GALSPECT AS OF 11 OCT 2004

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ABSTRACT

This is a report on our examination of GALSPECT data taken in the early September 2004. It is based on an examination of six 15-minute FITS files. Two of these had the Ealfa lo setting and 4 the Galfa lo setting.

The conclusion: everything works really well! All spectral peculiarities appear to arise from real interference instead of errors or overflows. There is no correlation of interference from beam-to-beam or between orthogonal polarizations on a single beam.

1. ERROR CODES

Two characteristics of the error codes stand out:

1. For any given beam, the error codes for the two polarizations are always identical. This is true even for the two polarizations of beam 0. Recall that the rf amplifier for (pol, beam)=(0,0) was malfunctioning, meaning that the levels for this spectrometer were anamolously low—with the corollary that it's unlikely that its error codes were, in fact, equal to the normally-functioning (pol, beam)=(1,0).

   Dan Werthimer tells us that the error codes for the two polarizations should, in fact, be identical because of system architecture, so maybe this is normal operation. If so, it's not a particular problem.

2. Throughout all six files, only two types of error code (as reported on the fits files) were ever nonzero. They are

   - narrowband mixer saturation
   - wideband FFT overflow

There was no particular correlation between these two codes. Sometimes you'd have a nonzero error in one, sometimes in the other, sometimes in both together.

2. NARROWBAND SPECTRA

It is easy to summarize the narrowband (nb) spectra because they are so good. We can say confidently that

1. The theoretical nb bandpass shape very closely matches the actual one. After dividing an observed power spectrum by the theoretical one, the result contains a residual slope instead of being flat. However, this is almost certainly (99% level) in the rf power changing with frequency.

2. There are no discernable nb spectral peculiarities correlated with any error code.

3. NB spectral peculiarities appear sporadically in time and have all the characteristics of real interference. About 0.5% of the nb spectra are so contaminated. We can deal with these problems using standard astronomical data reduction techniques.

3. WIDEBAND SPECTRA—E-ALFA LO SETTING

Wideband (wb) spectra have real problems with the Ealfa lo setting, for which the SJU radar is within the band. There are lots of error codes, severe changes in bandpass shape, and severe regularly-spaced birdies across the bandpass when the radar is on. Dan pointed out the obvious, namely that when we are using the Ealfa lo setting we should compensate by changing the GALSPECT second lo frequency, which will remove the SJU radar from the wideband. So we need not discuss this case further.

4. WIDEBAND SPECTRA—GALFA LO SETTING

For this setting, the SJU 1350 MHz lies well outside the wb bandpass. Generally speaking we had no problems. However, we do see low-level spikes every 12 seconds when the SJU radar comes on. These spikes are not correlated with error codes. We therefore conclude that these spikes are real interference generated by the radar and not associated with overflow within GALSPECT.

Figure 1 shows a grey-scale image of the wb spectra for one of the four Galfa-lo files. Each spectrum is divided by the mean of all spectra, which makes the mean value for all pixels unity. Some characteristics of this image:

1. The vertical black stripe at channel 128 is baseband zero frequency. There is a big spike here whose intensity, relative to the rest of the passband, depends on the power level. This accounts for the little white blip every 12 seconds in this channel. This dc spike is not at all a problem for us in data reduction and analysis.

2. The vertical stripe near channel 80 is Galactic HI. Its variation with time occurs because the telescope is changing position. This is a feature, not a bug!

3. The horizontal stripe between 360 an3 370 seconds is the noise diode being used to calibrate the system. Again, a feature not a bug!

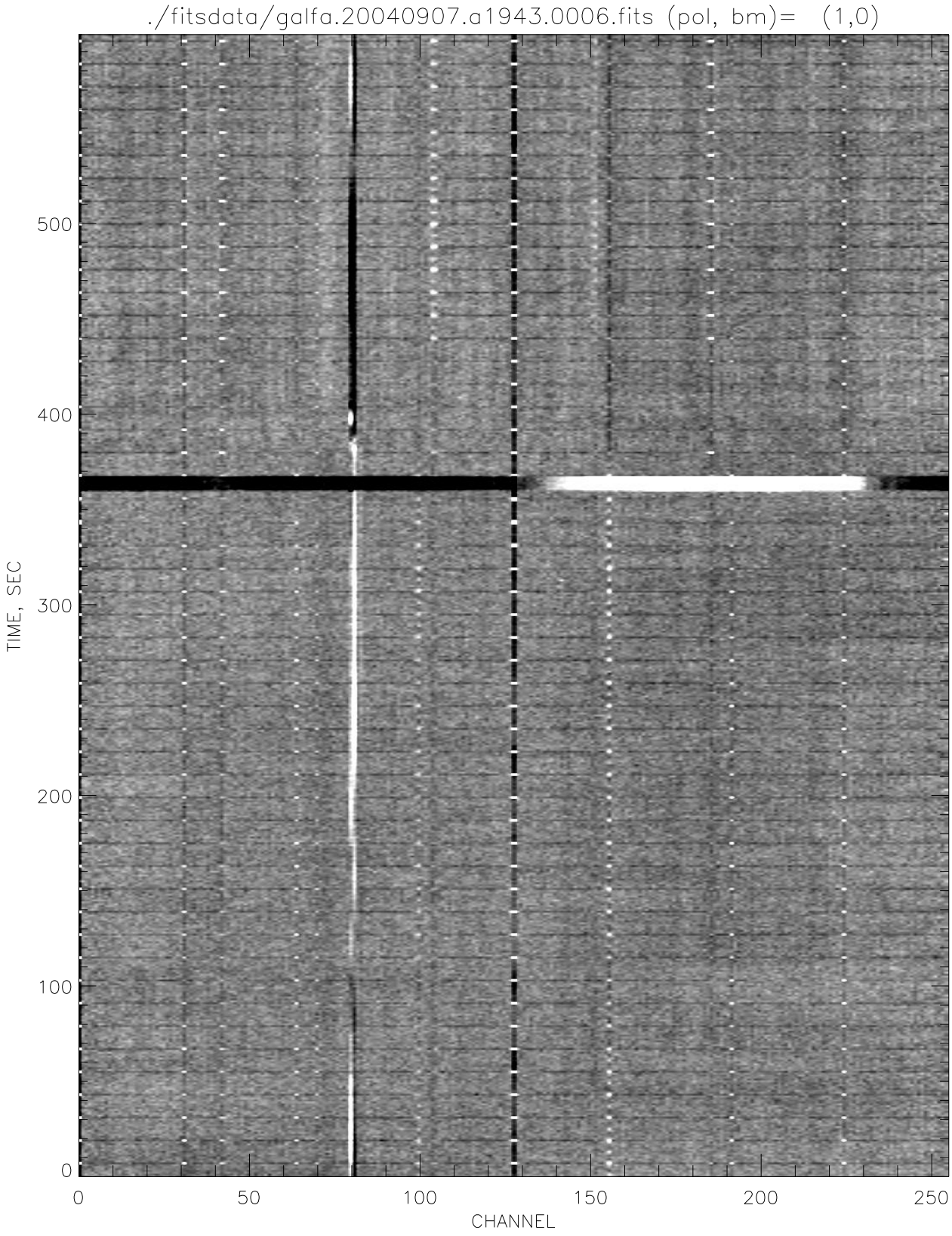
4. Every 12 seconds there is a horizonal black line with about 8 white pips. These pips are the aforementioned low-level spikes. These pips do not always correlate with error code; they can exist when all error codes are zero.

Figure 2 shows three spectra from Figure 1 for times 340, 343, and 365 seconds. The top spectrum, at 340 seconds, is a typical one and shows only the HI and baseband DC spikes. The middle one shows the spectrum when the SJU radar is on. The bottom shows the cal deflection; its variation with frequency indicates the change of the rf gain with frequency.

5. CORRELATION OF INTERFERENCE WITH POLARIZATION AND BEAM-TO-BEAM

Interference does not correlate

1. between orthogonal polarizations on the same beam
2. between different beams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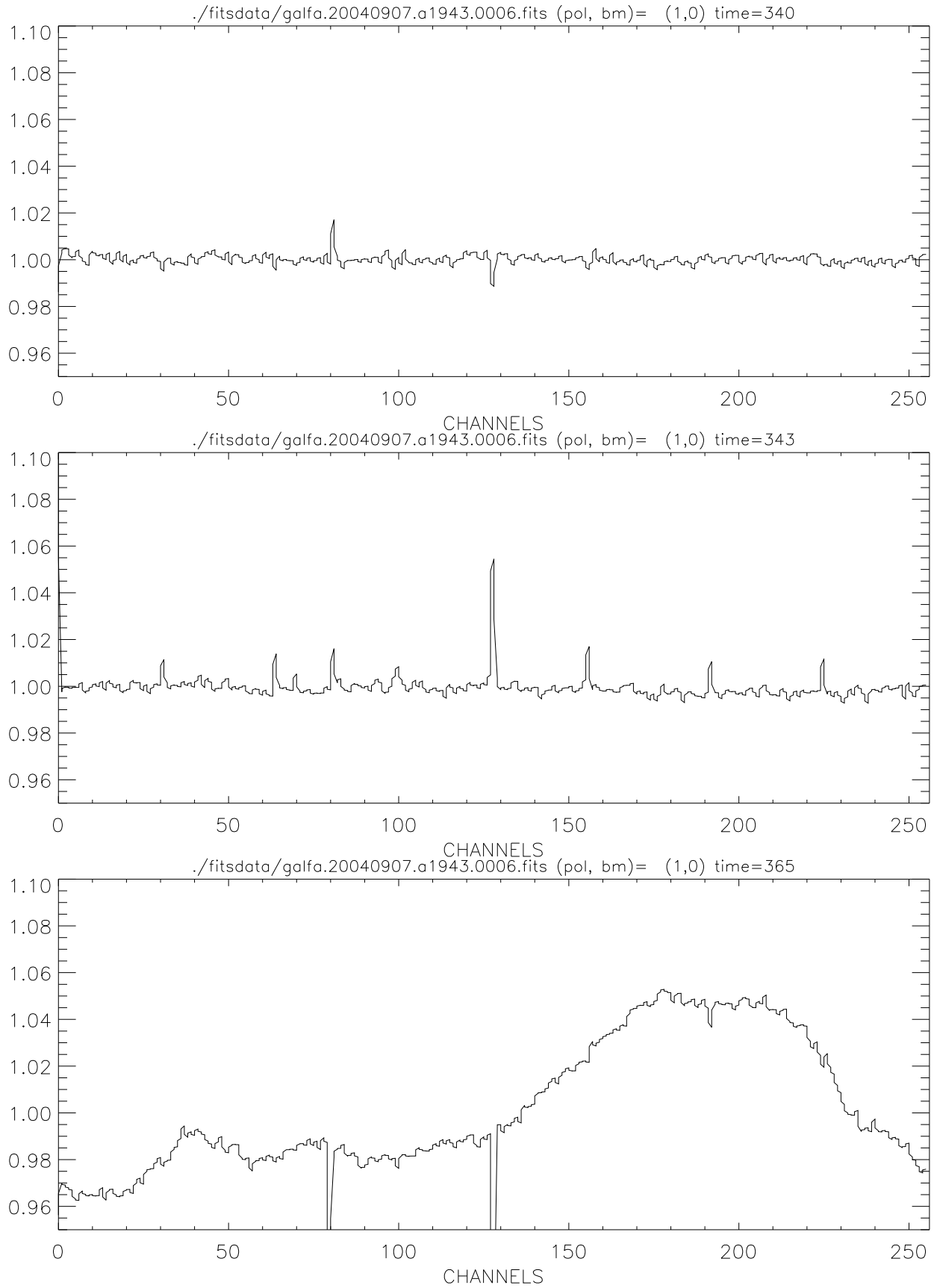
TIME, SEC
0
100
200
300
400
500
0
50
100
150
200
250
CHANNEL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1.08
1.06
1.04
1.02
1.00
0.98
0.96
0
50
100
150
200
250
CHANNELS
./fitsdata/galfa.20040907.a1943.0006.fits (pol, bm)= (1,0) time=343
1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0
50
100
150
200
250
CHANNELS
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1.10
1.08
1.06
1.04
1.02
1.00
0.98
0.96
0
50
100
150
200
250
CHANNELS