The Ultraviolet Spectrograph on the JUICE Mission (JUICE-UVS)

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JUICE-UVS Science Objectives

Icy Moons
– How are their tenuous atmospheres generated, how are they distributed, and what is their composition?
– How do the atmospheres respond to changes in Jovian plasma conditions?
– What are the non-ice surface components, and are they primarily exogenic or endogenic?

Jupiter
– How do minor species vary with latitude in the upper and lower stratosphere?
– Is global thermospheric circulation dominated by auroral energy input?
– How do faint & diffuse auroral structures vary with changing magnetospheric conditions?

Io System
– What controls the flow of mass and energy from Io’s atmosphere into neutral clouds, the torus, and eventually the magnetotail? Volcanos? Sublimation?
– How are the high-energy electrons re-energized? What do they contribute to the power emitted by the torus
– How are changing torus and inner magnetosphere conditions related to low-latitude Jovian auroras?
JUICE-UVS Science Methods

JUICE-UVS addresses its primary and other important science questions using the powerful technique of photon-counting spectral imaging of:

1) UV Emissions
2) UV Reflections
3) UV Transmissions

Aurora & Airglow
Surface Albedos
Stellar & Solar Occultations
## JUICE-UVS Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
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<tbody>
<tr>
<td>Mass:</td>
<td>5.2 kg (plus 9.7 kg TaW shielding)</td>
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<tr>
<td>Power:</td>
<td>8.5 W</td>
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<tr>
<td>Dimensions:</td>
<td>34.6 cm x 29.4 cm x 14.5 cm</td>
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<tr>
<td>Spectral Range:</td>
<td>55-210 nm</td>
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<tr>
<td>Spectral Resolution:</td>
<td>&lt;0.6 nm (point source); &lt;1.2 nm (extended source)</td>
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<tr>
<td>Spatial Resolution:</td>
<td>0.16° (AP); 0.041° (HP), Nyquist sampled</td>
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<tr>
<td>Field of View:</td>
<td>0.1° x 7.3° + 0.2° x 0.2°</td>
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<tr>
<td>Effective Area:</td>
<td>0.6 cm² @ 125 nm</td>
</tr>
<tr>
<td>Telescope / Spectrograph:</td>
<td>Off-axis Primary / Rowland circle mount</td>
</tr>
<tr>
<td>Detector Type:</td>
<td>2D MCP (solar blind), CsI photocathode, cross-delay-line (XDL) readout, 2048 spectral x 512 spatial x 256 PHD</td>
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<tr>
<td>Radiation Mitigation:</td>
<td>Contiguous Tantalum / Tungsten shielding (4π sr @ detector and electronics)</td>
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**JUICE-UVS Instrument**

*Conceptual Drawing*

**Instrument Components**

- **Housing**
  - Al Structure
  - Doors
  - TaW Shielding
- **Apertures**
  - Airglow Port (AP)
  - High-spatial-resolution Port (HP)
  - Solar Port (SP)
- **Optics**
  - Off-axis Paraboloid (OAP) Mirror
  - Solar pickoff mirror
  - Grating
  - Slit
- **MCP XDL Detector Assembly**
- **Electronics**
  - Detector
  - Command & Data Handling (C&DH)
  - Low Voltage Power Supply (LVPS)
  - High Voltage Power Supply (HVPS)
JUICE-UVS Heritage Instruments

A) Rosetta-Alice
B) Pluto-Alice
C) LRO-LAMP
D) Juno-UVS
JUICE Remote Sensing FOVs

- **UVS**: 7.3° × 0.1° + 0.2° × 0.2°
- **JANUS**: 1.72° × 1.29°
- **MAJIS**: 3.44° × 0.00716°
- **SWI**: 0.057° × 0.057°

*Shown at common nadir boresight location*

*JUICE-UVS does not have a scan mechanism*

*Along-track*

*Cross-track*
Robust campaigns of stellar occultations are planned in the first year, including Europa plume searches well before the flybys.

Io torus and Jupiter aurora monitoring are useful at large distances, including approach.

JUICE-UVS Science Operations
Flybys generally follow a common sequence – stellar occultations during approach and departure, disk scan and limb imaging closer in, and ride-along regional targeting (with other instruments) at closest approach.

Only a few flybys have geometries suitable for solar occultations, which JUICE-UVS can also observe through its specialized solar port (SP).
Two JUICE flybys of Europa are planned.

JUICE-UVS will use stellar occultations to search for extinction by plumes on approach and departure from Europa.

JUICE-UVS will use limb stares and disk scans to study plume emissions closer to Europa (up to ~1 hour from C/A).
JUICE-UVS Europa Aurora Imaging

- Upper left figure shows the JUICE-UVS count rates expected during a Europa flyby.
- Excellent data quality at the same Lyman-α and oxygen wavelengths used to detect the water vapor plume with HST.
- Lower left figure shows the expected background radiation count rates and total extracted charge from penetrating electrons are manageable, throughout the entire mission.
JUICE-UVS Science Operations at Ganymede

• JUICE-UVS science during the Ganymede Elliptical Orbit (GEO) phase focuses on stellar & solar occultations, disk scan images, and targeted aurora imaging

• JUICE-UVS science during the Ganymede Circular Orbit (GCO) phases emphasize nadir observations, including nightside imaging and HP-mode (solar occultations near poles are nice-to-have)
JUICE-UVS Going Forward

• JUICE-UVS is a versatile and robust instrument, capable of addressing 16 of the 19 proposed science objectives of the JUICE mission

• Major JUICE-UVS reviews and other milestones coming up are:
  – Preliminary Requirements (10 Feb 2014)
  – Consolidation (1 Sep 2014)
  – Science Verification (1 Feb 2015)
  – Preliminary Design (1 Jul 2016)
  – Critical Design (1 Aug 2017)
  – Qualification (1 Feb 2018)
  – Delivery to ESA (1 Nov 2018)
  – JUICE launch from Kourou (4 Jun 2022)
  – Jupiter Orbit Insertion (15 Jan 2030)
  – Ganymede Orbit Insertion (15 Sep 2032)
  – End Of Mission (2 Sep 2034)