LUVOIR Science Definition Document

Table of Contents

1 Are Earth-like habitable environments common or rare on worlds around other stars? 1

2 Science Measurements 1

2.1 Find terrestrial planets in habitable zones of nearby stars 1

2.2 Measure frequency of water vapor in planets’ atmospheres 1

2.3 Measure planetary orbits to determine surface energy input 1

2.4 Measure atmospheric surface pressure 2

3 Description of Observations 2

3.1 Direct imaging search for small planets in habitable zones 2

3.2 Optical/near-IR direct spectroscopy of water vapor features 2

3.3 Multi-epoch direct imaging 2

3.4 Near-IR direct spectroscopy of pressure-sensitive O4 feature 3

3.5 Planet mass determination with radial velocities or astrometry 3

## Are Earth-like habitable environments common or rare on worlds around other stars?

Section heading is a high-level science goal / question. Imagine saying it to your congressperson. Below that, put an explanation of the goal and **why** we want to do it. Please use statements accessible to a general reader.

## Science Measurements

### Find terrestrial planets in habitable zones of nearby stars

Here, describe **what** measurements are needed to achieve the science goal and why. Target audience might be a scientist not in your specific field.

Explain target selection and sample size choices. Add figures if desired. Add as many science measurements as necessary.

### Measure frequency of water vapor in planets’ atmospheres

### Measure planetary orbits to determine surface energy input

### Measure atmospheric surface pressure

## Description of Observations

### Direct imaging search for small planets in habitable zones

Describe **how** we are going to achieve the science measurements. Time to get specific. Here you’re speaking to experts in your field.

Describe projects and needed observations in detail (wavelengths, contrast, spectral resolution, etc.). Provide any calculations, figures, tables, and references to other documents.

At the end of each subsection, we want to have a table of observation requirements for the project filled out, with values for three different levels of progress. Modify (or add to) table rows as needed. These will be used to define instrument capabilities, and to evaluate progress for each project after mission architecture is designed.

Table 1: Observation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Observation  Requirement | Major  Progress | Substantial  Progress | Incremental  Progress |
| Wavelengths |  |  |  |
| Spatial resolution |  |  |  |
| Spectral resolution | Not applicable | Not applicable | Not applicable |
| Field-of-view |  |  |  |
| Contrast |  |  |  |
| Telescope aperture |  |  |  |
| Exposure time |  |  |  |

### Optical/near-IR direct spectroscopy of water vapor features

Table : Observation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Observation  Requirement | Major  Progress | Substantial  Progress | Incremental  Progress |
| Wavelengths |  |  |  |
| Spatial resolution |  |  |  |
| Spectral resolution |  |  |  |
| Field-of-view |  |  |  |
| Contrast |  |  |  |
| Telescope aperture |  |  |  |
| Exposure time |  |  |  |

### Multi-epoch direct imaging

Table : Observation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Observation  Requirement | Major  Progress | Substantial  Progress | Incremental  Progress |
| Wavelengths |  |  |  |
| Spatial resolution |  |  |  |
| Spectral resolution | Not applicable | Not applicable | Not applicable |
| Field-of-view |  |  |  |
| Contrast |  |  |  |
| Telescope aperture |  |  |  |
| Exposure time |  |  |  |

### Near-IR direct spectroscopy of pressure-sensitive O4 feature

Table : Observation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Observation  Requirement | Major  Progress | Substantial  Progress | Incremental  Progress |
| Wavelengths |  |  |  |
| Spatial resolution |  |  |  |
| Spectral resolution |  |  |  |
| Field-of-view |  |  |  |
| Contrast |  |  |  |
| Telescope aperture |  |  |  |
| Exposure time |  |  |  |

### Planet mass determination with radial velocities or astrometry

Table 5: Observation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Observation  Requirement | Major  Progress | Substantial  Progress | Incremental  Progress |
| Wavelengths |  |  |  |
| Spatial resolution |  |  |  |
| Spectral resolution |  |  |  |
| Field-of-view |  |  |  |
| Contrast |  |  |  |
| Telescope aperture |  |  |  |
| Exposure time |  |  |  |