LUVOIR
Large UV / Optical / Infrared Surveyor

Un concept de télescope spatial dans la tradition du HST
January 2015 → NASA Astrophysics Division initiated a community-based process for identifying *large mission* candidates by the 2020 Decadal Survey, to follow JWST and WFIRST

- Science Case
- Design reference mission with strawman payload
- Technology developments needs
- Cost requirements assessment (*large mission* → total cost exceeding $1B)

- The Habitable-Exoplanet Imaging Mission (HabEx - https://www.jpl.nasa.gov/habex/)
- The X-ray Surveyor (Lynx - https://wwwastro.msfc.nasa.gov/lynx/)
- The Large UV, Optical, and Infrared Surveyor (LUVOIR - https://asd.gsfc.nasa.gov/luvoir/)
LUVOIR: Telling the Story of Life in the Universe

- Is there life elsewhere?
- Is our world unique?
- How do stars form?
- What are the building blocks of structure?
- How did our galaxy, solar system, and Earth arise and evolve?

<table>
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<tr>
<th>General Science Drivers</th>
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<tr>
<td><strong>Epoch</strong></td>
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<tr>
<td>z = 1–4</td>
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<tr>
<td>z = 0.5–1</td>
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<tr>
<td>&lt;100 Mpc</td>
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<tr>
<td>&lt;100 kpc</td>
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<td>&lt;50 AU</td>
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LUVOIR: Telling the Story of Life in the Universe

- 9 - 15 m mirror aperture
- Diffraction limited at 500 nm
- Segmented, deployable, ultra-stable telescope
- Broad wavelength coverage from 100 nm – 2.2 μm
- Halo orbit about the Sun-Earth L2 point
- Serviceable and Upgradable
- Lifetime ~ 25 years for non-serviceable components
- Suite of Coronograph, Imager and Spectrographs
- Guest observer-driven program
- Launch date ~ 2035
• Instantaneous Field-of-View: 10’ x 8’
• 1.15-m flat-to-flat segments (120x)
• Effective area is 135 m²

15-m diameter aperture, 4 instrument bays:

- Optical / NIR Coronagraph
- High-definition Imager
- UV Multi-object Spectrograph ("LUMOS")
- Pollux: UV High-Resolution Spectro-polarimeter
The resolution is shown assuming a 12 m aperture, diffraction limited at 500 nm.

The E-ELT is assumed to perform at its diffraction limit at wavelengths longer than 1 micron and seeing-limited (0.6 arcsec) for wavelengths below 1 micron.
High Definition Imaging Instrument

UV/Vis Imaging (200 nm - ~1.0 μm) - Diffraction-limited at 500 nm

NIR Imaging (~1.0 μm – 2.5 μm) - Diffraction-limited at 1.2 μm

Each channel contains a suite of spectral filters (narrow, med and broadband)

Field-of-view: 2 x 3 arcmin

High precision astrometry (~0.1 μas)

High-speed photometry with 50 ms exposures

High Precision Astrometry (for exoplanets masses)

5σ photometric limits of AB = 33–33.5 for point sources

A simulated galaxy viewed by Hubble, JWST, and HDST at z = 2 for a 1h observation
Spectral signatures of individual stars and star clusters and groups in galaxies (d<~50 Mpc).

Imaging of stellar systems to identify multiplicity
LUVOIR UV Multi-Object Spectrograph

Multi-object imaging spectrograph, medium and low-resolution spectral modes

Near-UV IFU and NUV+FUV imaging mode

Spectral Bandpass: 100 – 400 nm (90 – 400 nm)

Spectral Resolving power:
- M = 15,000 – 60,000
- L = 5,000 – 15,000 and LL = 500

Temporal Resolution: 1msec

Multi-object FoV: 3’ x 2’

Micro-shutter array 0.14” x 0.07”

Angular Resolution in MOS mode: 30 mas

Regions of the Milky Way where LUVOIR could collect high-S/N, high spectral resolution data in the NUV (~1800 - 3100 Å) for red giants (Mv = -0.5)

LUMOS: 25th mag galaxy at 5σ in 1 hour
Aoki et al. (2006)

M83 4.6 Mpc

Parsec-scale Resolution of Inflow, Outflow, Dust, and Radiative Transfer in Nearby Galaxies
Massive stars in the Magellanic Clouds

Rapid rotation and mass loss are expected to play a crucial role in creating the conditions required by LGRB models \(\Rightarrow\) 2D RT models to probe the properties of the wind structure/velocity law.

The largest sample of massive stars in the SMC

\[ Z \approx 0.2Z_\odot \Rightarrow \text{lower mass-loss than in the Galactic case} \]

Surface abundances

SMC \(\Rightarrow\) 60kpc

LMC \(\Rightarrow\) 50kpc

\[ Z \approx 0.5Z_\odot \]

Bouret et al. In prep

Bouret et al. 2013
Garcia et al. 2014

Massive stars beyond the Local Group

HST/COS → IC1613 (0.7Mpc) and WLM (0.9Mpc)

Need UV for Mdot, $v_\infty$ and Fe/H

Fe/H of IC1613 < SMC → $z \sim 2$
Sub-solar $[\alpha/Fe]$ of $-0.10$

low R (2-5 orbits/star) → 8 stars

high R (5-7 orbits/star) → (3 stars)

Bouret et al. 2015
Massive stars far beyond the Local Group

Leo P (Z ~ 0.1Z⊙, 1.65 Mpc) ➔ At least 50ks exposures for HST-COS data per star (14 orbits)

Goal: UV spectra of individual massive stars up to I Zw 18 (18 Mpc, Z ~ 0.03Z⊙) to test predictions at very low Z
POLarimètre en Lumière Uv eXtrême: POLLUX

High-resolution, FUV to Optical, Spectropolarimeter

Spectral Resolving power: $R = 120,000$

Spectral Bandpass: 98 – 390nm

Full wavelength range in two shots

Circular (V) and linear (QU) polarization

Mode on/off for the polarimeters

Aperture size: 0.03''
Participate

Details on meetings can be found on the events page.

Working Groups

We welcome participation in any of the LUVOIR working groups. To sign up, please contact the working group leads.

- Cosmic Origins Science:
  - Lead: John O’Meara (jomeara@bom.net) and Jane Wragg (jane.wragg@nasa.gov)
- Space Science:
  - Lead: Mark Marley (mark.s.marley@nasa.gov) and Avi Mandel (avimandel@nasa.gov)
- Solar System Science:
  - Lead: Will Harris (wharris@ps.arizona.edu) and Geronimo Villanueva (geronimo.villanueva@nasa.gov)
- Communications:
  - Lead: Debra Fischer (debra.fischer@yale.edu) and Shara Domagal-Goldman (shara.domagal-goldman@nasa.gov)
- Simulations:
  - Lead: Jason Tumlinson (jtumlinson@nasa.gov) and Ali Robarge (alrobarge@nasa.gov)
- Technology:
  - Lead: David Redding (david.r.redding@jpl.nasa.gov) and Matt Bolcar (matthew.bolcar@nasa.gov)

Tools

This page links to performance simulation and visualization tools for the LUVOIR mission, a future ultraviolet/optical/near-infrared observatory concept. These are experimental. If they are not working, email Jason Tumlinson (STScI). For the Planetary Spectrum Generator, email Geronimo Villanueva (GSFC).

- LUVOIR Science Case Template
  - Word document to describe a LUVOIR science case.
- Coronagraphic Spectra of Exoplanets
  - Simulate optical/near-IR reflection spectra of various exoplanets with realistic noise.
- Multiplanet Yield Tool
  - Tool for visualizing yields of observed exoplanets (of various types) as function of basic mission parameters.
- Planetary Spectrum Generator
  - Advanced tool for simulating spectra of Solar System bodies (with LUVOIR and other telescopes).
- HDI Photometric ETC
  - Basic exposure time calculator for optical photometry in multi-band images.
- LUMOS Spectroscopic ETC
  - Simple exposure time calculator for UV spectroscopy.
- UV MOS Visualizer
  - See the impact of UV multi-object spectroscopy on the study of stellar clusters and their feedback.
- High-Resolution Imaging
  - Examples of astronomical objects viewed with different sized telescopes.