MARS EXPRESS

PLANETARY FOURIER SPECTROMETER

SCIENCE OPERATIONS

MEX-CNR-FUM8

PFS – FUM8

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1 - INTRODUCTION

1.1 - PFS DATA TAKING AND TRANSMISSION

In order to describe the data transmission modes we give first some information on the data acquisition modes.

1.1.1 - Modes of operation, data acquisition cycle

PFS has 5 operating modes:ASTRA, Autotest , Sleeping , Calibration , Science mode . In the Sleeping mode all peripherals are switched off except DAM which is able to receive telecommands and send telemetry information. In the ASTRA mode no data are taken . During the Autotest mode all modules are switched on and PFS makes measurements testing all its parts , gain factors, speed of double pendulum and so on. These operation modes of PFS are described in the Flight Operation Manual .

A transition between Sleeping and Observation modes is controlled by the cyclogram subsystem of the DAM software. The cyclogram subsystem can be deactivated by a telecommand, and PFS will always operate in the Sleeping mode. This possibility should be used during the orbital spacecraft maneuver and following setup of a new observation program.

DAM, ICM (FFT module), the Scanner and module O work in parallel during the Observation session, and DAM coordinates operations of other modules by sending commands and receiving messages. The commands and messages are specific for the modules, but each module begins every operation by a command "START" and sends a message "DONE" upon completion of the operation. When the operation is completed, DAM sends commands to get data (interferograms from module O, spectra from ICM, *etc*) and status information.

During the measurements the Scanner must be motionless while module O acquires data. This is the only synchronization point in the data acquisition cycle. Upon completion of the acquisition all modules work asynchronously while DAM coordinates their operations:

- **starts rotation of the Scanner.**
- **receives LW and SW interferograms from module O.**
- **if spectra required, uploads LW and SW interferograms received during the previous cycle into ICM and downloads computed spectra.**
- **prepares the telemetry data pack i.e. splits information into frames and stores them in the Mass Memory.**
- **upon completion of the Scanner rotation gives a command to module O to start new acquisition.**

After each data acquisition cycle PFS checks whether new telecommands have been received and executes them (if any). The telemetry information can be sent at any time on request from the spacecraft.

1.2 - IN FLIGHT CALIBRATION

During the Observation session on the Martian orbit PFS periodically performs calibrations by sending commands to the Scanner to point sequentially to following calibration sources:

- **the black body (module A)**
- **a calibration lamp**
- **the deep space**

The measurement conditions obtained from module O after each calibration measurement contain, in particular, temperatures of sensors and the black body. These data are used for the computation of the absolute spectra for the LW and the SW channel.

PFS for each orbit the sequence of the telecommands and their timing define the calibration activity (number of measurements to be taken), and the sequence of calibration sources to observe. The sequence can be changed by telecommands in advance .

1.3 - DATA TRANSMISSION MODES

For every measurement PFS sends measurement conditions and data. The measurement conditions contain an angle of the Scanner position, a state of the module O during the acquisition, a data transmission mode and other parameters to be used for the correct interpretation of the scientific data. The data transmission mode defines the kind of scientific data PFS must select and store in the Mass Memory to be sent to the Earth.

THE DATA TRASMISSION MODES ARE OBTAINED WITH PFS OPERATING IN THE SCIENCE OPERATING MODE DESCRIBED LATER. ONLY DATA TRASMISSION MODE 0 IS OBTAINED IN THE PFS OPERATING MODE CALLED AUTONOMOUS TEST

For any science data transmission mode PFS acquires both LW and SW interferograms. If spectra are required, PFS makes Fast Fourier transform of the interferograms. Then, depending on the data transmission mode, PFS selects required data. Interferograms can be selected either completely or in half (the central part) giving reduced resolution. Modules (absolute values) of spectra can be selected in terms of spectral intervals (reduced range).

There are defined 15 data transmission modes, some modes provide interferograms and some modes provide spectra (the numbering is inheritance of mars 96 project):

- **MODE 0 – It is a special mode of transmission of Autonomous test data . 20 Kwords**

- **MODE 2 - full LW interferograms. 4096 MEASUREMENTS , 65 536 BITS. 4 Kwords**
- **MODE 4 - reduced resolution interferograms (2048 points in the LW channel and 8192 in the SW channel). 163 840 BITS. Only the central part of the interferogram is transmitted neglecting the outer parts . 10 Kwords.**

- **MODE 5 - reduced resolution LW interferograms. 32 768 BITS. 2 Kwords.**

- **MODE 6 - reduced resolution SW interferograms. 131 072 BITS. 8 Kwords.**
- **MODE 7 – In this mode the lw interferogram is transmitted complete,while the sw interferogram is cut in the following way : 2000 words around the zopd are identified , then the interferogram is completed only on right side. 13 Kwords =26 K Bytes.= 208 000 bits.**
- **MODE 8 – similar to mode 7 but for both channels on the right side: 12 Kwords = 24 K bytes.=192 000 bits.**
- **MODE 9 - modules of LW and SW spectra (8192 spectral points in the SW channel and 2048 points in the LW channel).**

NOTE THAT THE NUMBER OF BITS WOULD BE 163 840 BITS, BUT THERE IS NO SPECTRAL INFORMATION IN THE FIRST 200 POINTS OF LW CHANNEL AND IN THE FIRST 2000 POINTS OF SW CHANNEL , THEREFORE WE HAVE 6192 + 1848 POINTS = 128 640 BITS.

- **MODE 10 - modules of LW spectra. 29 568 bits per measurement.**
- **MODE 15 - modules of SW spectra with reduced range, with the LW complete (2000 points in the LW channel and 2000 points in the SW channel). Total 4000 measurements , 64000 bits. This is the night sidemode.**
- **MODE 16 - modules of SW spectra (6144 points) , 98 304 bits.**
- **MODE 17 - full interferograms (4096 points in the LW channel and 16384 points in the SW channel)**
- **MODE 18 - full SW interferograms (and 16384 points in the SW channel)**
- **MODE 27 – In this mode the lw interferogram is transmitted complete,while the sw interferogram is cut in the following way : 2000 words around the zopd are identified , then the interferogram is completed only on left side. 13 Kwords =26 KBytes.= 208 000 bits. the night sidemode.**
- **MODE 28 – similar to mode 27 but for both channels on the left side: 12 Kwords = 24 K bytes.=192 000 bits.**

1.4 - DATA TAKING ALONG THE ORBIT

IT SHOULD BE CLEAR THAT INTERFEROGRAM MODES ARE PREFERRED OVER THE MODES WITH FFT (9- 10- 15- 16) .

First we ask how many bits we take in the 15 modes.
Repetition time has been assumed to be 10 sec.

WORKING BELOW 4000 KM ALTITUDE WE HAVE 90 MINUTES , IF EACH MEASUREMENT TAKES 10 SEC , WE HAVE 540 MEASUREMENTS PER ORBIT TO WHICH WE HAVE TO ADD 60 CALIBRATION MEASUREMENTS (MORE IN COMMISSIONING PHASE) and two autotest data set:

NUMBER	MODE	Number Kwords	Bits per measure	bits per s	Megabits per orbit	Megabits per day
0	AUTOTEST	20	327 680	32 768	2x= 0.655	1.965
2	INTERF LW	4	65 536	6 554	35.389	106.167
4	INTERF (S+L)/2	10	163 840	16 384	88.473	265.419
5	INTERF LW/2	2	32 768	3 277	17.694	53.082
6	INTERF SW/2	8	131 072	13 107	70.779	212,337
7	INT L+1SIDE S	13	212 992	21 299	115.015	345.045
8	1 SIDE L+S	12	196 608	19 661	106.168	318.504
17	FULL INT L+S	20	327 680	32 768	176.947	530.841
18	FULL INT S	16	262 144	26 214	141.557	424,671
27	INT L+1 SIDE S	13	212 992	21 299	115.015	345.045
28	1 SIDE L+S	12	196 608	19 661	106.168	318.504
9	SPECTRLW+SW	8	131 072	13107	70.779	212,337
10	SPECTR LW	2	32 768	3276	17.694	53.082
15	SPECTR PARTS	4	65 536	6553	35.389	106.167
16	SPECTR PARTS	6	98 304	9830	53.083	159.249

THE PREVIOUS NUMBERS INCLUDE THE PACKETIZATION OF THE INFORMATION, BUT DO NOT INCLUDE THE MEASUREMENTS HEADER WHICH ARE EVALUATED TO BE 256 BYTES PER MEASUREMENT = 1213.64 Kbits PER ORBIT, THEREFORE = 3639.46 Kbits PER DAY.
TO HAVE THE TOTAL DATA VOLUME REQUESTED FOR PFS WE HAVE TO ADD THE HOUSEKEEPING DATA WHICH WILL BE 256 BYTES EVERY 10 MINUTES, 295 Kbits per day.
IN TOTAL 3.93 MEGABITS PER DAY SHOULD BE ADDED TO THE PREVIOUS TABLE.

IN TOTAL 600 MEASUREMENTS PER ORBIT,
1800 MEASUREMENTS PER DAY,

THIS IS OUR BASELINE

NOTE THAT THE FOOT PRINT FOR OBSERVATIONS FROM 2000 Km IS OF THE ORDER OF 68 Km FOR THE SW CHANNEL AND 136 KM FOR THE LW CHANNEL , THEREFORE STILL RELATIVELY SMALL

Our formal request is to work below 4000 Km . We are aware that because of conflicts with other experiments , will not be always possible to operate the entire period , so we shall loose

some observation possibilities . The message here is that in order to get our share of the data volume per day we must be ready to work below 4000 Km any time it is possible.

We note that we would get as many spectra as IRIS in 40 days , if we are able to work every orbit all the orbits .

The data will be taken around pericenter. Indeed we have the following footprint size :

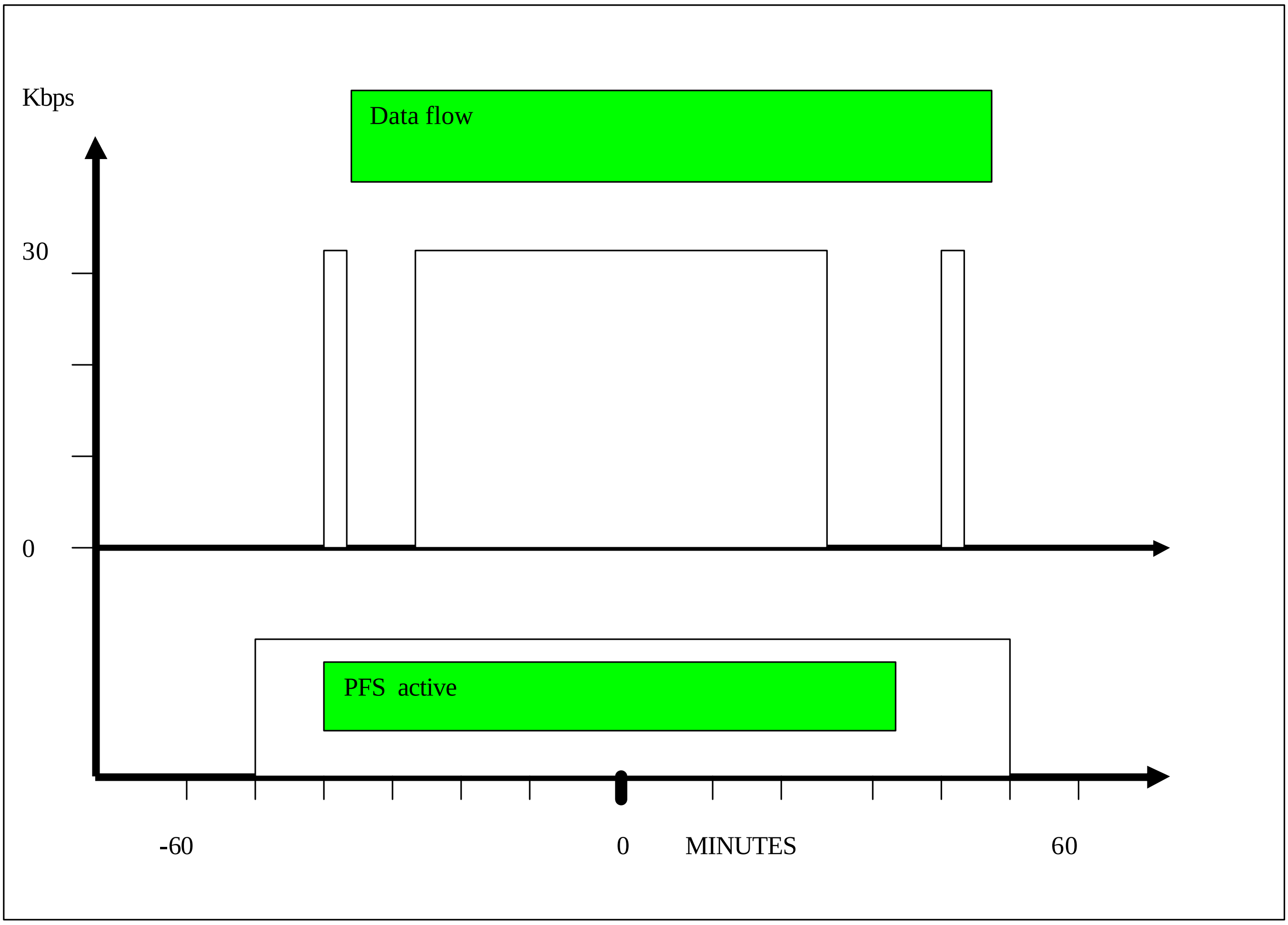
altitude Km	250	300	400	800	1200	2000	4000
sw	8.5	10	13.6	27.2	40.8	68	136
lw	17.0	20	27.2	54.4	81.6	136	272

In order to explain how PFS will make use of the internal mass memory , we have to take into account that the spacecraft will accept data from PFS at the average rate of 24 Kbits per second, max rate 74 Kbits per second. In order to have the data production rate congruent with the rate with which the data are given to the spacecraft we need to study the cyclogram of PFS activity along the orbit and around the pericenter.

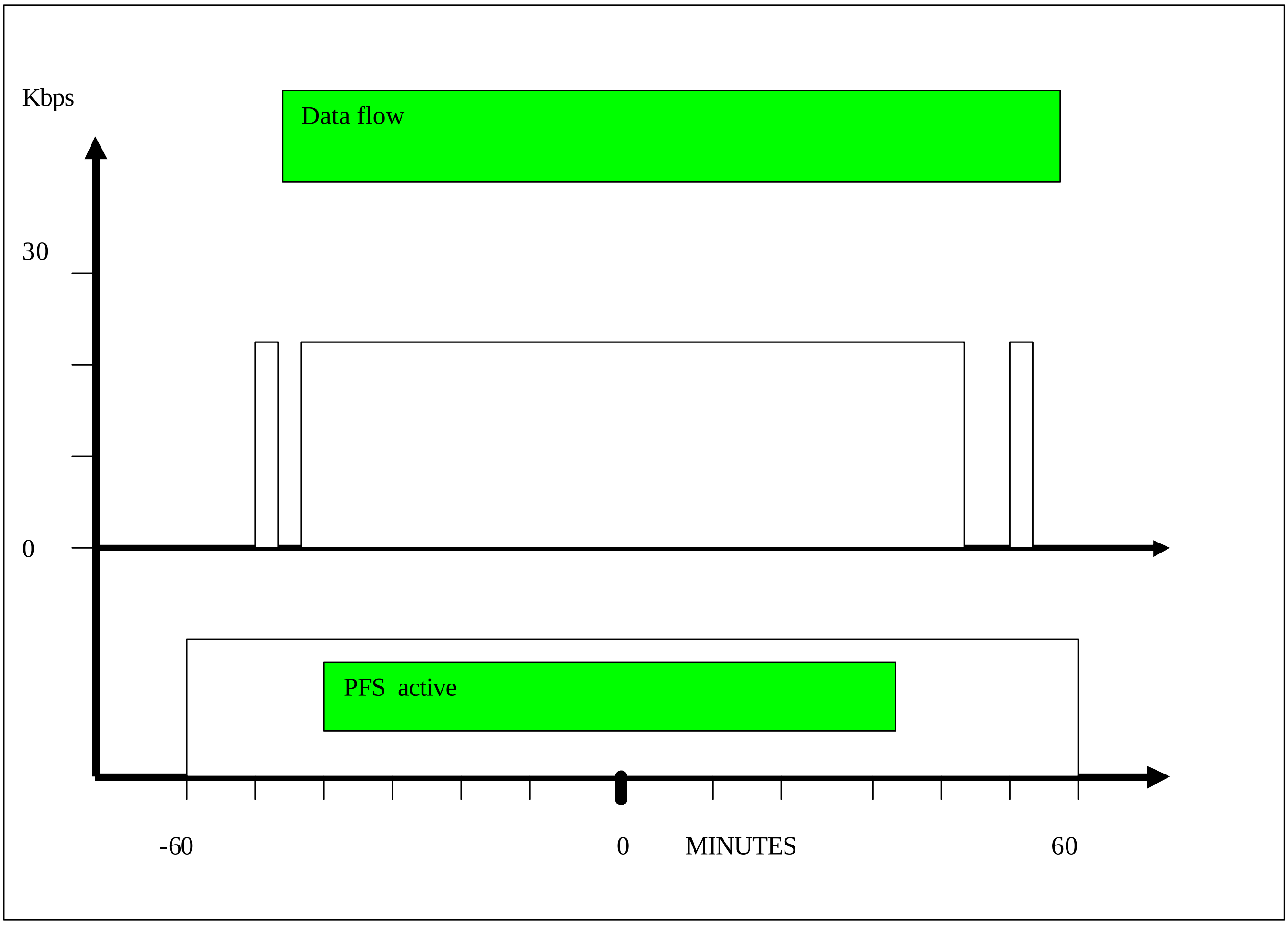
PFS will take martian spectra when the altitude of the spacecraft above the surface is lower than 4000 Km. But the wake-up from the sleepig mode is some time before. We shall follow the scheme given below:

- **apocenter :**
  pfs is in sleeping mode . telecommands can be received.
- **Pericenter – 60 minutes :**
  wake-up ; wait for warm-up ; start autonomous test ; calibration LW ; calibration SW ; calibration deep space. Scanner in nadir direction.Give data to the spacecraft.
- **Pericenter – 2700 seconds, start martian observations. Give data to the spacecraft.**
- **Pericenter + 2700 seconds, stop martian observations. Give data to the spacecraft.**
- **Pericenter +56 minutes : calibration LW ; calibration SW ; calibration deep space. Autonomous test. Give data to satellite . Go to sleep mode.**
- **Up to apocenter in sleep mode.**

If we consider that the autonomous test and the calibrations are taken separately, we can say that there is no problem in providing that information to the spacecraft , making use, if needed , of the PFS mass memory.



PFS MODE 17 DATA TRASMISSION



PFS MODE 9 DATA TRASMISSION

1.5 – PFS DATA VOLUMES

PFS HAS 15% OF THE DATA VOLUME ALLOCATED FOR TELEMETRY DOWNLINK , WE SHALL DISCUSS HERE HOW TO USE THIS DATA SHARE AND THE MODES OF DATA TRASMISSION GIVEN ABOVE.

We shall consider the 3 bit rate of the spacecraft :

case 1 = 2500 Megabits / day	**PFS share : 375 Megabits / day**	**125 Mbit/orbit**
case 2 = 1300 Megabits /day	**PFS share : 195 Megabits/ day**	**65 Mbit/orbit**
case 3 = 700 Megabits / day	**PFS share : 105 Megabits /day**	**35 Mbit/orbit**

case 1

In the first 30-40 days we have :

commissioning phase : 10 days or less
science high rate : 20 days

commissioning phase : calibrations 13+13+13 13+13+13 tot 78 meas.
mode 17 interferograms 290 meas.
header , housekeeping etc autotest
total data volume : 25.55 Megabit
95.03 Megabit
5.0 Megabit
total 125.58 Megabits/orbit
total 376.74 Megabits/ day

MODE 8 science high rate : calibrations 10+10+10 10+10+10 tot 60 meas. In mode 8 : 11.796 Mbits
Measurements mode 8 540
Header housekeeping autotest.
total data volume : 11.796 Megabit calibrations
106.168 Megabit data
5.0 Megabit housekeeping+ haeder
total 122.964 Megabits/orbit
total 368.890 Megabits/day

MODE 7 science high rate : calibrations 60 meas.
Measurements mode 7 500
Headeer housekeeping autotest.
Total data volume : 12.779 Megabit
106.496 Megabit
5.0 Megabit
total 124.275 Megabit/orbit
total 372.825 Megabits/day

MODE 4 EXTENDED science high rate :
Calibrations 60 meas.
Measurements mode 4 670
Header housekeeping autotest.
Data volume : 9.830 Megabit
109.772 Megabit
5.5 Megabit
total 125.102 Megabit/orbit
total 375.306 Megabits/day

Note that at the end of the first period we should have if we use
10 days mode 17
10 days mode 8
10 days mode 4 :
10 x 3 x 78 + 20 x 3 x 60 calibrations = 2340 + 3600 = 5940 calibrations
10 x 3 x 290 + 10 x 3 x 540+10x3x670 = 8700 + 16200+20100 = 45 000 spectra
The preferred modes are MODE 17 for the commissioning phase and EXTENDED MODE 7 for the next 20 days.

case 2

After 30 days of very high data volume return , we will have 60 days with 1300 Megabits /day, corresponding to 195 Megabits per day for PFS :

science high rate : 60 days

MODE 7 (or 27) science rate : calibrations 8+8+8 8+8+8 tot 48 meas.
Measurements mode 7 250
Header housekeeping autotest.
total data volume : 10.223 Megabit
53.248 Megabit
5.0 Megabit
total 68.471 Megabits/orbit
total 205.413 Megabits/day

MODE 8 (or 28) science rate : calibrations 48 meas.
Measurements mode 8 250
Headeer housekeeping autotest.
Total data volume : 9.436 Megabit
49.152 Megabit
5.0 Megabit
total 63.612 Megabit/orbit
total 190.8 Megabits/day

MODE 4 EXTENDED science high rate :
Calibrations 48 meas.
Measurements mode 4 320
Header housekeeping autotest.
Data volume : 7.864 Megabit
52.386 Megabit
4.5 Megabit
total 64.7 Megabit/orbit
total 194.1 Megabits/day

mode 17 , mode 8 , mode 4, mode 7

Note that at the end of the first perio d we should have :
10 x 3 x 78 + 20 x 3 x 60 calibrations = 2340 + 3600 = 5940 calibrations
10 x 3 x 290 + 10 x 3 x 540+10x3x670 = 8700 + 16200+20100 = 45 000 spectra
Note that at the end of the second period , assuming we use 30 days in mode 7 and 30 in mode 4 we should have :
30 x 3 x 48 + 30 x 3 x 48 calibrations = 4320 + 4320 = 8640 calibrations
30 x 3 x 250 + 30 x 3 x 320 = 22500 + 28800 = 51300 spectra
total 96 300 spectra and 14580 calibrations

case 3

After 94 days of high data volume return , we will have 300 days with 700 Megabits /day, corresponding to 105 Megabits per day for PFS , 35 Mbits per orbit :

science low rate : 300 days

MODE 4 science rate : calibrations 8+8+8 8+8+8 tot 48 meas.
Measurements mode 4 150
Header housekeeping autotest.
total data volume : 7.864 Megabit
24.576 Megabit
2.0 Megabit
total 34.4 Megabits/orbit
total 103.32 Megabits/day

MODE 2 science rate : calibrations 8+8+8 8+8+8 meas. Tot 48 meas.
Measurements mode 2 330
Headeer housekeeping autotest.
Total data volume : 7.864 Megabit
24.903 Megabit
4.0 Megabit
total 36.767 Megabit/orbit
total 110.30 Megabits/day

MODE 8 science rate : calibrations 5+5+5 5+5+5 meas. Tot 30 meas.
Measurements mode 2 140
Headeer housekeeping autotest.
Total data volume : 5.898 Megabit
27.525 Megabit
2.0 Megabit
total 35.423 Megabit/orbit
total 106.269 Megabits/day

MODE 15 science rate : calibrations 5+5+5 5+5+5 meas. Tot 30 meas.
Measurements mode 15 420
Headeer housekeeping autotest.
Total data volume : 1.966 Megabit
27.525 Megabit
2.0 Megabit
total 31.491 Megabit/orbit
total 94.473 Megabits/day

MODE 17 science rate : calibrations 5+5+5 5+5+5 meas. Tot 30 meas.
Measurements mode 2 75
Headeer housekeeping autotest.
Total data volume : 9.830 Megabit
24.576 Megabit
1.0 Megabit
total 35.40 Megabit/orbit
total 106.18 Megabits/day

In this long period of 300 days we shall have the following strategy :

We devide the period in 10 months and for each month we shall have 2 days in mode 17 , 3 days in mode 8 , 10 days in mode 4 ,5 days in mode 15 and 10 days in mode 2 :

In terms of orbits we shall have :

(6 mode 17 + 9 mode 8 + 30 mode 4+15 mode 15 + 30 mode 2) x 10
in terms of measurements taken we have :
(6 x 75 + 9 x 140 + 30 x 150 +15x420 + 30 x 330)x 10 =
(450 + 1260 + 4500 +6300 + 9900) x 10

Note that at the end of the first period we should have :
10 x 3 x 78 + 20 x 3 x 60 calibrations = 2340 + 3600 = 5940 calibrations
10 x 3 x 290 + 10 x 3 x 540+10x3x670 = 8700 + 16200+20100 = 45 000 spectra
Note that at the end of the second period , assuming we use 30 days in mode 7 and 30 in mode 4 we should have :
30 x 3 x 48 + 30 x 3 x 48 calibrations = 4320 + 4320 = 8640 calibrations
30 x 3 x 250 + 30 x 3 x 320 = 22500 + 28800 = 51300 spectra
Note that at the endof the third period we should have
(6 x 30 + 9 x 30 + 45 x 48 + 30 x 48) x 10 calibrations
1800 + 2700 + 21 600 + 14 400 = 40500 calibrations and
(4500 + 12600 + 45000 +63000 + 99000) spectra

IN 390 DAYS WE SHALL HAVE

13200 + 28800 + 93 900 +63000+22500 +99000
MODE 17 , MODE 8 , MODE 4, MODE 15, MODE 7,MODE 2

In total 320 400 spectra and 55080 calibrations

2 - CRUISE PHASE

2.1 – NEAR EARTH VERIFICATION.

A few days after launch there will be the so called near Earth verification . The sequence prepared for PFS is given below. We call 𝕋 , To respectively the launch moment and the PFS switch on .

Test 1	**only housekeeping**
Test 2	**synthetic interferogram**
Test 3	**move scanner and perform autotest**
Test 4	**calibration data**
Test 5	**rotate gain factors for lw and sw**
Test 6	**heat the laser diode and take measurements**
Test 9	**just take data**

. The sequence should be as follows (keep in mind that we have 2 days of possible operation , and it is for the single experiment , one at a time) :

𝕋	**launch**
𝕋+3000 minutes	**ASTRA on**
……………..	
T0 -	**PFS Switch-on** **Set DTM mode 17.**
T0+0.1 m -Test 1	**we can monitor voltages and temperatures inside module O. Frequency can be every 100 seconds . As the radiator is for us unknown, to study the thermal behaviour of the experiment is essential.**
T0+300 m- Test 2	**we can test now the communications between the Modules of the experiment. 2 measurements should be requested.**
T0+310 m –	**Unblock pendulum**

T0+325 m – N=4: perform autonomous test.

T0+335 m – Test 1 : monitor of temperatures goes on . 100 sec.

T0+400 m – Scanner over BB – N=200 – dtm 17 – gain 0,0- Test 9

T0+431 m – Scanner deep space – N=200 – dtm 17 –gain 0,0-Test 9.
T0+465 m – Scanner Cl.Lamp – N=200 –dtm 17 – gain 0,0 -Test 9.
T0+490 m – Scanner BB- N=20 – Test5 .
T0+540 m – Test 6 : N= 20 .
T0+610 m – Scanner on deep space.
T0+611m –Test 5 : N=20
T0+660 m – Test 6 : N= 20.
T0+ 730 m – Test 1 : 100 sec.

T0+1000 m -Test 1 we can monitor voltages and temperatures inside module O. Frequency can be every 100 seconds . As the radiator is for us unknown, to study the thermal behaviour of the experiment is essential.

T0+1300 m- Test 2 we can test now the communications between the Modules of the experiment. 2 measurements should be requested.

T0+1325 m –N=4: perform autonomous test.
T0+1335 m – Scanner over BB – N=200 – Test 9
T0+1366 m – Scanner deep space – N=200 - Test 9.
T0+1400 m – Scanner Cl.Lamp – N=200 - Test 9.
T0+1430 m – Scanner BB- N=20 – Test5 .
T0+1480 m – Test 6 : N= 20 .
T0+1530 m – Scanner on deep space.
T0+1531 m –Test 5 : N=20
T0+1580 m – Test 6 : N= 20.
T0+ 1650 m – Test 1 : 100 sec.

T0+1660 m – N=4: perform autonomous test.
T0+1670 m – Test 4 : N= 30 .
T0+1700 m – Scanner on Black Body.
T0+1701m –Test 5 : N=10
T0+1730 m – Test 6 : N= 20.
T0+1790 m – Test 1 : 100 sec.
T0+2000 m – block Double pendulum.
T0+2020 m – Stop data.
T0+2030 m – PFS off.

With this data we can study :

- **The thermal behaviour of PFS.**
- **The internal and exthernal communication.**
- **The optical alignement in space.**
- **The mechanical behaviour .**
- **The calibration sources status.**
- **Responsivity and NER in space.**
- **The best laser diode working temperature.**
- **The best gain factors for SW and LW channel.**
- **The effect of the SW filter thermal reduction.**

2.2 – PAYLOAD CHECKOUT.

This is a 4 hours testing done in November when we are close to Mars and before the release of the Beagle lander .

T0 - PFS Switch-on
Set DTM mode 17.
T0+0.1 m -Test 1 we can monitor voltages and temperatures inside module O. Frequency can be every 10 seconds .
T0+30 m- Test 2 we can test now the communications between the Modules of the experiment. 2 measurements should be requested.
T0+40 m – Unblock pendulum
T0+55 m –scanner on deep space -Test 5-N =10 .
T0+80 m – Test 6 : N=10 .
T0+120 m – Scanner on Black Body.
T0+120m –Test 5 : N=10
T0+145m – Test 6 : N= 10.
T0+185 m –Test 1 : monitor of temperatures goes on . 20 sec.
T0+200 m – block Double pendulum.
T0+220 m – Stop data.
T0+230 m – PFS off.

3 – COMMISSIONING PHASE.

When in orbit around Mars we shall have the so called commissioning phase. We assume this to last the first 15 orbits .

The activity during this period must be to control the status of the experiment , first by means of autonomous test , then by means of calibration measurements and finally by means of martian spectra (better interpherograms). We need also , however , to test the different mode of operations and of data trasmission that later we are going to use most: MODE 17 , MODE 8 , MODE 4, MODE 7,MODE 2 .It is clear , also , that we are not able to quickly react to any problem, as the downlink will occur only once per day , therefore for the moment we have a plan for the 15 orbits in which we plan to take a lot of calibrations , of autonomous tests , and in which we change gain and amplification factors of the laser diodes , assuming that everything is going to function nominally. Later we shall discuss more in details this activity.

We give in the table, for each orbit , the cyclogram that we want to perform , and this is implemented by means of telecommands that should be sent up to thespacecraft . In the table the parameters are :

Orbit Number	**Orbit number**
T wake up	**Wake-up time minutes before pericenter**
Set DTM	**Data trasmission mode =0**
autotest	**Time for autotest procedure**
Set DTM	**Data trasmission mode =DTM**
Set Nc	**Fix parameter Nc (number of calibrations to be taken)**
T calib	**Time to start calibration procedure**
Scann. dir	**fix scanner position**
Set Nm	**Fix parameter Nm (number of measurements to be taken)**
Test numb.	**test number procedure**
T Start	**time to start measurements**
Peric.	**pericenter**
T stop	**Time to stop measurements**
T calib	**Time to start calibration procedure**
Scan.close	**fix scanner position closed**
Set DTM	**Data trasmission mode =0**
autotest	**Time for autotest procedure**
Go to sleep	**Go to sleep**

N cal	**For the calibrations**
N mars	**For mars**

After that we have the total number of measurements taken :
For the autotest
Finally we have the detector gain and the laser diode gain.

In the first pfs operating orbit we need to be switched on far away from pericenter (apocenter would be OK) : the sequence could be the following :

T0 is first pericenter.

T0-240 m PFS switch on.
T0-239 m . Set DTM mode 17.
-Test 1 we can monitor voltages and temperatures inside module O. Frequency can be every 100 seconds .
T0-130 m- Test 2 we can test now the communications between the Modules of the experiment. 10 measurements should be requested.
T0-128 m – Unblock pendulum
T0-113 m –Test 3 : for each position of the scanner perform autonomous test.
T0-110 m – Go to sleep.

For the moment we assume that PFS commissioning will be done for one week starting orbit 20. After 20 orbits of commissioning , we assume also that it will be possible to operate PFS at the usual rate of 15 % of data volume.
Unless differently specified , Test 9 must be done with gain Lw = 1, SW = 3.

OrbitNum.	…	..			19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
T wake up	--	--			--	--	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-65	-60	-60
Set DTM							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest							-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-55	-50	-50
Set DTM							17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Set Nc							10	20	10	20	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib							-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-53	-48	-48
Scann. dir							nad	nad	nad	nad	Nad	nad	nad	Nad	Nad	nad	nad	nad	nad	nad	Nad	nad	nad
Set Nm							10	10	10	10	588	540	540	540	588	540	540	540	588	540	588	540	540
Test numb.							5x3	6x2	5x3	6x2	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start							-40	-35	-40	-35	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-45	-40	-40
pericenter							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop							45	45	45	45	58	53	53	53	58	53	53	53	58	53	53	53	53
T calib							48	48	48	48	58	53	53	53	58	53	53	53	58	53	53	53	53
Scan.close							53	53	53	53	63	58	58	58	63	58	58	58	63	58	58	58	58
Set DTM							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest							59	59	59	59	64	59	59	59	59	59	59	59	64	59	59	59	59
Go to sleep							60	60	60	60	65	60	60	60	60	60	60	60	65	60	60	60	60
N cal							60	120	60	120	60	60	60	60	60	60	60	60	60	60	60	60	60
N mars							480	440	480	440	540	540	540	540	540	540	540	540	588	540	588	540	540

OrbitNum.	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
T wake up	-65	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-55	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	17	17	17	17	17	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-53	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	Nad	nad	Nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	Nad	Nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	588	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test numb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-45	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Go to sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N mars	588	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test numb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Go to sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N mars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4	4	4	4	4	4	4
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50 -

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OrbitNum.	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	4	4	4	4	4	4	4	4	4	4	9	9	9	9	9	9	9	9	9	9	9
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50 -

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OrbitNum.	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	9	9	9	9	9	9	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

OrbitNum.	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316
T wake up	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60	-60
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
Set DTM	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Set Nc	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
T calib	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48	-48
Scann. dir	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad	nad
Set Nm	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540
Test umb.	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
T Start	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
pericenter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T stop	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
T calib	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
Scan.close	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Set DTM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
autotest	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Goto sleep	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
N cal	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Nmars	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540	540

In the table above we perform test 5 and 6 . Test 9 means simply take measurements looking at Mars. Also test 5 and 6 measurements will be taken looking at Mars, but we will also be rotating all possible gains for SW and LW channel. Furthermore we test also the filter shape effect in the SW channel. In these cases we take only the number of measurements programmed for the test.
We shall also test DTM 7,8,4 , 17 . This means in practice, that we test the DTM for simple interferograms, the reduced resolution , and the one sided interferograms .
We should get (20x60) =1200 calibration measurements and a total of 5450 measurements looking at Mars.
We should get the thermal profile along the orbit at pericenter.
We should get the optimum gain set combination for LW and SW.
We should get an idea of the best way of working from DTM point of view .
We should get an idea of the best laser diode temperature .

It is not clear how many data we shall be able to take , as in test 5 and 6 there may be several interferogram saturated.
We should be able to get the procedure for producing calibrated data.

4 – SCIENCE OPERATIONS.

Data taking will be done with 3 scientific scenarios :
Nadir observations.
Selected points observations: Phase studies.
Limb observations.

4.1 - Nadir observations .

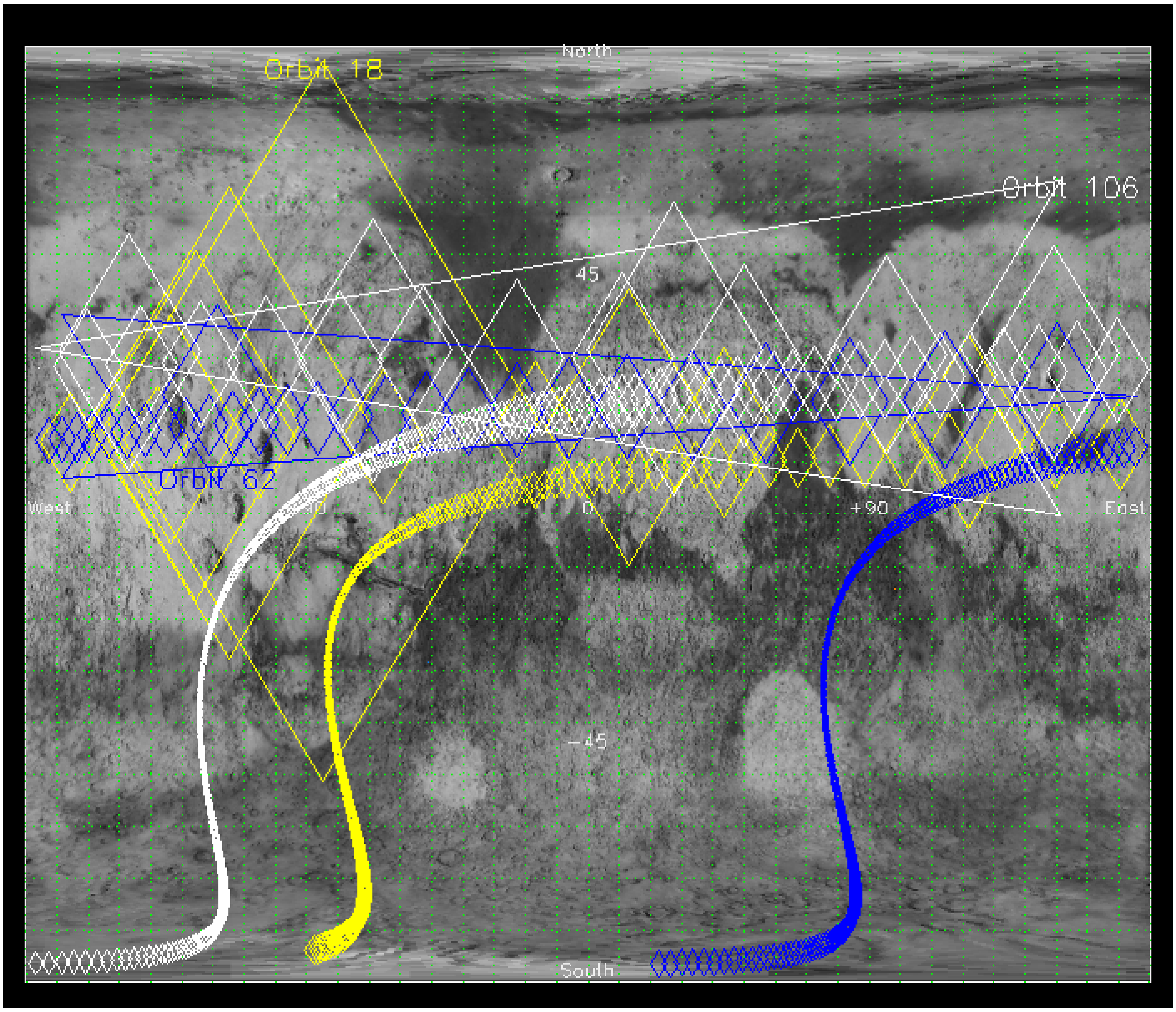
These are the default mode of observations, and shall be used most of the time in order to achieve the overall coverage of the surface of Mars that has been planned.

4.2 - Limb viewing .

In the orbits requested by the Radio Science experiment , the MEX spacecraft is kept on a 3 axis stabilized with the high gain antenna pointing to the Earth. It seems that in these orbits we have the best opportunity for Limb observations. Although we do not have the capability of limb scanning (vertical resolution) , limb viewing , increasing the airmass considered, may favor the minor species studies.

4.3 – Special spots.

Special spots to be considered are : Galleys , theWite rock , the kaolinite spot, the Beagle place.



In the figure given above , the footprint for 3 orbits is plotted on the Martian surface for the cases of 3 axis stabilization . Orbit 18 , 21, 28, 31, 34, 49 ,62, 65 , 68 , 78 , 81, 88, 91, 104 ,106 (from the first 118) are with fixed spacecraft orientation . In these orbits we can perform abundance measurements for minor species of the Martian atmosphere.

4.3 – PHASE PROPERTIES MEASUREMENTS.

As reported in the past , we can use the pointing system for studying phase properties of the aerosols (and/ or surface ?) . It has been shown that the 5 pointing directions of the scanner (-25 , -12.5 , 0 , 12.5 , 25 ,) can be used to cover the same location

On the surface if the different angles are used. The above figure shows the location where the 5 indicated orbits produce overlapping footprints.