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No. 33 - SMART-1 Closing in on the Moon

10 Dec 2004

On 9 December 2004, at 04:09 UTC, SMART-1 started its 12th orbit around the Moon. After the first orbit started on November 15 at 17:47 UTC, the following perilune passages have taken place:

Event	Day and Time (UTC)	Period (h)
Perilune Passage 1	15-11-2004 @ 17:47:38.762Z	89
Perilune Passage 2	19-11-2004 @ 11:01:02.127Z	75
Perilune Passage 3	22-11-2004 @ 14:29:38.449Z	69
Perilune Passage 4	25-11-2004 @ 11:36:11.520Z	59
Perilune Passage 5	27-11-2004 @ 22:42:28.011Z	59
Perilune Passage 6	30-11-2004 @ 01:59:00.054Z	51
Perilune Passage 7	01-12-2004 @ 23:25:21.011Z	46
Perilune Passage 8	03-12-2004 @ 16:05:27.002Z	41
Perilune Passage 9	05-12-2004 @ 05:08:18.135Z	37
Perilune Passage 10	06-12-2004 @ 15:08:27.116Z	34
Perilune Passage 11	07-12-2004 @ 22:40:07.437Z	31
Perilune Passage 12	09-12-2004 @ 04:08:57.443Z	29

From the above it can be seen that the period of the orbit is continuously reduced due to the thrust provided by the electric propulsion system, which reduces the semi-major axis and hence the orbital period.

Since the first start of the electric propulsion engine in the gravitational field of the Moon on 15 November at 05:23 UTC, it has been working well and has fired 20 pulses with a total ON time of 333 hours.

The following table shows the last activities of the electric propulsion engine:

Event	Day and Time (UTC)	Duration (s)
EPP Start	03-12-04 @ 03:18:33.000Z	68306
EPP End	03-12-04 @ 22:16:59.000Z	0
EPP Start	04-12-04 @ 09:13:08.000Z	8983
EPP End	04-12-04 @ 11:42:51.000Z	0
EPP Start	04-12-04 @ 16:49:09.000Z	67185
EPP End	05-12-04 @ 11:28:54.000Z	0
EPP Start	05-12-04 @ 20:32:52.000Z	8182
EPP End	05-12-04 @ 22:49:14.000Z	0
EPP Start	06-12-04 @ 03:27:37.000Z	62096
EPP End	06-12-04 @ 20:42:33.000Z	0
EPP Start	07-12-04 @ 04:59:52.000Z	7456

EPP End 07-12-04 @ 07:04:08.000Z 0

EPP Start 07-12-04 @ 11:17:21.000Z 58287

Orbital/Trajectory information

The following osculating orbital elements have been determined by a tracking campaign:

EPOCH (UTC) 2004/12/04 10:37:47.3

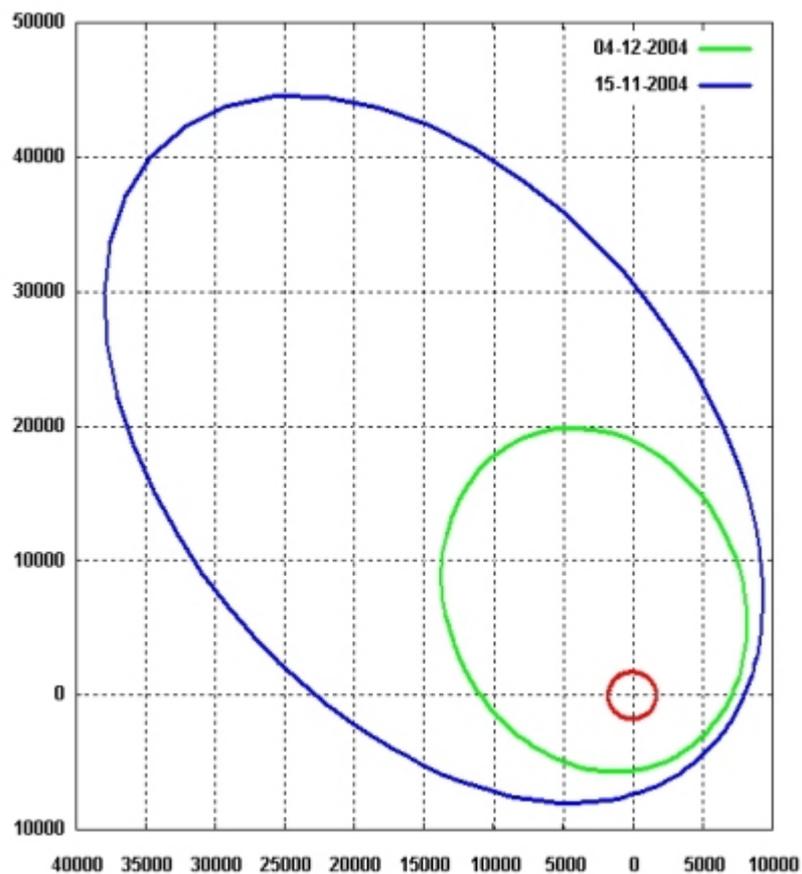
Elements WRT Moon and its equator of date

Pericentre Distance (km)	5 454.925035
Apocentre Distance (km)	20 713.095288
Semi Major Axis (km)	13 084.010162
Eccentricity	0.583085
Inclination (deg)	83.035497
Asc. Node (deg)	239.659898
Arg. of Pericentre (deg)	291.239623
True Anomaly (deg)	180.000986
Osc. Orbital Period (h)	37.304959

These elements are for the 9th apolune passage (true anomaly = 180°) which also marks the start of the 9th orbit as determined by the ESOC. In the previous two reports the perilune passage (true anomaly = 0°) was taken as the starting point of the orbit.

In the below diagram the 9th osculating lunar orbit (around apolune 9) is compared to the first one (around perilune 1). It shows the influence of the firings of the electric propulsion system on SMART-1's lunar orbit.

- the semi-major axis has decreased by 16 872 km
- the perilune height has decreased by 1249 km
- the apolune height has decreased by 32 495 km
- the orbital period has been reduced by 92 hours



SMART-1 first and ninth lunar orbit

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