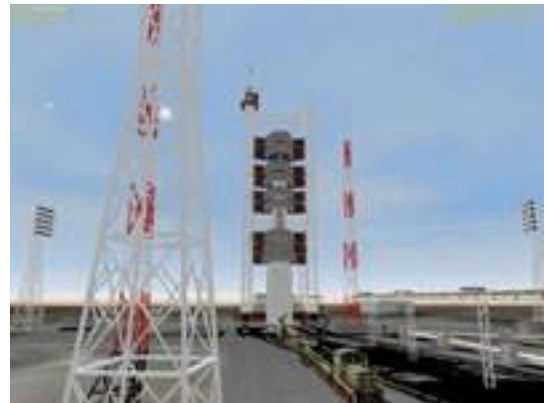
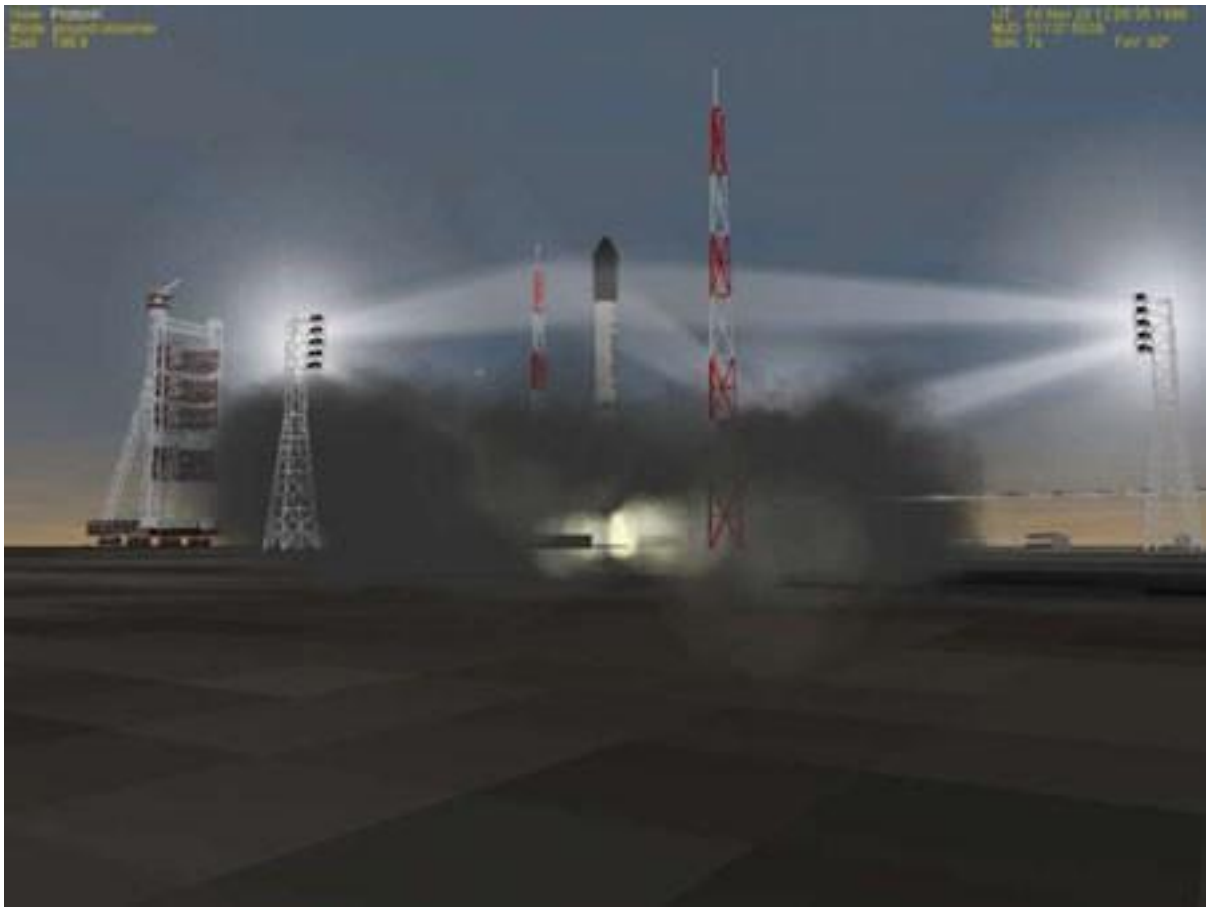


PROTON UR500 BAIKONUR PAD 24

Pack by Papyref
for Orbiter 2016

May 2017



HISTORICAL

The concept of Proton start with a study for ballistic rocket begun in 1961. The goal was to create a universal family of rockets called project UR (Universal Rocket)

The first Proton K takes off on July 16, 1965. It is a high rocket on three stages of 38m weighing approximately 740 tons without load and developing a thrust of 9,5 MN (970 tons)
It could put into orbit a little more than 8 tons in low orbit.
Various later evolutions of this model (lengthening of the second stages, increase in the engine output...) one allowed to put into orbit 22 tons in low orbit.

A fourth stage called block DM made its appearance in 1974 to make it possible to initially place a load in parking orbit and then to place it on a transfer orbit making it possible to reach the generally geosynchronous final orbit.

Proton DM give possibility to place 19 tons in low orbit and 5 tons in geosynchronous orbit
In this version with a long cap the height of the rocket is about 60 m and the weight without load 760 tons.

In 1995 new fourth stage called Bloc Briz was put at least to improve the performances. It makes it possible to put into orbit 21 tons in low orbit and 6,2 tons on geosynchronous orbit.

The complete family counts at least 10 types of assemblies of launchers and 10 types of fairings adapted to the various loads.

The pad 24 is a part of complex SK 81 on the site of Baikonur. It was renovated at the end of the years 1990 to allow the launch of Proton rockets with Briz stage since 2003.

The complete launcher is charged on a railway vehicle which leads it to the launching pad and it is placed on a retractable arm.

The arm equipped with powerful jacks makes it possible to straight the rocket in approximately 4 hours posing it on supports which return in the table of launching at the time of takeoff.

Then the tower of service is advanced to carry out the last preparations. It is what I tried to simulate in my animations.

The position of the launch table is 46.0709390 °N 62.9847630 °E

INSTALLATION

- **Unzip Pad24_ProtonUR500_O2016.zip in your Orbiter 2016 folder**
- **Install and activate OrbiterSound 4.0 by DanSteph you can download on the site <http://orbiter.dansteph.com>**
- **Install and activate Multistage2015 for Orbiter 2016 you can download on the site <http://orbithangar.com>**

If you use D3D9 client, create links in the Launchpad Video → Advanced → Create Symbolics Links otherwise you have CTD

SCENARIOS

Six scenarios are provided with an autopilot

It is preferable to avoid especially accelerating time during the phase of lighting of the first and the second stage.

It is possible to release the fairing manually by using **the key F**

The payload can be released by using **the key J**

Autopilot start by using **the key P**

- **1 - Proton K-NPL sans charge** simulates the launch without load on an orbit inclination $74^{\circ}79'$ with periapsis = 176 km and apoapsis = 176 km
- **2 - Proton KD + Spot** simulates the launch of Spot5 by Proton block DM (4 stages)

Goal:

To put Spot5 on an geosynchronous orbit inclined at 57.7° with into final an altitude at the periapsis = 35789 km and the apoapsis = 35789 km

This launch is the first phase of the operation which places in orbit 300x35789 km. See annex for completion of geosynchronous orbiting

When you are in correct orbit, appreciably observe on the MFD Map the regular passage of the satellite near Peenemünde

- **3 – Proton KD2 + Spot + Carina** simulates the launch of Spot5 with Carina by Proton block DM (4 stages) to give an example of launch with two satellites Inclined at 60° on the ecliptic
- **4 – Proton K + Zarya** simulates the launch of Zarya by Proton K (3 stages) at the time of the mission which allowed its placement on orbit as the first element of ISS

Launch of Proton 8K82K/11886 (in other words Proton K 3 stages) the 20/11/1998 at 6h40 GMT to put Zarya into orbit.

Goal:

To put Zarya on an orbit inclined at $51^{\circ}55'$ with a periapsis = 185 km and an apoapsis = 364 km
Three corrections were then made to achieve an orbit on 21/11 of 251x364 km, 23/11 of 312x399 km and finally on 24/11 of 386x484 km to wait for the shuttle that will bring Unity (not included in the scenario)

- **5 – Proton KM + Zvezda** simulates the launch of Zvezda by Proton block Briz (4 stages) on a high orbit.

The purpose of it is only to try the capacity of carrying of the rocket. By lighting the Briz stage again with the perigee one can create a very elliptic orbit with an apogee with 10M km.

In fact as Proton block DM this rocket is intended especially for the launching of the geosynchronous satellites.

When Zvezda is in orbit it is possible to try to dock with ISS with Zarya or realize a very elliptical orbit

- **6 – Proton K-NPL launch + Proton K en standby** Proton K-NPL (no load) ready for launch is on the pad and Proton K in standby on the train for placement when the pad is free

USING THE AUTOMATIC PILOT

When the scenario is loaded, the time counting starts only when the autopilot is switched on by the P key

In the scenarios the countdown MET before ignition of the motors is set to 20s after switching on with the P key

We can follow the evolution of time in two ways:

By passing in internal view by F1 one can see on the HUD in the top left the value of T negative before ignition (Here **T: 000: 00: 16**) or MET in positive after ignition (Here **MET 000: 00; 07**)

```
ProtonK-NPL
T-: 000:00:16
Stage: 1
Remaining Stage Burn Time: 02:20
```

```
ProtonK-NPL
MET: 000:00:07
Stage: 1
Remaining Stage Burn Time: 02:11
```

Still in internal view, the MFD Multistage 2015 can be used in GNC mode (see Multistage 2015 manual)

```
Multistage2015 MFD- GUIDANCE DISPLAY
MET Comand params
-----
-00:19 playsound 0.0 0.0 0.0 0.0 0.0 0.0 0.0
-00:05 orbit 176.0 176.0 74.8 1.0 80.0
-00:03 engine 0.0 100.0 3.0 0.0 0.0 0.0 0.0
00:00 engine 100.0 100.0 2.0 0.0 0.0 0.0 0.0
00:35 fairing 80.0 0.0 0.0 0.0 0.0 0.0 0.0
01:00 aoa 10.0 120.0 0.0 0.0 0.0 0.0 0.0

T-: 000:00:17 AP: ON
```

```
Multistage2015 MFD- GUIDANCE DISPLAY
MET Comand params
-----
-00:19 playsound 0.0 0.0 0.0 0.0 0.0 0.0 0.0
-00:05 orbit 176.0 176.0 74.8 1.0 80.0
-00:03 engine 0.0 100.0 3.0 0.0 0.0 0.0 0.0
00:00 engine 100.0 100.0 2.0 0.0 0.0 0.0 0.0
00:35 fairing 80.0 0.0 0.0 0.0 0.0 0.0 0.0
01:00 aoa 10.0 120.0 0.0 0.0 0.0 0.0 0.0

MET: 000:00:07 AP: ON
```

You can modify MET in the scenarios if you wish

ANIMATIONS

You must take the element control with F3. Take tab Class to have all the elements

IMPORTANT

If you use Windows 7 you must deactivate the number function on the numeric keyboard

- **For the tower (ProtonTower)** the initial position in the center, is placed on the rocket.

Opening of the footbridges > key G	Stop in progress > key G
Closing of the footbridges > keys Ctrl+G	Stop in progress > key G

Distance of the tower > key K	Stop in progress > key K
Bringing together of the tower > Ctrl+K keys	Stop in progress > key K

The height adjustment of the 9 footbridges of the tower can for adaptation to the rocket. They are numbered from 1 to 9 on the basis of the top and their position can be modified by using keys 1 to 9 of the digital keyboard following the footbridge to be ordered.

Descent > Shift+ key 1 to 9	Stop in progress > the same
Rise > Ctrl+Shift+ keys Ctrl+1 to 9	Stop in progress > the same

Pay attention because nothing prevents from overlapping the footbridges, also it is necessary well to look at which is the possible amplitude and the direction of the displacement which can be carried out.

- **For lighting (ProtonLights)**

Progressive ordering of the lamps by using keys 0 and. (not) of the numeric keypad as for the ordering of a Hover engine.

- **For the train (ProtonTrain)** the initial position is in the center of the launching pad to the foot of the rocket

Caution !

The train is ordered like a handling arm and you must launch the SoundConfig.exe file in the file Orbiter and to strip "Display has T+time counter At launch during 300s" which creates a disturbance of posting when one is on the ground

After the selection of ProtonTrain by using F3 the commands are:

- **Shift + SpaceBar** to take the train command (idem to leave)
- **Shift + 4 or 6 (numeric keypad)** to cycle in the two directions out of the three possible orders
 - **Advance or move back the train**
 - **Raise or lower the support**

The fastening jaws of the rocket are controlled automatically by the position of the support

A text is displayed to give the name of the actual command and a number give the value in position or rotation compared to the initial point

- **Shift + 2 or 8 (numeric keypad)** makes it possible to carry out the movement adapted for the selected order
- **Shift + 0 (zero)** makes it possible to release the rocket of the support once vertical or to hang up again it if you want to gain it.
You can see the state of attachment with **Ctrl+Q**

You can have a displacement or a rotation continuous by realising the Shift key before the numerical key. Then the stop is done by remaking the order.

For the likelihood of unloading a rocket, the support must only be raised when the train is in the extreme position near the pad

THE PAYLOADS

If you wish to modify the payload, it is enough to modify the Payload paragraph in the file ini of the rocket (in config / Vessels / ProtonUR500). to put that which you wish.

For example in the ProtonK.ini file one finds:

```
[PAYLOAD_1]
MeshName="Zarya-J"
name="Zarya-J"
Module="spacecraft\spacecraft3"
off=(0,0,38)
Diameter=3.00
Height=12.00
Mass=18500
```

It is enough to replace the values MeshName, Name and Module by those which correspond to the satellite that you wish to launch.

You can regulate his position under the cap by modifying the last value in the offset (here 38). While increasing it is placed higher, and while decreasing lower

If you modify the mass it may be that the file of guidance of the autopilot does not function correctly any more. I advise you to keep that there even if it is not the truth, if not you risk surprises!

If the dimensions allow it you can to put a second load by creating one [PAYLOAD _ 2]

For example like Zarya 12m measures and weighs more than 18 tons you can without problem embark for example two satellites of 5m length weighing each one up to 9 tons (It is preferable to keep a total weight for the loads equal to 18500 kg even if it is not the truth.

The overall diameter of the satellites should not exceed 4m.

The scenario Proton KD with Spot5 and Carina show this.

It is enough to create a file cfg and a file ini in the ProtonUR500 file in Vessels folder to create a new rocket by copying an existing file ini and adding a payload

In my example I took two files Proton KD2.cfg (not modification) and a file KD2.ini proton with an added load. Here the end of the file ini

```
[PAYLOAD_1]
MeshName="Carina"
name="Carina"
module="Carina"
off=(0,0,57)
Diameter=2.00
```

Height=5.40
Mass=3030

```
[PAYLOAD_2]
MeshName="Spot5"
name="Spot5"
Module="spacecraft\spacecraft3"
off=(0,0,53.5)
Diameter=2.00
Height=5.40
Mass=3030
```

In Payload_1 you find Carina which must be released in first since it is in front of Spot5.(see offset)

Read the explanatory note of Multistage to know some more

If you want to change the launch heading, it is enough to modify the third value in the first line of guidance file to replace it by the desired course

For example -5=orbit(35778, 35793,0.1,1,80). Here the heading is 0.1°

TAKE CARE

Don't modify the general structure of scénarios.

With O2016, Spacecraft don't function for the vessels on the ground as ProtonTower, ProtonTrain and ProtonLights and an invisible platform (a rocket in reality) wear this vessels as satellites. You can see in scenarios this element named Socle and the attachments to the Spacecraft

For the transport of the rocket on the train a fictive launch platform attached to the train was created

From an existing scenario, replace only the rocket and of course the ini file and the guidance file Always keep the generic name ProtonK in the first line of definition of the rocket such as ProtonK: ProtonUR500 / ProtonK-NPL if you have to attach it to the train

Thanks to Jacquesmomo and Fred18 for assistance

Annex - Making a geosynchronous orbit

We will establish an orbit at altitude 35789 km, allowing us to pass once a day at the same time above the site of Peenemünde.

1 - Searching for launch cap

It can be calculated by the formula

Cap = arcsin [cos (desired inclination) / cos (latitude of launch point)]

We leave Baikonur at 46.07 ° N and we want to fly over Peenemünde at 54.1 ° N

Peenemünde being further north than Baikonur it is possible to establish the orbit since the latitude of the launching point is less than the desired inclination which is at least the latitude of Baikonur.

With these values we have:

Cap = arcsin [cos (54.1) / cos (46.01)] = 57.7 °

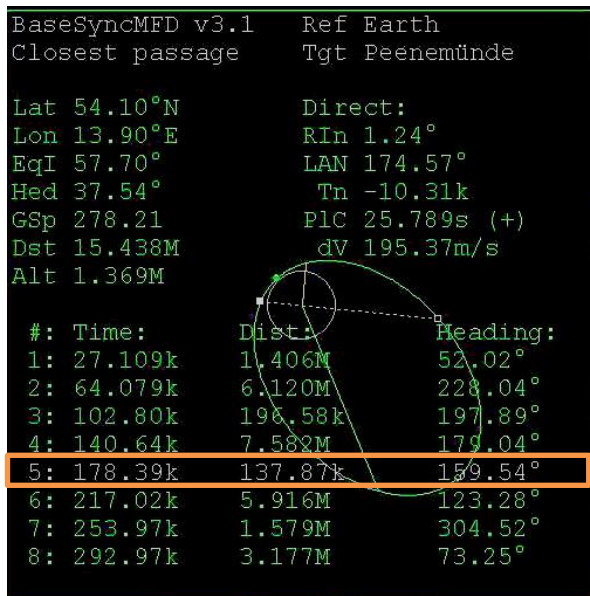


Scenario 2 - **Proton KD + Spot.scn** performs the launch and placing on an orbit 300x35789 km inclined at 57.7 °

2 - Synchronize the orbit

We will use the BaseSyncMFD module from Jarmo Nikkan which can be loaded at <http://www.orbithangar.com/searchid.php?ID=6965>
Activate it in the Module tab of the Launchpad

Open the MFD BaseSyncMFD on the left MFD and the Orbit MFD on the right MFD



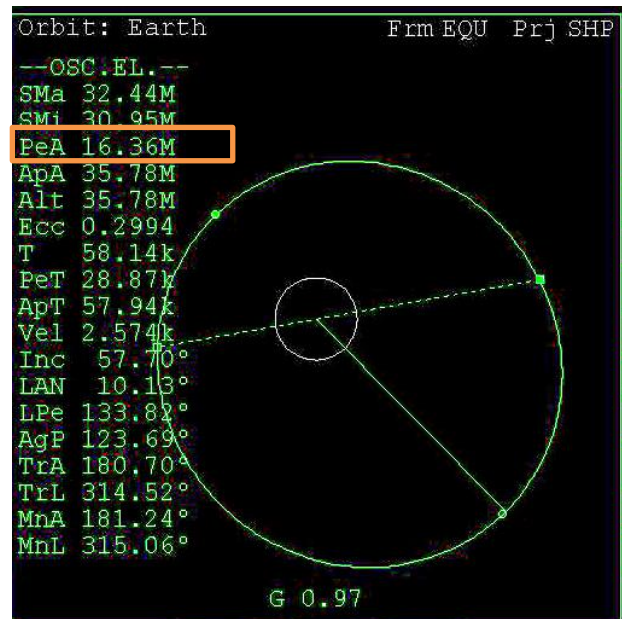
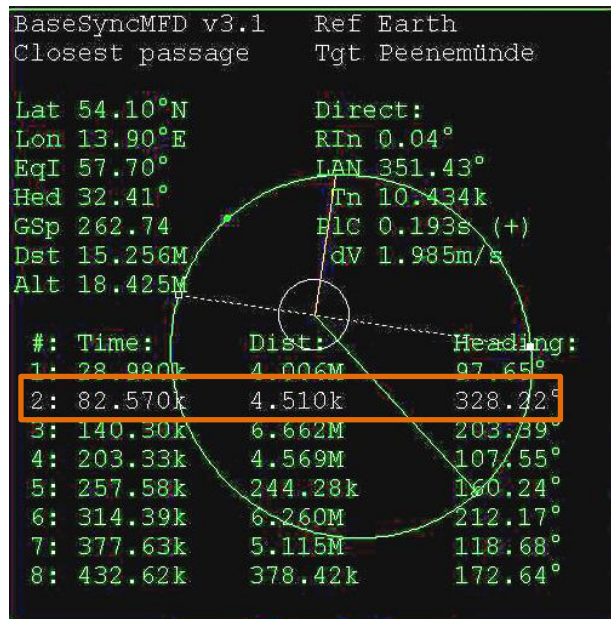
If necessary switch to BaseSybcMFD in Closest Pass and Direct mode and enter TGT ☐ Peenemünde as the goal (do not forget the umlaut!)

The goal will consist of placing itself in the Prograde position at the Apoapsis of the orbit that was created in paragraph 1 and turning on the engine to reduce as much as possible the Dist value read in the highlighted line (here Line 5)

Then the maneuver will consist of placing itself in position Prograde to the Apoapsis of the orbit which was created in paragraph 1 and of lighting the engine to reduce as much as possible the value of Dist read in the line highlighted. This value will change line during maneuvering
Il faut faire attention à ne pas dépasser la valeur de 35.78M pour PeA

- When ApT = 0 on the Orbit MFD turn on the engine (you can speed up time to gain faster position)
- Monitor Dist on the BaseSynchro MFD and stop the ignition when it reaches a low value if possible less than 2 or 3 km with PeA of the order of 10M to 15M

Be careful that PeA remains less than 35.79M



Above a solution with a distance of 4.51k to the passage in the second round for a PeA of 16.36M

3 - Circularize the orbit

All you have to do is turn it (you can accelerate the time) until the highlighted line (at rank # 2 in this example) arrives in rank 1.

It is necessary to wait to reach the Apoapsis in this last turn to circularize while remaining synchronous. The value of Dist will vary slightly because our settings are a little imperfect because of the precision of calculation and display of the data.

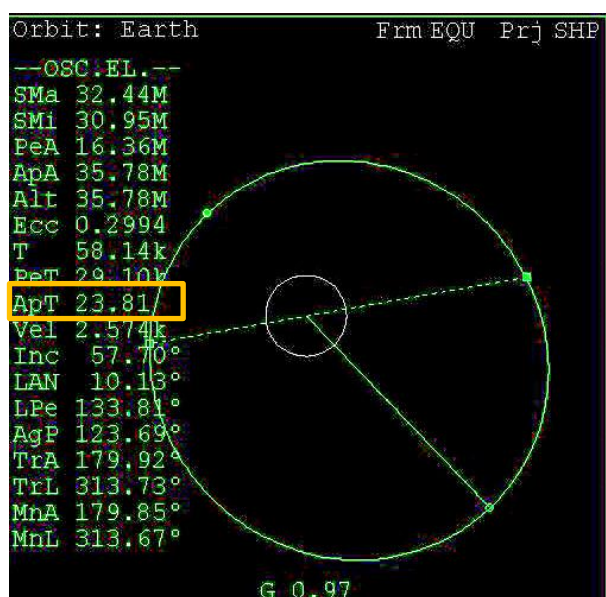
We will use IMFD 5.7 by Jarmo Nikkanen

<http://users.kymp.net/p501474a/Orbiter/Orbiter.html>

Load it and activate it in the launchpad Modules

Open IMFD in an MFD and take Menu → Circularize

In the upper left is seen the required ignition timing BT at a given instant



- When ApT approaches 0 and is roughly equal to $BT / 2$ roughly (here we have 23) go to Auto Burn on Orbital by doing AB
The rule that the ignition timing must be at $BT / 2$ before the time $ApT = 0$ for the orbit to be

symmetric.

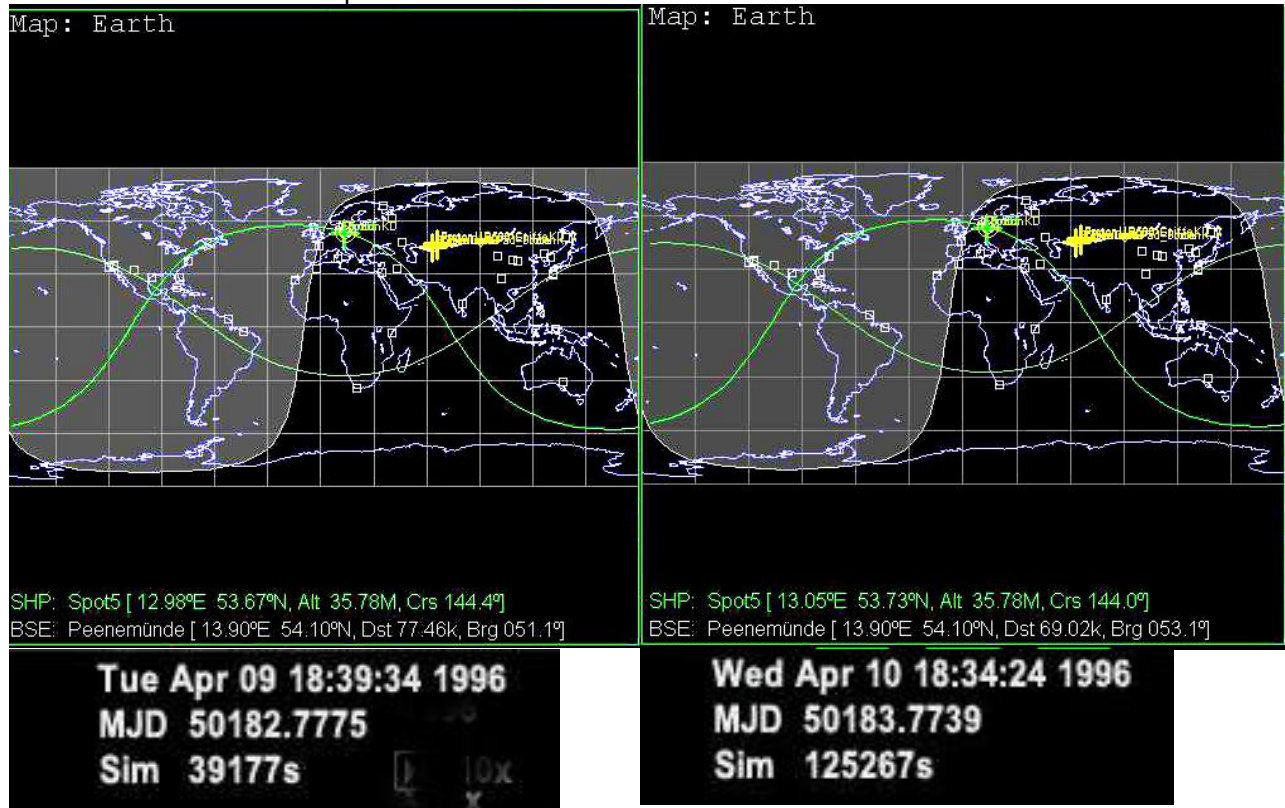
It is necessary to take care of this operation to keep a good synchronism

- When the operation is finished, press the J button to eject Spot5

4 - Check geosynchronism

Let us accelerate the time until we are close to the objective and let us take the time at which the distance Dst is minimum.

Refurbishment for a second pass



The distance from the target is less than 80 km in both cases, but the time shifts by about 5 mm per day. This is not a bad result given the tools and the precision they allow us and we must be satisfied

LIMITATIONS

This addon is limited to a use with the Orbiter software
 Its commercial use is strictly prohibited

I hope that you will take as much pleasure with this addon than I had of it to do it

Papyref
May 2017