

XI. Decay Epoch of the "Tiangong-1" Spacecraft. February 28, 2018

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The materials presented below represent a continuation of the text under the same name, posted on the “satmotion.ru” website from November 2017 to February 2018 [1–10].

1. The results for February 28, 2018

For 24 preceding time instants of attribution of measurements, the SC orbital parameters were updated over the array of initial measurements, which were presented by the well-known TLEs [11]. The results of the most recent updating (for ID 11) are presented below. Here the coordinates (in km) and velocities (in km/sec) are presented in the Topocentric Equatorial Coordinate System (as in TLEs).

21972.690980 - is the modified Julian date = February 27 16^h 35^m 0.672^s
 4290.453287 - x
 5064.919784 - y
 -0.163393 - z
 -4.3502128220 - V_x
 3.6652865110 - V_y
 5.2624981028 - V_z
 0.00276 - S_b (баллистический коэффициент, м²/кг).

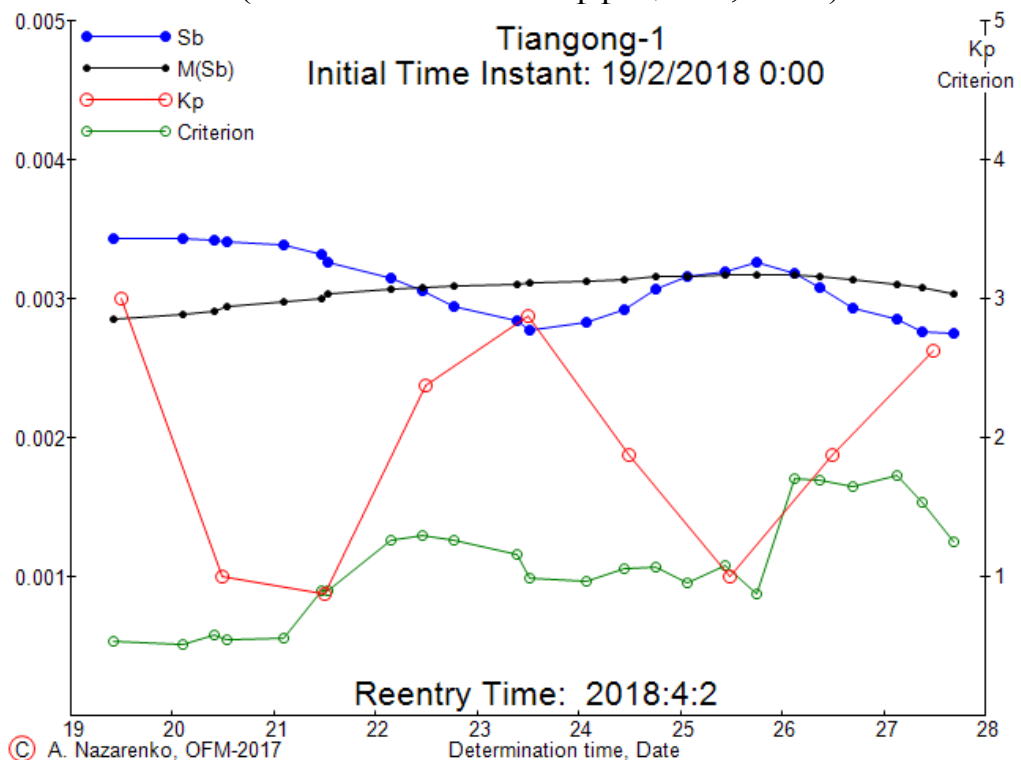


Figure 1. Values of ballistic coefficient S_b , K_p and minimized criterion

Figure 1 presents the ballistic coefficient estimates, the values of the geomagnetic disturbance index (K_p) and the minimized criterion for all preceding time instants of orbital parameters updating after February 18, 2018.

The estimates of ballistic coefficient (S_b) have changed within the range from 0.00276 to 0.00344 m^2/kg , i.e. 1.3 times. The highest drag variations have been observed after February 19, which is the consequence of strong and prolonged geomagnetic storms 15-19 February, as well as after the shorter storms February 23. The black line marks the S_b estimates averaged over some preceding time interval (the sliding average). On the time interval after February 18 these estimates increased by 13 %.

The values of a minimized criterion, presented in the figure, have a meaning of the ratio of residuals to the calculated RMS of errors, averaged over the time interval of measurements. These values depend on the magnitude of current residuals and vary from 0.52 to 1.73. Under perfect tuning of algorithm parameters, their average value should be close to one. The average value of the criterion (0.99) was close to the ideal value.

The last smoothed ballistic coefficient value (0.00304 m^2/kg) was used as a constant value in the prediction of SC motion until its entering the dense layers of the atmosphere. The relevant prediction results for the aforementioned initial data (ID 11) are shown in figure 2.

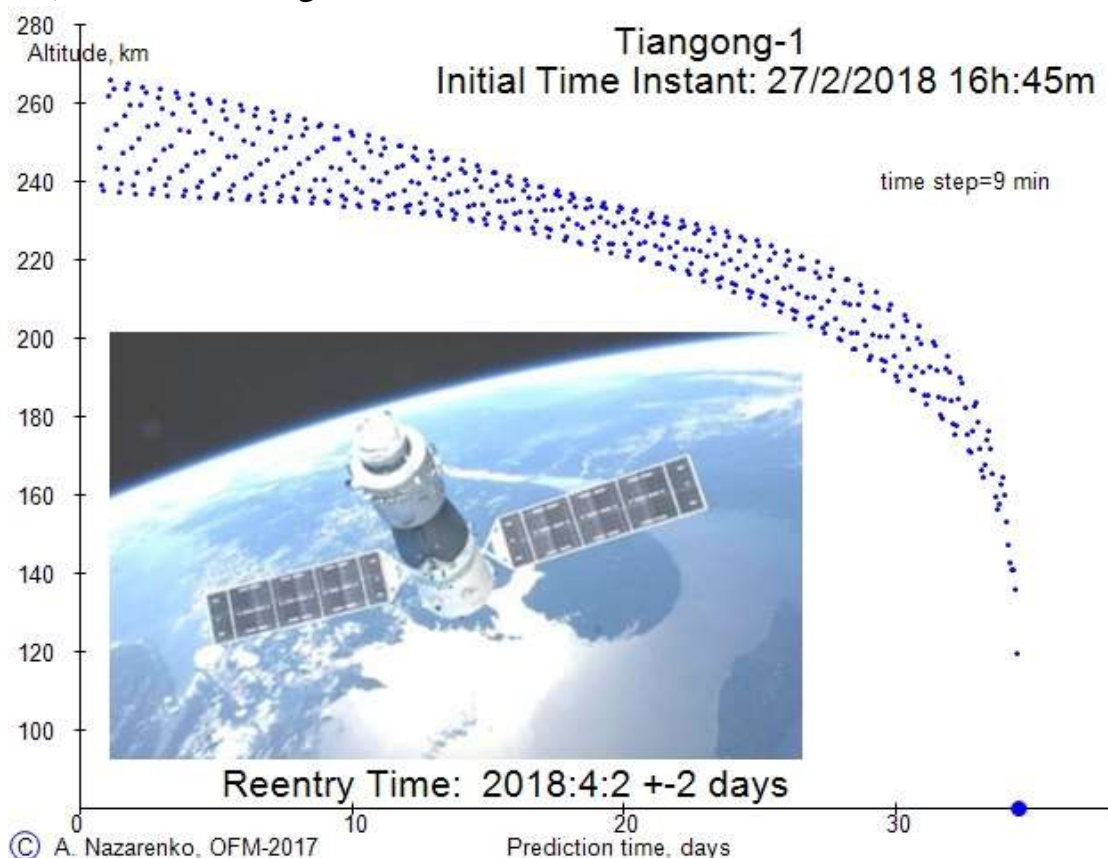


Figure 2. Change of the altitude on the prediction interval

Reentry Information.

Tiangong-1 is predicted to reenter on April 2, 2018 ± 2 days.

Figure 3 presents the results of all 148 preceding determinations of Tiangong-1 SC reentry time after January 01.

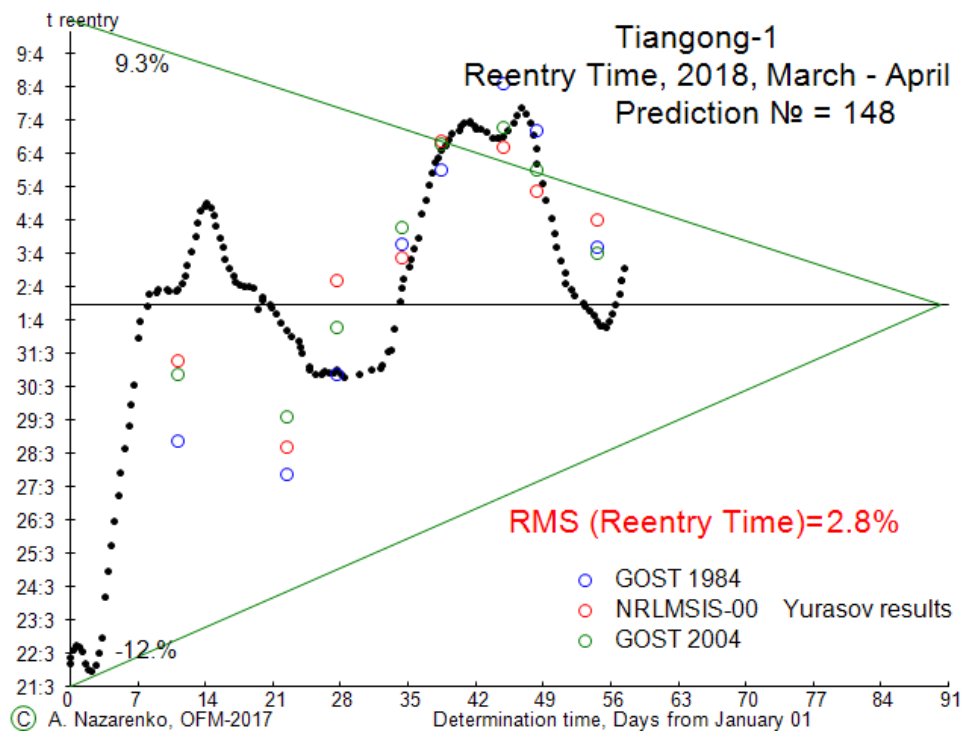


Figure 3. All determinations of Tiangong-1 SC reentry time after January 01

The average value of reentry time is \approx April 01. Deviations from the average value do not exceed 12% of remaining lifetime. The RMS of errors amounted **2.8%**, which is several times lower than the traditional estimates of errors. Reduction of reentry time after February 17 is the consequence of the impact of geomagnetic storms.

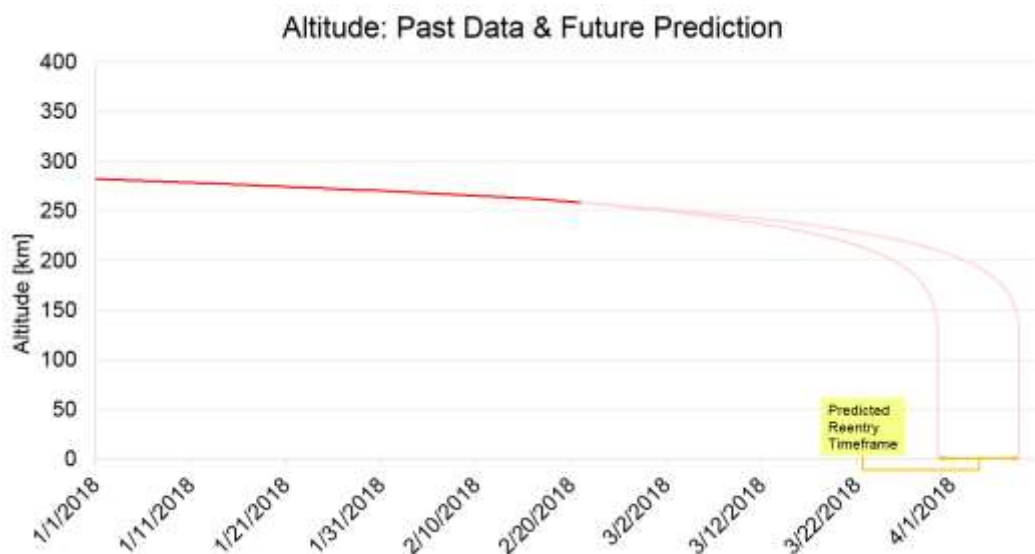
2. Recent publication of other authors

a) Aerospace Corporation

Reentry Information

Tiangong-1 is predicted to reenter in **early April 2018 \pm 1 week**.

This prediction was performed by The Aerospace Corporation on 2018 February 21.



b) Space-Track data [11]

DECAY DATA

Show 10 entries Search All Columns: 37820

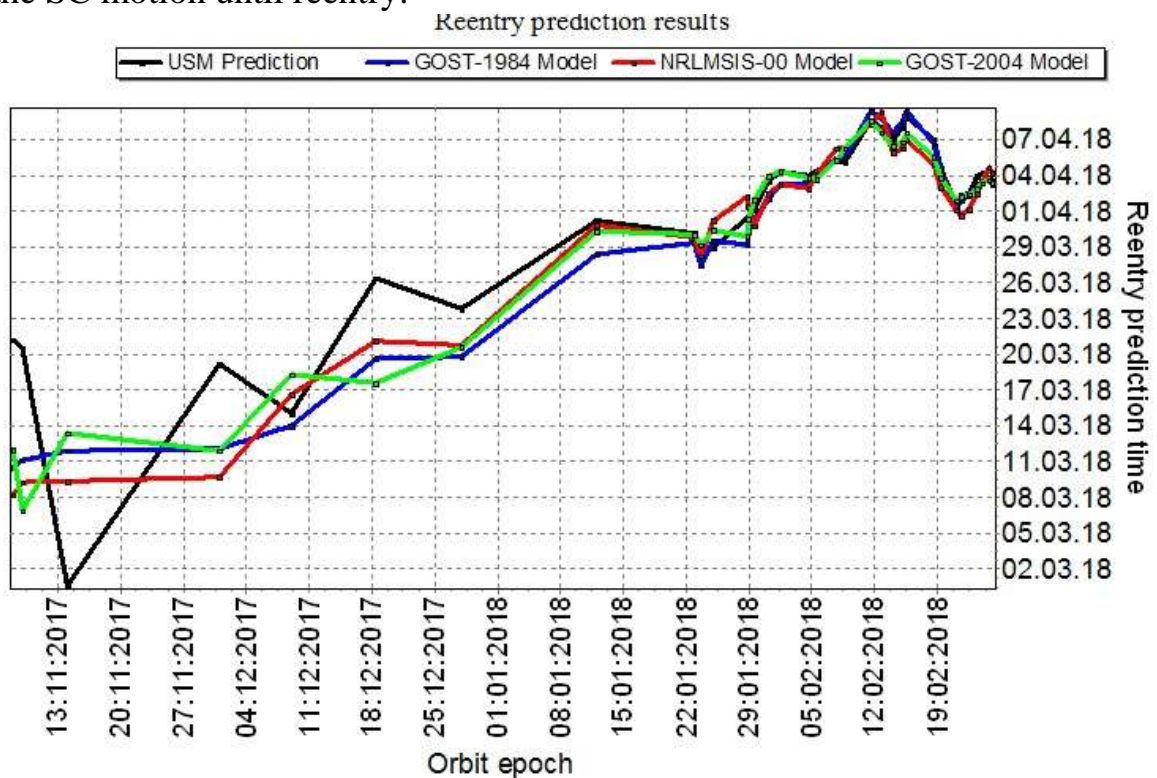
NORAD CAT ID	SATNAME	INTLDES	COUNTRY	MSG_EPOCH	DECAY_EPOCH	RCS	SOURCE	TLE	Type
37820	TIANGONG 1	2011-053A	PRC	2018-02-21 18:32:58	2018-04-10 0:00:00	LARGE	60day_msg	TLE	Prediction
37820	TIANGONG 1	2011-053A	PRC	2018-01-31 17:25:58	2018-03-12 0:00:00	LARGE	60day_msg	TLE	Prediction
37820	TIANGONG 1	2011-053A	PRC	2018-01-24 16:00:44	2018-03-12 0:00:00	LARGE	60day_msg	TLE	Prediction
37820	TIANGONG 1	2011-053A	PRC	2017-12-27 16:48:42	2018-02-22 0:00:00	LARGE	60day_msg	TLE	Prediction

Showing 1 to 4 of 4 entries (filtered from 58,119 total entries)

Country Legend RCS Legend

b) Data by V.S. Yurasov (private message).

The TLE processing results over the preceding week interval and the forecast of the SC motion until reentry:

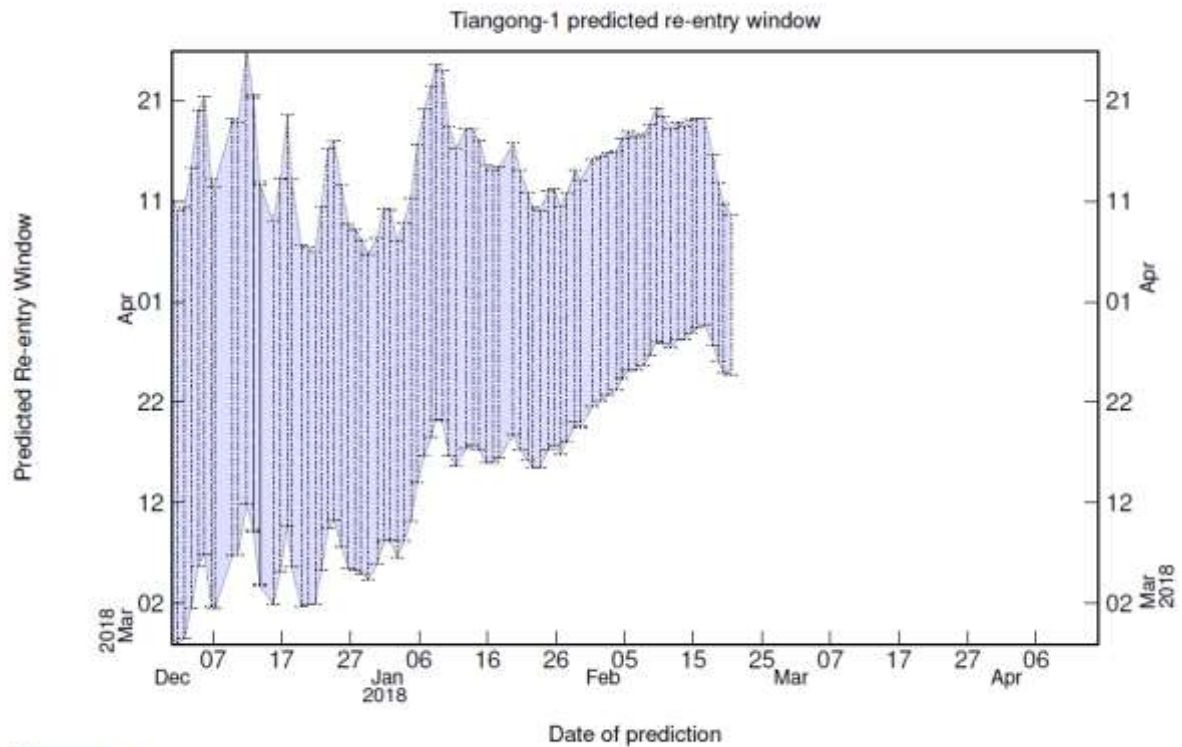


r) ESA (<http://blogs.esa.int/rocketscience/2018/01/12/tiangong-1-reentry-updates/>)

The current estimated window is **~24 March to ~19 April**; this is highly variable.

Update 21 February 2018

Reentry will take place anywhere between 43°N and 43°S (e.g. Spain, France, Portugal, Greece, etc.). Areas outside of these latitudes can be excluded. At no time will a precise time/location prediction from ESA be possible. This forecast will be updated approximately every week in January and February.



References

1. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. November 1, 2017.
2. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. November 15, 2017.
3. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. December 1, 2017.
4. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. December 10, 2017.
5. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. December 20, 2017.
6. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. December 30, 2017.
7. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. January 15, 2018.
8. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. January 30, 2018
9. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. February 10, 2018
10. A.I. Nazarenko. Decay Epoch of the "Tiangong-1" Spacecraft. February 18, 2018
11. <http://www.space-track.org>