



Large Ultraviolet Optical Infrared (LUVOIR) Surveyor Mission Concept Study for the 2020 Decadal Survey

Study Office & Team

LUVOIR Study Manager Julie Crooke

August 18, 2016





Deliver to Decadal a scientifically compelling, technically executable mission concept study that is feasible with respect to technical, cost, and risk resources

- Present implementation strategies as "reference missions" credible hardware configurations that can achieve the science goals and are sufficiently defined for a reasonable cost evaluation
- Consider "mission cost vs. science capability"
- Consider the sweet spot factoring in science, technology, cost, and risk
- Provide parametric results for key scientific performances
- Develop credible technology roadmaps (describe required technology funding and timeline) that show how TRL5 will be achieved by KDP-B and how TRL6 will be achieved by PDR



LUVOIR Study Schedule Overview

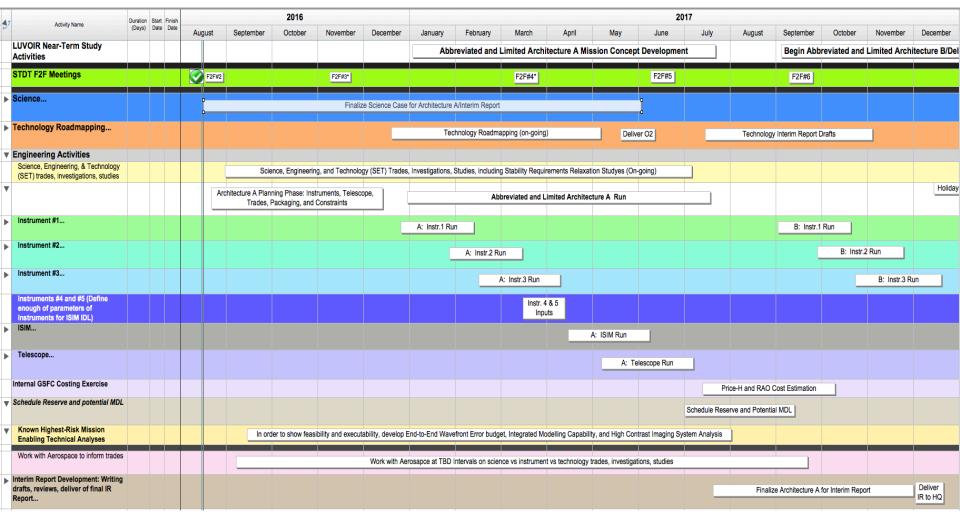


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Activity Name	Start Date	Finish Date				20)16									2017	7										2018	8					2	2019		
	Duration (Days)				May J	Jun	Jul A	ug Se	apt O	ct No	v Dec	o Jan	Feb	Mar	Apr 1	May J	lun -	Jul /	lug Sep	t Oct	Nov	Dec	Jan	Feb	Mar	Apr N	lay Ju	In	Jul A	ug Se	pt Oc	Nov	Dec	Jan	Feb	Mar
LUVOIR Surveyor Mission Concept Study Development SCHEDULE OVERVIEW																																				
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LUVOIR SCHEDULE MAJOR COMPONENTS																																				
LUVOIR Science Cases for Architecture A and Architecture B													LUVO	DIR Sci	ence	Cases	s for A	Archite	ecture A	and A	Archite	cture	В													
LUVOIR Science, Engineering, Technology (SET) Investigations/Trades, Requirements Relaxation Studies								Ir	nitial S	SET Tr	rades						On-g	going	SET Tra	ades, I	nvesti	gatior	ns, Sti	udies												
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LUVOIR Architecture A and Architecutre B development. LUVOIR Study Team (STDT + Study Office) provides input parameters/requirements and develop architecture(s)								instr	rumer	cide on hts/tele itudy T	escope	- 1		ed /Abb out para					s, capti	ure & v					Arch. Ilize a	B run rchitect	ures									
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* = Joint F2F meetings with LUVOIR and HabEx

LUVOIR Study Near-Term Schedule (CY17)





* = Joint F2F meetings with LUVOIR and HabEx





- What instruments are needed for the science laid out so far? (decide Aug 2016 F2F)
- What is the instrument prioritization based on science? (Aug 2016 F2F)
- What instrument details still need to be defined? (Aug 2016 F2F)
- What simulation tools need to be developed to decide instrument details? (Aug 2016 F2F)
- Provide input on engineering choices / trades (Aug Jan 2017)
- Decide telescope apertures A and B, balancing science and perceived cost risk (Nov 2016 F2F)
- Finalize instrument parameters for Architecture A (Jan 2017)

Near-Term Timeline (STDT Actions)



• August F2F meeting : focus on instruments

- $\,\circ\,$ Prioritize instruments based on science
- $\,\circ\,$ Start defining instrument parameters
 - More detail on required parameters will be presented at a telecon coming soon.
- Assign science lead(s) to each prioritized instrument
- Request instrument optical designs from experts

• November F2F meeting: focus on telescope options

 Define input parameters. Decide on aperture(s), FOV(s), FOR, wavelength range, on-axis vs. off-axis, etc.





- 1. Number of instruments? (typically this is just one)
- 2. If known, tell us your thoughts on the design form(s) and reasons for such. (e.g. three-mirror-anastigmat telescope, due to wide field imaging required, etc.
- 3. Wavelength range, or bandpass, and "design to" wavelength (e.g. desire diffraction limited performance at 1 micron).
- 4. If the instrument is a spectrometer, please include desired spectral resolution.
- 5. Aperture requirement
- 6. Is this driven by radiometry (i.e. sensitivity), or resolution (i.e. diffraction limited) ?
- 7. Field of view requirement
- 8. What is the object distance (e.g. infinity for stars, or altitude for ground observing) ?
- 9. What is your desired Pixel sampling on the sky or ground ?
- 10. Do you have a detector concept in mind? If so, tell us the pixel size and array size.
- 11. Please also discuss your performance figure of merit related to pixels (e.g. Airy disc FWHM should span two pixels, or spot size < 1/2 pixel diameter, spectral resolution desired to span two pixel width, etc.)
- 12. If this is a scanning instrument, tell us the full field of regard.
- 13. Systems requirements
- 14. What do you think is your strongest engineering driver: cost, volume, mass, or performance?
- 15. Are there any optically important mechanisms (e.g. scan or steering mirrors, micro-mirror arrays, etc.)?
- 16. Are there any optical interfaces with other instruments? (e.g. exit pupil location, field stop, etc.)
- 17. Are there any significant **packaging** or mass constraints for this instrument? Special materials (e.g. Beryllium, etc.)?
- 18. Are there any special considerations or concerns for ground testing or self-calibration components that may influence the optical design? (e.g. well-corrected interfaces between instrument modules).





Back Up





- The final study deliverable shall include:
 - Science case for the mission
 - Mission and observatory performance requirements that deliver these science capabilities
 - Design reference mission, including straw-man payload trade studies conducted to arrive at the final mission concept
 - Technology assessment:
 - $\circ\,$ Current status, at the time of submittal of the final report
 - Roadmap for maturation to both TRL-5 by the start of Phase-A and
 - TRL-6 by the mission PDR
 - Phased resources needed to achieve the required technology maturity levels by the start of Phase A and by mission PDR
 - Cost assessment, major technical, and risk burn-down plans as a function of science capability.
 - Top-level schedule for major phases of development including a notional launch date (assuming entering phase-A as a post-WFIRST budget wedge opens) and top schedule risks.





- Prime objective
 - Achieve a better understanding of technical, cost-risk trades and the impacts on the large concepts
- Approach for achieving the prime objective
 - Allow study teams to understand cost and risk implications of their mission architecture choices
 - Allow study teams to better distinguish between areas for deeper engineering and areas where rules of thumb can suffice
 - Allow Aerospace Corporation to provide independent guidance and suggestions to the study teams for consideration in reducing the technical and cost risk of the engineering elements.
 - Allow Aerospace to better understand mission concepts, technology requirements and technology maturity as the studies progress, without commenting on the science merits and without creating a conflict of interest situation with National Academies
 - The support will be provided in two phases as described in the following charts
- The cost of this support is provided through the PCOS/COR Program Office and individual study funds will not be used for this support





- Risk and Cost Driver Identification
 - It is anticipated that each concept team will have a range of technical options to best determine the desired cost or budget target for the desired science goals. Aerospace will attend meetings of the SDT teams to understand key science requirements and potential impact on the concept design.
 - Aerospace will offer periodic assessments, as appropriate, of top technical and programmatic risks and identify key cost drivers.





- Trade Study Support
 - Focus on trade studies for a baseline concept design
 - Support the tailoring of the CML4 for each study team
 - Offer specialists for more in-depth review at suggested "deepdive" sessions in top technical risk areas and assist in trade studies to provide focus in development of more mature point designs.
 - Additional deep dive meetings will also be supported where technology must be matured for the mission concept.



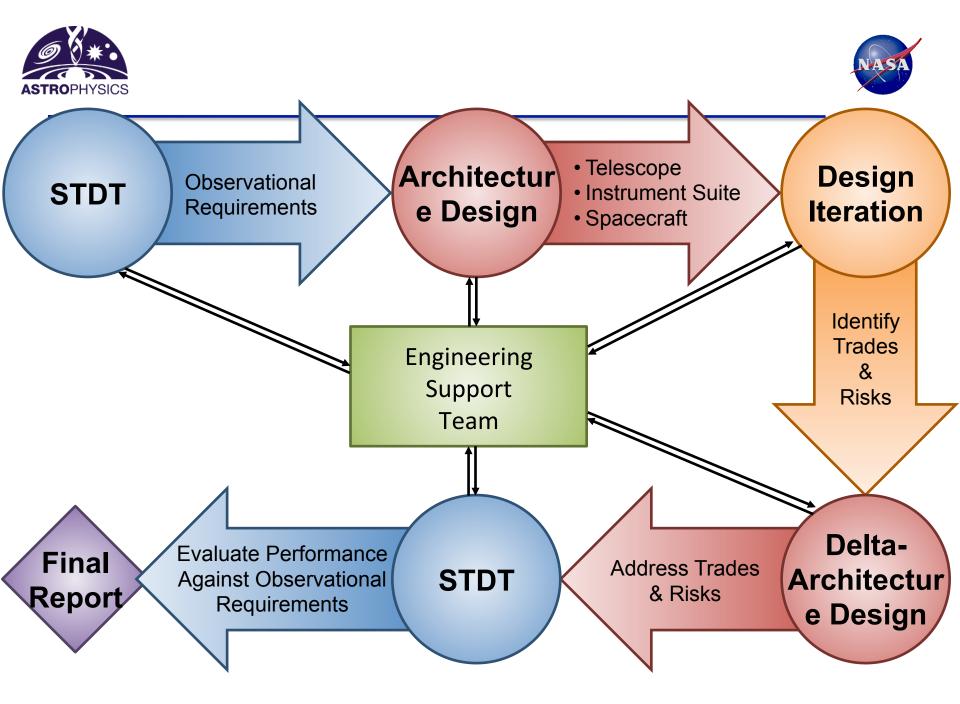


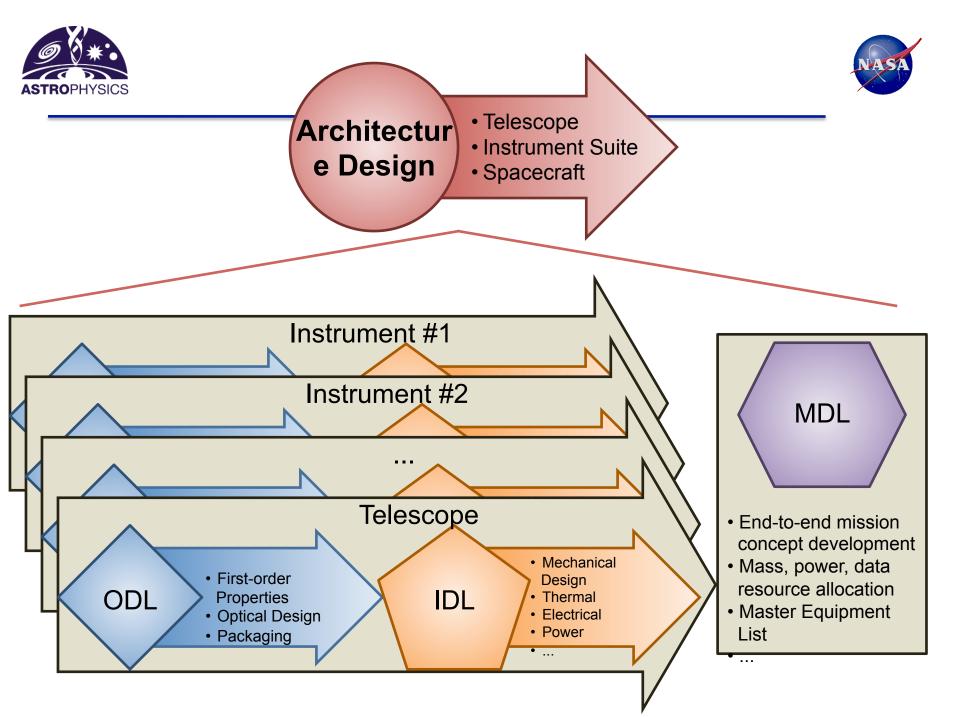
- Study teams to include designated Aerospace representative on the mailing list for STDT and Engineering team meetings
- Study teams may make direct contact with Aerospace to arrange a consultation, as per the scope described on previous pages; contact Debra Emmons, e-mail: <u>debra.l.emmons@aero.org</u> or Zigmond Leszczynski, e-mail: zigmond.v.leszczynski@aero.org
- Study teams must inform DSMT (through the Astrophysics Program Scientist) whenever a consultation is arranged with Aerospace
- DSMT reserves the right to disallow a consultation if
 - The consultation purpose is out of scope of Aerospace task
 - The consultation topic will create a conflict of interest situation for Aerospace with National Academies
 - Aerospace is evaluating creation of a separate CATE team firewalled from these NASA commissioned study activities
 - The consultation will exceed the allocated budget for Aerospace task





NASA GSFC's Integrated Design Center (IDC) Instrument Design lab (IDL) Required and/or Desired Inputs









- NAME of point of contact (POC) for the study, and the alternate
 - The study POC is the ultimate authority on the technical and programmatic decisions during the study
 - The study POC is also the single person the IDL team will distribute study products to; any further distribution is only done with the permission of the POC (this is true even after the study is complete)
- One line statement of study objective
- Milestones for the IDL team to execute during the performance of the study
 - trades or decisions about the conceptual design to implement
- Information or support needed to complete the study
 - Any prework analysis, input, our guidance from the IDL or IMDC that would influence the approach for your instrument design
- Date when the study is to be completed
 - Or when specific products like a mass or cost estimate are needed





- NAME of the instrument and the mission it is intended to support
- General class or type of instrument (e.g. spectrometer)
- Previous flight history summary, if any
- Observation desired (field of regard, target, wavelength, resolution)
- Observation dwell time or repetition desired
- Critical instrument technology to achieving the observation
- Recommended or concept for focal plane
- Other focal planes or technologies that should be considered





- If your instrument is immature and the IDL team is largely "starting from scratch", please proceed to the next chart
- If your IDL study is <u>based on a current instrument design</u>, we'd like to get as much information as possible (without reading through technical ICDs or long proposals)

Please condense the information down to the specific technical content requested in this prework questionnaire

When possible, please provide the following:

- Any figures or illustrations available, either hardcopy or electronic
- A specific list of changes to be implemented relative to a previously flown or proposed instrument
- Mechanical models of the instrument or mechanism you would like us to implement
 - Or of the spacecraft bus or of any relevant mechanical component
 - In any mechanical drawing software format
- Any optical models of the instrument, or specific optical components (e.g. a beam expander)
 - ZEMAX, Code IV, Avatech, FRED, Other ______
- Any performance models of the instrument, or specific components
 - e.g. detector QE curves
- Tall poles in the design that you want the IDL team to modify
- Required inputs vary depending on if you are starting with a design or starting from scratch





If your instrument is immature and the IDL team is largely "starting from scratch", please proceed to the next chart

If your IDL study is <u>based on a current instrument design, or a specific</u> <u>instrument approach</u> (i.e. you are asking the IDL to design an instrument based on a design that your provides), please provide us with the following component-level information to initiate our thermal models, and flesh out our mass model of the instrument, which will become the basis for the cost model

Component level descriptions for our mass model, for any specific component you want us to implement in your instrument design:

- Dimensions
- Mass estimate
- Materials
- TRL
- Operating temperature and temperature stability requirements
- Power requirements and power dissipation
- Survival (non-op) temperature requirements
- If the component is available commercially (i.e. it's COTS)
 - Purchase estimate
 - % composition (e.g. 70% electronics, 30% structure) this only applies to COTS components
 - % modification/customization (if necessary)
- Heritage mission references





- Description of the desired flight data set
- Data array dimensions and refresh frequency
- Estimate of data collection rate
- Description of data format and relation to instrument field of regard





- Summary of mission objective
- Relationship of the instrument under study to the mission objective
- Description of the spacecraft orbit, altitude, inclination, etc., and its relationship to the target observation
- Concept of the mission operation and data collection plan





- Instrument mass and dimension constraints
 - Is there a specific launch vehicle fairing identified for this mission?
- Packaging concept for instrument and supporting electronics
- Critical instrument tolerances
- Instrument mounting concept and field of view constraints
- Spacecraft orientation and pointing stability requirements regarding the observation target or desired data set
- Orientation conflicts regarding other spacecraft instruments or field of view intrusions (either fixed or transient)
- Special material used: Titanium, Beryllium, Stainless Steel, etc.
- Are there any contamination requirements or concerns that affect any of the materials selections?





- Number and type of mechanisms required
 - e.g. aperture covers, launch lock, calibration, and focus mechanisms
- The duty cycle for each mechanism
 - e.g. continuous during science mode, once per orbit
- Description of mechanism operation
 - Number of repetitions per operation, and number of operations per mission
 - The range of motion and required step of motion
 - The precision and knowledge requirements for the step and final position(s)
 - The permitted time to achieve position(s)
- Any guidance, references, or mechanical models of heritage mechanisms for the IDL to implement in your design





- Instrument optical design concept please provide a block diagram if possible
- Concept Name (e.g. Ritchey-Chretien,TMA,Offner,Ebert-Faster;etc.)
- Please provide any optical models or optical descriptions available, or provide requirements for the following:
 - Collector area
 - Focal length(s)
 - Plate scale
 - Angular resolution requirements
 - Wavelength Range
 - Spectral resolution and/or dispersion requirements
- Calibration concept and requirements
- Contamination concerns
- Stray Light Requirements
 - Stray light suppression techniques
 - External and Internal stray light sources
 - Optics and Structure: surface finishes and paints
- Discussion of critical optical features
- Special optical requirements such as cooling





- Are there any Observing Limitations with respect to the following sources: sun, moon, bright stars, target object, background light, extended sources?
- Is image stability required?
 - Is an active or passive approach anticipated?
 - What is the stability requirement? (arc seconds over milliseconds)
- Is "tracking" of the target required?
 - What is the required pointing stability during an observation? (arc seconds over milliseconds)
- Is attitude knowledge required?
 - What is the required accuracy and precision of the knowledge? (arc seconds over milliseconds)
- Are their any assumptions about the exchange of guidance and attitude knowledge between the instrument and the spacecraft?





- Reference Documents or URL's.
- What level of design and analysis support is needed?
 - Does an optical design exist?
 - Is conceptual design required?
 - Is tolerance analysis required? (mechanical, thermal?)
 - Is stray light modeling or analysis required?
- How is optical performance defined or measured?
 - RMS Spot Size; MTF; Wavefront Error; etc.
- Any optical models of the instrument, or specific optical components? (e.g. a beam expander)
 - ZEMAX, Code IV, FRED, Other _
 - CAD models, STEP, IGES, SAT, or other files
- Spectral Selection Technique? (filters, gratings, holograms, prisms, etc.)
- Material Types? (glasses, mirrors, metals, structural supports, etc.)





- Type of detector to be used?
 - Please provide a datasheet and a plot of the detector quantum efficiency (QE), if possible
 - Pixel well depth (electrons)
 - Radiation tolerance
 - Estimated integration period (or frame cadence)
 - Digitization resolution (bits)
- Detector operating temperature?
- Detector active area and dimensions?
- Number of pixels and sequence of pixel readout?
- Detector readout rate (Hz)?





- What is the assumption of the incoming flux?
- What are the band centers for the various instrument channels?
- What are the bandwidths for the various channels, full-width half-max or other measures?
- What is the system entrance aperture?
- What are the detector pixel solid angles in object space?
- What are the throughputs for each of the optics and the total estimated instrument throughput?
- What are the background factors such as detector dark current?
- What are the temperatures of the various optics, walls, windows, etc.?
- What are the noise factors thru the system (read, crosstalk, A/D, thermal, etc.)?
- What are the gain factors?
- What integration times are used for each channel and signal case?
- How many data samples per result? (TDI,etc.)
- What dynamic ranges are used? (bits per channel, etc.)
- Are there any weak, intermediate or strong signal or noise cases to be analyzed?





- Instrument to spacecraft thermal interface concept
 - e.g. is the instrument thermally isolated from the spacecraft
- Passive or active cooling requirements for the instrument and specific components (e.g. detectors)
 - Please include temperature stability and gradient requirements
- Instrument radiator field of view requirements or restrictions
- Potential thermal impact of solar aspect or Sun intrusion
- Instrument structure, focal plane, optics, or Sun shield thermal considerations





- Data system interface concept (point to point, data bus, other)
- Uncompressed instrument output data rate
- Modes of instrument operation including impact on data rate and power requirements
- Data storage requirements
 - e.g. Will data be stored in the instrument or on the spacecraft?
 - What is the anticipated downlink approach (how many minutes per day)?
- Instrument command and management concept
- Power requirements (normal operations, thermal control, other)
- Power bus constraints
- Emergency instrument power requirements (emergency heaters, actuators, other)





- Modes of instrument operation (including impact on data rate and power requirements) such as:
 - Boot / Initialization
 - Standby
 - Diagnostics
 - Keep-Alive
 - Safe
 - Science
- Special safing / commanding requirements
- List science algorithms required for processing science data
- List on-board autonomy required
- List any fine guidance knowledge or computation required
- List any data compression requirements (loss-less or lossy)
- List the time-tag accuracy of the data handling and how you expect to achieve this timing requirement
- List on-board configuration characteristics
- List spacecraft interface complexities





- Instrument Lifetime Requirements? (years)
- Instrument Lifetime Goals? (years)
- Are their any reliability requirements for this instrument, or subset of instrument channels?
- Are their any redundancy requirements or recommended approaches?
- Is there any reliability data (I.e. life test data, reliability estimates,etc.) for any unique components (I.e. special detectors, lasers, klystroms, etc.) used on this instrument?
- What is the desired/required Probability of Success for the instrument for the required mission? For the goal mission?
- What critical function (or subset of functions) must the instrument be able to perform so that it can be considered in an operating state? What function (or subset of functions), if lost, would constitute a failed state for the instrument? Are there partial failure modes (e.g. loss of non-critical functions) that need to be analyzed?





- Specific trades requested
 - List them in order of priority; we may only be able to address one in a 1-week study
- Technology infusion considerations
- Special materials to be reviewed
 - E.g. documents, websites, previous missions, or previous IDL studies
- Alternate mission operations concepts to by assessed
- Areas of critical margins that may drive instrument design and desired constraint relief
- Open areas for alternate instrument architecture and considerations



Cost Assumptions



- Mission schedule
 - Contract award date, PDR, CDR, instrument delivery

• In-house or out-of-house production

- for design, development, I&T, and FSW
- If it is a contractor, should we assume a medium or large contractor company?
- Electronics Class (e.g. Class S, Class B, Class B-1, etc.)
- Full-up Instrument Production units
 - Flight unit, engineering test unit (ETU), engineering development unit (EDU), flight spares
- Sparing philosophy for major assemblies / sub-assemblies/ components
- Should we assume a specific Constant Year dollars or Real Year dollars



LUVOIR Study Schedule Overview



		Duration					2016							2017						-		20	18						2019	
A	Activity Name	(Days)	Start Date	Finish Date	Apr May	Jun Ju	I Aug	Sept	Oct N	ov Dec	Jan F	eb Mar	Apr Ma	y Jun .	Jul Aug	Sept Oc	t Nov	Dec Jar	Feb	Mar /	Apr Ma	y Jun	Jul	Aug S	Sept O	ct Nov	Dec Ja	n Feb	Mar	Apr M
	LUVOIR Surveyor Mission Concept Study Development SCHEDULE OVERVIEW																													
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	M1: Comments on Study Requirements and Deliverables				M1																			_				-		
	O1: Optional: Initial Technology Gap Assessment					01																								
	O2: Optional: Update Technology Gap Assessment													02																
	M4: Interim Report																M4													
-	Provide science case and mission concept																M4													
	Deliver initial technology roadmaps; estimate technology development costs																M4	í												
	COSIS CML4 tailored approach (optional)						++										M4													
	O3: Optional: Update Technology Gap Assessments																					03								
▼	M6: Complete Decadal CML4 Audit and Freeze Point Design																							M6						
	Provide science case and mission concept																							M6						
	Support independent cost estimation/validation process																							M6						
	M7: Final Report	4.00	0/0/40	0.014.0																							M	7		
	M8: Submit to Decadal	1.00	8/9/19	8/9/19																									M8	
	UVOIR STDT F2F Meetings				F2F1		F2F2	J	F2	F3*		F2F4	1	F2F5		F2F6		F2F	7		F2	-8		F	2F9					
	UVOIR SCHEDULE MAJOR COMPONENTS																													
	UVOIR Science Cases A and B/Delta							1 1			LUVOIF	R Scienc	e Case A	rchitectur	e A and	Architectu	ire B													
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	UVOIR Study Team (STDT + Study Office) provides input parameters, advises on working decisions, future analysis/actions capture and leveloping architecture								LUVO	IR Stud	y Team p	provide ir	nput para	meters, w	orking d	ecisions,	capturing	and wo	rking fi	iture ac	tions									
	Nork with Aerospace Team A on SET trades and other questions						L	UVOIR	t Study	Team c	onsult/w	ork with	Aerospac	e Team A	at TBD	intervals	to suppo	rt trade s	tudies	and ad	vise wa	iys to lo	wer ri	sk, cos	t					
	nterim Report Writing and Preparation, Reviews												Interim	Report W	riting, Re	eviewing (M4)													
	Freeze Point Design and CML4 Audit (M6)																					ze Point CML4 A								
	Aerospace Team B CATE																							A	erospa	ace Tear	n B CAT	E		
	UVOIR Final Report Writing and Review Process																									ort Writin ess (M7)				
	Deliver Final Report to HQ																										M	7		
	Deliver Final Report to Decadal Committee																												M8	
	UVOIR STDT Chairs Brief Decadal Committee																													/OIR
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LUVOIR Study Near-Term Schedule (CY16)



	Duration 3	August 2016	September 2016		October 2016			mber 2016		ember 2016
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LUVOIR Near-	-Term Study									
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Science										
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(See IDL Inpl		Instrument #1 Input para	ameters derived from science flowed to instrume	ent requirements						
	1 Optical Design						L 102			
(may be dela				Instrument #1 Op	tical Design Developmen	nt and refinement (contribu	ited?)			
 Instrument #2 										
Instrument #2	2 Input parameters		Instrument #2 Input parameters de	erived from science flowed to instrument require	ments					
(See IDL Inpu	ut Sheets)									
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be delayed to	o ODL)				Insuc	ument #2 Optical Design L	vevelopment and reimement (com	nouleu?)		
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(See IDL Inpl	ut Sheets)									
	3 Optical Design						Instrument #3 Ontical Design	Development and refinement (or	contributed?)	
(may be dela	yed to ODL)									
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 Known Highest 		To show feasib	bility and executability, develop End-to-End Way	vefront Error budget, Integrated Modelling Capa	bility, and High Contrast	Imaging System Analysis				
Enabling Techr	nical Anályses				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
Work with Aero	ospace to inform trades									
				Wo	rk with Aerosapce at TBI	U intervals on science vs i	instrument vs technology trades, i	ivestigations, studies		

LUVOIR Study Near-Term Schedule (CY17)

ASTROPHYSICS



+		Duration	Start Finish						20	17					
2	Activity Name	(Days)	Date Date	January	February	March	April	Мау	June	July	August	September	October	November	December
	LUVOIR Near-Term Study Activities			Abbreviat	ed and Limited Ar	chitecture A Missi	ion Concept Deve	lopment				Begin Abbrevia	ted and Limited Ar	chitecture B/Delta	Mission Concept
	STDT F2F Meetings					F2F#4*			F2F#5			F2F#6			
	Science														
_	Technology Roadmapping				Tec	chnology Roadmapping	g (on-going)								
	Technology Schedule Development														
1	Technology Costing														
	Technology Prioritization Inputs (O2)							D	eliver O2						
,	Engineering Activities														
	Science, Engineering, & Technology (SET) trades, investigations, studies			luding Stability Require	ments Relaxation Stud	dyes (On-going)									
,				Abbr	eviated and Limited Are	chitecture A Mission Co	oncept Development								Holidays
1	Instrument #1														
	Instrument #1 IDL Input parameters Required			Instr.1 Inputs								Instr.1 Inputs			
	Instrument #1 Optical Design Required			Instr.1 ODL?								Instr.1 OI	DL?		
	Instrument #1 in IDL				Instr.1 IDL								Instr.1 IDL		
1	Instrument #2 Instrument #2 Input parameters														
	Required			Instr.2	Inputs							Ins	tr.2 Inputs		
	Instrument #2 Optical Design Required				Instr.2 ODL?								Instr.2 OI	DL?	
	Instrument #2 in IDL					Instr.2 IDL								Instr.2 IDL	
"	Instrument #3														
	Instrument #3 Input parameters Required				Instr.3 Inpu	ts							Instr.3	Inputs	
	Instrument #3 Optical Design Required					Instr.3 ODL?								Instr.3 ODL	?
	Instrument #3 in IDL						istr.3 IDL								Instr.3 IDL
	Instruments #4 and #5 (Define enough of parameters of instruments for ISIM IDL) (Allocate Mass, Volume, and Power, etc.)					Instr. 4 & 5 Inputs									
1	ISIM														
	ISIM Input parameters Required						ISIM Inputs								
1	ISIM Optical Design Required							ISIM in ODL							
	ISIM in IDL								IDL						
,	Telescope														
	Telescope Input parameters Required							Telescope Inputs							
	Telescope Optical Design Required							T	elescope in ODL						
	Telescope in IDL								Telescope						

Mission/Instrument Concept Development Architecture A [Note: Architecture study is abbreviated and limited in scope]

LUVOIR Study Near-Term Schedule (CY17)



41	Activity Name	Duration								2	017					
÷.		(Days)	Date	Date	January	February	March	April	May	June	July	August	September	October	November	December
	LUVOIR Near-Term Study Activities															
	STDT F2F Meetings						F2F#4*			F2F#5			F2F#6			
	nternal GSFC Costing Exercise										Price-H	and RAO Cost Estin	nation			
▼	Schedule Reserve and potential MDL										Schedule Reserve	and Potential MDL				
▼	Known Highest-Risk Mission Enabling Technical Analyses				In order to show fea	asibility and executability	y, develop End-to-End	Wavefront Error budg	et, Integrated Modelling	Capability, and High C	contrast Imaging System	Analysis				
	Work with Aerospace to inform trades				Work with Aerosapce	at TBD Intervals on sci	ience vs instrument vs	technology trades, inv	estigations, studies							
	inalize Architecture A										Fina	ize Architecture A for	Interim Report]		
	Finalize Science Case for Architecture A									Finalize Science Ca	ase for Architecture A/Int	erim Report				
	Finalize Interim Technology Roadmap									Deliver O2	1	echnology Interim Re	eport Drafts	J		
▼	nterim Report Development															
	Blue Team Review (BTR)										BTR					
	Interim Report Draft 1										Inter	im Report Draft 1				
	Blue Team Review for Interim Report											Interim Repo	rt Graphics Developmen	t		
	Interim Report Draft 2-n												Interim Report Draft 2-n			
	Interim Report Final Draft for RTR and distribute to reviewers													RTR Read		
	Red Team Review (RTR) for Interim Report													RTR		
	Close Red Team Actions													RTA	tions	
	Final Editing of Interim Report														Final Edits	
	Executive Review of Interim Report														ER	
	Deliver Interim Report (IR) to HQ/APD															Deliver IR to HQ

LUVOIR Study Near-Term Schedule (CY18)



4.7	Activity Name	Duration	Start Finish						2	018						2019
P		(Days)	Date Date	January	February	March	April	Мау	June	July	August	September	October	November	December	Januar
	LUVOIR Near-Term Study Activities				Abbreviated	and Limited Archit	ecture B/Delta Mi	ssion Concept D	evelopment							
	STDT F2F Meetings			F2F#7				F2F#8				F2F#9				
►	Science	-														
V	Technology Roadmapping				-	Technology Roadmappi	ng (on-going)									
	Technology Schedule Development															
	Technology Costing															
	Technology Prioritization Inputs (O2)								Deliver O3							
V	Engineering Activities															
	Science, Engineering, & Technology (SET) trades, investigations, studies			Scien	ce, Engineering, and Te	chnology (SET) Trades	, Investigations, Studi	es, including Stability	Requirements Relaxat	ion Studyes (On-going)						
V				Abbreviated an	d Limited Architecture	B/Delta Mission Conc	ept Development								Holidays	
V	Instrument #1															
	Instrument #1 IDL Input parameters Required	3														
	Instrument #1 Optical Design Required															
	Instrument #1 in IDL															
				NOTE: Instru												
V	Instrument #2			Architecture performed												
	Instrument #2 Input parameters Required			(See CY												
	Instrument #2 Optical Design Require	ď		(000)	TT Silde)											
	Instrument #2 in IDL															
¥	Instrument #3 Instrument #3 Input parameters															
	Required															
	Instrument #3 Optical Design Required															
	Instrument #3 in IDL															
	Instruments #4 and #5 (Define enough of parameters of			Instr.	4 & 5											
	Instruments for ISIM IDL) (Allocate Mass, Volume, and Power, etc.)			In	puts											
¥	ISIM															
	ISIM Input parameters Required				ISIM Inputs											
	ISIM Optical Design					ISIM in ODL										
	Required ISIM in IDL						ISIM									
							in IDL									
V	Telescope Telescope Input parameters															
	Required					Telescope Inputs										
	Telescope Optical Design Required						Telescope in ODL									
	Telescope in IDL							lescope								
								in IDL								

Mission/Instrument Concept Development Architecture B/Delta [Note: Architecture study is abbreviated and limited in scope]

LUVOIR Study Near-Term Schedule (CY18)



41	Activity Name	Duration	Start Finish								2018						2019
		(Days)	Date Date	Janua	ary	February	March	April	Мау	June	July	August	September	October	November	December	Januar
	LUVOIR Near-Term Study Activities				[Abbreviate	d and Limited Arc	hitecture B/Delta Mi	ssion Concept De	velopment							
	STDT F2F Meetings			F2F#	7				F2F#8				F2F#9				
v	Mission Design Lab (MDL)															Holiday	5
	Prep Work and Input for MDL								MDL Prep	2							
	LUVOIR Architecture B/Delta in MDL									MDL							
	Final LUVOIR Architecture Adjustments										Final Adjustments for LU Decadal	VOIR going to					
	Freeze LUVOIR Point Design and CML4 Aufit (M6)											M6	1				
	nternal GSFC Costing Exercise										Price-	H and RAO Cost Estir	nation				
•	Schedule Reserve and potential MDL			Schedule Reserve							Schedule Reserve						
۳	Known Highest-Risk Mission Enabling Technical Analyses			In order t	to show fea	sibility and executal	bility, develop End-to-E	End Wavefront Error bud	get, Integrated Modellir	ng Capability, and	High Contrast Imaging Sys	stem Analysis					
	Work with Aerospace to inform trades				Work	k with Aerosapce at	TBD Intervals on scie	nce vs instrument vs tec	hnology trades, investig	ations, studies							
	Finalize Architecture B											Finalize Architectur	e B for Final Report				
	Finalize Science Case for Architecture B											Finalize Scien	ce Case for Architectu	re B Final Report			
	Finalize Final Technology Roadmap									Deliver O3			Technology Fi	nal Report Drafts			
V	Final Report Development																
	Blue Team Review (BTR)											BTR					
	Final Report Draft 1											Final Report Dr	aft 1				
	Blue Team Review for Final Report											Fina	Report Graphics Dev	elopment			
	Final Report Draft 2-n												Final R	eport Draft 2-n			
	Final Report Final Draft for RTR and distribute to reviewers														RTR Read		
	Red Team Review (RTR) for Final Report														RTR		
	Close Red Team Actions														Close RT Actions		
	Final Editing of Final Report														Fina	I Edits	
	Executive Review of Final Report															ER	
	Deliver Final Report (FR) to HQ/APD																Deliver FR to HQ

Mission/Instrument Concept Development Architecture B/Delta [Note: Architecture study is abbreviated and limited in scope]