THEMIS EARTH FIELD COMPARISON

First Results

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Verification of THEMIS attitude and magnetic field measurements by comparison with the Earth's magnetic field.

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2. THM_SOC_101_TIME	THEMIS TIME Definition
3. THM_SOC_108_GMAG_L1_VARNAMES	THEMIS GMAG Variable Name Def's
4. THM_SOC_111_SUNSENSPROC	THEMIS SUN SENSOR Science Processing
5. THM_SOC_112_SCIATT_PROC	THEMIS Science ATT Determination
6. THM_SOC_113_FGM_CALPROC	THEMIS FGM CAL File and Processing
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13. pturin e-mail on Faro alignment results (9/28/06)	FGM, SCM mag alignments
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2. First Results

We performed our first Earth field comparisons at times when we had the luxury of having both fgl and fge data at perigee for all five spacecraft (2007, Mar 04 and 06). The next fits we did for 2007, June 08 when we again had both fgl and (improved) fge data from THEMIS C, D and E. We did another set of fits for 2007, June 29. Our fits contained data inside of 2 Re. We used the Tsyganenko 2001 as well as the IGRF 2005 models. In order to check how stable the results are we divided each pass into two parts and calculated the parameters for the first half, the second half and for the whole pass. We did not use times when the magnetometers were in saturation or when the spacecraft were eclipsed. When the spacecraft are eclipsed the phase angle shows very strong drifts. **Figure 1** shows such an example. Our new software is able to fix such drifts in *phi*.

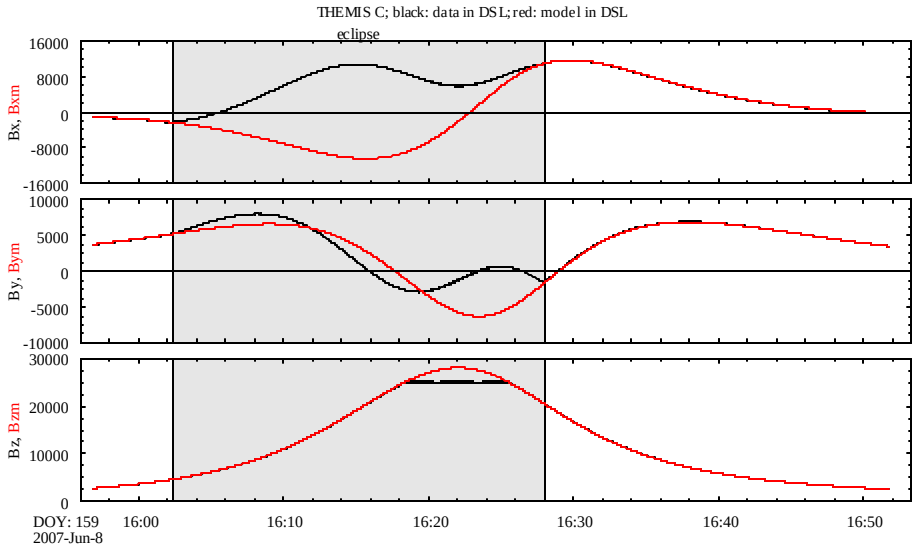

Figure 1 THEMIS C data and model are displayed in DSL-coordinates. The gray region marks the eclipsed period. The two spin plane components show large differences to the model due to drifting *phi* angle.

Calibration parameters that we solve for:

Gxy : gain correction of the spin plane gains (multiplies previous gain)
Gz : gain correction of the spin axis gain (multiplies previous gain)
dphi : zero angle correction of the spin plane (**subtract** from existing *phi*)
dras : correction to right ascension of the true spin axis (add to existing *ras*)
ddec : correction to declination of the true spin axis (add to existing *dec*)

We found that the phase is drifting for all 5 spacecraft at perigee even if the spacecraft are not eclipsed. This caused problems for our software that we had developed before the launch. We had to rewrite the software so that all calibration parameters can be determined without knowing the precise phase angle. Furthermore we were able to calculate *dphi* in high time resolution. Solving for *dphi* in high time resolution greatly improved the RMS error of our fits. Future reports will also contain the other parameters in higher time resolution which appear to be more stable than *dphi.*

The values that we calculated for 2007, June 08 and June 29 ('full flyby') represent our currently best results and can be used to improve attitude and magnetometer calibration. Nevertheless we need to further investigate the accuracy of our calculations especially *dphi. Tables 20* and *21* give a summary of the first results.

2.1 Summary of Results

2.1.1 2007, Mar 04 to 06

The RMS errors of the fits that we did using fge data are higher than those we got from fgl data. Most calibration parameters that we got from fge data are roughly in agreement with the ones from fgl data except for *dphi*. *dphi* is significantly different between fge and fgl data. Most results that we got for Mar 04 are not stable. We get different results for "`first half`", "`full flyby`" and "`second half`" (see *Tables 1a, 1b, 5a, 5b, 9a, 9b, 13a, 13b*). On Mar 06 the results are more stable (see *Tables 2a, 2b, 6a, 6b, 10a, 10b, 14a, 14b, 17a, 17b*).

2.1.2 2007, June 08

On June 08 THEMIS C, D and E again have simultaneous fge and fgl data at perigee. The fge data had been greatly improved since Mar 06. The fits for fge and fgl data give the same results and the RMS of fit is also roughly the same. This means that fge data can now be used for Earth field comparison. *dphi* is drifting for all 5 spacecraft (see **Figures 2**, **3**, **4**, **5** and **6**).

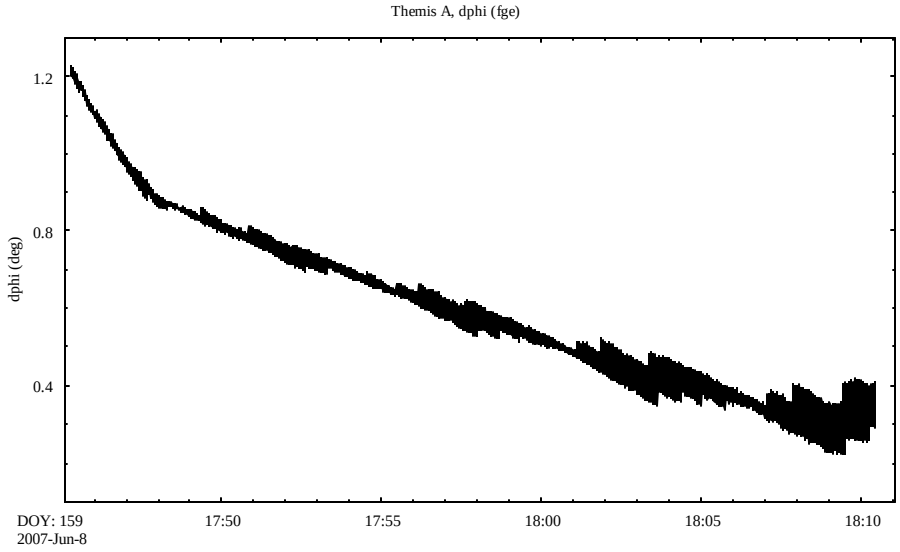

Figure 2. Themis A, drifting phase after eclipse.

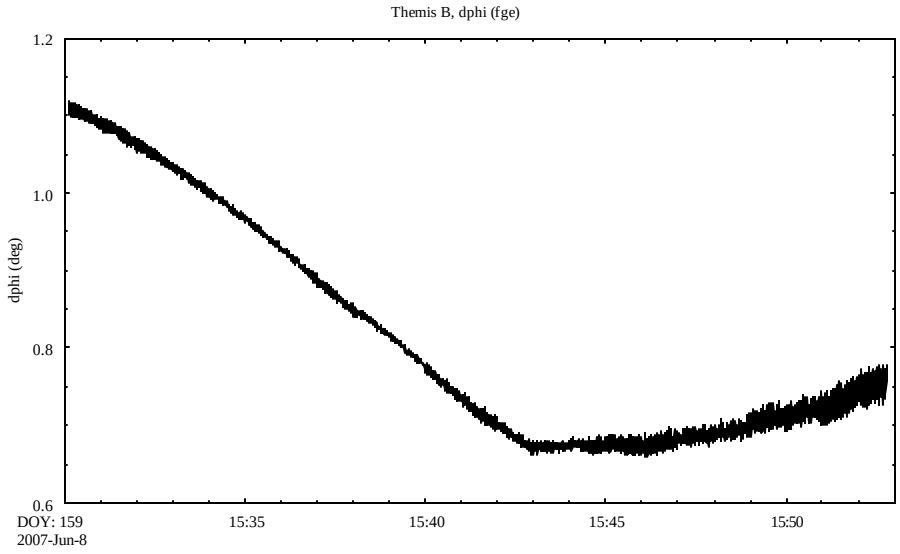

Figure 3. Themis B, drifting phase after eclipse.

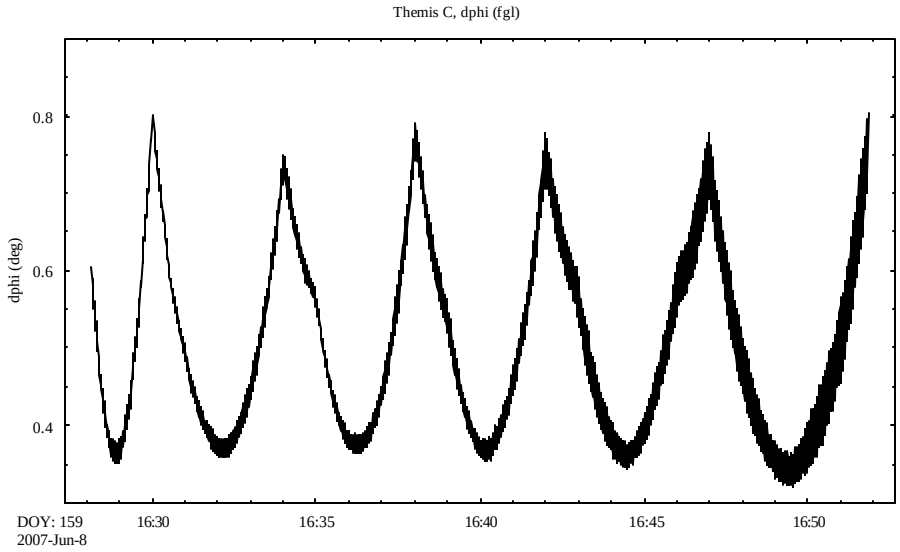

Figure 4. Themis C, drifting phase after eclipse.

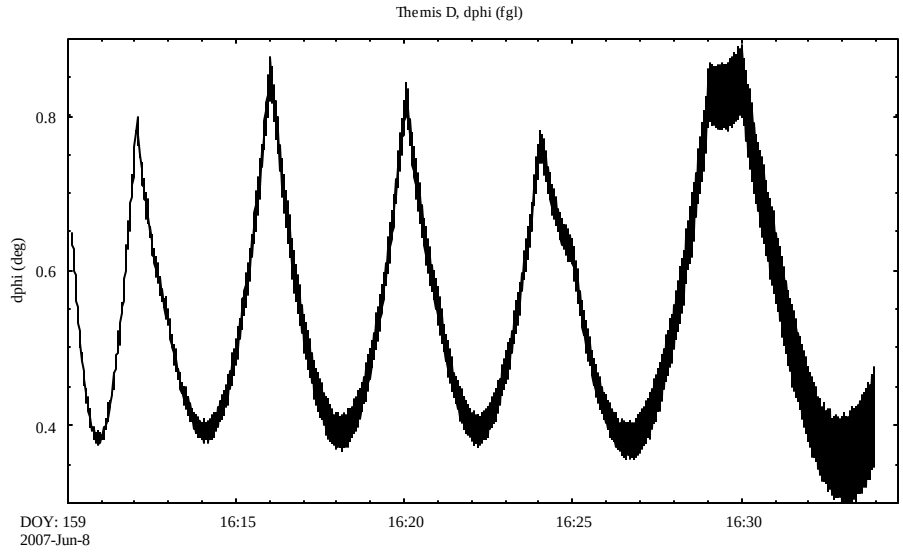

Figure 5. Themis D, drifting phase after eclipse.

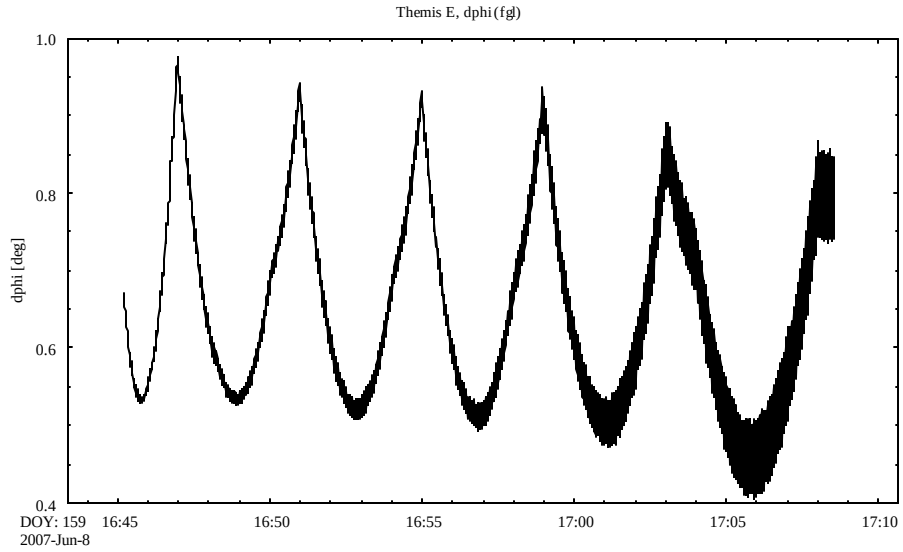

Figure 6. Themis E, drifting phase after eclipse.

Having *dphi* in high resolution drastically improves the RMS of fit of the spin plane components x and y (see *Tables 3a, 3b, 7a, 7b, 11a, 11b, 15a, 15b, 18a, 18b*).

2.1.3 2007, June 29

The results for June 29 are similar to the results from June 08. *dphi* again is drifting for all 5 spacecraft (see **Figures 7**, **8**, **9**, **10** and **11**).

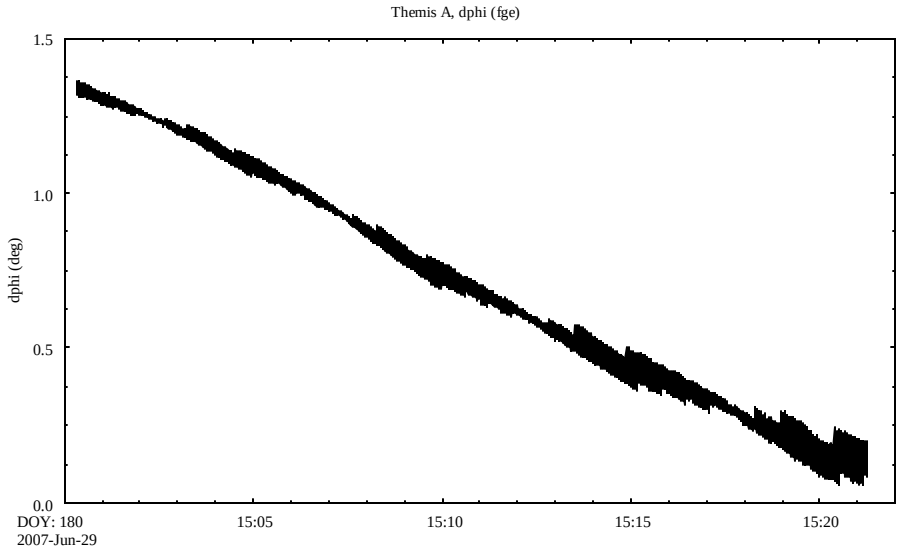

Figure 7. Themis A, drifting phase after eclipse.

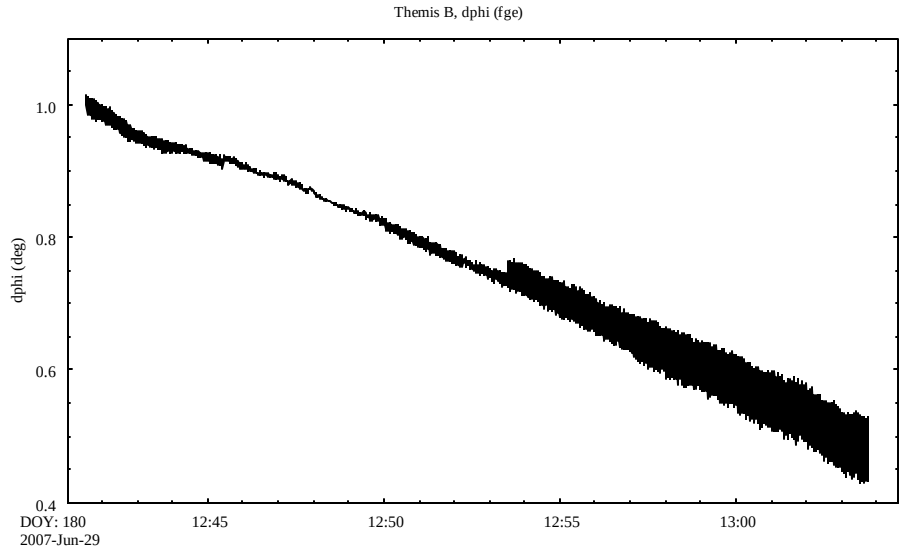

Figure 8. Themis B, drifting phase after eclipse.

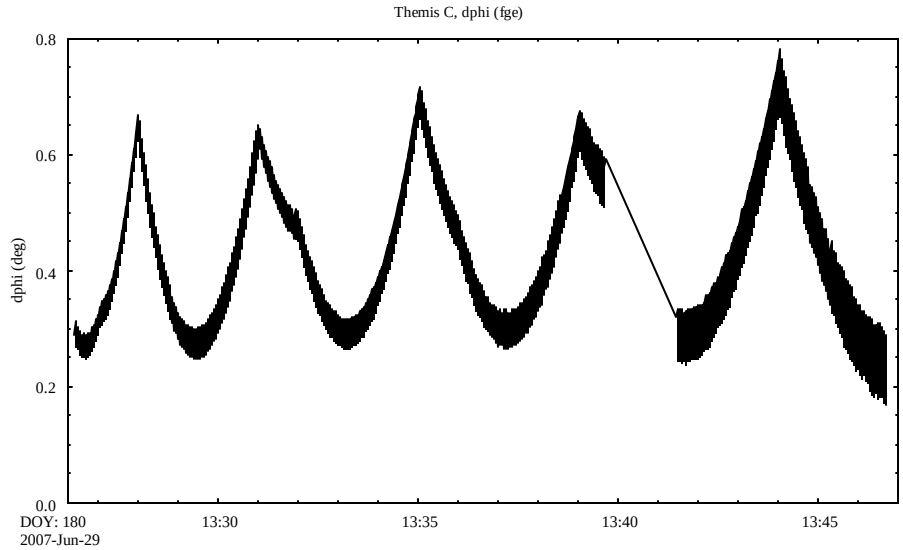

Figure 9. Themis C, drifting phase after eclipse.

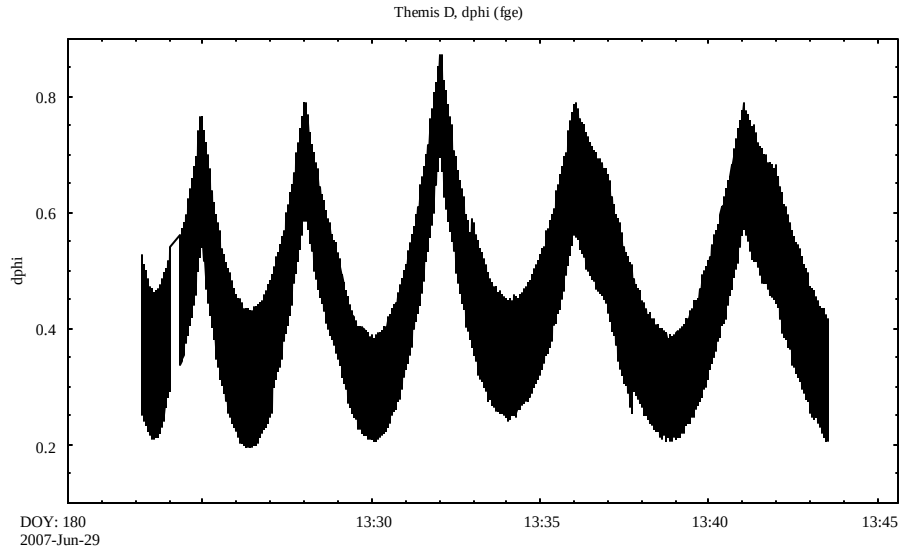

Figure 10. Themis D, drifting phase after eclipse.

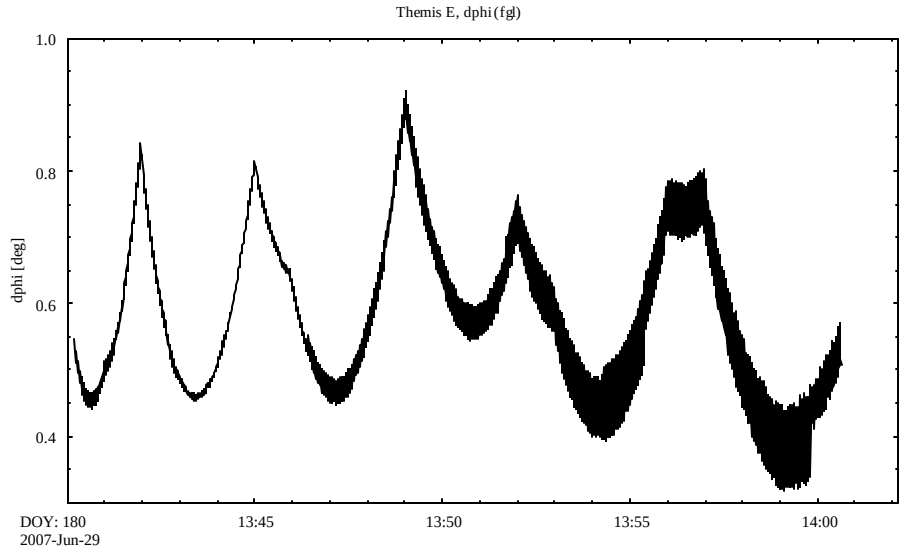

Figure 11. Themis E, drifting phase after eclipse.

Table 1a

2007, Mar 04

THEMIS A fgl

```
RMS x in [nT]:              54.6         123.2         165.5
RMS y in [nT]:              89.3          83.7          77.7
RMS z in [nT]:              66.3          59.4          51.5

                       first half    full flyby    second half

Gxy          :          0.9965189     0.9966977     0.9971170
Gz           :          0.9944776     0.9941838     0.9947261
phi     [deg]:               1.43          0.71          1.02
ras     [deg]:              -0.62         -0.53         -0.42
dec     [deg]:              -0.37         -0.22         -0.19

RMS x out[nT]:              32.8          69.0          35.7
RMS y out[nT]:              71.3          49.4          27.6
RMS z out[nT]:               4.5           9.3           2.0

 high res phi:
RMS x out[nT]; full flyby:               15.0
RMS y out[nT]; full flyby:               21.9
```

Table 1b

THEMIS A fge

```
RMS x in [nT]:              75.7          98.7         117.3
RMS y in [nT]:             123.9         107.6          88.4
RMS z in [nT]:              66.2          59.4          51.6

                       first half    full flyby    second half

Gxy          :          0.9963310     0.9967919     0.9972618
Gz           :          0.9944870     0.9941942     0.9946720
phi     [deg]:               0.73         -0.06          0.42
ras     [deg]:              -0.61         -0.53         -0.42
dec     [deg]:              -0.37         -0.22         -0.19

RMS x out[nT]:              48.8         120.3         106.1
RMS y out[nT]:              86.5          81.9          78.8
RMS z out[nT]:               4.5           9.3           2.5

 high res phi:
RMS x out[nT]; full flyby:               26.0
RMS y out[nT]; full flyby:               34.8
```

Table 2a

2007, Mar 06

THEMIS A fgl

```
RMS x in [nT]:              30.8          78.6         106.7
RMS y in [nT]:              85.4          66.9          40.8
RMS z in [nT]:              41.1          51.9          60.7

                       first half    full flyby    second half

Gxy          :         0.9989524     0.9998360     0.9999474
Gz           :         0.9977012     0.9980796     0.9997207
phi     [deg]:              1.00          0.60          0.65
ras     [deg]:             -0.20         -0.12         -0.02
dec     [deg]:             -0.26         -0.25         -0.29

RMS x out[nT]:              31.9          19.8          22.8
RMS y out[nT]:              55.7          23.0          16.2
RMS z out[nT]:               5.3           9.4           2.8

 high res phi:
RMS x out[nT]; full flyby:                 8.8
RMS y out[nT]; full flyby:                13.0
```

Table 2b

THEMIS A fge

```
RMS x in [nT]:              58.2          72.2          83.9
RMS y in [nT]:             131.6         100.6          54.1
RMS z in [nT]:              40.7          51.6          60.6

                       first half    full flyby    second half

Gxy          :         0.9989430     0.9997783     0.9998667
Gz           :         0.9977323     0.9981029     0.9996478
phi     [deg]:              0.54         -0.17         -0.14
ras     [deg]:             -0.19         -0.12         -0.02
dec     [deg]:             -0.26         -0.25         -0.29

RMS x out[nT]:              68.6          53.7          62.8
RMS y out[nT]:             107.0          49.8          44.4
RMS z out[nT]:               5.4           9.2           2.3

 high res phi:
RMS x out[nT]; full flyby:                21.3
RMS y out[nT]; full flyby:                29.8
```

Table 3

2007, June 08

THEMIS A fge

RMS x in [nT]:	44.8	41.7	38.2
RMS y in [nT]:	97.8	70.4	18.8
RMS z in [nT]:	9.0	6.9	3.8
	first half	full flyby	second half
Gxy :	0.9981498	0.9993067	0.9984987
Gz :	0.9987093	0.9990422	0.9968192
phi [deg]:	0.85	0.79	0.51
ras [deg]:	0.00	0.09	0.20
dec [deg]:	-0.10	-0.08	-0.17
RMS x out[nT]:	14.2	20.5	9.2
RMS y out[nT]:	25.5	18.2	6.0
RMS z out[nT]:	1.2	1.1	0.7
high res phi:			
RMS x out[nT]; full flyby:		3.1	
RMS y out[nT]; full flyby:		3.5	

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 4

2007, June 29

THEMIS A fge

RMS x in [nT]:	46.4	38.2	27.5
RMS y in [nT]:	201.3	146.3	47.5
RMS z in [nT]:	6.8	5.5	3.8
	first half	full flyby	second half
Gxy :	0.9972020	0.9973828	0.9965912
Gz :	1.0000983	1.0005693	1.0005354
phi [deg]:	1.20	1.09	0.55
ras [deg]:	-0.22	-0.20	-0.19
dec [deg]:	-0.05	-0.02	-0.02
RMS x out[nT]:	22.9	39.3	16.0
RMS y out[nT]:	30.7	27.4	7.2
RMS z out[nT]:	0.7	0.7	0.5
high res phi:			
RMS x out[nT]; full flyby:		3.6	
RMS y out[nT]; full flyby:		3.3	

Comment: ‘second half’ has lower field values so parameters are not as well determined as ‘first half’ and ‘full flyby’

Table 5a

2007, Mar 04

THEMIS B fgl

```
RMS x in [nT]:              58.2         144.3         195.5
RMS y in [nT]:              41.4          89.7         119.9
RMS z in [nT]:             141.0         162.8         182.1

                       first half    full flyby    second half

Gxy          :          1.0043737     1.0031528     1.0008520
Gz           :          0.9925750     1.0021864     1.0022320
phi     [deg]:              -0.28         -0.05         -0.61
ras     [deg]:              -2.39         -2.79         -3.89
dec     [deg]:               0.31          0.37          0.13

RMS x out[nT]:              65.9          26.8          38.5
RMS y out[nT]:              12.2          29.8          28.8
RMS z out[nT]:               5.0          28.8           8.8

 high res phi:
RMS x out[nT]; full flyby:                 9.4
RMS y out[nT]; full flyby:                23.6
```

Table 5b

THEMIS B fge

```
RMS x in [nT]:             114.3         140.9         163.2
RMS y in [nT]:              95.9         122.5         144.3
RMS z in [nT]:             141.0         162.8         182.1

                       first half    full flyby    second half

Gxy          :          1.0042965     1.0031619     1.0010045
Gz           :          0.9925851     1.0021893     1.0022622
phi     [deg]:              -0.85         -0.37         -0.98
ras     [deg]:              -2.39         -2.79         -3.88
dec     [deg]:               0.31          0.37          0.13

RMS x out[nT]:             164.7         109.1         110.9
RMS y out[nT]:              68.0          71.4          61.5
RMS z out[nT]:               5.0          28.8           8.8

 high res phi:
RMS x out[nT]; full flyby:                19.3
RMS y out[nT]; full flyby:                52.1
```

Table 6a

2007, Mar 06

THEMIS B fgl

```
RMS x in [nT]:             106.8          77.6          25.2
RMS y in [nT]:              45.0          55.7          64.6
RMS z in [nT]:              57.0          54.2          51.3

                       first half    full flyby    second half

Gxy          :         1.0001987     0.9998711     1.0018684
Gz           :         0.9982339     0.9978267     0.9987373
phi     [deg]:              0.40          0.48          0.59
ras     [deg]:              0.49          0.59          0.59
dec     [deg]:              0.22          0.22          0.35

RMS x out[nT]:              38.3          22.4          13.7
RMS y out[nT]:              18.0          18.3          17.1
RMS z out[nT]:               5.1           5.3           1.8

 high res phi:
RMS x out[nT]; full flyby:                 6.6
RMS y out[nT]; full flyby:                13.1
```

Table 6b

THEMIS B fge

```
RMS x in [nT]:             140.3         109.4          65.5
RMS y in [nT]:              94.6          84.8          73.7
RMS z in [nT]:              56.5          54.2          51.7

                       first half    full flyby    second half

Gxy          :         0.9996441     0.9993771     1.0020151
Gz           :         0.9981898     0.9977838     0.9987806
phi     [deg]:              0.19          0.10          0.19
ras     [deg]:              0.50          0.59          0.59
dec     [deg]:              0.22          0.22          0.37

RMS x out[nT]:             124.3          90.5          38.0
RMS y out[nT]:              87.7          70.9          48.2
RMS z out[nT]:               3.9           4.9           2.1

 high res phi:
RMS x out[nT]; full flyby:                25.8
RMS y out[nT]; full flyby:                42.9
```

Table 7

2007, June 08

THEMIS B fge

	first half	full flyby	second half
RMS x in [nT]:	128.5	106.4	78.3
RMS y in [nT]:	204.5	146.3	31.3
RMS z in [nT]:	19.4	22.8	25.7
Gxy :	1.0005740	1.0006453	0.9995988
Gz :	1.0000900	1.0000581	0.9966351
phi [deg]:	1.03	0.96	0.71
ras [deg]:	-0.64	-0.63	-0.42
dec [deg]:	0.01	0.01	-0.06
RMS x out[nT]:	20.0	20.6	1.8
RMS y out[nT]:	15.1	12.4	2.5
RMS z out[nT]:	1.1	0.9	0.5

high res phi:

RMS x out[nT]; full flyby:	1.2
RMS y out[nT]; full flyby:	2.4

Comment: ‘second half’ has lower field values so parameters are not as well determined as ‘first half’ and ‘full flyby’

Table 8

2007, June 29

THEMIS B fge

RMS x in [nT]:	106.1	90.1	70.6
RMS y in [nT]:	207.9	150.3	44.7
RMS z in [nT]:	14.9	15.9	16.7
	first half	full flyby	second half
Gxy :	1.0000881	1.0000386	0.9994189
Gz :	1.0008000	1.0008514	1.0000553
phi [deg]:	0.94	0.90	0.72
ras [deg]:	-0.48	-0.48	-0.41
dec [deg]:	-0.07	-0.06	-0.05
RMS x out[nT]:	12.2	18.6	9.0
RMS y out[nT]:	10.1	8.4	2.5
RMS z out[nT]:	1.6	1.3	0.8
high res phi:			
RMS x out[nT]; full flyby:		1.9	
RMS y out[nT]; full flyby:		2.0	

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 9a

2007, Mar 04

THEMIS C fgl

```
RMS x in [nT]:              59.8         121.3         160.8
RMS y in [nT]:              53.8          49.2          44.1
RMS z in [nT]:              47.3          88.5         115.9

                       first half    full flyby    second half

Gxy          :          1.0009185     1.0010380     1.0012914
Gz           :          0.9993683     0.9992903     0.9998342
phi     [deg]:               0.70          0.74          0.89
ras     [deg]:               0.17          0.13          0.10
dec     [deg]:              -0.41         -0.43         -0.46

RMS x out[nT]:               8.1          30.0          30.5
RMS y out[nT]:              11.7          14.8          17.0
RMS z out[nT]:               2.7           4.4           3.3

 high res phi:
RMS x out[nT]; full flyby:                 5.4
RMS y out[nT]; full flyby:                 3.8
```

Table 9b

THEMIS C fge

```
RMS x in [nT]:              48.9         101.8         135.5
RMS y in [nT]:              97.4          95.7          94.0
RMS z in [nT]:              47.3          88.5         115.9

                       first half    full flyby    second half

Gxy          :          1.0009838     1.0011536     1.0014312
Gz           :          0.9993728     0.9992970     0.9998780
phi     [deg]:               0.18          0.12          0.46
ras     [deg]:               0.17          0.13          0.11
dec     [deg]:              -0.41         -0.43         -0.46

RMS x out[nT]:              37.0         101.9         121.6
RMS y out[nT]:              41.4          68.6          86.3
RMS z out[nT]:               2.5           4.4           3.3

 high res phi:
RMS x out[nT]; full flyby:                30.6
RMS y out[nT]; full flyby:                38.1
```

Table 10a

2007, Mar 06

THEMIS C fgl

RMS x in [nT]:	69.3	105.8	132.6
RMS y in [nT]:	146.8	149.6	152.4
RMS z in [nT]:	116.8	89.7	49.3
	first half	full flyby	second half
Gxy :	1.0017283	1.0015061	1.0009347
Gz :	0.9992228	0.9990990	0.9987689
phi [deg]:	0.44	0.56	0.64
ras [deg]:	-1.34	-1.33	-1.34
dec [deg]:	-0.46	-0.45	-0.47
RMS x out[nT]:	28.4	16.5	13.2
RMS y out[nT]:	13.5	17.1	15.3
RMS z out[nT]:	4.0	4.2	4.2
high res phi:			
RMS x out[nT]; full flyby:	4.2		
RMS y out[nT]; full flyby:	4.6		

Table 10b

THEMIS C fge

RMS x in [nT]:	111.8	110.9	110.0
RMS y in [nT]:	154.2	145.9	137.2
RMS z in [nT]:	117.1	89.9	49.4
	first half	full flyby	second half
Gxy :	1.0017282	1.0015631	1.0009624
Gz :	0.9991940	0.9990796	0.9987004
phi [deg]:	-0.03	0.14	0.26
ras [deg]:	-1.34	-1.33	-1.34
dec [deg]:	-0.46	-0.45	-0.48
RMS x out[nT]:	85.5	71.7	59.2
RMS y out[nT]:	63.1	56.3	49.3
RMS z out[nT]:	5.1	5.0	4.7
high res phi:			
RMS x out[nT]; full flyby:	22.8		
RMS y out[nT]; full flyby:	30.9		

Table 11a

2007, June 08

THEMIS C fgl

RMS x in [nT]:	68.3	61.6	54.0
RMS y in [nT]:	69.5	49.8	11.5
RMS z in [nT]:	18.4	14.0	7.1
	first half	full flyby	second half
Gxy :	1.0005465	1.0004874	1.0025643
Gz :	0.9999694	0.9998866	1.0033844
phi [deg]:	0.51	0.51	0.48
ras [deg]:	0.03	0.02	-0.19
dec [deg]:	-0.11	-0.11	0.00
RMS x out[nT]:	11.2	11.1	11.3
RMS y out[nT]:	19.0	13.8	4.7
RMS z out[nT]:	1.4	1.0	0.5
high res phi:			
RMS x out[nT]; full flyby:	1.5		
RMS y out[nT]; full flyby:	2.2		

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 11b

THEMIS C fge

RMS x in [nT]:	68.4	61.6	54.0
RMS y in [nT]:	69.4	49.7	11.5
RMS z in [nT]:	18.4	14.0	7.1
	first half	full flyby	second half
Gxy :	1.0006871	1.0005327	1.0029202
Gz :	1.0000637	0.9998952	1.0040491
phi [deg]:	0.51	0.51	0.47
ras [deg]:	0.03	0.02	-0.23
dec [deg]:	-0.10	-0.11	0.01
RMS x out[nT]:	11.2	11.1	11.3
RMS y out[nT]:	19.1	13.9	4.7
RMS z out[nT]:	1.4	1.1	0.5
high res phi:			
RMS x out[nT]; full flyby:	1.5		
RMS y out[nT]; full flyby:	2.2		

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 12

2007, June 29

THEMIS C fge

	first half	full flyby	second half
RMS x in [nT]:	70.8	62.5	52.9
RMS y in [nT]:	41.7	30.5	11.1
RMS z in [nT]:	60.7	47.5	28.8
Gxy :	0.9997712	0.9994029	0.9997386
Gz :	1.0007656	1.0002378	1.0014532
phi [deg]:	0.40	0.41	0.39
ras [deg]:	0.35	0.35	0.24
dec [deg]:	-0.25	-0.28	-0.27
RMS x out[nT]:	12.6	11.6	11.3
RMS y out[nT]:	19.5	14.0	5.5
RMS z out[nT]:	1.0	0.8	0.6

high res phi:
RMS x out[nT]; full flyby: 2.3
RMS y out[nT]; full flyby: 2.4

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 13a

2007, Mar 04

THEMIS D fgl

```
RMS x in [nT]:              70.1         156.4         209.8
RMS y in [nT]:              82.5          81.4          80.4
RMS z in [nT]:              37.8          49.0          58.1

                       first half    full flyby    second half

Gxy          :          0.9994797     0.9991542     0.9985943
Gz           :          0.9980148     0.9976051     0.9950979
phi     [deg]:               1.06          1.04          1.06
ras     [deg]:              -0.12         -0.15         -0.24
dec     [deg]:              -0.29         -0.24         -0.19

RMS x out[nT]:              43.3          45.2          45.5
RMS y out[nT]:              41.8          36.9          31.9
RMS z out[nT]:               3.9           5.5           4.5

 high res phi:
RMS x out[nT]; full flyby:                25.7
RMS y out[nT]; full flyby:                26.5
```

Table 13b

THEMIS D fge

```
RMS x in [nT]:              63.8         103.6         131.9
RMS y in [nT]:              84.9          87.3          89.7
RMS z in [nT]:              37.8          49.0          58.1

                       first half    full flyby    second half

Gxy          :          0.9996476     0.9991661     0.9985691
Gz           :          0.9980176     0.9976066     0.9950850
phi     [deg]:               0.50          0.65          0.55
ras     [deg]:              -0.12         -0.15         -0.24
dec     [deg]:              -0.29         -0.24         -0.19

RMS x out[nT]:              62.2          83.9          98.8
RMS y out[nT]:              70.9          76.3          83.1
RMS z out[nT]:               3.8           5.4           4.4

 high res phi:
RMS x out[nT]; full flyby:                35.8
RMS y out[nT]; full flyby:                47.3
```

Table 14a

2007, Mar 06

THEMIS D fgl

```
RMS x in [nT]:              95.2         119.6         139.8
RMS y in [nT]:             106.4          85.1          56.2
RMS z in [nT]:              49.2          50.1          51.0

                       first half    full flyby    second half

Gxy          :          0.9988832     0.9994855     0.9997411
Gz           :          0.9982475     0.9983416     0.9985512
phi     [deg]:               1.13          0.82          0.73
ras     [deg]:              -0.05          0.02          0.13
dec     [deg]:              -0.26         -0.22         -0.23

RMS x out[nT]:              29.0          16.3           9.8
RMS y out[nT]:              41.1          26.4           6.8
RMS z out[nT]:               5.1           7.8           2.1

 high res phi:
RMS x out[nT]; full flyby:                 7.6
RMS y out[nT]; full flyby:                12.7
```

Table 14b

THEMIS D fge

```
RMS x in [nT]:              62.0          89.5         110.4
RMS y in [nT]:             103.9          86.2          63.7
RMS z in [nT]:              48.9          49.9          50.8

                       first half    full flyby    second half

Gxy          :          0.9989533     0.9994563     0.9996572
Gz           :          0.9982728     0.9983698     0.9986472
phi     [deg]:               0.48          0.26          0.25
ras     [deg]:              -0.05          0.02          0.13
dec     [deg]:              -0.26         -0.22         -0.23

RMS x out[nT]:              60.5          82.7         102.5
RMS y out[nT]:              69.6          66.6          60.8
RMS z out[nT]:               5.3           7.9           2.8

 high res phi:
RMS x out[nT]; full flyby:                28.0
RMS y out[nT]; full flyby:                44.4
```

Table 15a

2007, June 08

THEMIS D fgl

```
RMS x in [nT]:              63.3          61.0          58.5
RMS y in [nT]:              87.5          63.2          18.8
RMS z in [nT]:              13.0           9.4           2.7

                       first half    full flyby    second half

Gxy          :         0.9992955     0.9994763     0.9997749
Gz           :         0.9996458     0.9996917     0.9994259
phi     [deg]:              0.53          0.54          0.51
ras     [deg]:             -0.09         -0.09         -0.07
dec     [deg]:             -0.10         -0.10         -0.10

RMS x out[nT]:              12.6          13.1          14.0
RMS y out[nT]:              19.9          14.6           5.1
RMS z out[nT]:               1.7           1.5           1.3

 high res phi:
RMS x out[nT]; full flyby:                 2.1
RMS y out[nT]; full flyby:                 3.0
```

Comment: ‘second half’ has lower field values so parameters are not as well determined as ‘first half’ and ‘full flyby’

Table 15b

THEMIS D fge

```
RMS x in [nT]:              63.4          61.0          58.5
RMS y in [nT]:              87.4          63.2          18.7
RMS z in [nT]:              13.0           9.4           2.7

                       first half    full flyby    second half

Gxy          :         0.9994534     0.9994921     1.0004619
Gz           :         0.9997641     0.9996944     1.0008086
phi     [deg]:              0.54          0.54          0.51
ras     [deg]:             -0.08         -0.09         -0.14
dec     [deg]:             -0.09         -0.10         -0.06

RMS x out[nT]:              12.6          13.2          14.3
RMS y out[nT]:              19.9          14.7           5.2
RMS z out[nT]:               1.7           1.5           1.3

 high res phi:
RMS x out[nT]; full flyby:                 2.1
RMS y out[nT]; full flyby:                 3.0
```

Comment: ‘second half’ has lower field values so parameters are not as well determined as ‘first half’ and ‘full flyby’

Table 16

2007, June 29

THEMIS D fge

RMS x in [nT]:	70.5	62.8	53.9
RMS y in [nT]:	64.7	47.8	19.4
RMS z in [nT]:	52.7	40.2	21.5
	first half	full flyby	second half
Gxy :	0.9991764	0.9984543	0.9997635
Gz :	1.0007696	0.9994311	1.0025448
phi [deg]:	0.45	0.45	0.37
ras [deg]:	0.17	0.17	-0.11
dec [deg]:	-0.21	-0.28	-0.30
RMS x out[nT]:	21.5	17.8	13.8
RMS y out[nT]:	25.5	19.0	9.7
RMS z out[nT]:	23.0	18.5	12.3
high res phi:			
RMS x out[nT]; full flyby:		10.6	
RMS y out[nT]; full flyby:		8.3	

Comment: ‘second half’ has lower field values so parameters are not as well determined as ‘first half’ and ‘full flyby’

Table 17a

2007, Mar 06

THEMIS E fgl

```
RMS x in [nT]:              70.8         156.0         208.9
RMS y in [nT]:             107.3          91.0          71.0
RMS z in [nT]:              43.9          56.5          66.7

                       first half    full flyby    second half

Gxy          :          0.9967442     0.9988005     0.9990300
Gz           :          0.9983096     0.9990097     1.0008110
phi     [deg]:               1.16          0.92          1.13
ras     [deg]:              -0.13         -0.12         -0.09
dec     [deg]:              -0.22         -0.31         -0.32

RMS x out[nT]:              49.1          45.0          45.3
RMS y out[nT]:              39.0          24.0          28.2
RMS z out[nT]:               5.3           9.4           9.9

 high res phi:
RMS x out[nT]; full flyby:                 6.7
RMS y out[nT]; full flyby:                21.9
```

Table 17b

THEMIS E fge

```
RMS x in [nT]:              75.2         131.2         169.6
RMS y in [nT]:             119.1         100.8          78.4
RMS z in [nT]:              43.5          54.1          62.8

                       first half    full flyby    second half

Gxy          :          0.9966804     0.9991137     0.9997218
Gz           :          0.9983225     0.9989001     1.0006769
phi     [deg]:               0.66          0.52          0.73
ras     [deg]:              -0.12         -0.13         -0.12
dec     [deg]:              -0.21         -0.29         -0.30

RMS x out[nT]:              80.8         102.1         118.5
RMS y out[nT]:              73.8          69.3          66.1
RMS z out[nT]:               5.4           6.0           3.3

 high res phi:
RMS x out[nT]; full flyby:                24.3
RMS y out[nT]; full flyby:                48.3
```

Table 18a

2007, June 08

THEMIS E fgl

RMS x in [nT]:	70.3	65.9	61.2
RMS y in [nT]:	106.7	77.0	22.0
RMS z in [nT]:	16.6	12.4	5.6
	first half	full flyby	second half
Gxy :	0.9994212	0.9996015	0.9993776
Gz :	1.0003965	1.0005305	1.0003970
phi [deg]:	0.66	0.67	0.65
ras [deg]:	-0.03	0.00	0.03
dec [deg]:	-0.07	-0.06	-0.05
RMS x out[nT]:	12.0	11.9	11.2
RMS y out[nT]:	20.0	14.6	4.9
RMS z out[nT]:	1.7	1.4	1.1

high res phi:

RMS x out[nT]; full flyby:	2.0
RMS y out[nT]; full flyby:	2.4

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 18b

THEMIS E fge

RMS x in [nT]:	70.3	65.9	61.0
RMS y in [nT]:	106.5	76.9	21.8
RMS z in [nT]:	16.6	12.4	5.6
	first half	full flyby	second half
Gxy :	0.9994446	0.9996150	0.9979574
Gz :	1.0003477	1.0005733	0.9978671
phi [deg]:	0.66	0.67	0.66
ras [deg]:	-0.03	0.00	0.19
dec [deg]:	-0.07	-0.06	-0.12
RMS x out[nT]:	11.9	11.8	11.2
RMS y out[nT]:	20.0	14.6	4.8
RMS z out[nT]:	1.7	1.4	1.1

high res phi:

RMS x out[nT]; full flyby:	2.0
RMS y out[nT]; full flyby:	2.4

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 19

2007, June 29

THEMIS E fge

RMS x in [nT]:	79.5	69.5	57.8
RMS y in [nT]:	85.5	62.8	24.3
RMS z in [nT]:	48.7	37.3	20.3
	first half	full flyby	second half
Gxy :	0.9984340	0.9992235	0.9963685
Gz :	0.9997738	1.0015388	0.9970961
phi [deg]:	0.55	0.59	0.63
ras [deg]:	0.14	0.16	0.50
dec [deg]:	-0.27	-0.18	-0.23
RMS x out[nT]:	12.2	11.5	10.4
RMS y out[nT]:	18.3	14.1	4.3
RMS z out[nT]:	1.7	1.4	0.4
high res phi:			
RMS x out[nT]; full flyby:		3.9	
RMS y out[nT]; full flyby:		3.9	

Comment: 'second half' has lower field values so parameters are not as well determined as 'first half' and 'full flyby'

Table 20

2007, Jun 08	Gxy	Gz	dphi [deg]	dras [deg]	ddec [deg]
THEMIS A	0.9993067	0.9990422	0.79	0.09	-0.08
THEMIS B	1.0006453	1.0000581	0.96	-0.63	0.01
THEMIS C	1.0004874	0.9998866	0.51	0.02	-0.11
THEMIS D	0.9994763	0.9996917	0.54	-0.09	-0.10
THEMIS E	0.9996015	1.0005305	0.67	0.00	-0.06

Please note: dphi should be subtracted from existing phase

Table 21

2007, Jun 29	Gxy	Gz	dphi [deg]	dras [deg]	ddec [deg]
THEMIS A	0.9973828	1.0005693	1.09	-0.20	-0.02
THEMIS B	1.0000386	1.0008514	0.90	-0.48	-0.06
THEMIS C	0.9994029	1.0002378	0.41	0.35	-0.28
THEMIS D	0.9984543	0.9994311	0.45	0.17	-0.28
THEMIS E	0.9992235	1.0015388	0.59	0.16	-0.18

Please note: dphi should be subtracted from existing phase