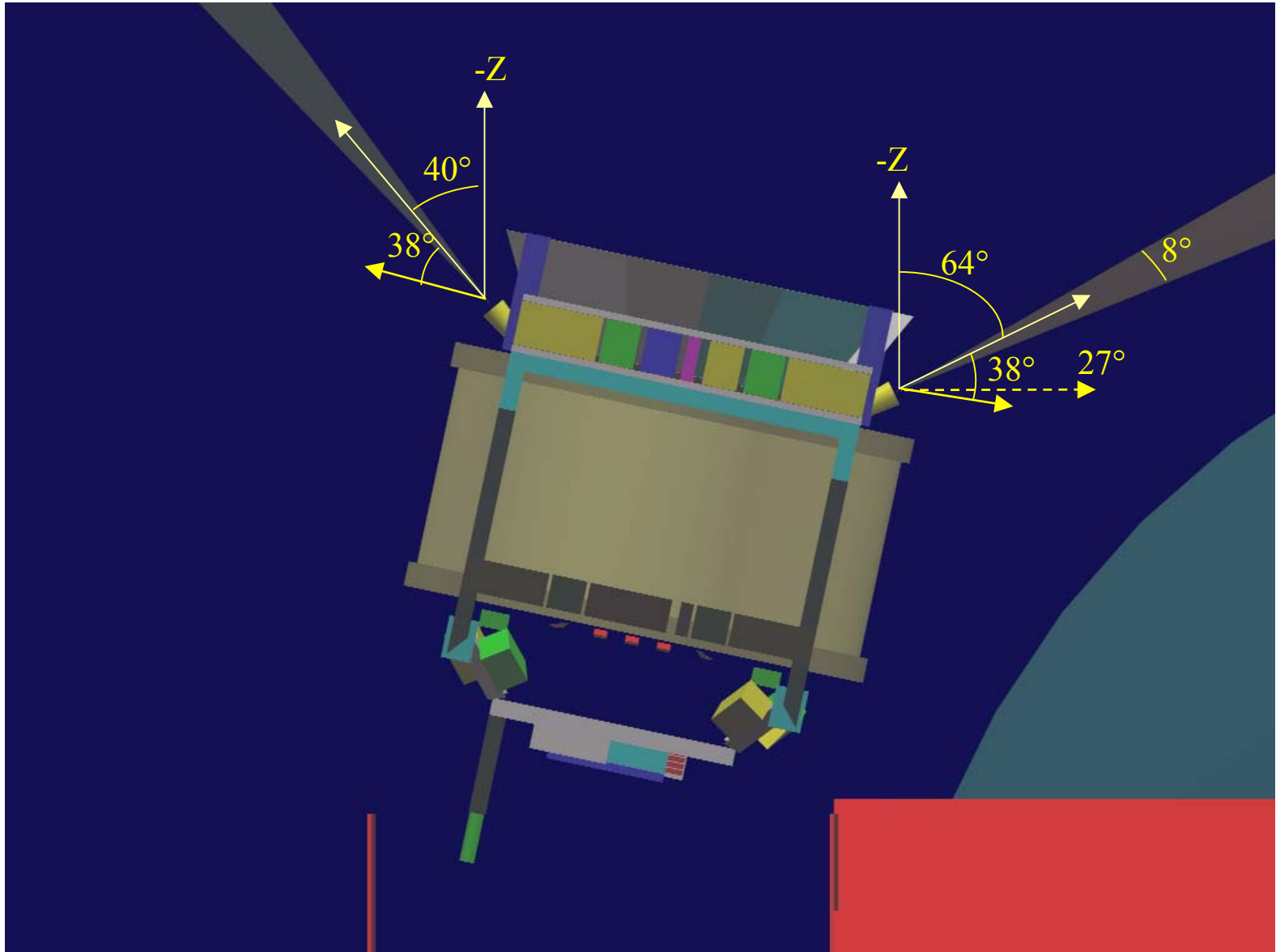
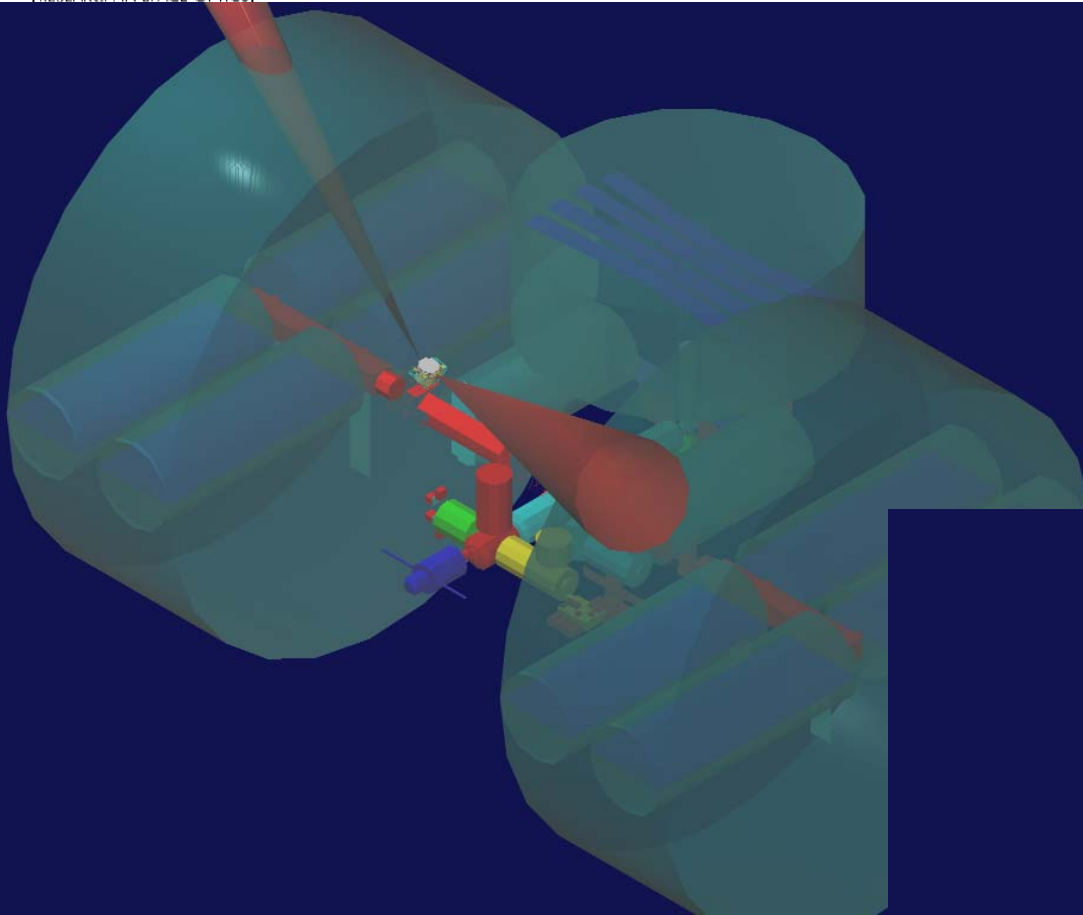
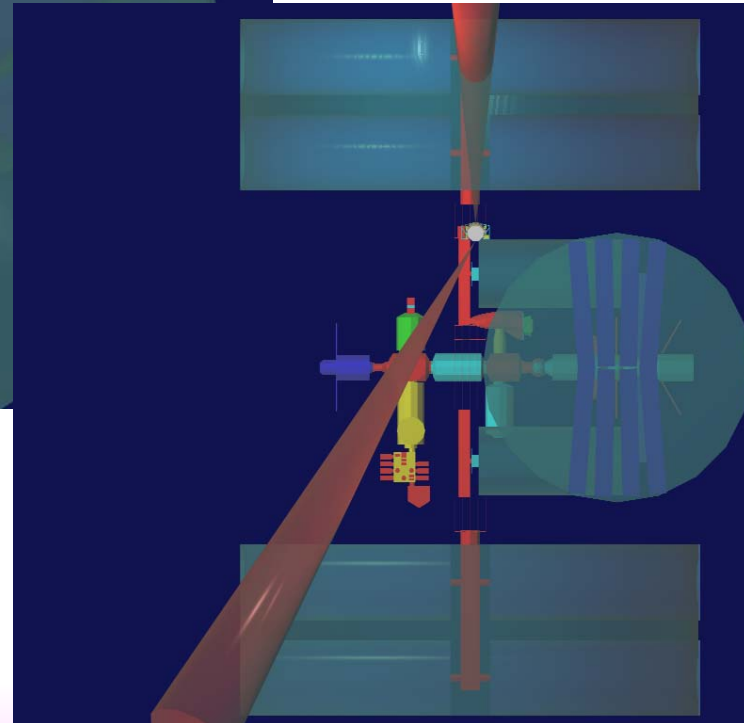


AMS TIM – Amica Star Tracker



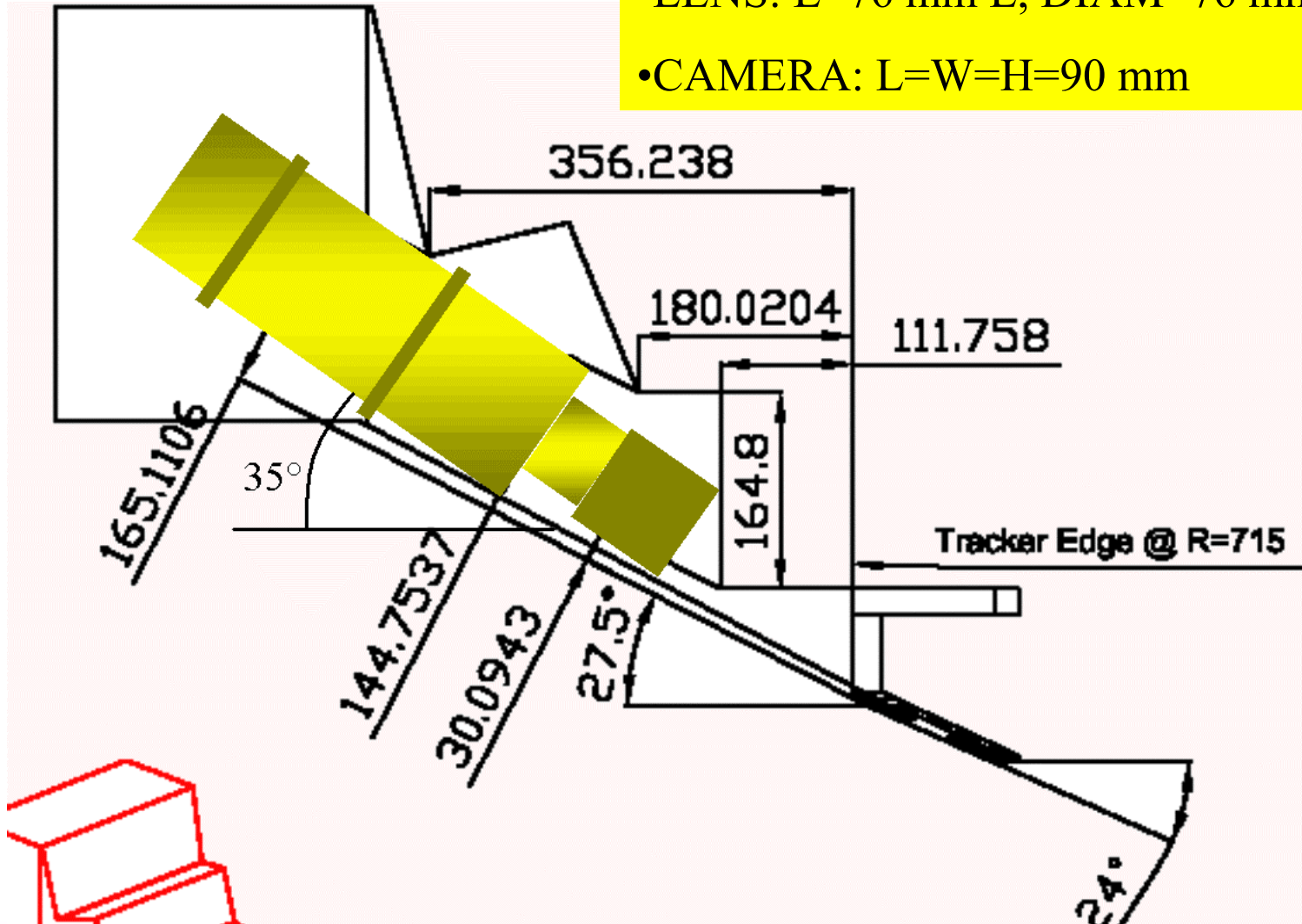


**30° Rotation in RAM of
the ASTC2**



AMS TIM – Amica Star Tracker

- BAFFLE : L=350 mm L, DIAM=130 mm
- LENS: L=76 mm L, DIAM=76 mm
- CAMERA: L=W=H=90 mm

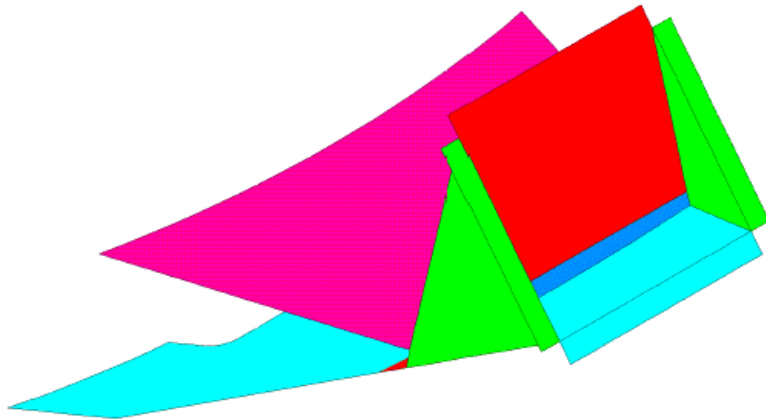


ISATEC : ASTS Finite Element Analyses

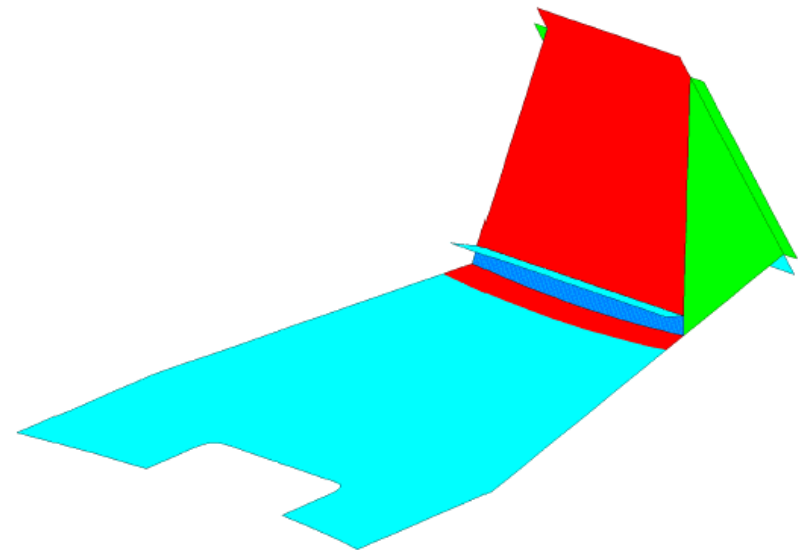
I.S.A.^{teo}
ENGINEERING

I.S.A.^{teo}
ENGINEERING

The **upper structure** consists of only one plate, which is bolted to the outer tracker plate as well as to the lower support structure.



FE-Model, Support w/o Camera Box



FE-Model, Lower Part
(Fixed to Conical Tracker Flange)
consists of different plates bonded together
before assembly

sts02

ISATEC Finite Element Analyses

ASTS: Material Properties

For the CFC support structure, isotropic, linear elastic material properties are presumed, characterized by a Poisson Ratio = 0,3 and a Modulus of Elasticity:

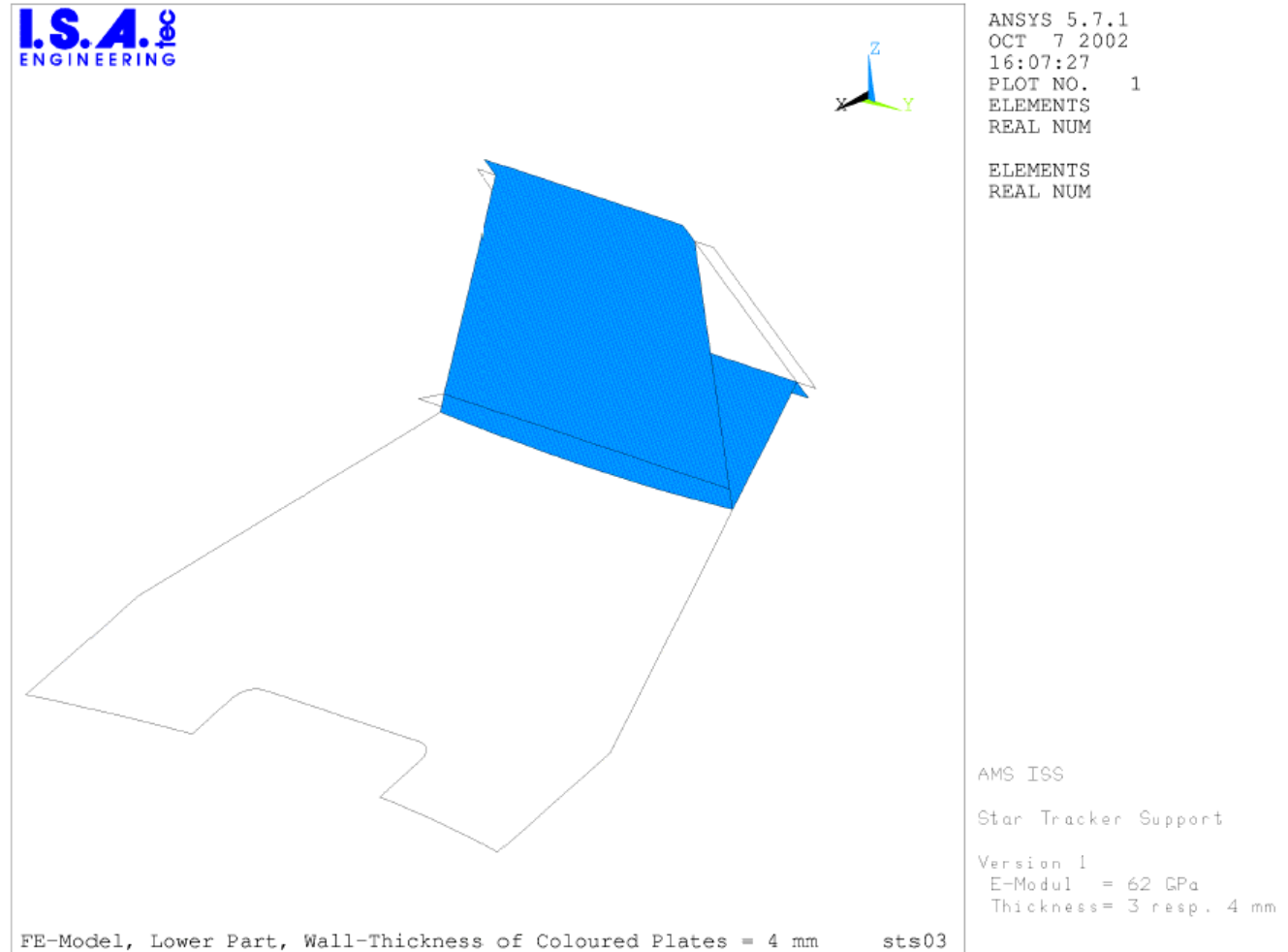
Version 1: E = 62 GPa, corresponding to Composite T300J/EP with biaxial layup,

Version 2: E = 100 GPa, corresponding to Composite HM40/EP with biaxial layup,

- The Density of $\rho = 1,6 \text{ kg/cm}^3$ results in a mass of 0,85 kg for Version 1 and 0,80 kg for Version 2 for each STS.

- The properties of the camera box are: E = 70 GPa and $\nu = 0,34$. The density is chosen appropriate to a resulting mass of 1,5 kg per camera box.

In general the wall-thicknesses of the support structure amount to 3 mm for both model versions, except for version 1, where some plates of the lower support structure, shown in plot sts03, have a thickness of 4 mm.



ISATEC Finite Element Analyses

ASTS: Results of the Modal Analysis

Modal Analysis of Model **Version 1** (E = 62 GPa):

First Natural Eigenfrequency = **49,5 Hz**. The corresponding mode shape is shown in plots sts06 (with undeformed structure overlaid) and sts07.

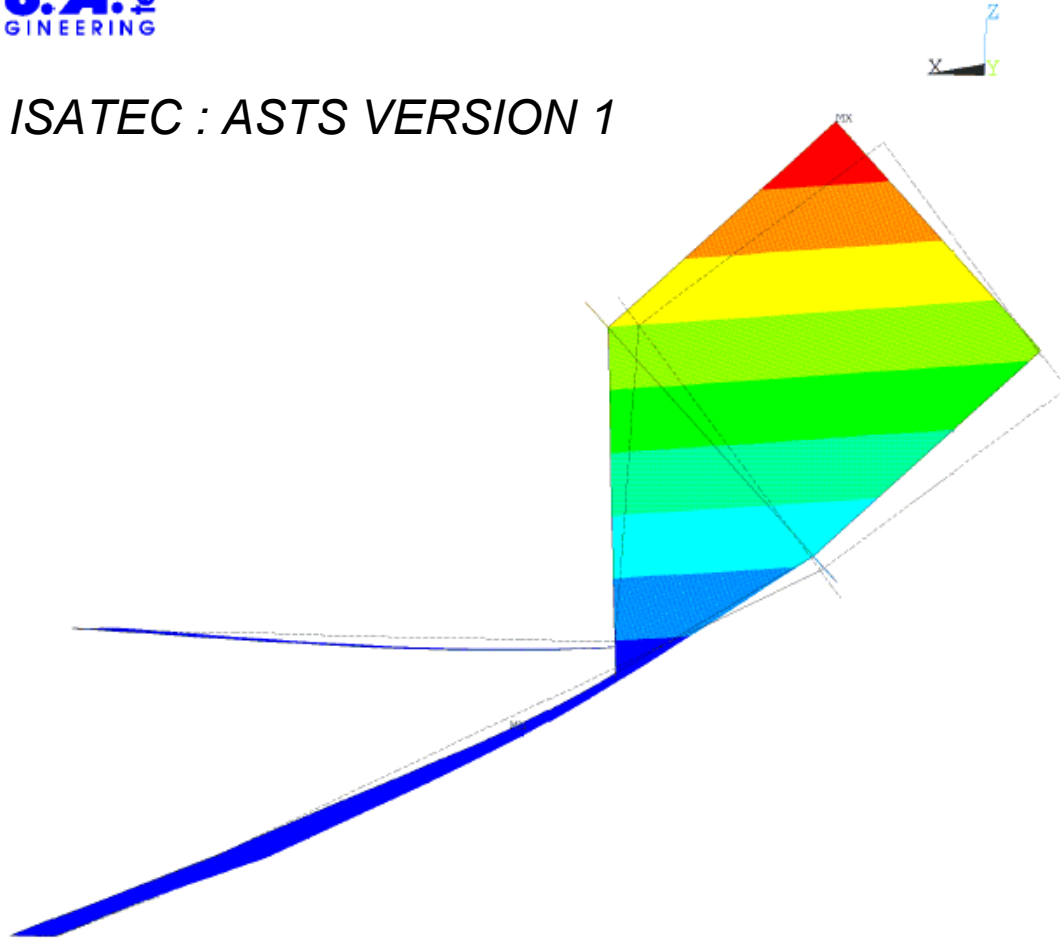
Modal Analysis of Model **Version 2** (E = 100 GPa):

First Natural Eigenfrequency = **58,9 Hz**. The corresponding mode shape is shown in plots sts08 (with undeformed structure overlaid) and sts09.

For both analyses the succeeding frequencies lay comfortably above 300 Hz, so that they have not to be regarded in more detail.

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ISATEC : ASTS VERSION 1



```

ANSYS 5.7.1
OCT 7 2002
12:29:15
PLOT NO. 1
NODAL SOLUTION
STEP=1
SUB =1
FREQ=49.528
UX
TOP
RSYS=0
DMX =1.079
SMN =-.1035
SMX =1
-.1035
.019111
.141723
.264334
.386945
.509556
.632167
.754778
.877389
1
  
```

AMS ISS

Star Tracker Support

Version 1

E-Modul = 62 GPa

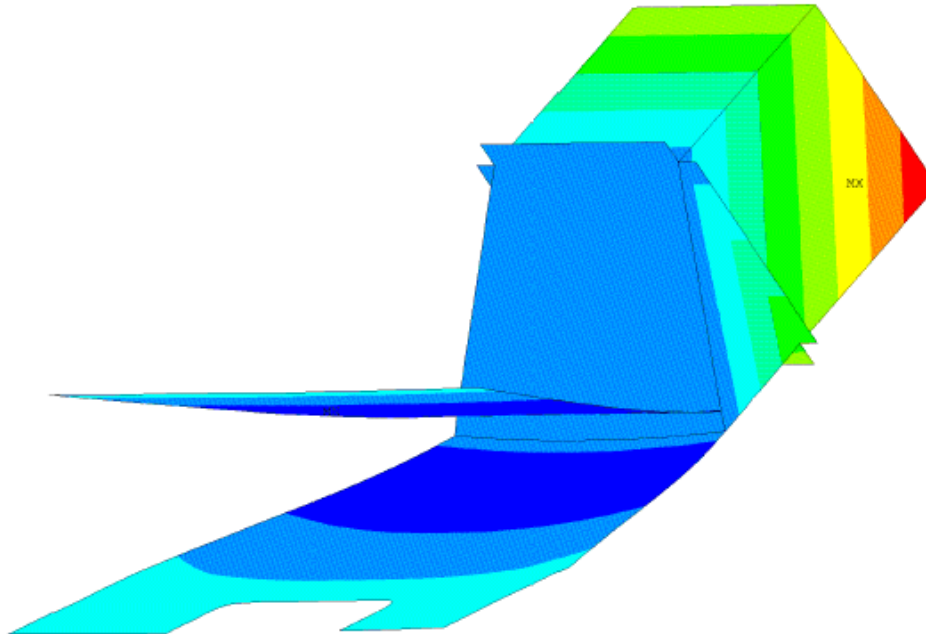
Thickness= 3 resp. 4 mm

FE Modal Analysis, First Natural Freq.= 49,5 Hz, Horiz. Displ., sts06

I.S.A.tec

 ENGINEERING

ISATEC : ASTS VERSION 1



```

ANSYS 5.7.1
OCT  7 2002
12:33:24
PLOT NO.    1
NODAL SOLUTION
STEP=1
SUB  =1
FREQ=49.528
UZ
TOP
RSYS=0
DMX  =1.079
SMN  =-.246083
SMX  =.774735
  .-.246083
  .-.132659
  .-.019235
  .09419
  .207614
  .321038
  .434462
  .547886
  .661311
  .774735
  
```

AMS ISS

Star Tracker Support

Version 1

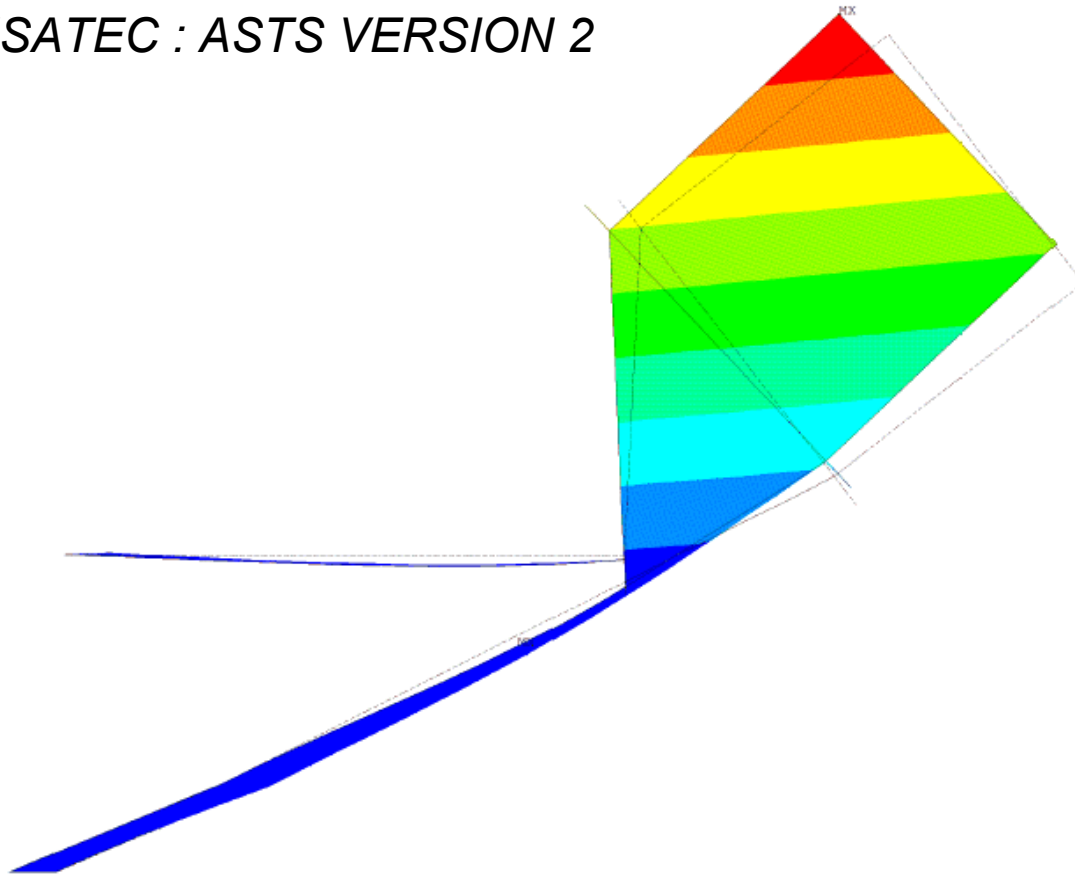
E-Modul = 62 GPa

Thickness= 3 resp. 4 mm

FE Modal Analysis, First Natural Freq.= 49,5 Hz, Vertical Displ., sts07

I.S.A.
 ENGINEERING

ISATEC : ASTS VERSION 2



ANSYS 5.7.1
 OCT 7 2002
 10:25:24
 PLOT NO. 1
 NODAL SOLUTION
 STEP=1
 SUB =1
 FREQ=58.886
 UX
 TOP
 RSYS=0
 DMX =1.082
 SMN =-.092855
 SMX =1

Blue	-.092855
Light Blue	.028573
Cyan	.150001
Green	.27143
Light Green	.392858
Yellow-Green	.514287
Yellow	.635715
Orange	.757143
Red	.878572
Red	1

AMS ISS

Star Tracker Support

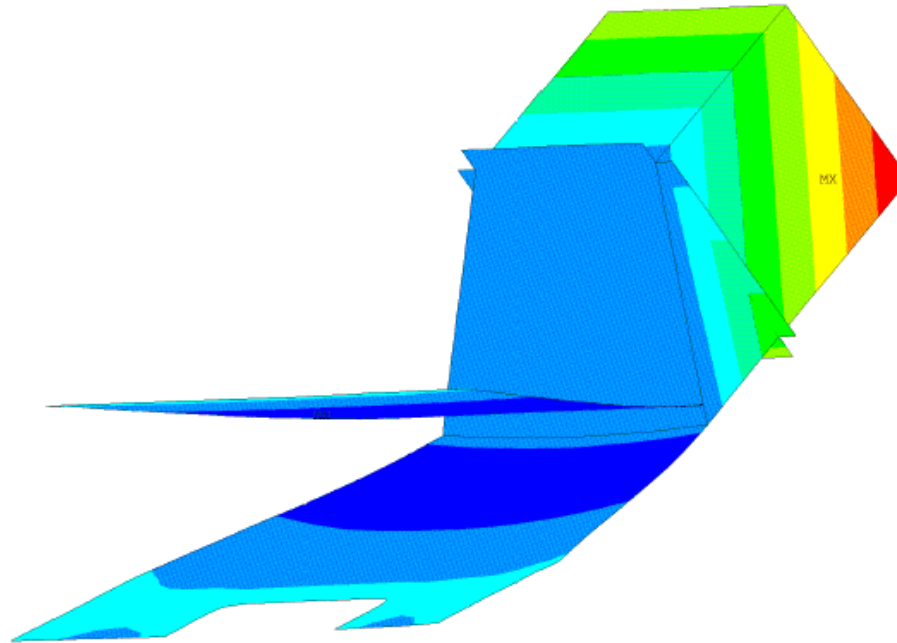
Version 2

E-Modul = 100 GPa
 Thickness = 3 mm

FE Modal Analysis, First Natural Freq. = 58,9 Hz, Horiz. Displ., sts08

I.S.A.
ENGINEERING

ISATEC : ASTS VERSION 2



```

ANSYS 5.7.1
OCT  7 2002
10:28:51
PLOT NO.   1
NODAL SOLUTION
STEP=1
SUB  =1
FREQ=58.886
UZ
TOP
RSYS=0
DMX  =1.082
SMN  =-.227644
SMX  =.780611
      -.227644
      -.115616
      -.003587
      .108441
      .220469
      .332498
      .444526
      .556554
      .668582
      .780611
  
```

AMS ISS

Star Tracker Support

Version 2

E-Modul = 100 GPa

Thickness = 3 mm

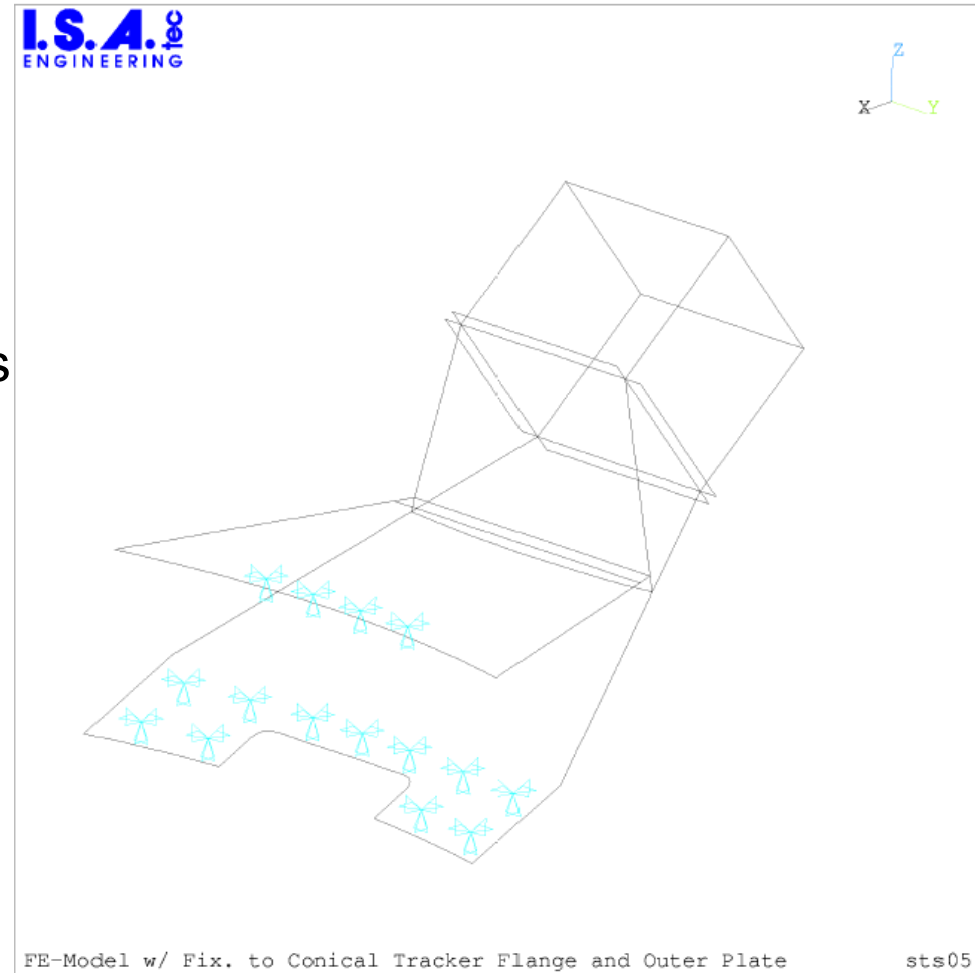
FE Modal Analysis, First Natural Freq. = 58,9 Hz, Vertical Displ., sts09

ISATEC Finite Element Analyses

ASTS : Results of the Static Analyses

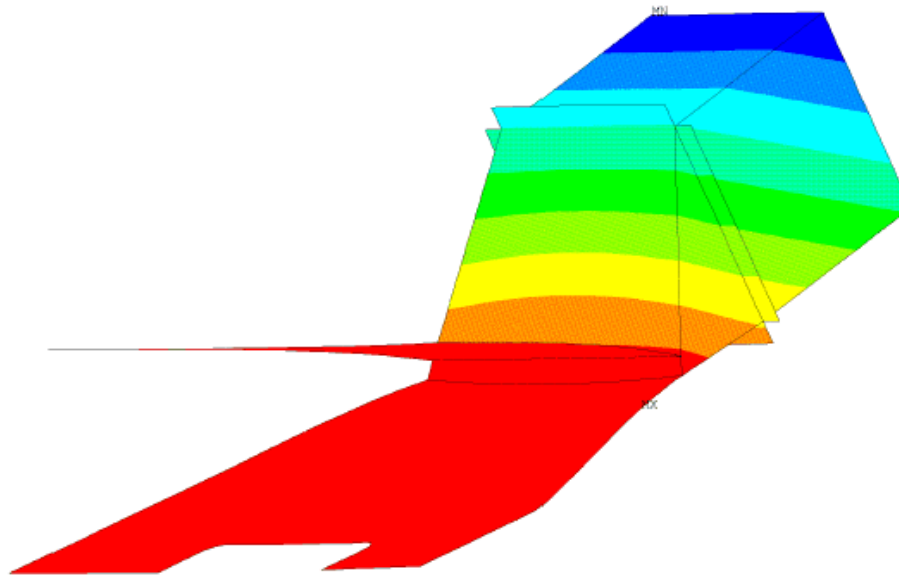
The acceleration load =
 $\{N_x; N_y; N_z\} = \{40 \text{ g}; 10 \text{ g}; 10 \text{ g}\}$
 represents the worst case with respect
 to the maximum bolt forces and causes
 displacements as shown in plot sts10.
 Following maximum forces arise at the
 bolt positions for model version 2:

- Bolting to the **outer tracker plate**:
 transverse force **Ft = 760 N**;
 longitudinal force **FI = 52 N**.
- Bolting to the conical tracker flange:
 transverse force **Ft = 1205 N**;
 longitudinal force **FI = 164 N**.



AMS TIM – Amica Star Tracker

I.S.A. Inc
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ANSYS 5.7.1
 OCT 7 2002
 16:42:38
 PLOT NO. 1
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 UX
 TOP
 RSYS=0
 DMX =3.954
 SMN =-3.651
 SMX =.337274
 -3.651
 -3.208
 -2.764
 -2.321
 -1.878
 -1.435
 -.992018
 -.548921
 -.105823
 .337274

AMS ISS

Star Tracker Support

Version 2

E-Modul = 100 GPa

Thickness = 3 mm

FEA, Accel: 40gx, 10gy, 10gz, Horizontal Displ. = -3,65 mm

sts10

ISATEC Finite Element Analyses

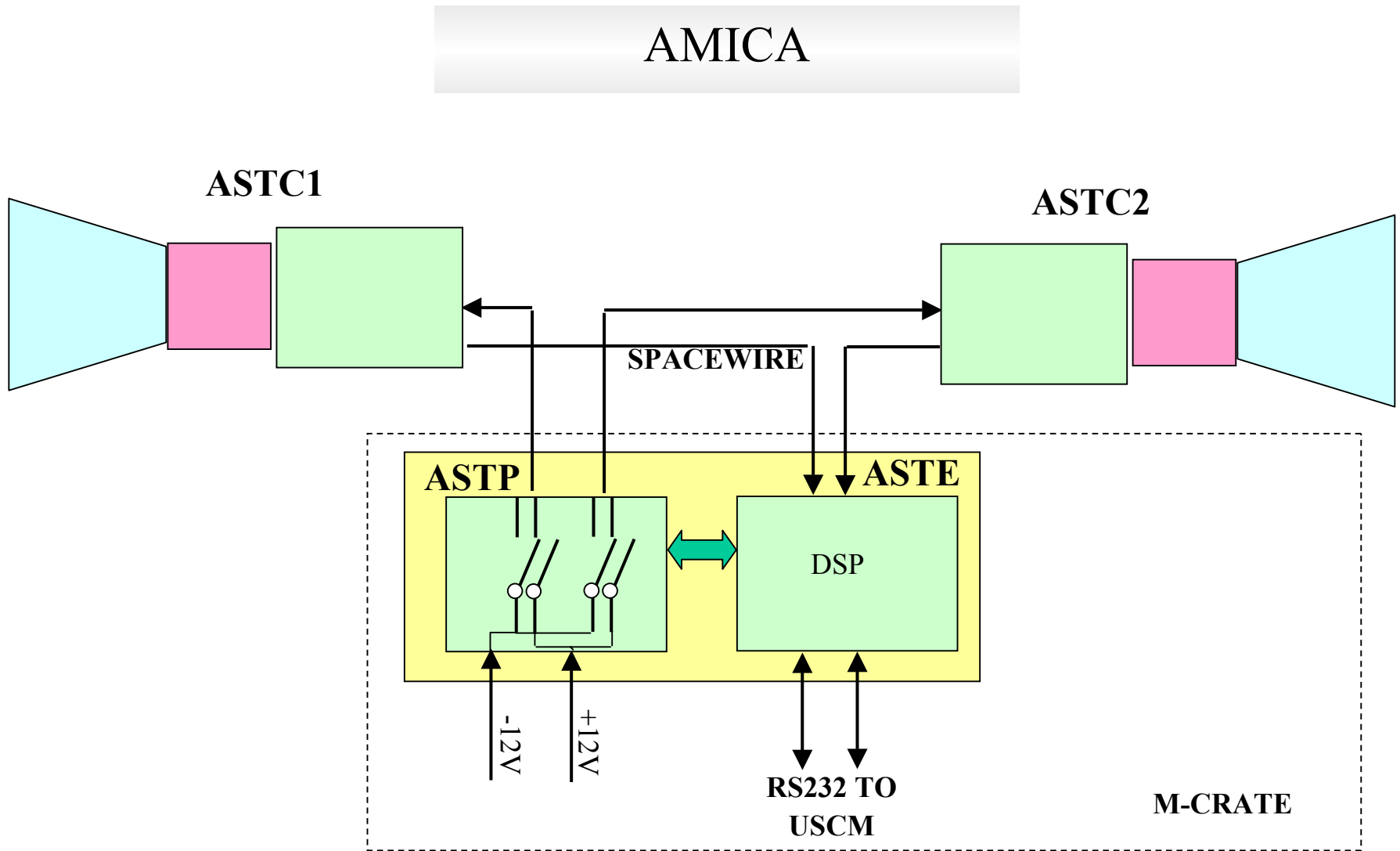
ASTS : Conclusion and Prospect

The first natural frequency of the Star Tracker Support model, reflecting the current state of development, of nearly 50 Hz is acceptable high, esp. in regard of the possibility, of choosing a stiffer fibre type with an appropriate composite layup, increasing the first natural frequency to comfortable nearly 59 Hz.

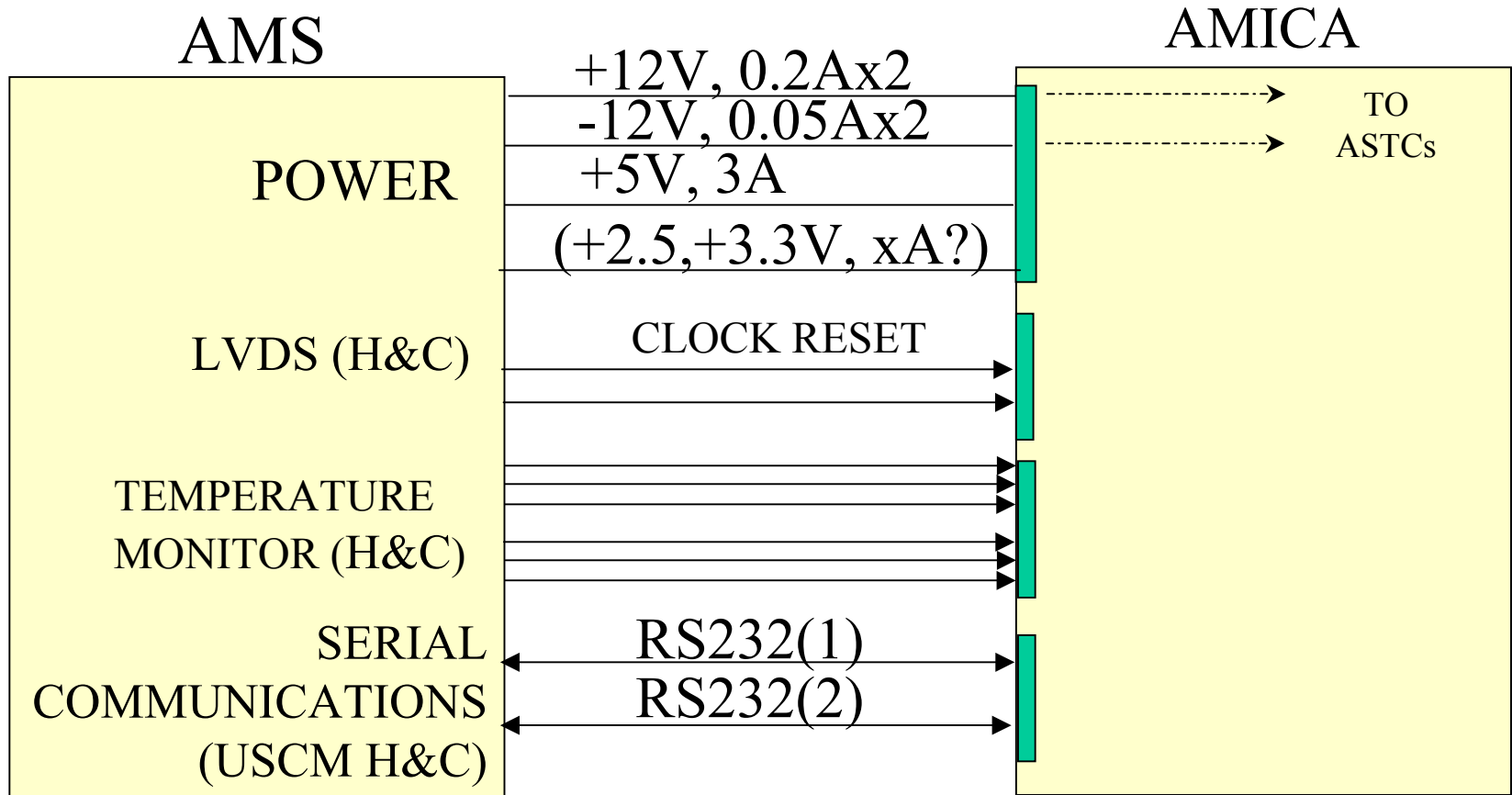
The appearing forces at the bolt positions could be beared by an appropriate Insert-Bolting combination analogous to the connection of the outer tracker plate on the conical tracker flange.

Other acceleration load combinations where also checked, but the resulting forces are smaller then those given above.

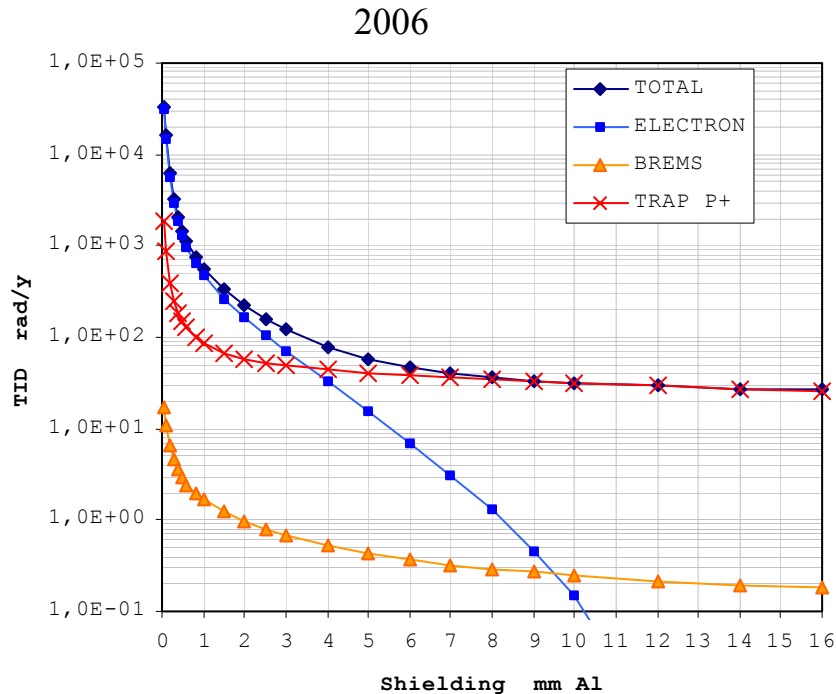
More detailed analyses could regard in addition the stiffness of the adjacent components, i. e. the outer tracker plate and tracker flange or even the complete tracker and/or can regard a more detailed anisotropic layup.



STAR TRACKER I/O LINES

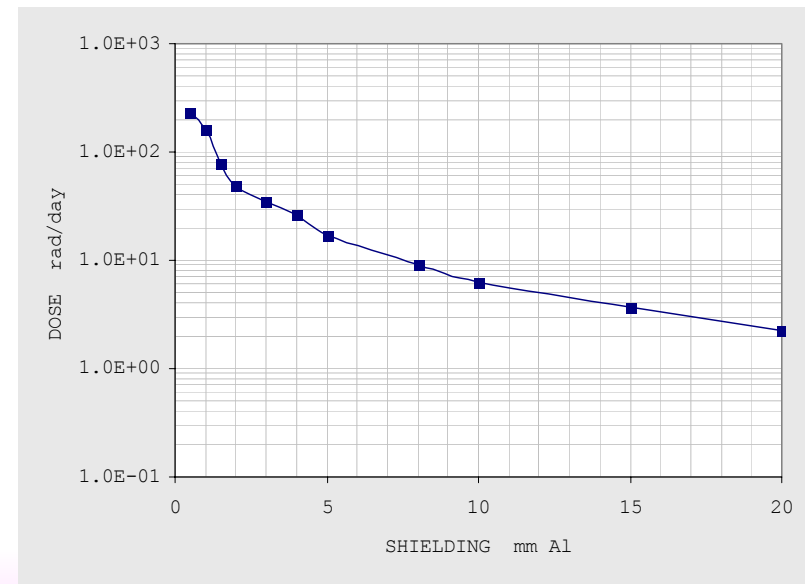


AMICA: RADIATION ANALYSIS

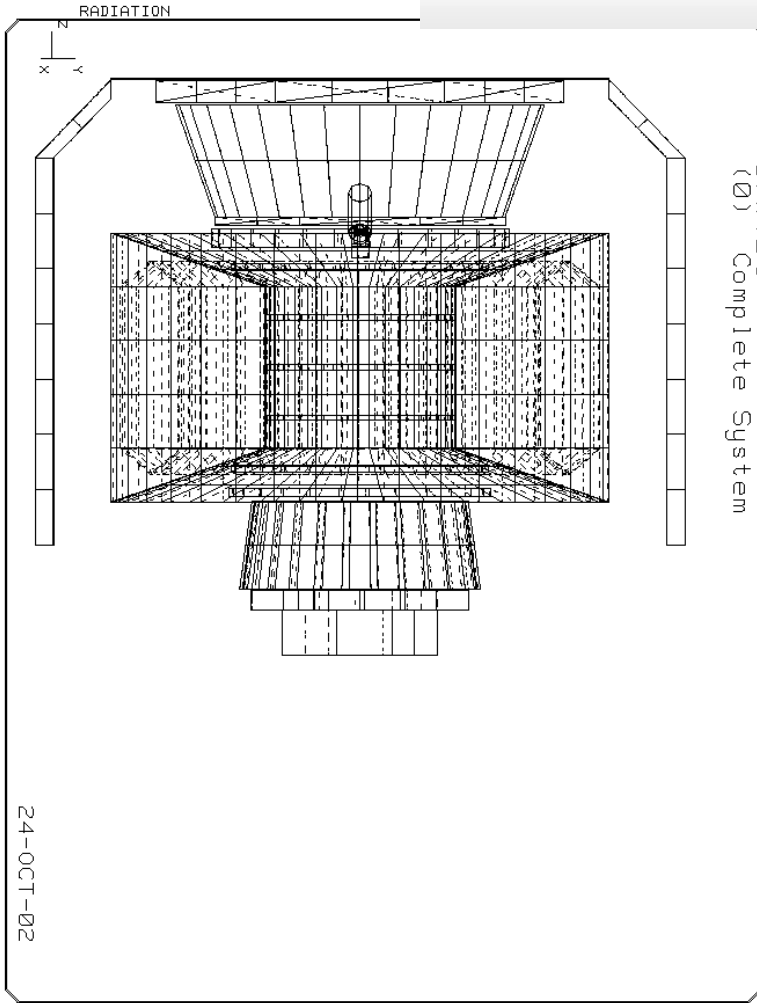


Year	TID at 3 mm Al
2006	122 rad
2007	120 rad
2008	141 rad
2009	220 rad
2010	334 rad

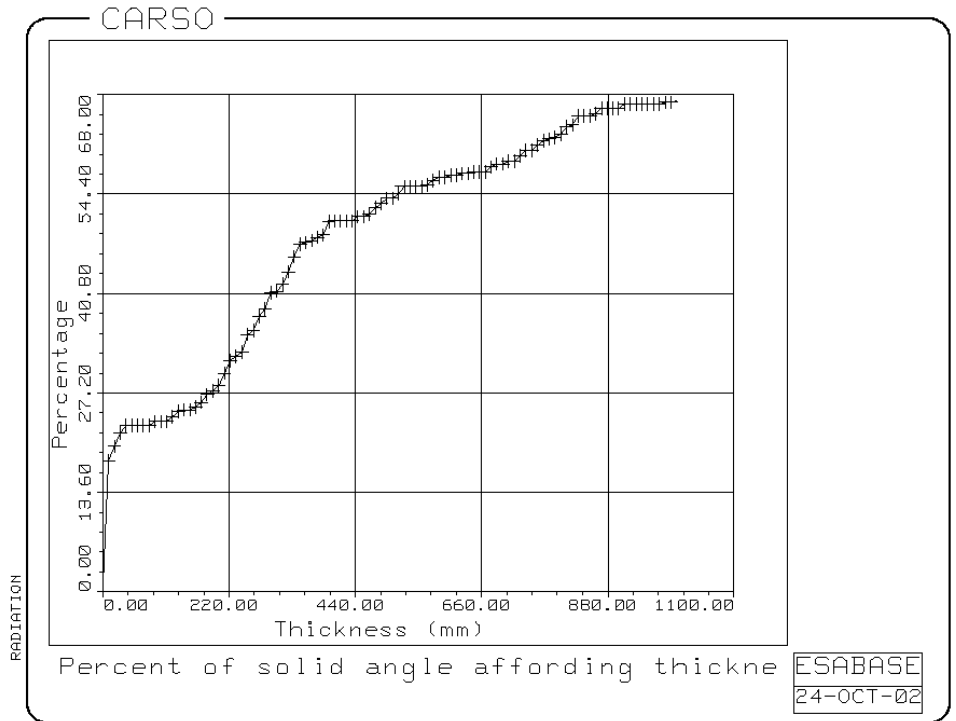
one-day-long Solar
Event during the
mission



AMICA: RADIATION ANALYSIS



ESABASE SIMULATIONS



AMICA: RADIATION ANALYSIS ESABASE SIMULATIONS

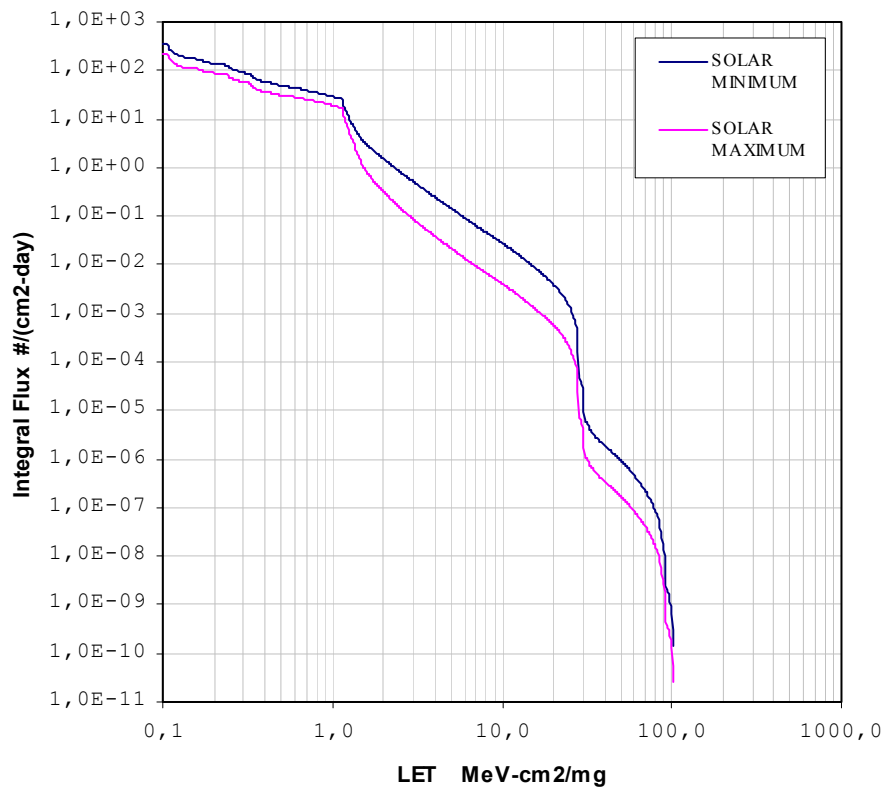
SOLAR MINIMUM – 2007

OVERALL SHIELDS			
BOX FACE	RAD. DOSE (rad)	SOLID ANGLE (steradian)	TOT.EQU. THICK. (mm)
+X	7.00	2.09	6.38
+Y	5.01	2.09	10.90
+Z	1.67	2.09	59.99
-X	1.67	2.09	59.99
-Y	5.01	2.09	10.90
-Z	1.67	2.09	59.99
TOTAL	22.02	12.57	21.06

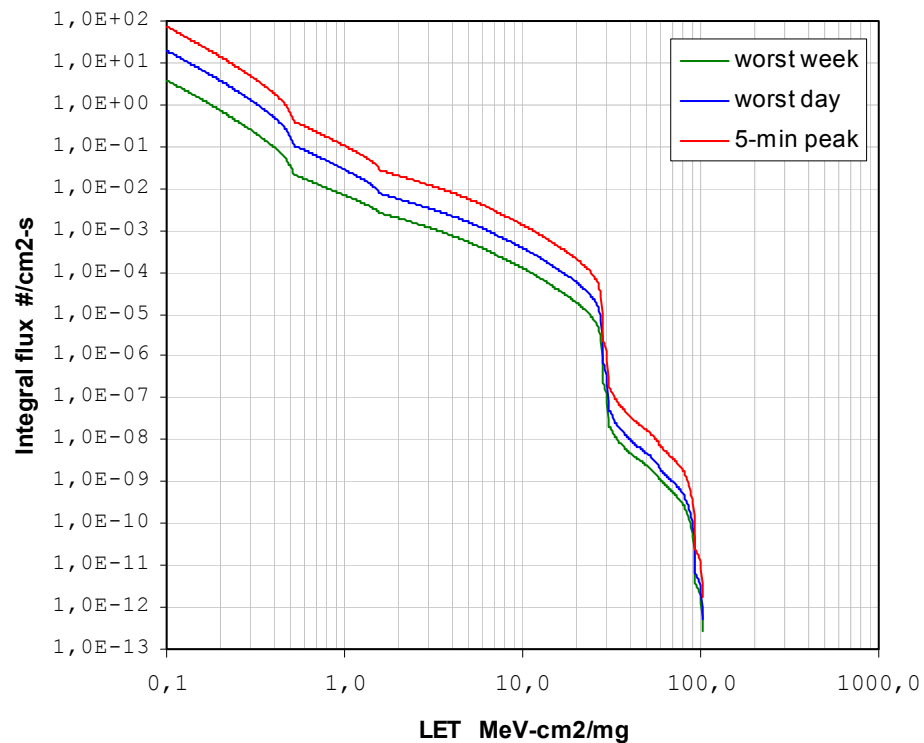
SOLAR MAXIMUM – 2010

OVERALL SHIELDS			
BOX FACE	RAD. DOSE (rad)	SOLID ANGLE (steradian)	TOT.EQU. THICK. (mm)
+X	15.85	2.09	5.47
+Y	12.28	2.09	6.35
+Z	3.33	2.09	59.99
-X	3.33	2.09	59.99
-Y	12.28	2.09	6.35
-Z	3.33	2.09	59.99
TOTAL	50.41	12.57	10.49

AMICA: SEE RADIATION ANALYSIS

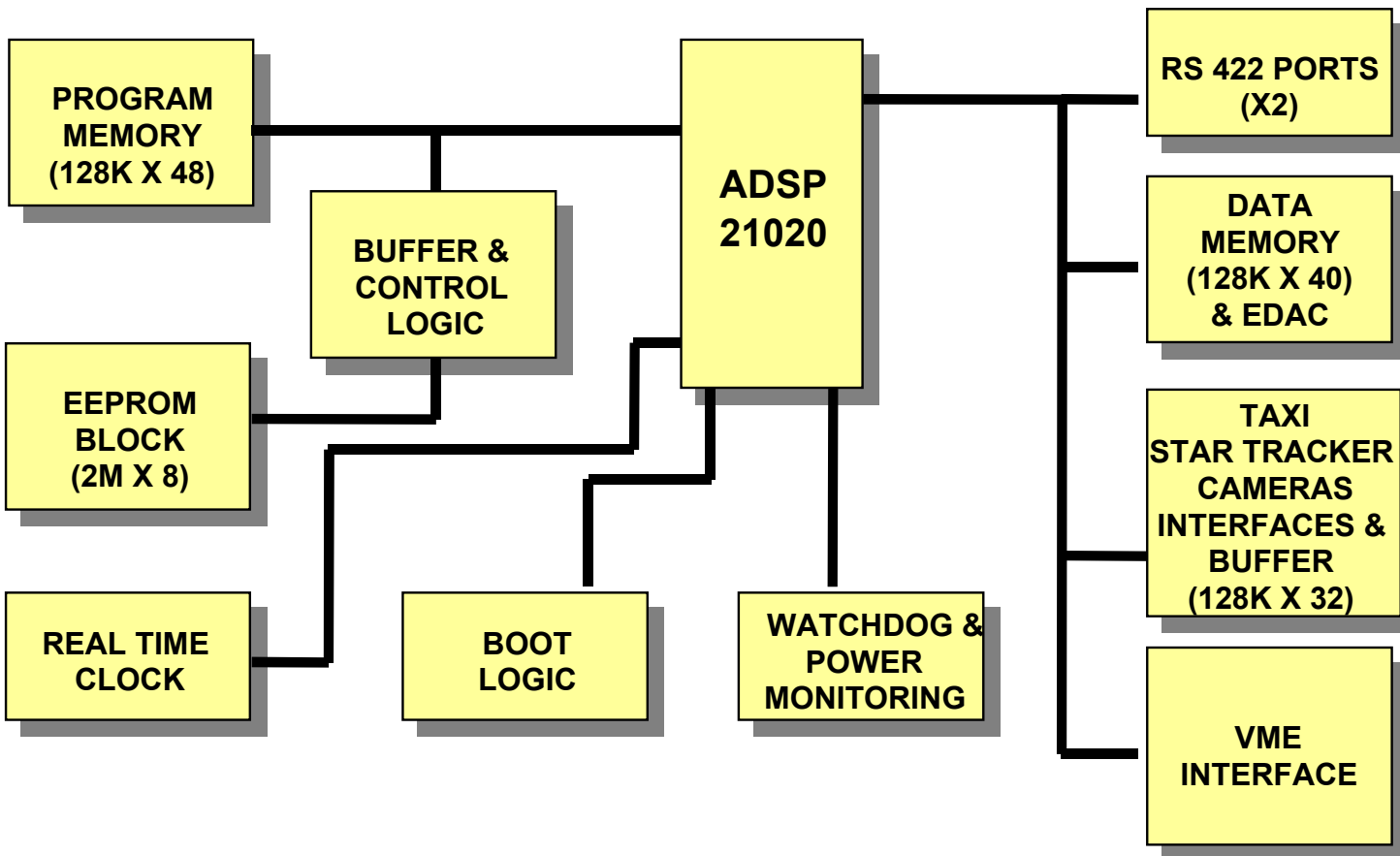


GCR component

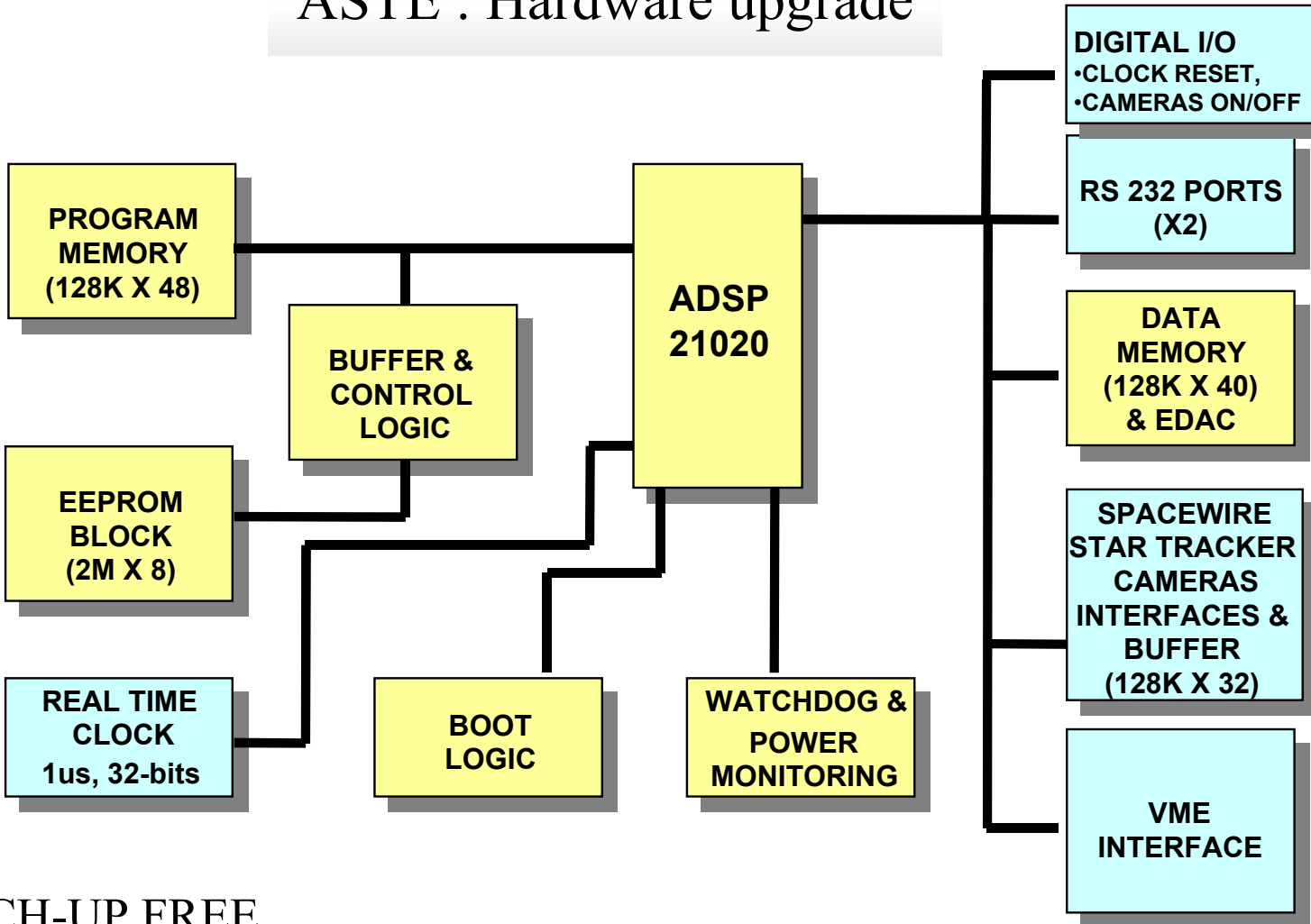


Solar component

ASTE : Existing hardware



ASTE : Hardware upgrade



- LATCH-UP FREE

- SUBSTITUTION OF ALL FPGAs WITH ACTEL A54SXggA-3ppnnnI

ASTE : Hardware upgrade

DESCRIPTION	SUPPLIER	ID.CODE	NEW
FPGA	Actel	A1020B-1CQ84C	ACTEL A54SXggA-3ppnnnl
FPGA 2000 gates	Actel	A1020B-3 PL841	ACTEL A54SXggA-3ppnnnl
128K32 SRAM module	Aeroflex	ACT-S128K32N-025FC	OK, or UT8R128K32
Taxi Receiver	AMD	AM7969-125/DC	IEEE 1355
DSP	Analog Dev.	21020 PG80	TSC21020F?
16bit Buff. Bid. Transc.	Avnet EMG	74FCT16245CTPV	OK
16bit Buff. Line Driver	Avnet EMG	74FCT16244ATPV	OK
Bidir. Transceivers	Avnet EMG	IDT74FCT245ATSO	OK
EEPROM 32Kx8	Cypress	CY27C256	PROM UT28F256
VME I/F ADAP.	Cypress	VIC 068A-GM	ACTEL A54SXggA-3ppnnnl / None
3Mbit CMOS SRAM	Dense Pac	DPS128x243H3C30C	UT8R128K32
16bit Bidir. Transceiver	IDT	74FCT16245CTPV	OK
16bit Buff. Bid. Transc.	IDT	74FCT16245CTPV	OK
16bit Buff. Line Driver	IDT	74FCT16244ATPV	OK
16bit Latch Transceiver	IDT	74FCT16543ATPV	OK
20bit Buffer	IDT	74FCT16827ATPV	OK
64 bit Err. Detection	IDT	IDT 49C466APQF	ACTEL A54SXggA-3ppnnnl
Oct. D-F.F. with M. R.	IDT	IDT74FCT273ATSO	OK
UART	Intel	MD 82510	TTL levels: Not Used
CPLD 2000 gates	Lattice	1016-60LJ	ACTEL A54SXggA-3ppnnnl
CPLD 2000 gates	Lattice	1016-125LJ	ACTEL A54SXggA-3ppnnnl
CPLD 8000 gates	Lattice	1032-60LJ	ACTEL A54SXggA-3ppnnnl
uProc. Supervisory	Maxim	MAX696CPE	to be verified
1-To-8 Clock Driver	National	CGS54ACT2525	to be verified
Diff. Line Driver	National	DS26C31TN	Not Used
Diff. Line Receiver	National	DS26C32ATN	Not Used
Real Time Clock	National	DP8572AN	to be verified
Mem. Back-Up Batt.	Sonnenschein	SL-389/P	to be verified
512Kx8 EEPROM	White	WE512K8-200CC	MIL-STD_883

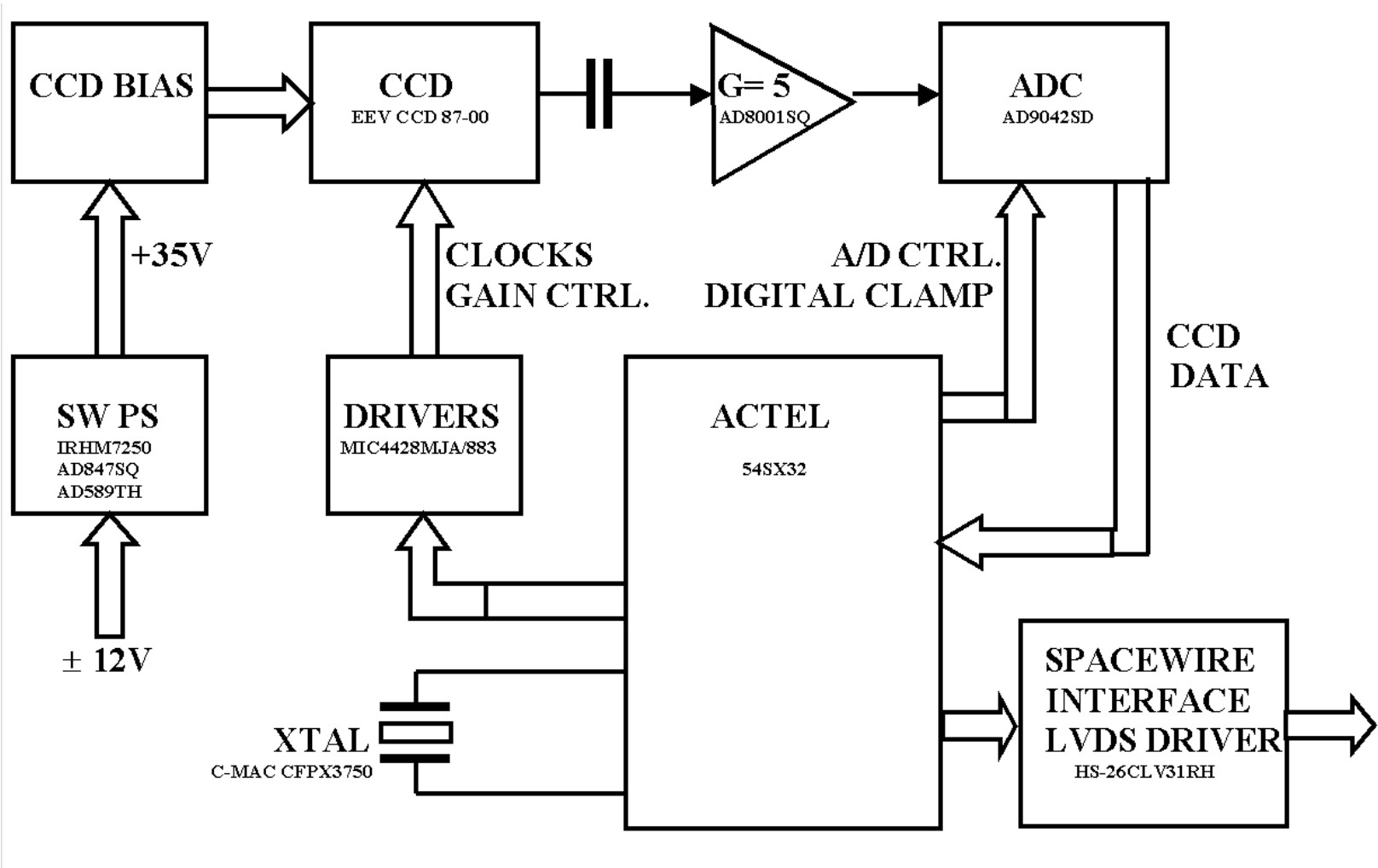
ASTE : Hardware upgrade

ADSP21020 SEE prediction

The starting point is the determination of the cross sections relative to Latch-up (σ_{LU}) and Upset (σ_{UPSET}). In the paper “EVALUATION OF THE DIGITAL SIGNAL PROCESSOR TSC21020F FROM THE MANUFACTURER TEMIC SEMICONDUCTORS MHS FOR SPACE APPLICATIONS” (Marielle BELASIC et al.) the results of Heavy Ions tests on ADSP21020 are reported. In this document the period of SEE occurrence for 3 specific orbits are given.

ORBIT	PARAMETERS	ADSP 21020		TSC 21020F	
		LU OCCUR. PERIOD	UPSET OCCUR. PERIOD	UPSET OCCUR. PERIOD	LU OCCUR. PERIOD
Geostationary	36000 Km, 0°	11.5 y	43 day	143y	/
Heliosynchronous	800 Km, 97°	43 y	141 day	500 y	/
TOPEX	1300 Km, 60°	62 y	177 day	670 y	/
ISS		241 y	2.6 y		

ASTC : Hardware upgrade



ASTC : Hardware upgrade

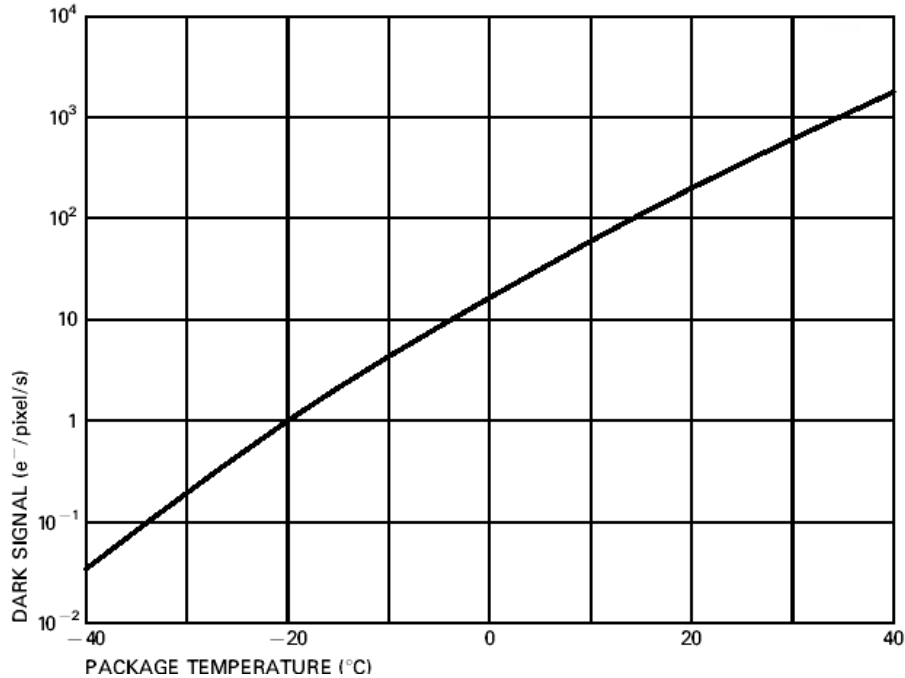
ASTC (15/09/02)			
COMPONENTS	DESCR.	MANUFACTURER	DSCC CODE
XTAL	ESA/SCC APPROVED	C-MAC	CFPX-3750 Series
RT54SX32S	FPGA	ACTEL	5962-0150803QYC
MIC4428MJA/883	MOSFET DRIVER	MICREL	5962-8850303PA
IRHM7250	POWER MOSFET	INTERNATIONAL RECTIFIER	JANSR2N7269
AD847SQ/883		ANALOG DEVICES	5962-8964701PA
AD589TH/QMLV	VOLTAGE REF.	ANALOG DEVICES	5962-8992901VXA
AD8001SQ/QMLR	OP.AMP.	ANALOG DEVICES	5962R9459301VPA
AD9042SD/QMLR	A/D CONVERTER	ANALOG DEVICES	-
HS-26CLV31RH		INTERSIL	5962-9666302QEC

ASTC : POWER CONSUMPTION

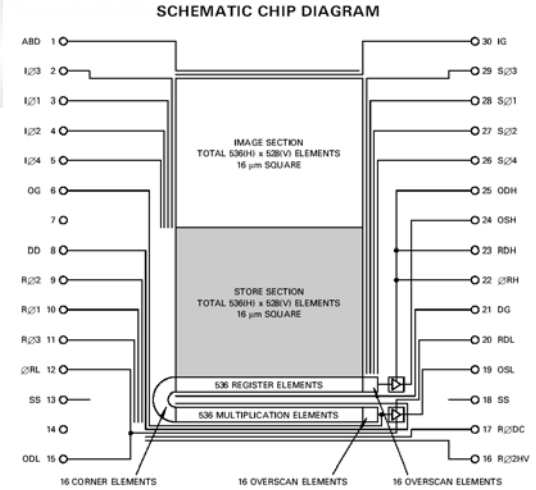
PART	MANUFACTURER	FUNCTION	N.°	I@ +12 V	I@ -12 V	I@ +5 VA	I@ -5 VA	I@ +5 VD	I@ +3.3 V	
CCD87-00		E2V CCD	1	0.02	0	0	0	0	0	
MIC4428	MICREL	BUFFER	5	0.008	0	0	0	0	0	
AD589	ANALOG DEVICES	VOLTAGE REF.	2	0.005	0	0	0	0	0	
AD8001	ANALOG DEVICES	AMPLIFIER	1	0	0	0.0055	0.0055	0	0	
AD9042	ANALOG DEVICES	A/D CONV.	1	0	0	0.15	0	0	0	
A54SX32S	ACTEL	FPGA	1	0	0	0	0	0	0.09	
T7906E	ATMEL	SMCSlite	1	0	0	0	0	0.09	0	
UT54LVDS031	AEROFLEX	LVDS DRIVER	1	0	0	0	0	0	0.02	
IRHM7250	IR	POWER MOS	2	0.02	0	0	0	0	0	
TOTAL CURRENT (A)				0.11	0	0.1555	0.0055	0.09	0.11	
POWER (W)				1.32	0	0.7775	0.0275	0.45	0.363	2.938

ASTC : New CCD

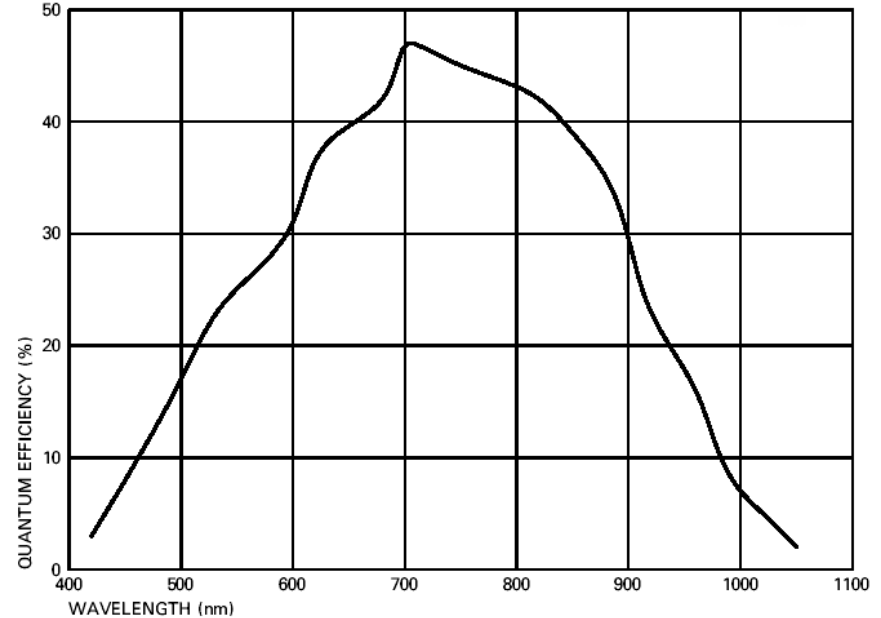
TYPICAL VARIATION OF DARK SIGNAL WITH TEMPERATURE



MARCONI CCD87

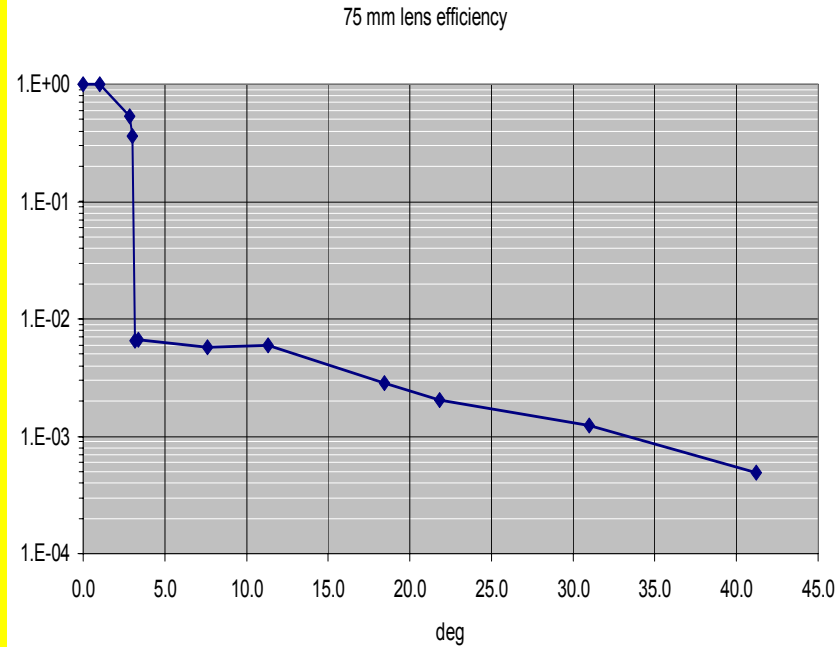
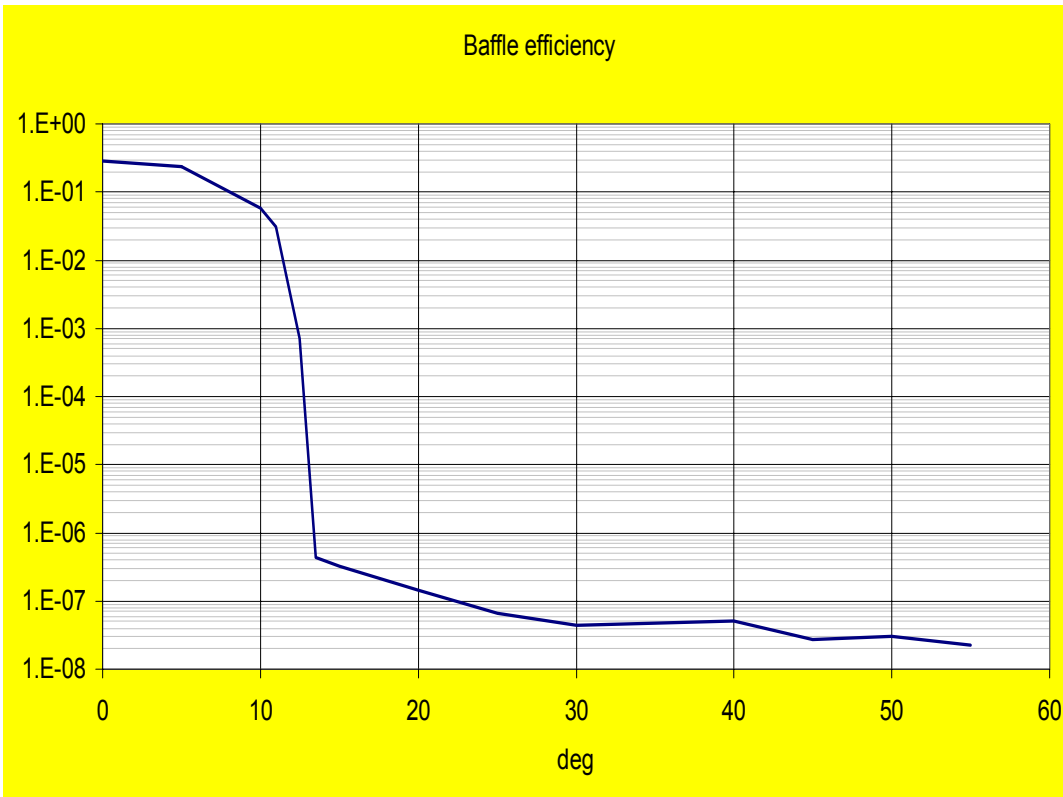


TYPICAL SPECTRAL RESPONSE: FRONT ILLUMINATED DEVICE



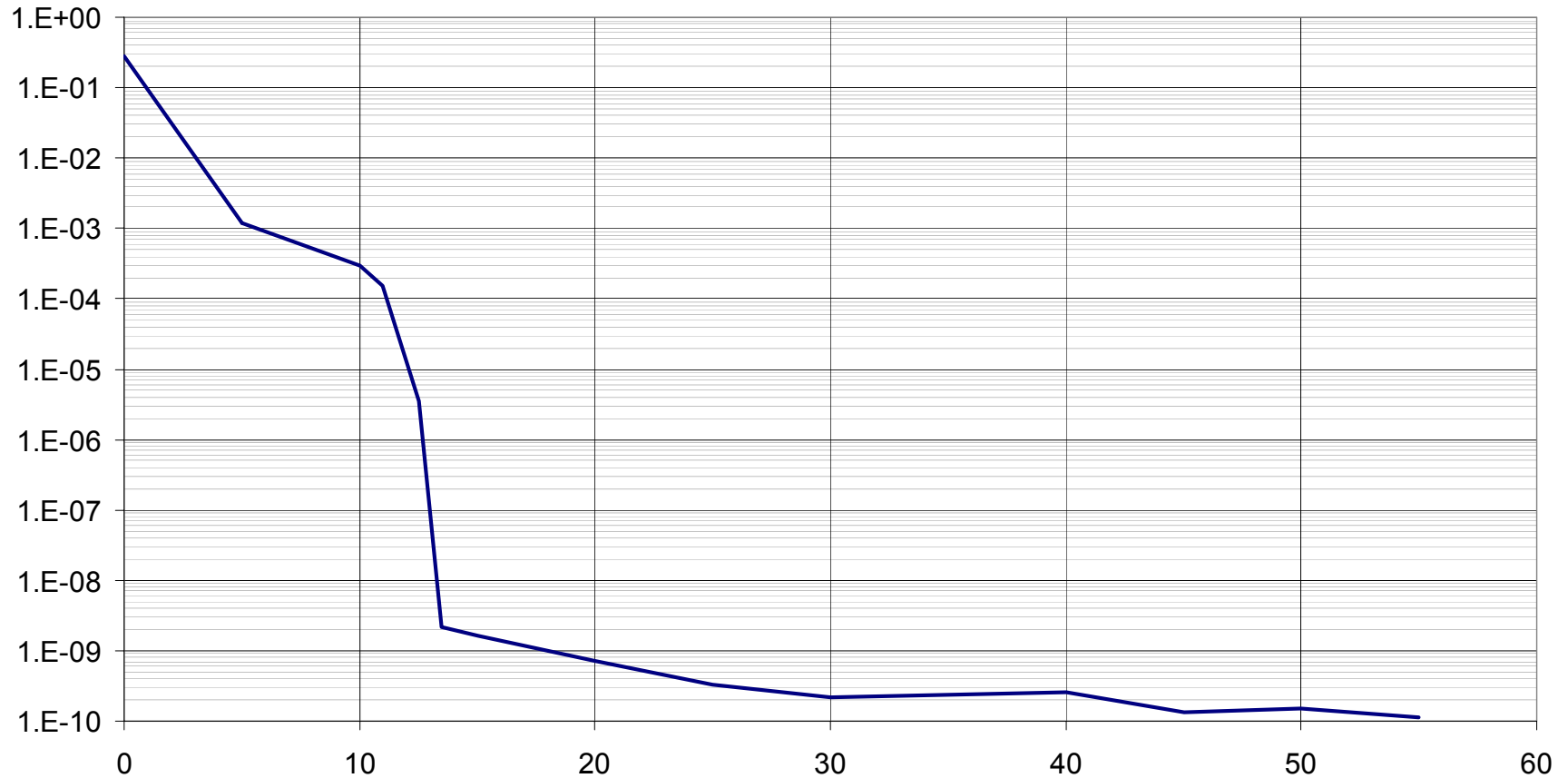
ASTC : BAFFLE

BAFFLE EFFICIENCY WITH COATING ABSORPTION OF 99%



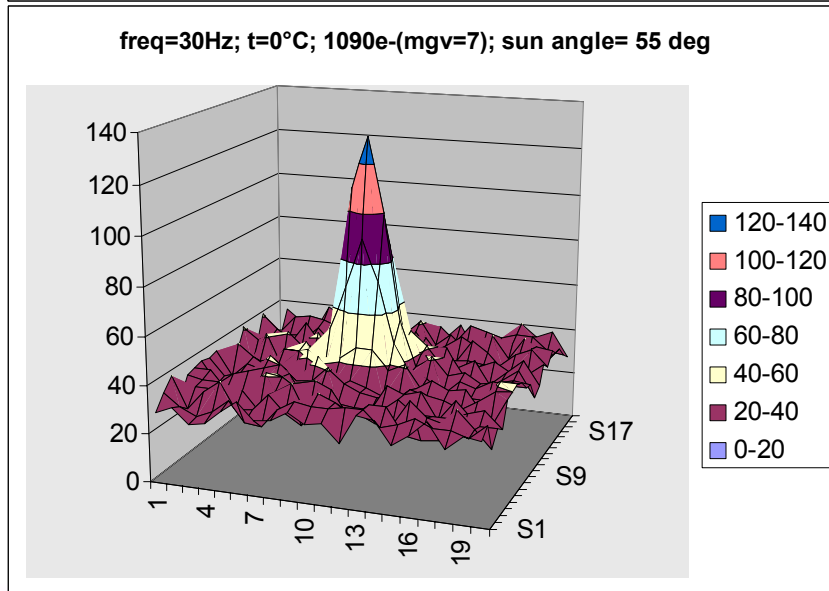
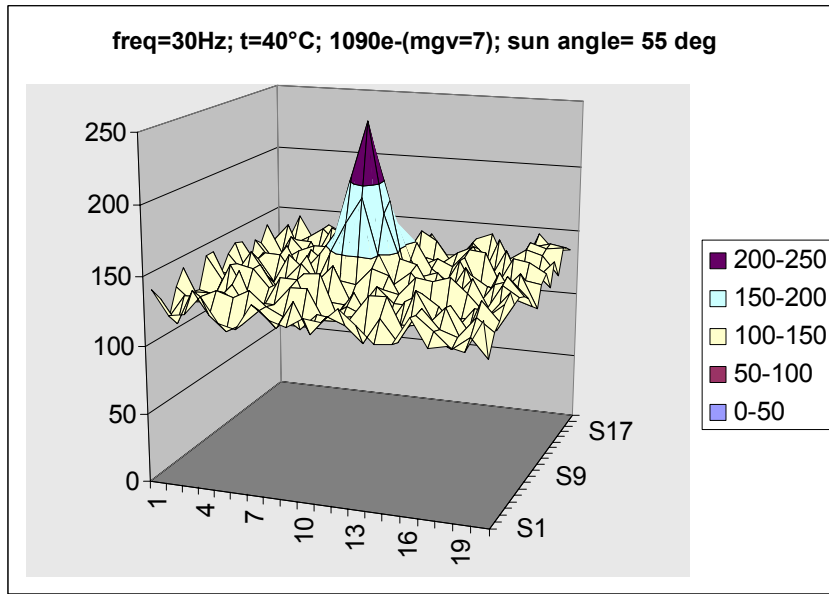
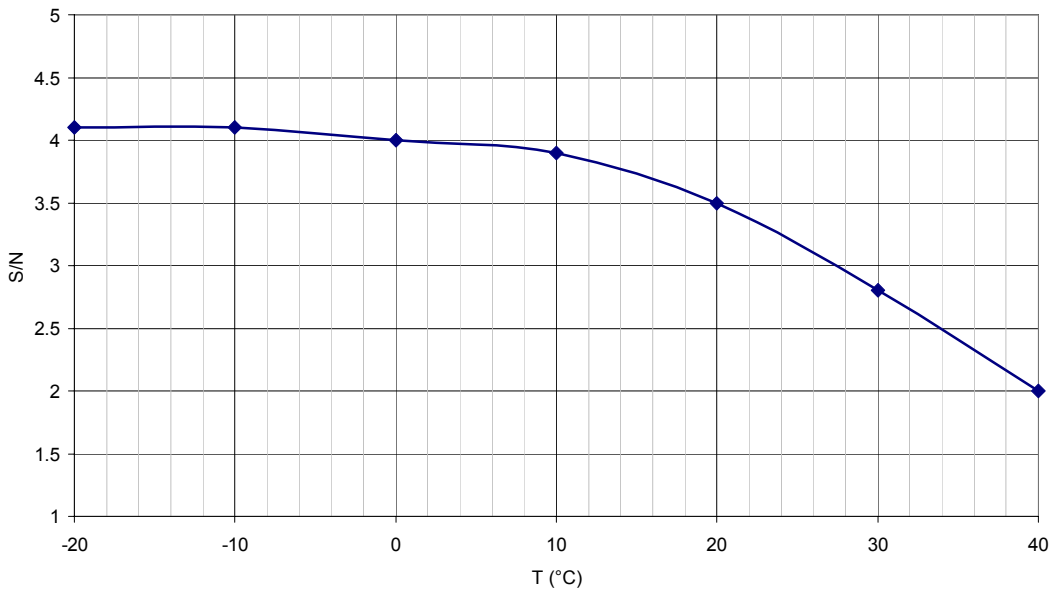
ASTC : BAFFLE

BAFFLE&LENS (=1/200) efficiency



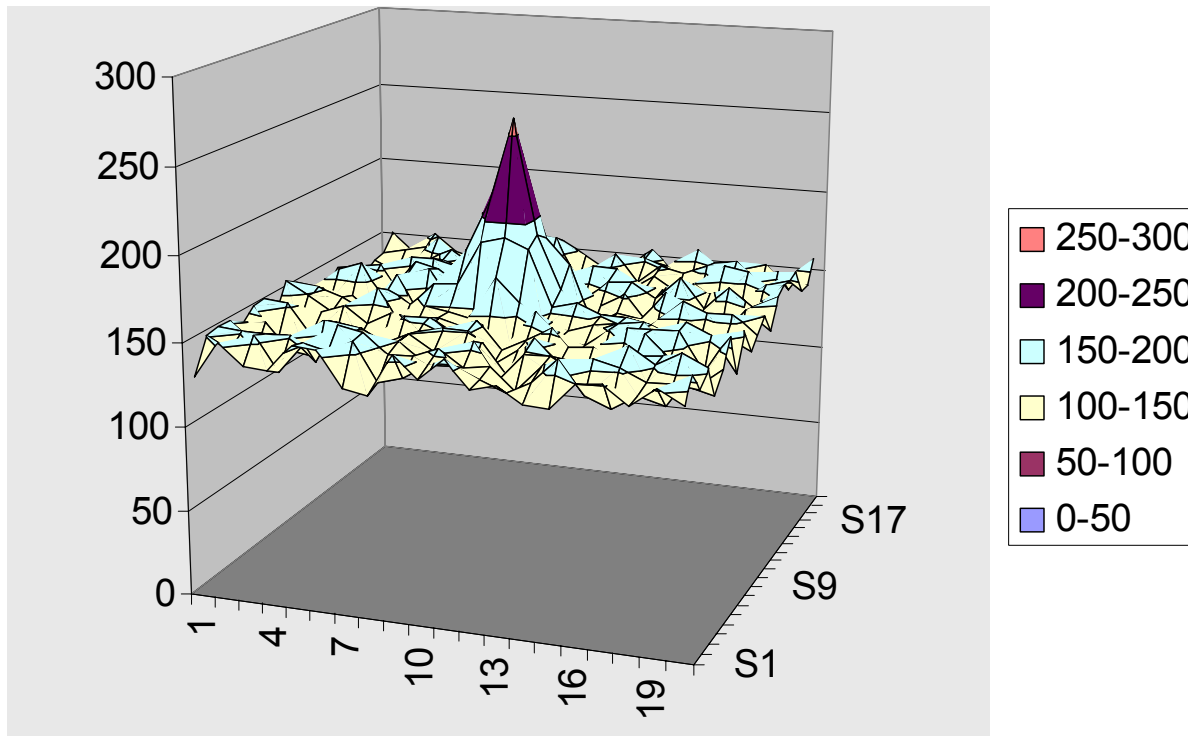
ASTC : S/N

- S/N vs. temperature of the border pixel of a 5x5 area for a star of 7th magnitude (R)



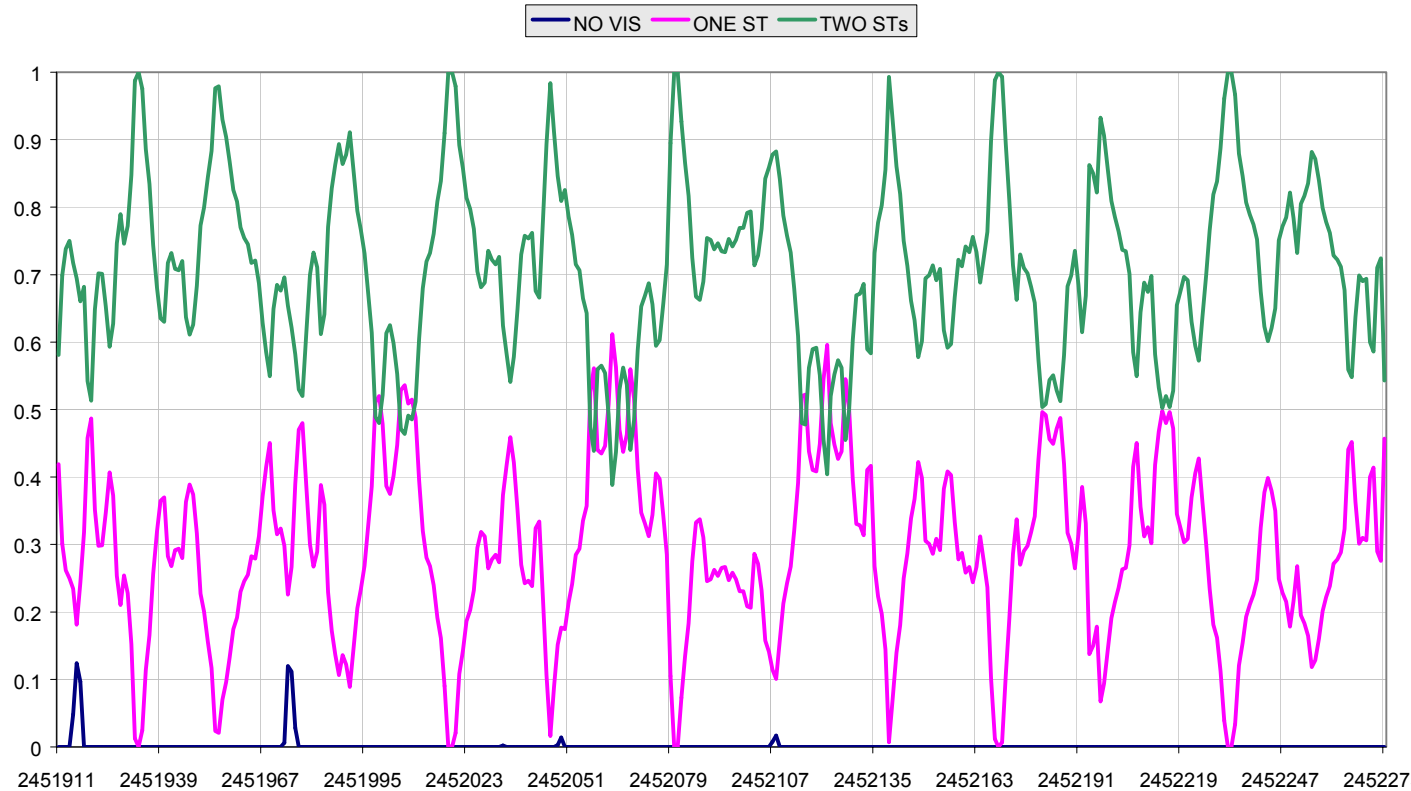
ASTC : S/N

freq=30Hz; t=15°C; 1090e-(mgv=7); sun angle= 25 deg



AMICA VISIBILITY STUDY

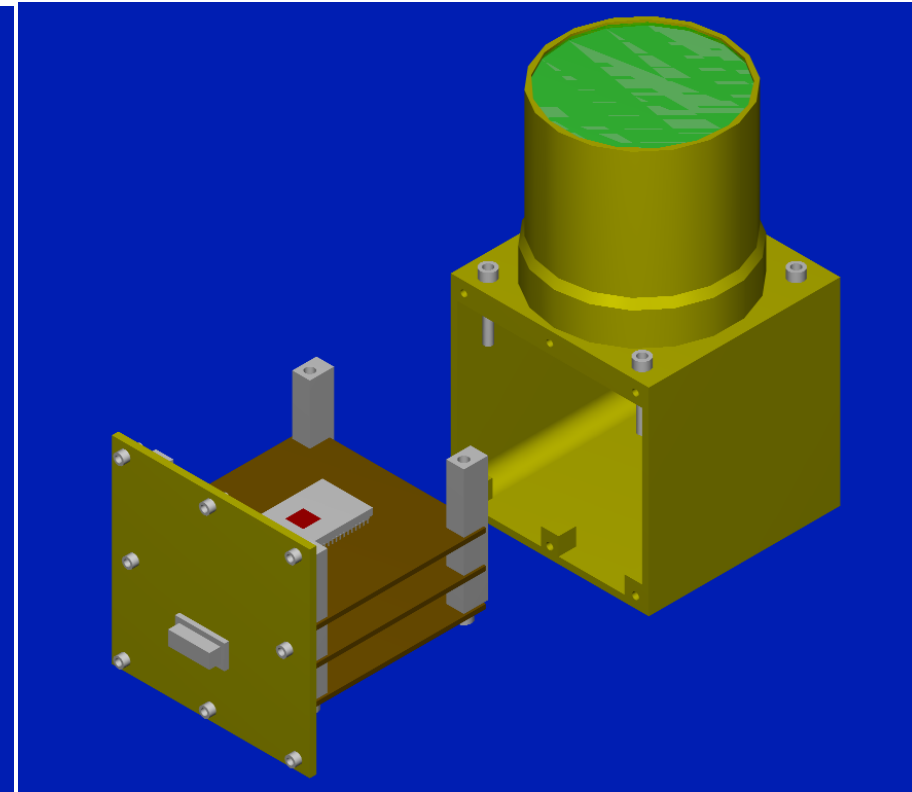
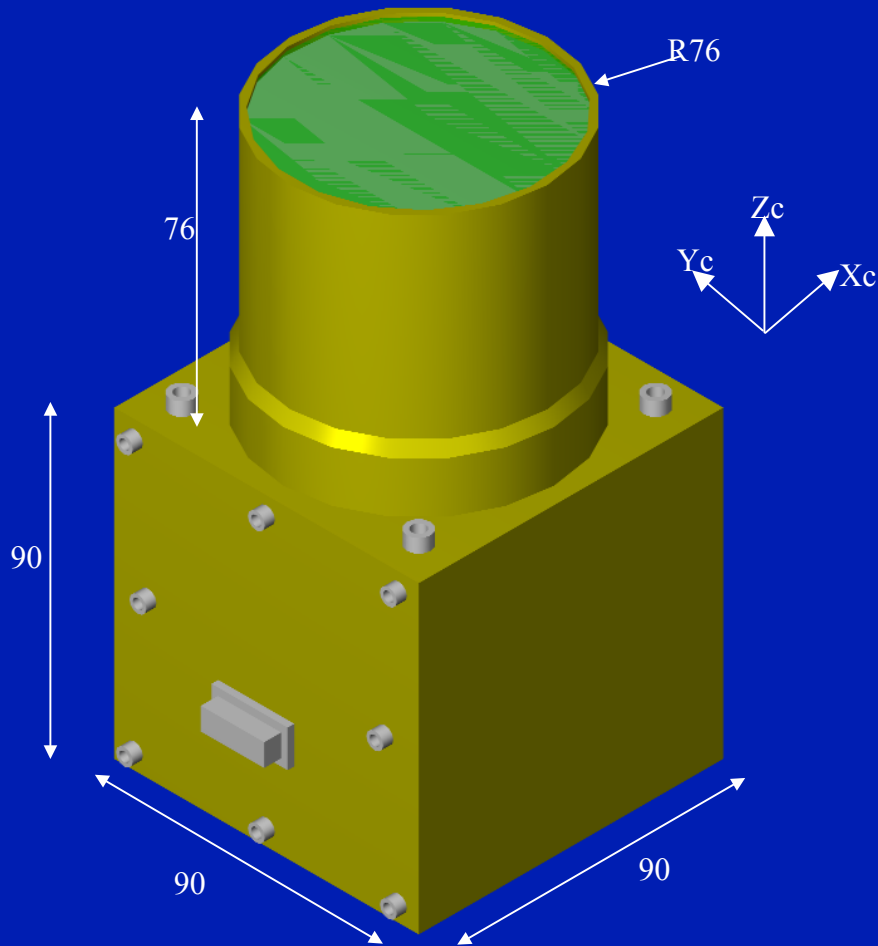
FAZ=0 FEL=50 SAZ=-150 SEL=26 SAA=40 MAA=20 SUN MOON



NO VIS	ONE ST	TWO STs
0.16%	28.84%	71.00%

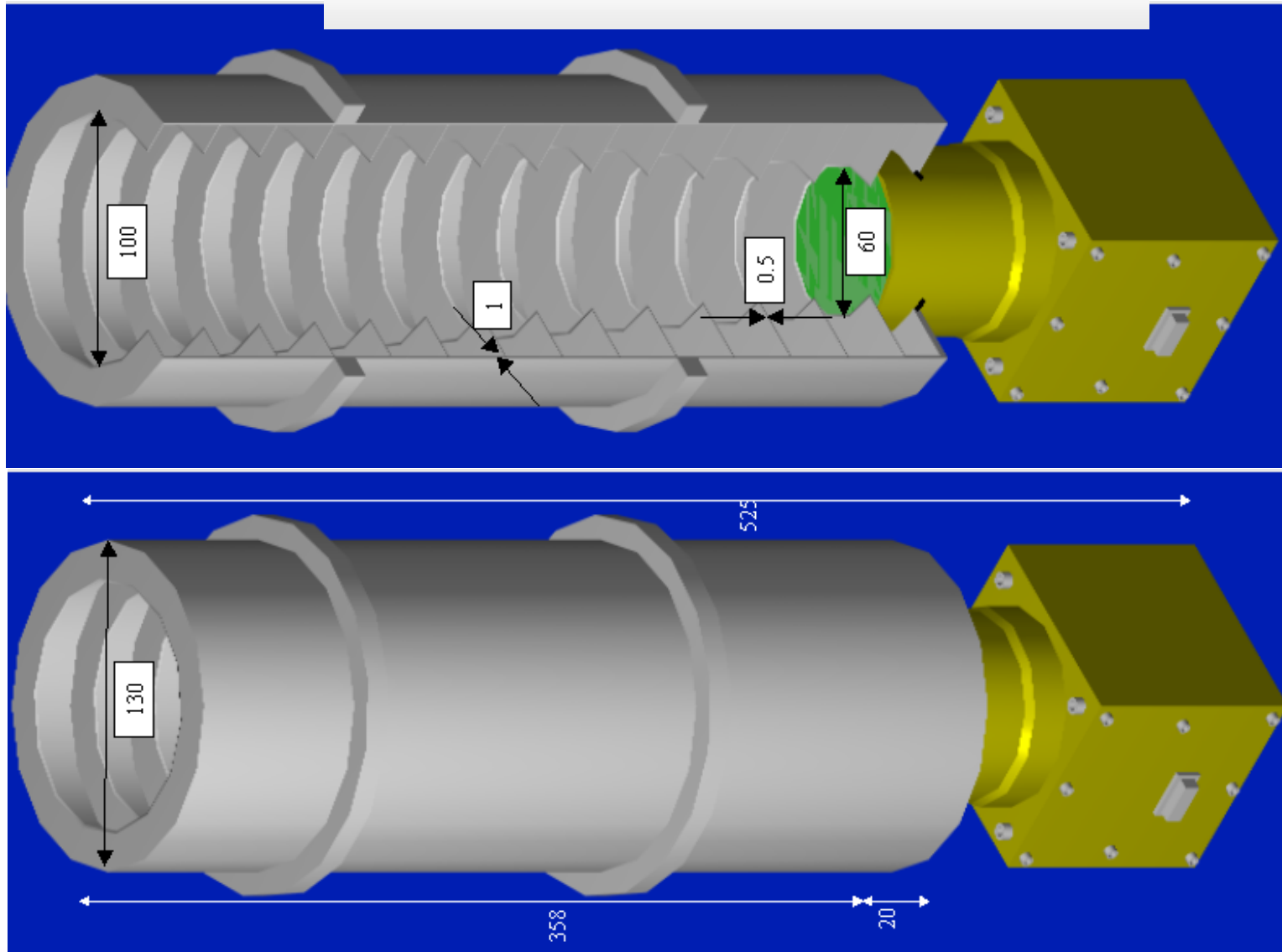
In the figure avoidance angles of +/- 40 deg for Sun and of +/- 20 deg for Moon are assumed. The Moon is always considered full. The graphs represent in ordinate the percentage of time during a day of visibility respectively with one ATSC, with both ATSC's and of none. The abscissa represents the period of one year.

ASTC : CAMERA



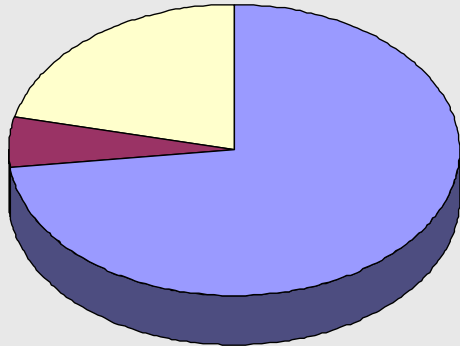
CoG in $X_c=45$, $Y_c=45$, $Z_c=97$ mm

ASTC : CAMERA+BAFFLE



AMICA:MASS

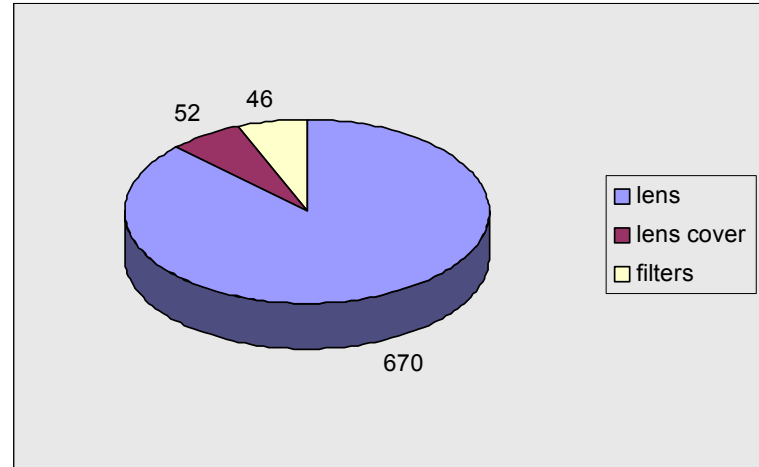
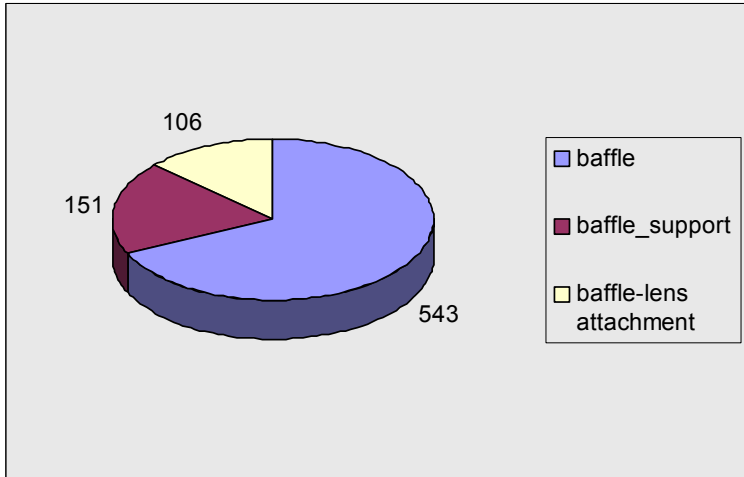
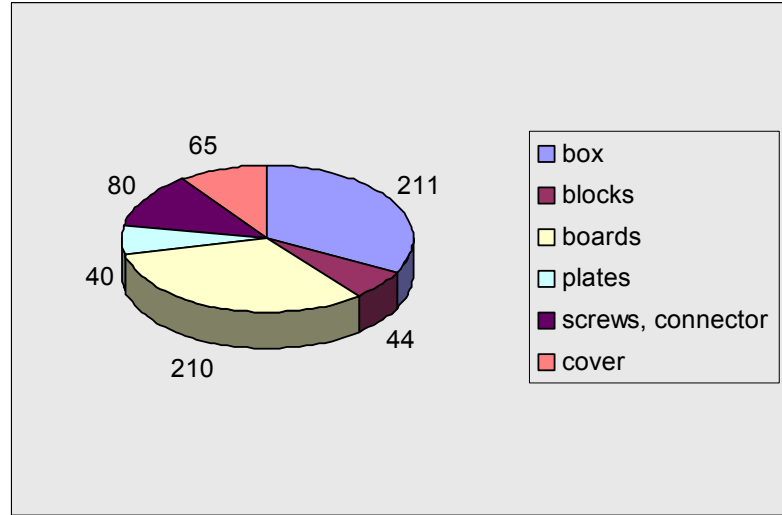
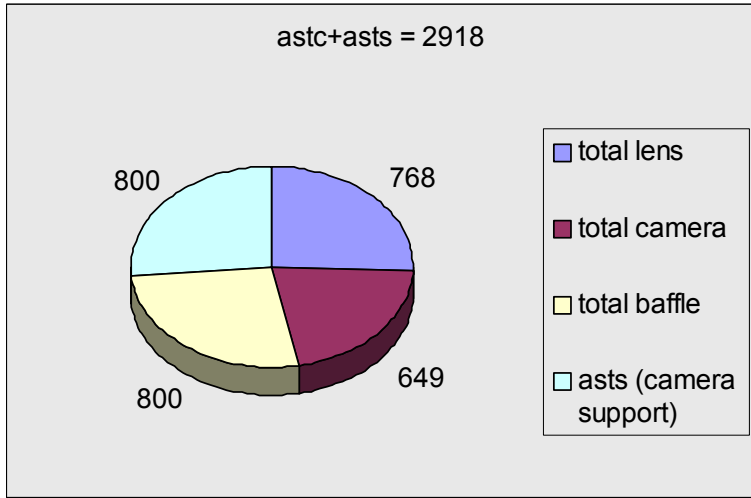
AMICA TOTAL=7996



- 2 x (ASTC + ASTS)
- total cables
- total ASTE

<i>part</i>	<i>volume</i>	<i>density</i>	<i>mass (g)</i>	<i>nr</i>	<i>total(g)</i>	<i>subsystem(g)</i>
lens			670	1	670	
lens cover	19,187	2.7	52	1	52	
filters	8,601	2.7	23	2	46	
total lens						768
box	124,198	1.7	211	1	211	
blocks	4,056	2.7	11	4	44	
boards			70	3	210	
plates	2,400	8.23	20	2	40	
screws, connector			80	1	80	
cover	23,889	2.7	65	1	65	
total camera						649
total camera&lens						1,319
baffle	201,202	2.7	543	1	543	
baffle_support	44,296	1.7	75	2	151	
baffle-lens attachment	39,246	2.7	106	1	106	
total baffle						800
ASTS (camera support)			800	1		800
ASTC + ASTS						2,918
2 x (ASTC + ASTS)						5,836
cables (m)	3	60	180	2	360	
connectors			50	2	100	
total cables						460
ASTP,ASTE board			450	2	900	
crate wall weight per slot			200	3	600	
backplane weight per slot			50	4	200	
total ASTE						1,700
AMICA TOTAL						7,996

ASTC : MASS



AMICA DEVELOPMENT PARTS

