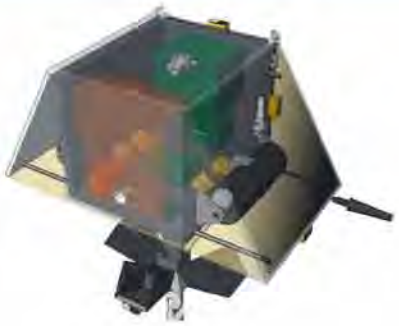
LUNAR EXPLORATION ORBITER - LEO

Lunar Exploration Orbiter (LEO) Twin Satellites

The Phases 0 and A studies for the Lunar Exploration Orbiter (LEO) program have been initiated by the German Aerospace Center in order to broaden the knowledge about the moon surface and its immediate space environment. The overall mission concept established during these studies consisted of a main spacecraft, accommodating moon observation instruments (optical, radar, infrared) and providing passage for two twin spacecraft from the Earth to the final moon orbit.



Satellite accommodation concept

As part of the overall mission SpaceTech signed responsible for the design of the twin spacecraft as well as the coordination and accommodation of the three related scientific payloads:

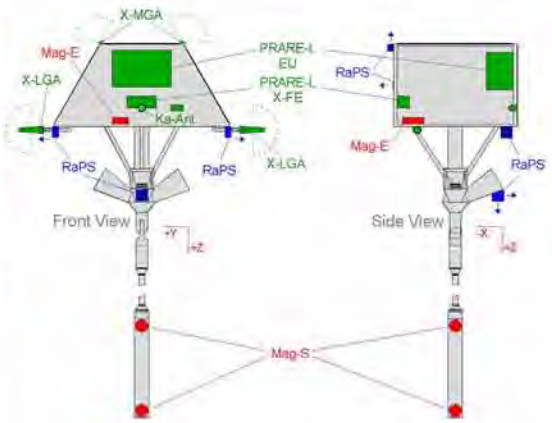
- the Lunar Precise Range and Range Rate (PRARE-L) instrument for the recovery of the gravity field via continuous Ka-band ranging based measurement of the relative distance between the twin satellites
- the Lunar Magnetometer (LunarMag) with a set of two locally separated magnetometers at a quiet spot at the end of a deployed boom on each spacecraft providing for excellent magnetic measurements with unprecedented spatial and temporal resolution
- the Radiation Pressure Sensor (RaPS) measuring the remnant radiation induced forces acting on the spacecraft in the low lunar orbit

Satellite structural concept

Special emphasis in the design of the spacecraft platform has been laid on the feasibility of a one year active measurement life time in the harsh space environment in the low (50 km) lunar near-polar orbit, a mechanically quiet environment for the Ka-band ranging system as well as a magnetically quiet environment for the magnetometers.

Physical Properties			
Dimensions	Length: 4305 mm (boom deployed) / Width: 1995 mm / Height: 1051 mm		
Mass (per satellite)	Dry: 102 kg	Payload: 15 kg	Cold Gas: 7 kg
	Total: 124 kg		
Thermal Control			
Type	Passive system using thermistors and heaters in combination with on-board thermal control application software; radiators to space only due to strong moon surface temperature variations		
Power System Characteristics			
Power Bus Type	Unregulated 28 V (24 ~ 33.6 V)		
S/A Regulator	Sequential Shunt Regulator		
Avg. Satellite Power	> 100 W		
S/A Cells	GaAs Triple Junction arranged on 3 roof panels		
Battery	Lithium-Ion	Name Plate Capacity	24 Ah
Attitude & Orbit Control			
Type	Three axes stabilized LVLH (spacecraft inherently gravity gradient stable)		
Sensors	Star Camera (3 Heads) Coarse Moon/Sun Sensor	Actuators	Reaction Wheels (4) Cold Gas Propulsion
RF Communication (X-Band)			
Uplink	2 kbps Omni-directional	Downlink	256 bps 5 W RF Power Omni-directional
Payloads			
• Lunar Precise Range and Range Rate (PRARE-L) including Ka-Band ranging link and direct X-band link to Earth • Lunar Magnetometer (LunarMag) • Radiation Pressure Sensor (RaPS)			
Payload Accommodation Concept			
See figure on the right Abbreviations: EU = Electronics Unit; Ka-Ant = Ka-Band Antenna; Mag-E = Magnetometer Electronics; Mag-S = Magnetic Sensor; PRARE-L = Lunar Precise Range and Range Rate; RaPS = Radiation Pressure Sensor; X-FE = X-Band Front-End Equipment; X-LGA = X-Band Low Gain Antenna; X-MGA = X-Band Medium Gain Antenna			

LEO twin satellites operations concept



Payload accommodation concept

The phases 0 and A of LEO have been performed in a subcontract to EADS-Astrium on behalf of the Agency of the German Aerospace Center.