

MGS AND ODYSSEY – RELAY SATELLITES FOR THE MER MISSION

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EXTENDED ABSTRACT

Both Mars Global Surveyor (MGS) and Odyssey are currently in low altitude, nearly circular and highly inclined orbits about Mars. Thus, they are available and compatible to serve as relay satellites for the Mars Exploration Rover (MER) mission. Consequently, the MER project developed requirements for MGS to be overhead during the atmospheric entry, descent and landing (EDL) phase of both MER vehicles. In particular, MGS was to be overhead for MER-A (Spirit) at Gusev crater, at maximum elevation, midway between lander separation and initial touchdown; in time, this was specified as 01/04/04, 04:24:55 UTC/SCET with a 30 sec tolerance. A similar requirement exists for the MER-B (Opportunity) EDL at the Meridiani Planum site on 01/25/04, 04:53:59 UTC/SCET. Plans were developed to generate a highly accurate orbit propagation model and to prepare for three orbit synchronization maneuvers (OSM) for the over-flight of each MER EDL. The result, after execution of a single OSM on 10/03/03, 92.4 days or 1130 orbits before Spirit's EDL, was that MGS was over Spirit eight seconds past the require time (Table 1 and Fig. 1).

Based on the current trajectory propagation and execution of an OSM on 01/04/04, 16:48:54 UTC/SCET, MGS is scheduled to overfly the Opportunity EDL on 01/25/04, 04:54:05 UTC/SCET which is six seconds after the required epoch (current estimate).

Requirements also exist for the Odyssey over-flight of the MER rovers after landing and the UHF telecommunications equipment has been deployed. For Spirit, the requirement was that Odyssey shall rise no earlier than 01/04/04, 06:34:00 UTC/SCET and attain a maximum elevation angle of at least 30 deg. A maneuver was executed on 11/22/03 (delta-velocity of 0.518 m/s) leading to an over-flight of Spirit on 01/04/04, 06:39:22 with a maximum elevation of 36.8 deg.

This paper will present the navigation plan, analysis of orbital data, trajectory propagation accuracy and maneuver execution for the successful MGS and Odyssey over-flights of both the MER rovers.

Table 1
MGS OSM PARAMETERS FOR MER EDL OVER-FLIGHTS

<u>Quantity</u>	<u>Spirit EDL</u>	<u>Opportunity EDL</u>
OSM epoch, UTC/SCET	10/03/03	01/04/04
Days/Orbits from OSM to over-flight	92.4/1130	20.5/251
Delta-velocity, m/s	0.534	0.211
Delta-period, sec	3.34	1.31
Time phasing required for over-flight, min:sec	62:19	05:24
Over-flight epoch difference (achieved-required), sec	+8.	+6. estimated
Maximum elevation, deg	23.2	51.7

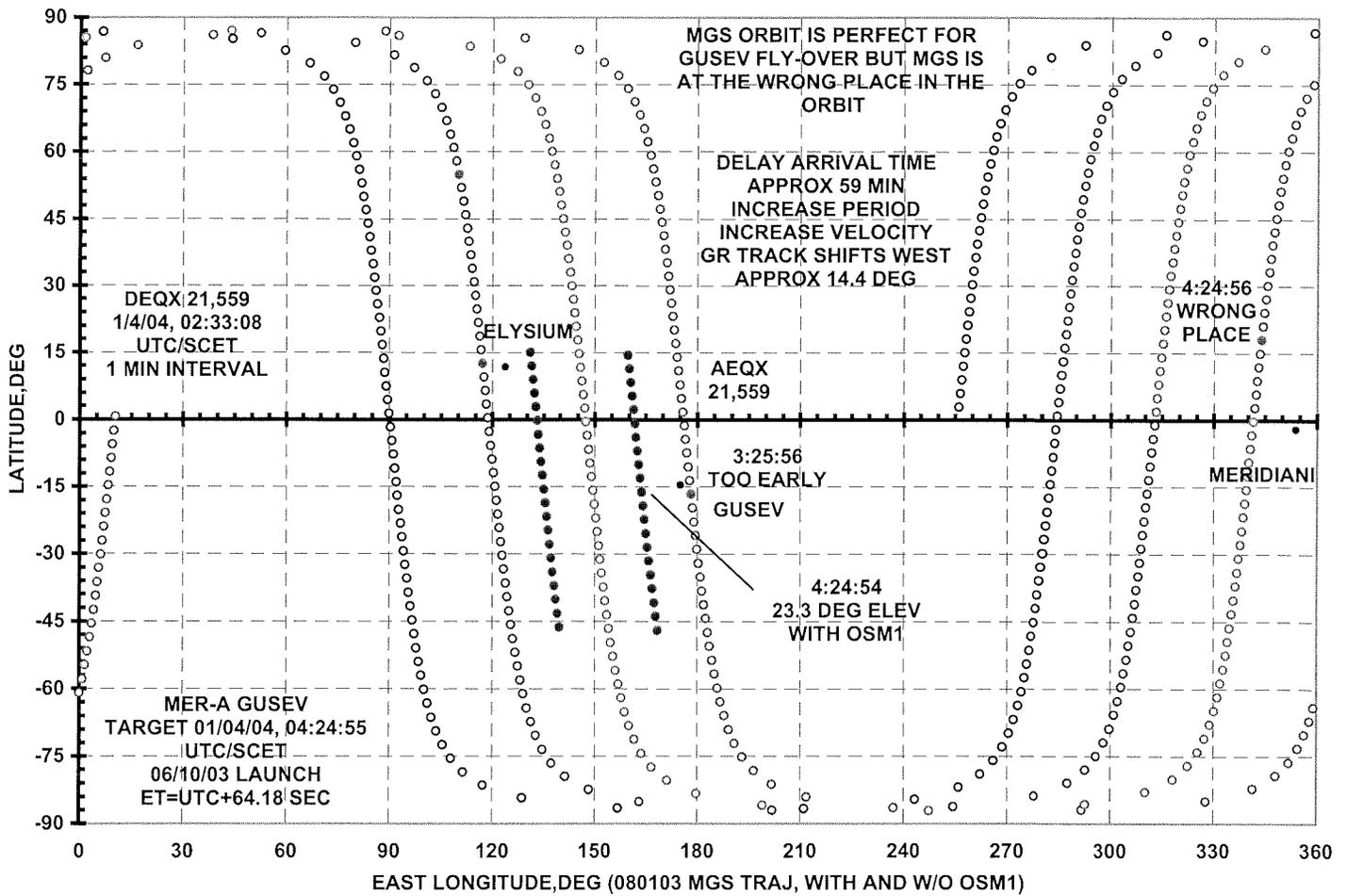


Figure 1 MGS ground tracks, propagated to 01/04/04, before and after the OSM on 10/03/03. Without the OSM, MGS would have been on the opposite side of Mars with respect to the Gusev site and the required over-flight time. AEQX refers to the ascending equator crossing during mapping orbit 21,559.

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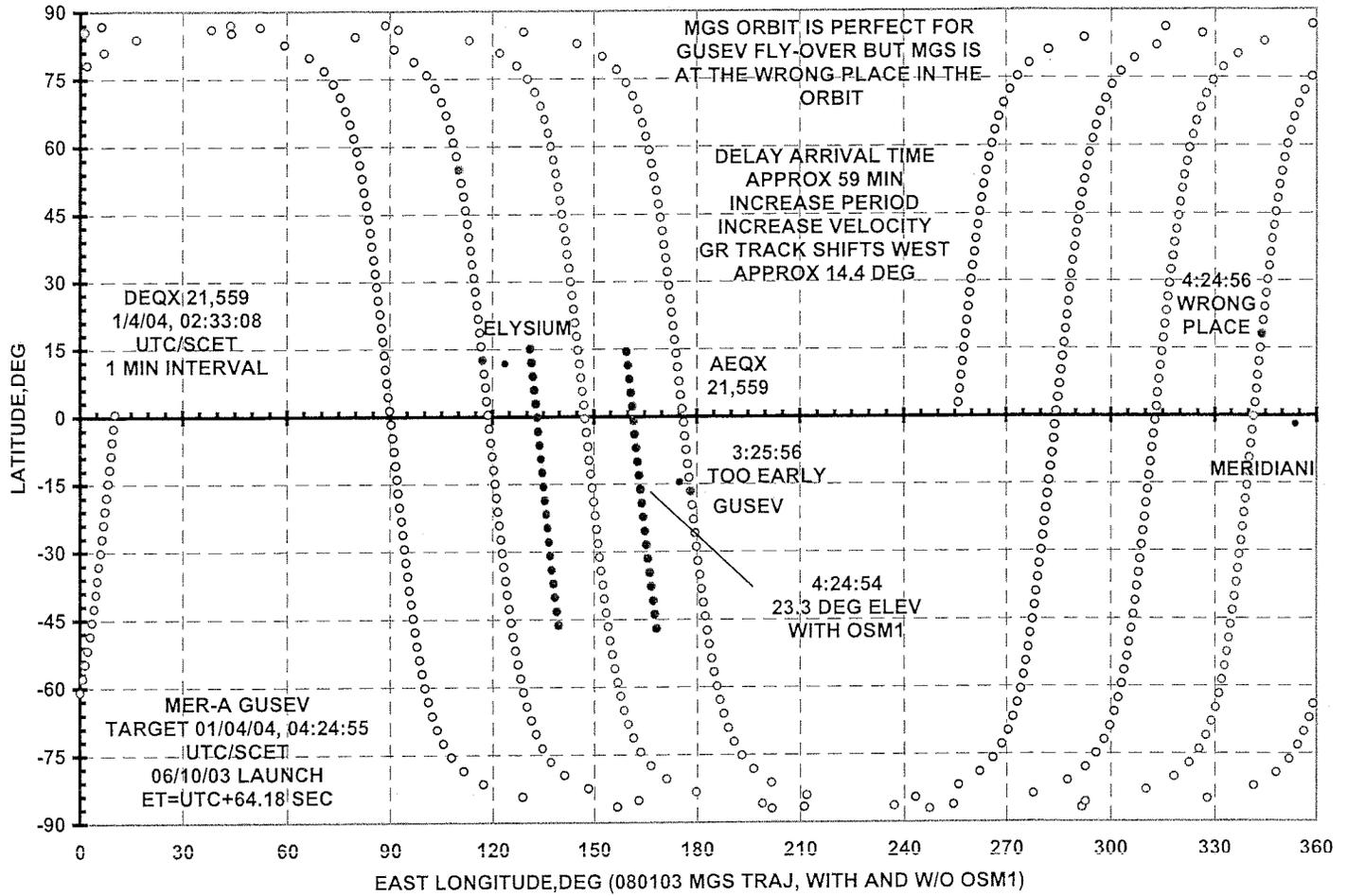


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