



LASER INTERFEROMETER SPACE ANTENNA (LISA)

System Technical Budgets

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REVISION SUMMARY			
Rev	Release Date	Brief Description/Reason For Change	Effective Pages
1.0	4/24/09	Initial release	All

Table of Contents

1 Purpose/Scope 3
 1.1 Purpose 3
 1.2 Scope 3
 1.3 Mission Baseline Parameters 3

2 Mass Budget 4
 2.1 Summary Mass Budget 4
 2.2 Spacecraft bus mass budget 5
 2.3 Scientific complement mass budget 7
 2.4 Propulsion module mass budget 8

3 Power Budget 9

1 Purpose/Scope

1.1 Purpose

The purpose of the Technical Resources Budget Document is to provide engineers, scientists, and program management with the latest LISA Spacecraft design technical resource allocations and systems budget information available.

1.2 Scope

The systems technical budget information contained in this document is based on the LISA Spacecraft design described in LISA-SC-DD-0001 dated 1/30/2009 and the LISA payload design described in LISA-MSE-DD-0001 dated 4/1/2009.

1.3 Mission Baseline Parameters

Parameter	Comments
Lifetime	5 year science operations (10 year goal) after 14 months cruise and 4 months commissioning.
Orbits	3 independent, Heliocentric, 20° earth trailing orbits, equilateral triangular constellation with 5×10^6 km +/- 1% arm lengths, constellation requires no active station keeping or maintenance over the mission lifetime
Launch Vehicle	Medium class EELV, $C3=0.5 \text{ km}^2/\text{s}^2$
Communications	Ka-Band – (2) HGA and (4) X-Band Omnis, 90 kbps downlink, 2 kbps Up DSN 34 m dish
GN&C	Star trackers, sun sensors, gyros
Propulsion	Micronewton thrusters
EPS	Fixed SA, triple junction Gallium Arsenide (GsAs), 957 W EOL @30° Sun Angle, 766 W required w/30% margin; 20Ah, LiIon Battery
Thermal	MicroKelvin stability with passive design
Mechanical	Bus is built around the Payload, Sciencecraft nests in Propulsion Module (P/M), 3 S/C are stacked in the fairing with the P/M carrying the majority of the launch loads
Propulsion Module	1100 m/s for primary burns, + 30 m/s for correction maneuvers delta V,

2 Mass Budget

2.1 Summary Mass Budget

System	CBE	Contingency	Allocation (CBE+cont)
Spacecraft Bus Total	348	104	452
Scientific Complement Total	138	42	180
Propulsion Module Dry Total	314	94	409
Cruisecraft Dry Total	801	240	1041
Propellant	527		527
Cruisecraft Wet Total	1328	240	1568
Wet Stack Total (3 cruisecraft)	3983	721	4704
Launch Vehicle Adapter Total	163	49	212
Total Wet Launch Mass	4146	770	4916

2.2 Spacecraft bus mass budget

Subsystem	Component	Qty	CBE Each	CBE Total	Contingency	Allocation (CBE+cont)
Structures & Mechanisms			Total	139.8	41.9	181.7
	Structure & Mechanism	1	105.0	105.0	31.5	136.5
	Secondary Structure	1	21.0	21.0	6.3	27.3
	HGAD Mechanism	2	0.5	1.0	0.3	1.3
	Launch Locks, misc.	10	0.3	2.5	0.8	3.3
	Separation system (S/C-P/M)	1	10.3	10.3	3.1	13.4
Power			Total	37.1	11.1	48.2
	Solar Array (5.3 m ²)	1	9.6	9.6	2.9	12.5
	Battery (Lithium Ion 20 AH)	1	6.2	6.2	1.8	8.0
	Power System Electronics (PSE)	1	21.3	21.3	6.4	27.6
Command & Data Handling			Total	45.3	13.6	58.9
	C&DH	1	29.2	29.2	8.8	37.9
	LISA Control Electronics (includes bulk mem, comm cards)	1	16.1	16.1	4.8	21.0
Telecom			Total	42.2	12.7	54.9
	Transponders (X/Ka)	2	3.1	6.2	1.9	8.1
	RFDU	1	2.4	2.4	0.7	3.1
	TWT (2 with 2 EPC's)	2	7.0	14.0	4.2	18.2
	HG Antenna	2	2.3	4.6	1.4	6.0
	LG Antenna	2	1.0	2.0	0.6	2.6
	Cabling	1	3.0	3.0	0.9	3.9
	X-Band PA's	2	2.5	5.0	1.5	6.5
	HGAD Electronics	2	2.5	5.0	1.5	6.5
Attitude Control			Total	46.4	13.9	60.4
	Gyro's	2	0.8	1.5	0.5	2.0
	Star Tracker Assembly					
	SC Optical Head	5	0.4	2.0	0.6	2.6
	SC Electronics	2	0.4	0.8	0.2	1.0
	Coarse Sun Sensor	18	0.2	2.9	0.9	3.7
	Microthruster Clusters	3	13.1	39.3	11.8	51.1

System Technical Budgets

Subsystem	Component	Qty	CBE Each	CBE Total	Contingency	Allocation (CBE+cont)
Thermal Control			Total	15.9	4.8	20.7
	MLI Blankets	3	0.6	1.8	0.5	2.3
	Heaters	32	0.0	1.3	0.4	1.7
	Thermistats	64	0.0	1.9	0.6	2.5
	Thermistors	150	0.0	4.5	1.4	5.9
	Radiators and plates	1	0.3	0.3	0.1	0.4
	Gold Paint Coatings	12	0.2	2.4	0.7	3.1
	Black Paint	20	0.2	3.0	0.9	3.9
	I/F material	35	0.0	0.7	0.2	0.9
Cabling			Total	21.0	6.3	27.3
	Cables & Harness	1	21.0	21.0	6.3	27.3
Spacecraft Bus Total			Total	347.7	104.3	452.0

System Technical Budgets

2.3 Scientific complement mass budget

Subsystem	Component	Qty	CBE Each	CBE Total	Contingency	Allocation (CBE+cont)
Electronics			Total	56.49	16.95	73.44
	LASER Unit Assembly	4	7.00	28.00	8.40	36.40
	USO	2	0.50	1.00	0.30	1.30
	Phase Meter Unit	1	15.00	15.00	4.50	19.50
	Charge Management Unit	1	5.10	5.10	1.53	6.63
	Caging System Electronics	1	5.89	5.89	1.77	7.66
	Diagnostic Driver Electronics	1	1.50	1.50	0.45	1.95
Opto-mechanics			Total	80.50	24.15	104.65
	Telescope	2	6.50	13.00	3.90	16.90
	Optical Bench	2	5.60	11.20	3.36	14.56
	Optical Assembly	1	3.50	3.50	1.05	4.55
	Mechanism Electronics					
	Optical Assembly Electronics	1	2.70	2.70	0.81	3.51
	Gravitational Reference Sensor					
	IRS Electronics (includes sensors?)	2	12.80	25.60	7.68	33.28
	Fiber Positioner	2	1.00	2.00	0.60	2.60
	OA Structure	2	5.00	10.00	3.00	13.00
	Telescope Shield Structure	1	6.00	6.00	1.80	7.80
	Mechanisms (point ahead - if required)	2	2.00	4.00	1.20	5.20
	Focus Mechanism	2	0.25	0.50	0.15	0.65
	Optical Telescope Articulation Mech. (OTAM)	2	1.00	2.00	0.60	2.60
Thermal			Total	1.50	0.45	1.95
	Heaters, Survival	1	1.50	1.50	0.45	1.95
Scientific Complement Total			Total	138.49	41.55	180.04

2.4 Propulsion module mass budget

Subsystem	Component	Qty	CBE Each	CBE Total	Contingency	Allocation (CBE+cont)
Structure			Total	231.90	69.57	301.47
	Primary Structure	1	161.70	161.70	48.51	210.21
	Secondary Structure	1	15.30	15.30	4.59	19.89
	Lightband (PM to PM)	3	18.30	54.90	16.47	71.37
PM C&DH and Comm			Total	11.09	3.33	14.42
	PM C&DH	1	9.09	9.09	2.73	11.82
	LG Antenna	2	1.00	2.00	0.60	2.60
Propulsion Components			Total	71.50	21.45	92.95
	Hz Fuel Tanks	1	13.61	13.61	4.08	17.69
	NTO Tank	2	6.80	13.60	4.08	17.68
	22N Hz Thruster	8	0.77	6.16	1.85	8.01
	Hz Valve	1	0.00	0.00	0.00	0.00
	Hz valve	1	0.00	0.00	0.00	0.00
	Heaters					
	Injector	1	0.00	0.00	0.00	0.00
	Heater					
	445 Newton	1	5.20	5.20	1.56	6.76
	Main Engine					
	Hz Valve	1	0.00	0.00	0.00	0.00
	NTO valve	2	0.00	0.00	0.00	0.00
	Injector	2	0.00	0.00	0.00	0.00
	Heater					
	Regulator	2	0.84	1.68	0.50	2.18
	Latch valves, check valves, filters, etc.	1	31.25	31.25	9.38	40.63
Propulsion Module Dry Total			Total	314.49	94.35	408.84
Propellant			Total	527.00	Included	527.00
Propulsion Module Wet Total			Total	841.49	94.35	935.84

3 Power Budget

System	Avg Power (W) (includes 30% margin)
Spacecraft Bus	465.9
Power (includes harness losses)	58.1
Command & Data Handling	81.9
Communications	111.5
Attitude Control	37.7
Microthrusters	131.2
Thermal	45.5
Scientific Complement	328.5
LOCS	224.9
LIMAS	103.6
Sciencecraft Total	794.4