

# RadioAstron orbit correction

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# Background

Spacecraft shadowing on the current trajectory:

- January 2017, deep penumbra ( $\alpha > 0.77$ ), more than 5 hours long
- January 2018, umbra, up to 7 hours.

Orbital lifetime:

- Until 18th July, 2021

## Requirements and assumptions

*Implementations<sup>1</sup> of new trajectory are to avoid unacceptable shadow encounters until 2019 and provide a lifetime up to July 2021 (10 years since the launch)*

Assumptions on all sources of errors

- Maneuver execution error does not exceed 6%.
- Additional 1% of execution error is considered as the approximation of maximum navigational errors.
- Solar radiation pressure coefficient varies from 0 to  $2\epsilon_0$ .

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<sup>1</sup>Nominal trajectory and its possible deviations due to maneuver execution errors and OD errors

## Target orbits considered

- ① Current orbit with minimum changes
- ② Less eccentric orbit
- ③ Apogee distance up to 1 mln km
- ④ Lower SMA

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## Target orbits considered

- 1 Current orbit with minimum changes
- 2 Less eccentric orbit

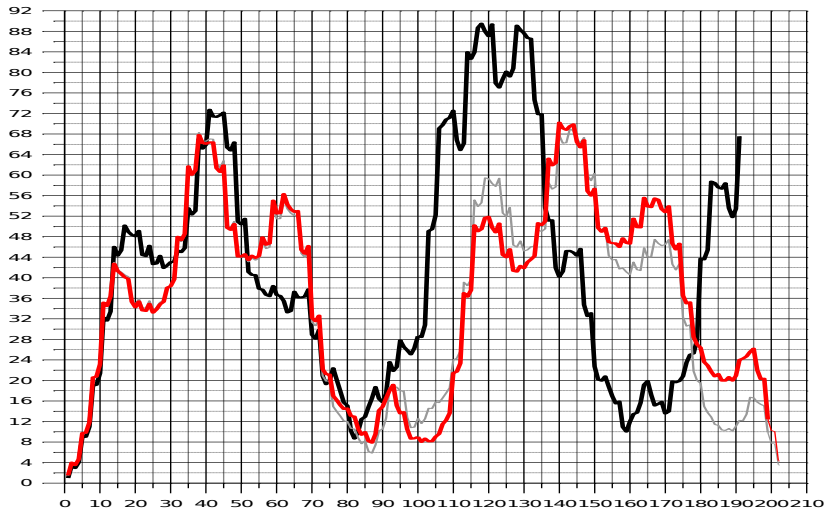
# Maneuver scheme

**Goal:** Avoid shadow, maintain lifetime and do not change actual orbit much.

## Maneuver scheme

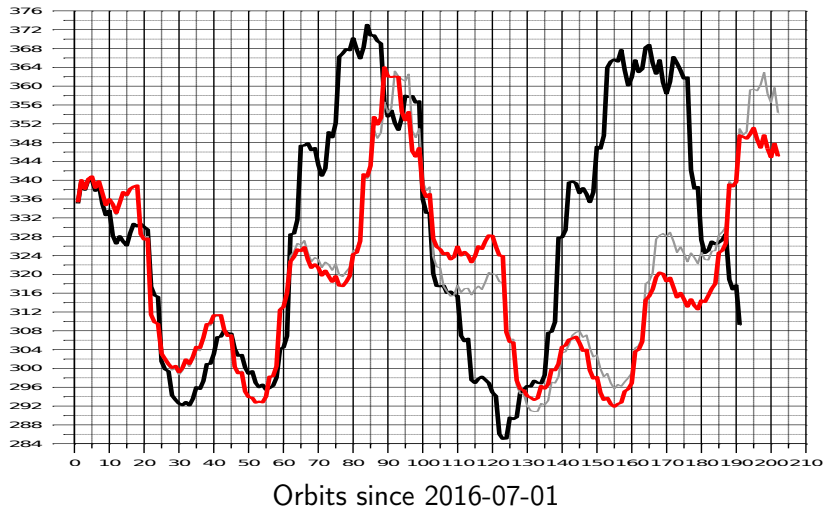
- ① 2016-06-12  $\Delta V \approx 6.90$  m/s near apogee;
- ② 2016-06-29  $\Delta V \approx 0.60$  m/s near apogee;

Even if the 2<sup>nd</sup> maneuver will not be performed dangerous shadows will not occur until 2019.

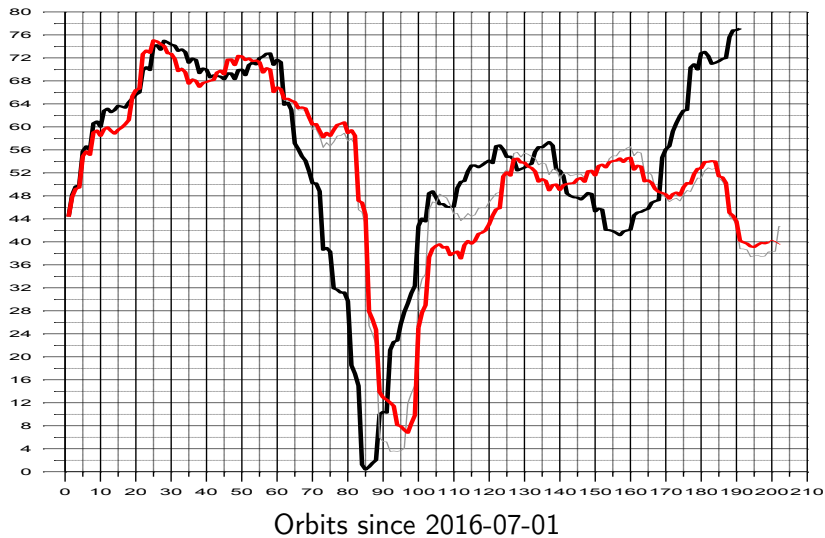
$H_{min}, 10^3 \text{ km}$ 

Orbits since 2016-07-01

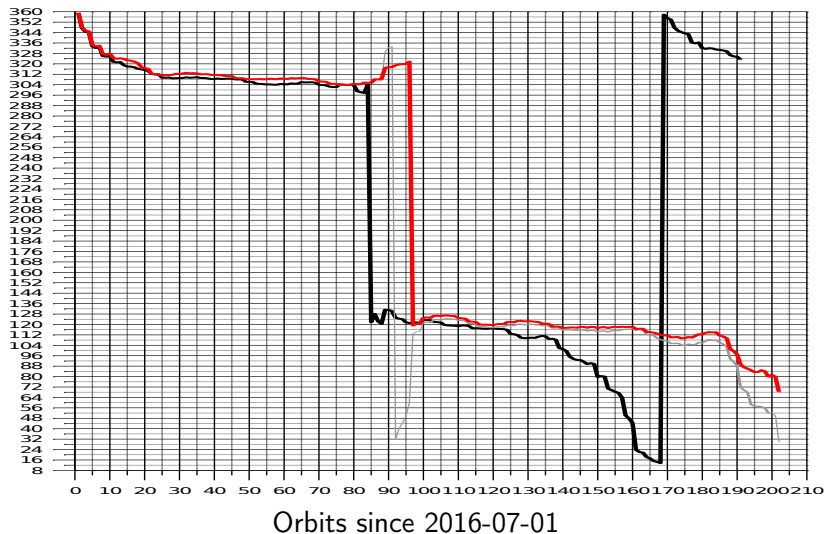


$H_{max}, 10^3 \text{ km}$ 

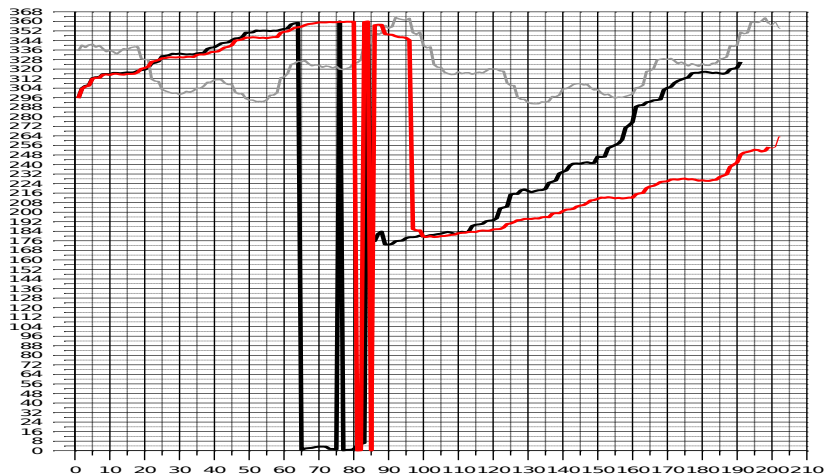
## Inclination, degrees



# Longitude of ascending node

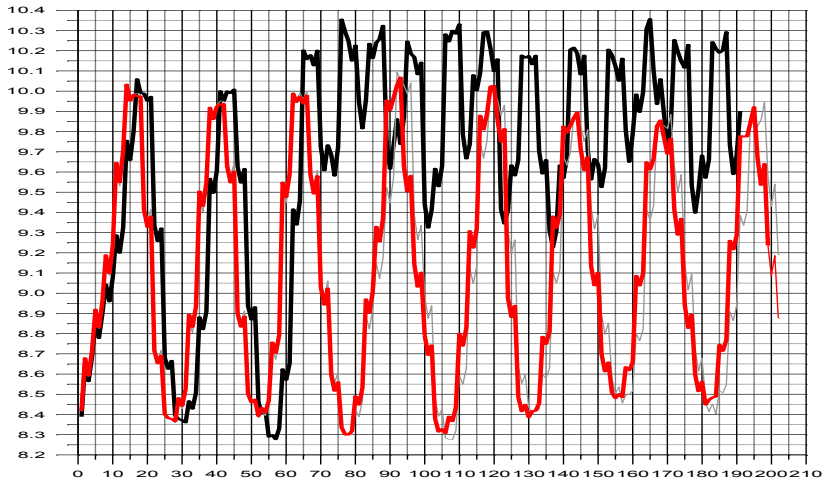


## Argument of perigee, degrees



Orbits since 2016-07-01

# Period, days



Orbits since 2016-07-01

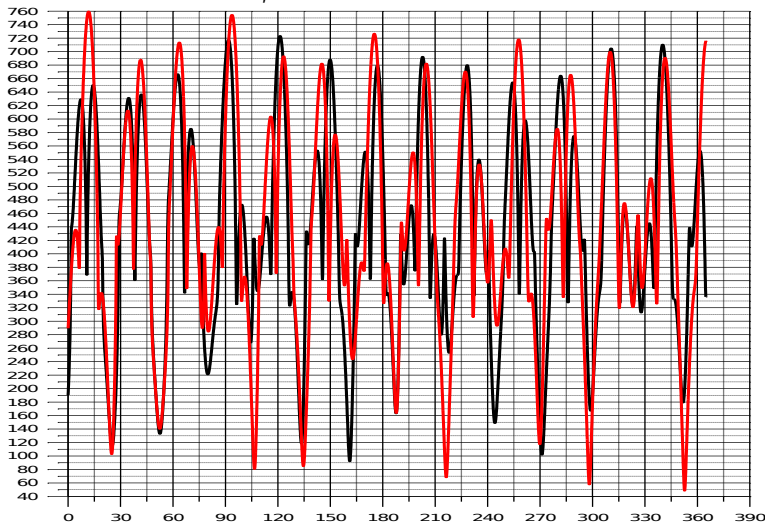
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# Maneuver scheme

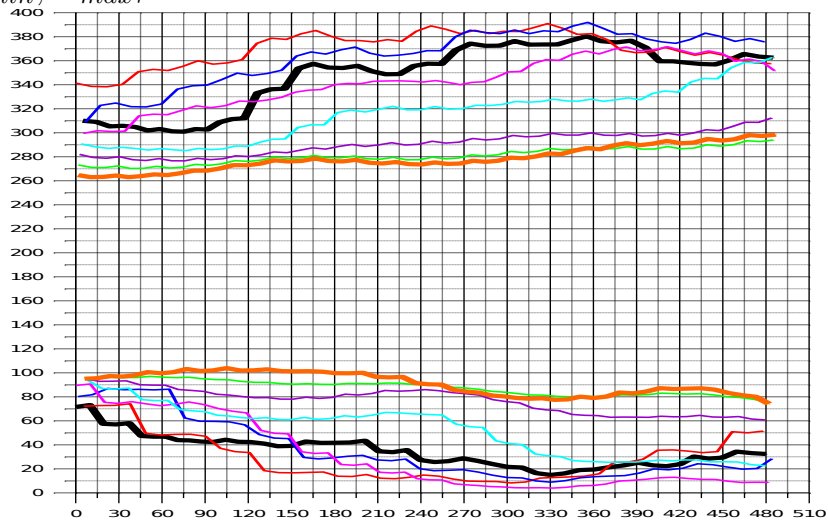
Maneuvers both avoid shadows and decrease orbit eccentricity

#	Time of application	$\Delta V$ , m/s	Orbital lifetime	First unacceptable shadow
1	2016-07-29 01:07	09.00	September 2020	January 2018
2	2016-08-17 17:54	04.70	July 2021	January 2018
3	2017-07-02 06:58	10.20	July 2021	January 2018
4	2017-07-12 20:42	10.20	May 2018	January 2018
5	2017-07-22 20:59	10.20	July 2021	January 2018
6	2017-08-01 14:34	10.20	July 2021	January 2018
7	2017-08-11 03:12	10.30	July 2021	January 2018
8	2017-08-29 07:45	10.20	July 2021	January 2019

Distance to the Moon,  $10^3$  km

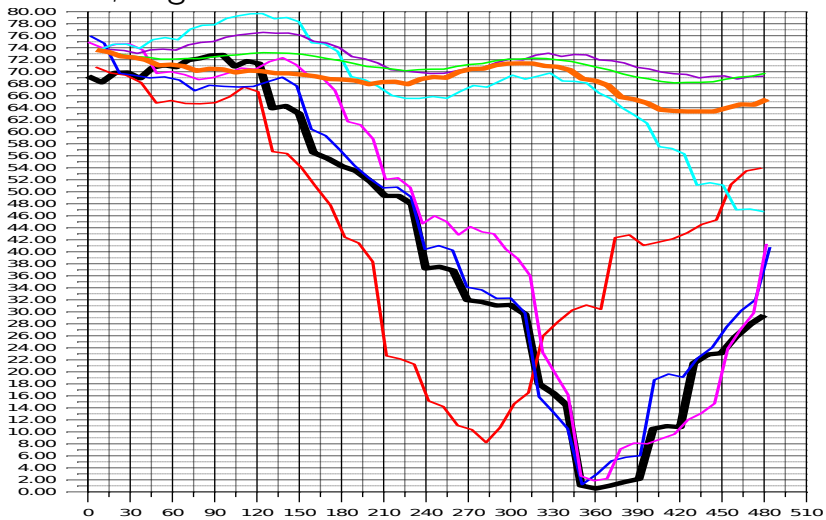
Days since 2016-09-01



$R_{min}, R_{max}, 10^3 \text{ km}$ 

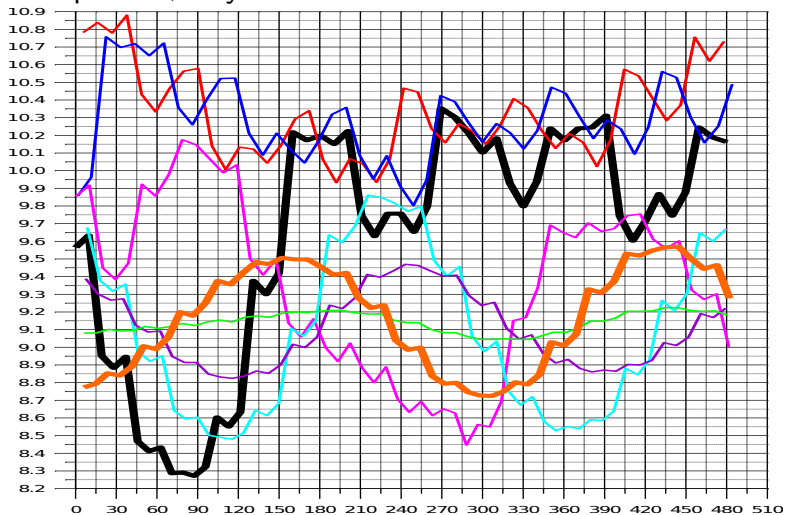
Days since 2017-09-01

## Inclination, degrees



Days since 2017-09-01

# Orbital period, days



Days since 2017-09-01

Thank you for your attention!