The ESA Mars Express Exploration of Phobos and Deimos and satellite and ring searches

T. Duxbury (Jet Propulsion Laboratory)

The ESA Mars Express Mission will have an excellent opportunity to explore Phobos, even in more detail than Viking. The elliptical, near polar orbit will have a period very near that of Phobos and allow hundreds of close flybys over the mission durations. The remote sensing suite of scientific instruments includes high resolution color imaging, multispectral infrared imaging, planetary Fourier spectrometry, sounding radar and radio science. Also dust observations will be made throughout the orbit of Phobos. The spacecraft mapping orbit will always be inside the orbit of Deimos, allowing only observations of the front side but at resolutions comparable to or better than Viking. Imaging scans of the equatorial region, within the orbit of Phobos, will be made when the spacecraft is near pericentre to search for rings and satellites. Details of this possible exploration will be given. Information gained would support studies of the possible origins of the Marian moons, including being captured asteroids.

Asteroids, Comets, Meteors 2002

The Mars Express Exploration of Phobos and Deimos with Ring and Satellite Searches

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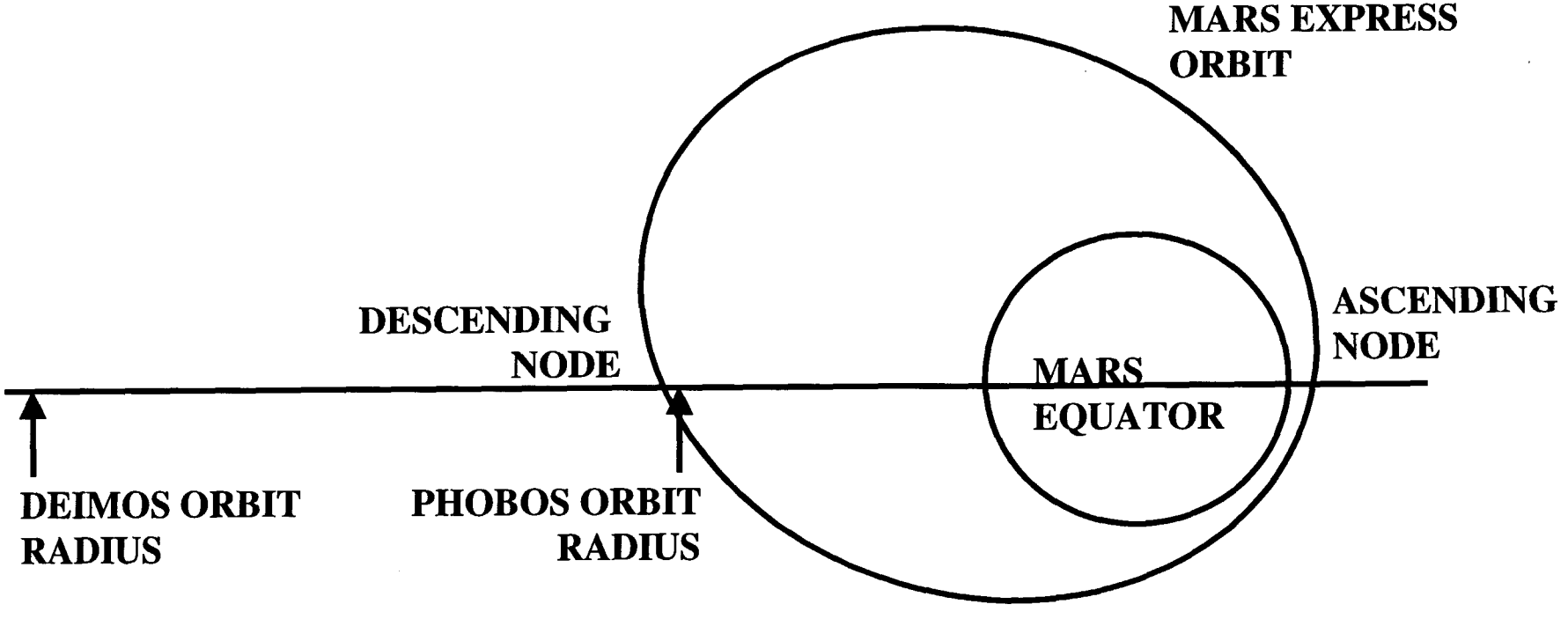
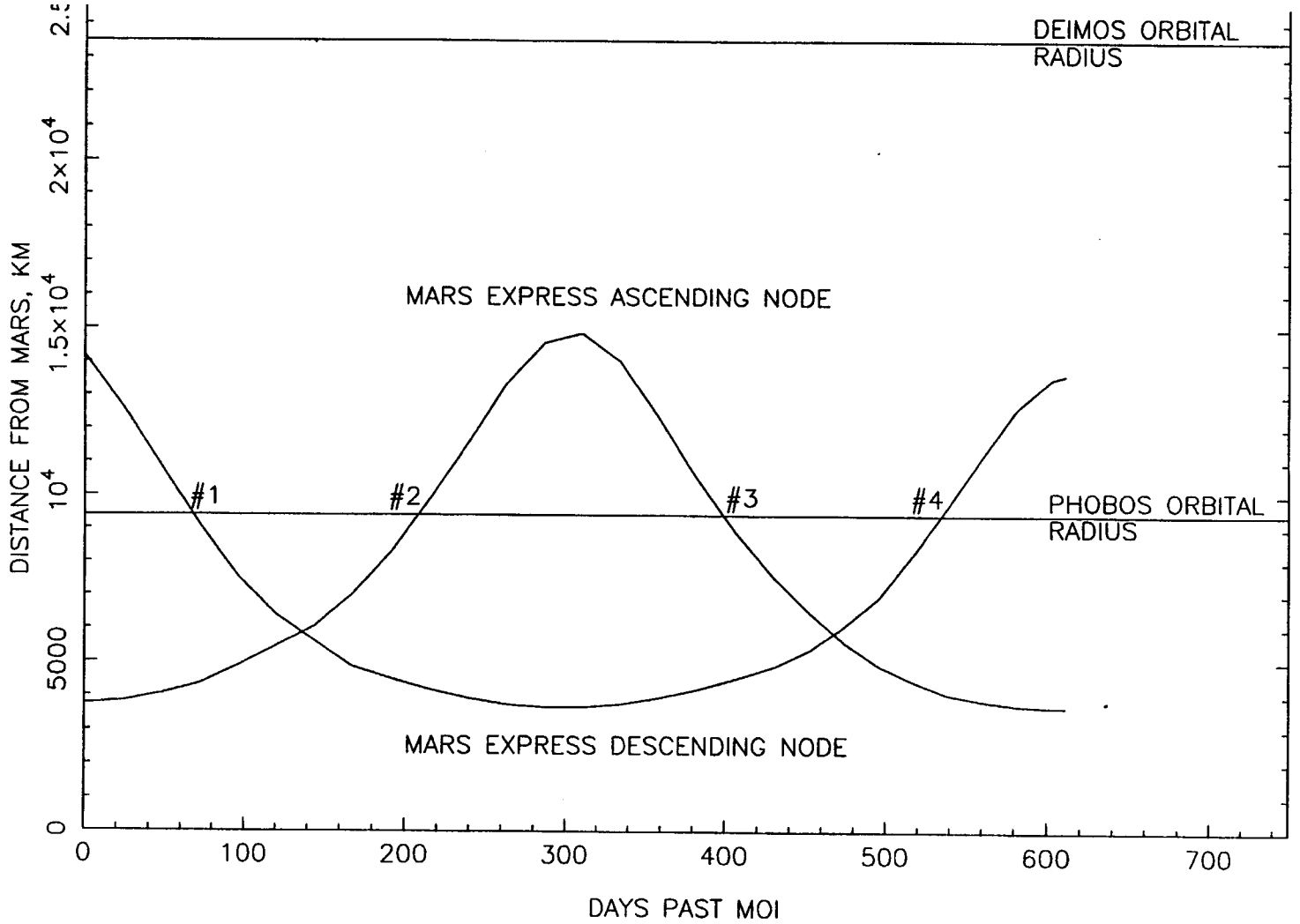
Phobos Encounters

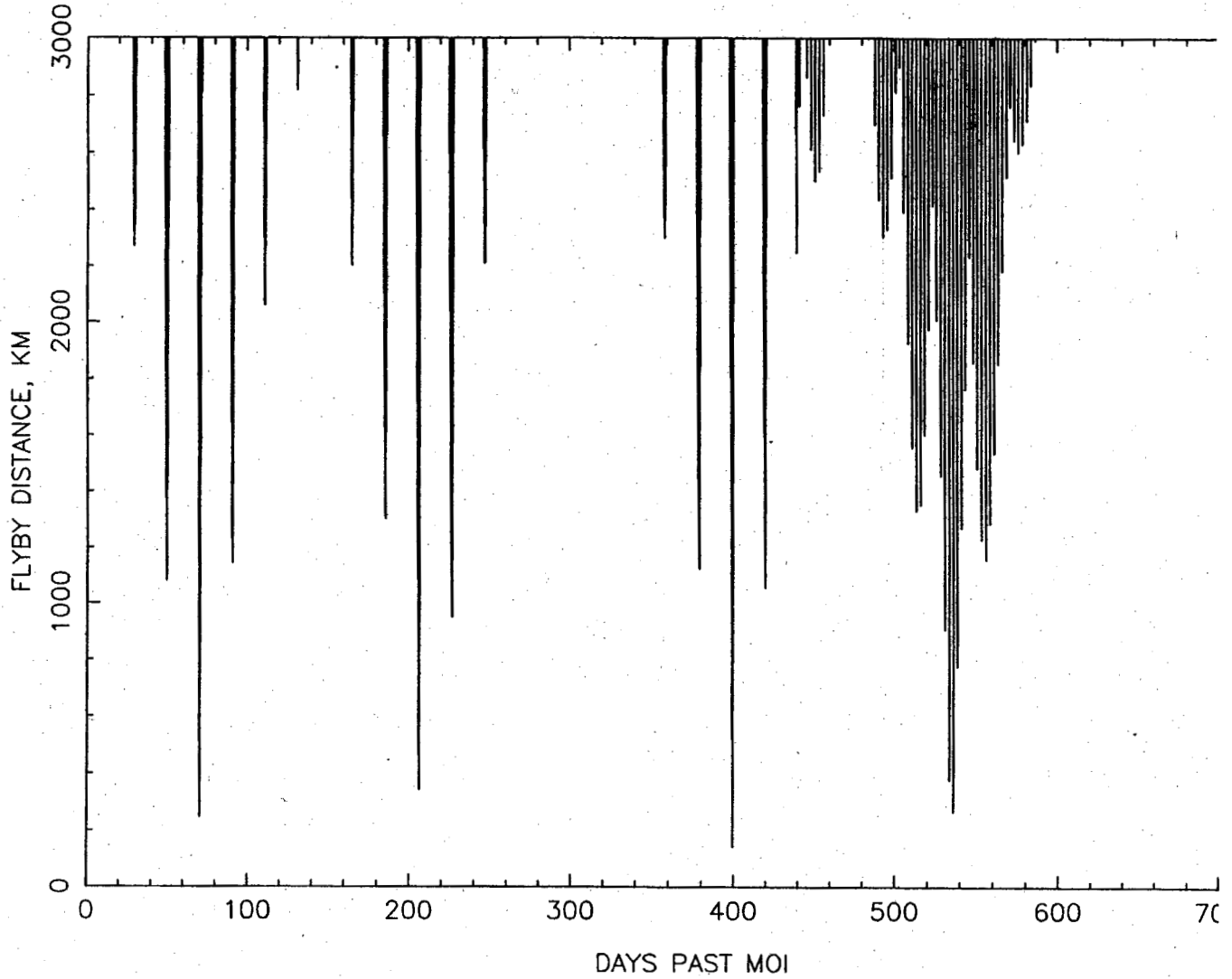
ONLY PHOBOS CLOSE ENCOUNTERS WILL OCCUR WHEN MARS EXPRESS ORBITER PASSES THROUGH ASCENDING OR DESCENDING ORBIT NODE ON MARS EQUATOR WHEN NODE IS AT PHOBOS DISTANCE FROM MARS



Node Crossings at Phobos Radius

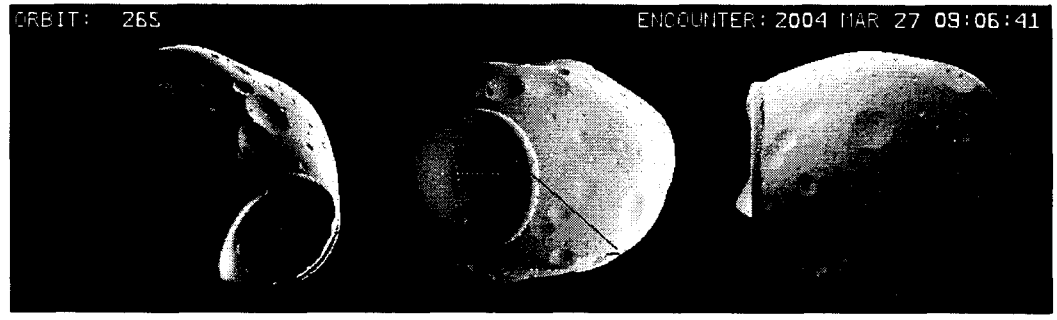


Phobos Close Encounters



Phobos Planning Information

- **PHBxxxxx.IMG**
  - xxxxx is Orbit #
  - 1024 samples / line & 325 lines
    - 3 label records & 1 histogram record
  - Produced Only When < 3000 km
  - For 1st 300 Orbits
- **phobos_g.txt**
  - ASCII Text File
  - Encounter Geometry @ 30 sec Intervals
  - Produced Only When < 3000 km
  - For 1st 4000 Orbits



ORBIT NO: 2280	TFP	RNG	***** MEX ***** LAT	LNG	****** SUN ***** LAT	LNG	PHASE
SCET - UTC	HR:MN	KM	DEG	DEG	DEG	DEG	DEG
2005 NOV 21 23:50:48	-1:17	486.	40.8	258.0	-12.0	16.8	119.5
2005 NOV 21 23:51:18	-1:16	402.	41.8	260.8	-12.0	16.4	117.0
2005 NOV 21 23:51:48	-1:15	318.	43.0	265.3	-12.0	16.0	113.2
2005 NOV 21 23:52:18	-1:15	237.	44.7	273.8	-12.0	15.6	106.8
2005 NOV 21 23:52:48	-1:15	163.	45.7	291.7	-12.0	15.2	94.1
2005 NOV 21 23:53:18	-1:14	108.	37.8	329.7	-12.0	14.8	65.3
2005 NOV 21 23:53:48	-1:14	109.	8.4	10.1	-12.0	14.4	20.9
2005 NOV 21 23:54:18	-1:13	165.	-12.0	29.9	-12.0	14.0	15.5
2005 NOV 21 23:54:48	-1:12	240.	-20.7	39.1	-12.0	13.6	25.8
2005 NOV 21 23:55:18	-1:12	321.	-24.9	44.0	-12.0	13.2	31.7
2005 NOV 21 23:55:48	-1:11	405.	-27.3	46.9	-12.0	12.9	35.3
2005 NOV 21 23:56:18	-1:11	489.	-28.8	48.7	-12.0	12.5	37.7
2005 NOV 21 23:56:48	-1:11	574.	-29.9	49.9	-12.0	12.1	39.3

First Phobos Encounter Series

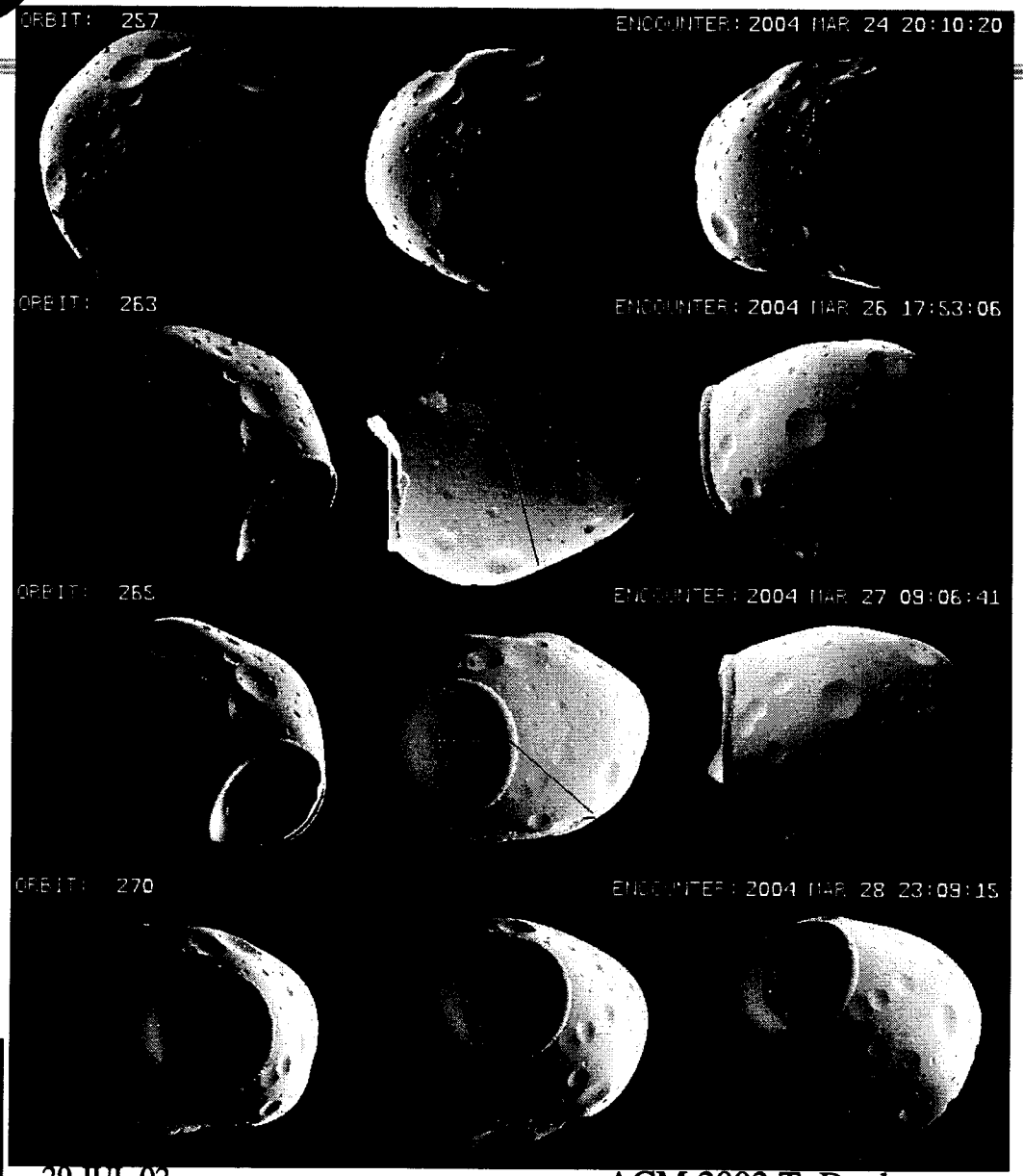
Best Viewing on Orbits 151 - 163
(2004 Feb 21 - 24)

90 to 60 Minutes Before Pericentre

Closest Encounter ~ 1200 km
(Orbit 157)

MARS EXPRESS - EXPLORATION OF PHOBOS

Second Phobos Encounter Series



Best Viewing on Orbits 257 - 270
(2004 Mar 24 - 28)

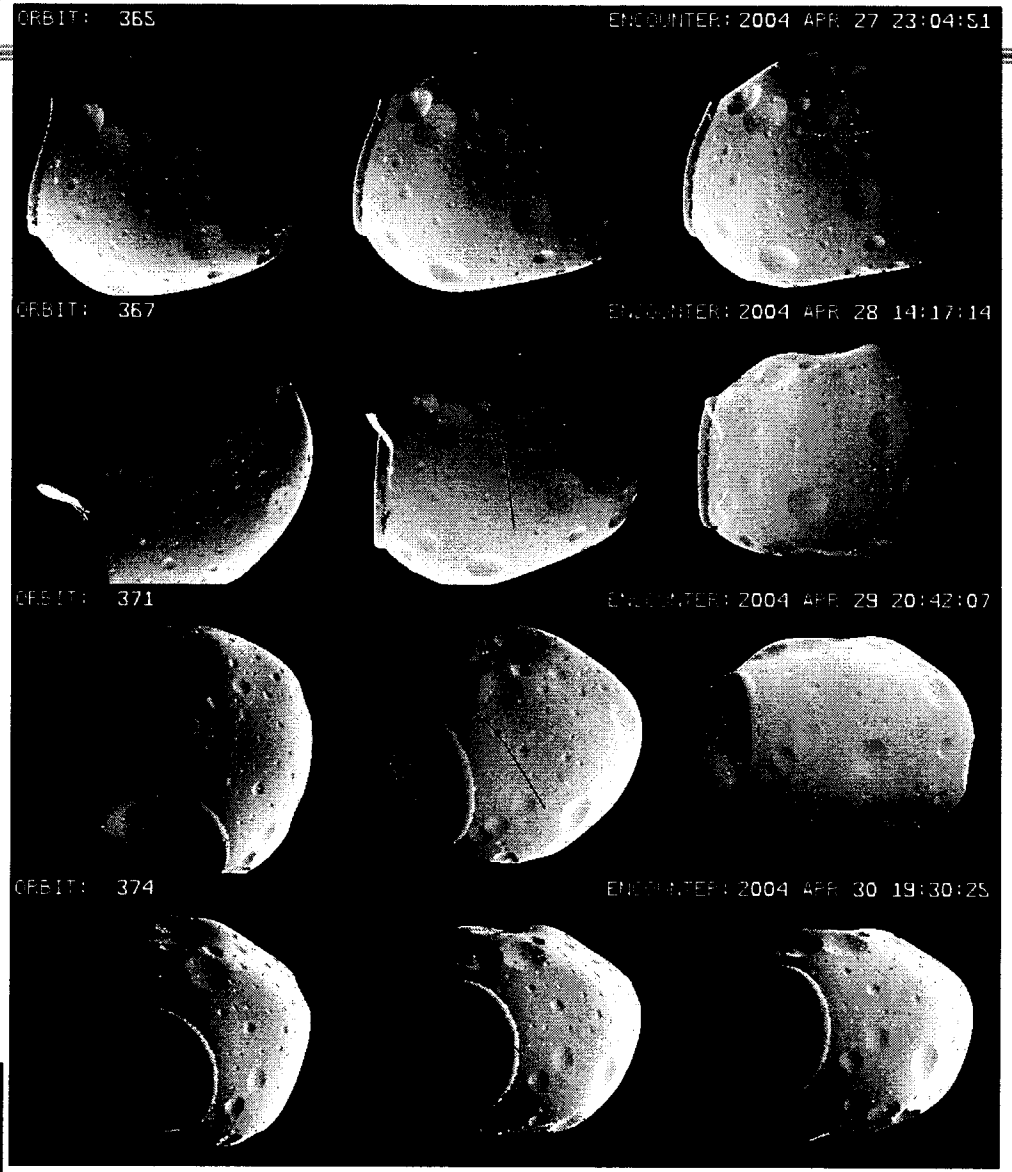
90 to 60 Minutes Before Pericentre

Closest Encounter ~ 700 km
(Orbit 263)

European Space Agency

MARS EXPRESS - EXPLORATION OF PHOBOS

Third Phobos Encounter Series



Best Viewing on Orbits 365 - 374
(2004 April 27 - 30)

60 to 40 Minutes Before Pericentre

Closest Encounter ~ 2200 km
(Orbit 370)

European Space Agency

Phobos Exploration

- Many Close Encounters will Occur Naturally
  - Many Much, Much Closer Than the 1st 3 Series
  - Operations Team May Need Divert Maneuver to Miss Phobos
  - Operations Team Needs to be Prepared When Phobos Comes Within Attitude Sensor Fields-of-View
  - Recommend Approach Mars / Phobos / Deimos SRC Images
    - Ephemeris Improvement / Orbital Dynamics Science
- Recommend Aggressive Phobos Exploration Program
  - All Remote Sensing Instruments, Plasma Instruments and Radio Science
  - Either 1 Hour Before or 1 Hour After Pericentre
  - Can Provide More and New Data Than Obtained by M'9, Viking + Phobos 88
- Recommend Periodic Deimos SRC Images Throughout Mission
  - Typically 12,000 - 15,000 km Distance
  - Mars Facing Side & Equatorial Region
  - No Backside + Limited Polar Viewing