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

R. Gladstone (1), K. Retherford (1), J. Eterno (1), S. Persyn (1), M. Davis (1), M. Versteeg (1), T. Greathouse (1), K. Persson (1), G. Dirks (1), B. Walther (1), M. Araujo (1), A. Steffl (2), E. Schindhelm (2), J. Spencer (2), M. McGrath (3), F. Bagenal (4), P. Feldman (5), and L. Fletcher (6)

(1) SwRI, San Antonio, TX, USA, (2) SwRI, Boulder, CO, USA , (3) NASA/MSFC, Huntsville, AL, USA, (4) LASP, University of Colorado, Boulder, CO, USA, (5) The Johns Hopkins University, Baltimore, MD, USA, (6) Oxford University, Oxford, UK (rgladstone@swri.org)

Abstract

The ultraviolet spectrograph instrument for the JUICE mission (JUICE-UVS) has been selected to provide a variety of ultraviolet science observations during the mission's survey of the Jovian system. The goals of our investigation are to explore the atmospheres, plasma interactions, and surfaces of the Galilean satellites; to determine the dynamics, chemistry, and vertical structure of Jupiter's upper atmosphere, from equator to pole, as a template for giant planets everywhere; and to investigate the Jupiter-Io connection by quantifying energy and mass flow in the Io atmosphere, neutral clouds, and torus. In this talk we describe the science objectives for JUICE-UVS, along with an overview of its design and expected performance.

1. Introduction

The three main science goals for JUICE-UVS are to:

1) Explore how the surfaces and atmospheres of Jupiter's icy moons interact with and are modified by their space environment;

2) Determine how Jupiter's upper atmosphere interacts with the lower atmosphere below and the ionosphere and magnetosphere above; and

3) Investigate the connections which transport mass and energy between Io, its neutral clouds, and its Torus.

The design of the JUICE mission enables each of these goals to be addressed, and the robust JUICE-UVS instrument makes the most of this opportunity to investigate the interfaces where hard radiation and dense plasmas meet tenuous atmospheres and icy surfaces in the Jovian system. JUICE-UVS goals are entirely complementary to those of Juno-UVS, which concentrate on exploring Jupiter's polar magnetosphere, but leave the Galilean satellites alone.

2. Instrument

JUICE-UVS is the fifth in a series of successful ultraviolet imaging spectrographs (Rosetta-Alice [1], New Horizons Pluto-Alice [2], LRO-LAMP [3]) and is largely based on the most recent of these, Juno-UVS [4]. It observes photons in the $55<\lambda<210$ nm range, at moderate spectral and spatial resolution along a 7.5° slit. A main entrance airglow port (AP) is used for most observations (e.g., airglow, aurora, surface mapping, and stellar occultations), while a separate solar port (SP) allows for solar occultations. Another aperture door, with a small hole through the center, is used as a high-spatial-resolution port (HP) for detailed observations of bright targets. Time-tagging (pixel list mode) and programmable spectral imaging (histogram mode) allow for observational flexibility and optimal data management. As on Juno-UVS, the effects of penetrating electron radiation on electronic parts and data quality are substantially mitigated through contiguous shielding, filtering of pulse height amplitudes, management of high voltage settings, and careful use of radiation-hard, flight-tested parts. JUICE-UVS will obtain excellent airglow and auroral observations, stellar and solar occultations, and surface albedo maps to address the above goals, even in the worst-case radiation environment near Europa.

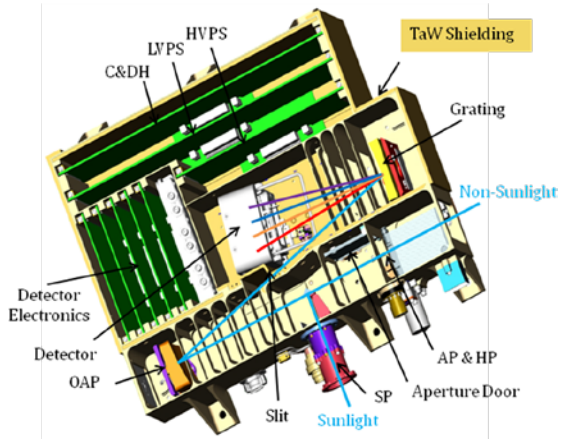

Figure 1: JUICE-UVS concept drawing.

3. Summary

As described in the ESA mission Science Requirements Document, a UVS instrument is considered of great importance to the JUICE mission, addressing 16 of the 19 proposed science objectives. We strongly agree with this assessment, and believe that JUICE-UVS provides unsurpassed science value. The JUICE mission will provide an in-depth look at the Jupiter system, focusing on the icy satellites through flybys and eventual insertion into Ganymede orbit, and also including significant magnetospheric science and remote sensing of Jupiter and Io. The potential for cross-disciplinary comparative research is very high, and there is a strong need for science instruments like JUICE-UVS which are rugged, versatile, and able to study the physics occurring at the interfaces between the magnetospheres, atmospheres, and surfaces in the Jovian system.

JUICE-UVS capitalizes on the UVS/Alice family of predecessor instruments, utilizing their designs, processes, parts, flight spares, materials, ground equipment, suppliers, software, and operations. We believe that JUICE-UVS is ideally suited to the JUICE payload, and we are committed to maximizing UV and interdisciplinary science return on this exciting mission.

Acknowledgements

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