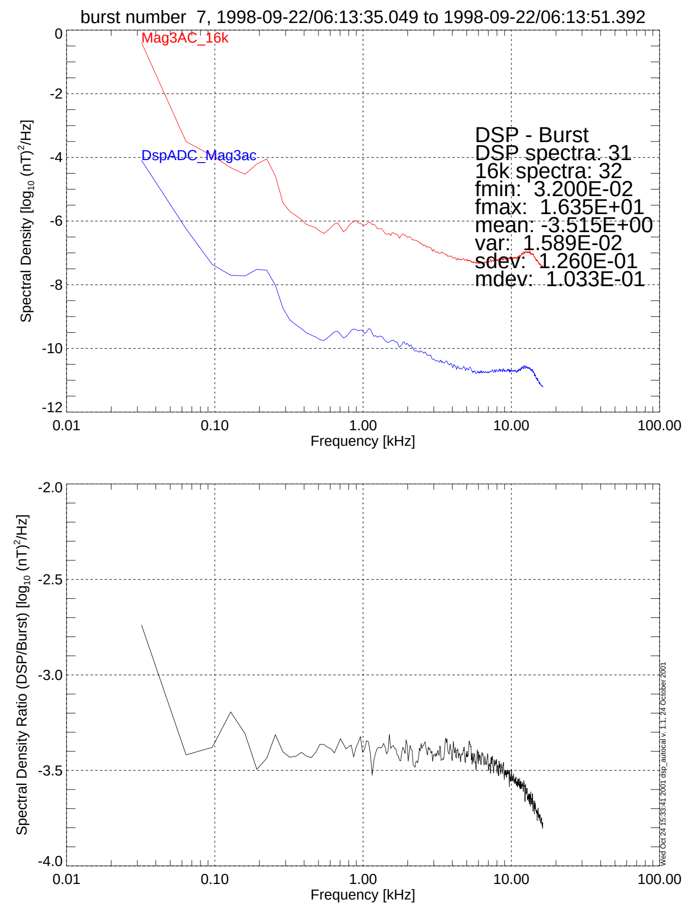
DSP_AUTOCAL Output

Electric Field



Magnetic Field



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HSBM Gain State for Spin Plane Long Boom Antennas (`V1-V4` and `V5-V8`).

- Sometime in March 1997 (?), a factor-of-four attenuation was added to the `V1-V4` and `V5-V8` signals fed to the HSBM, DSP, SFA, and BBF channels in order to reduce the occurrence of saturated signals.
- Code was added to the `fastcal` package to detect and account for this additional attenuation by detecting the gain state in the given DQD's header and adjusting the channel gain accordingly.
- A bug in that additional code (`hsbm_gain()`) actually prevents detection of the gain state (a tricky C operator precedence error).
- The HSBM header gain state bits themselves appear unreliable (mixed gain states, and gain states that do not match those reported in the Mode sheets). An end-to-end check of the `HSBMDecom` has demonstrated that this is a problem with the gain state information in the LZP files, rather than a problem with the decomutation procedure.
- Brute force solution: Impose a manual gain change in the appropriate `.cal` files as of 14 March 1997, and treat the data in March 1997 as "uncalibrated", noting it as such on the Fields Help page. Remove the automatic gain detection code from `fastcal` for that particular gain state.

HSBM/16k Burst VLF Intercalibration

- When the standard calibration procedures are used, the electric field spectral density estimates from the HSBM and 16k Burst channels do not agree in the VLF band. The spectral densities derived from the HSBM data are ≈ 2 times higher than those derived from the 16k Burst data (see following figure).
- The polarity of the `V7-V8` HSBM channel (channel 2 of mode 128) is inverted relative to the 16k Burst channel, as well as the other short spin plane electric field antennas (`V1-V2`,`V5-V6`).

HSBM/16k Burst Intercalibration Discussion

- The following plot shows the ratio of spectral density estimated from HSBM data to spectral density estimated from 16k Burst data in the 0-16 kHz band.
- The left and right columns of panels show the same data, with different color bar ranges.
- The x-axis of each panel is frequency in kHz. The y-axis of each panel is spectral density ($(\mathrm{mV/m})^2/\mathrm{Hz}$) of the 16k Burst spectrum at each frequency, and the z-axis (color) is the ratio of HSBM spectral density to 16k Burst spectral density.
- One can see the drop off of the 16k Burst spectrum estimate at frequencies near 16 kHz; this is due to the anti-aliasing filter in the 16k Burst channel that is not found in the HSBM channel.
- One can also see a strong amplitude dependence at low-frequencies. This is believed to be due to the different resolutions of the two channels (10-bit for HSBM, 16-bit for 16k Burst).
- One can also see the otherwise mild frequency-dependent ratio at a given amplitude in the body of each panel, as well as the mild channel-dependence (ie. different ratios for different antennas).
- Details of the procedure used to make these intercalibration measurements are available via e-mail (`jbonnell@ssl.berkeley.edu`).

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HSBM-16k Burst Spectrum Comparison