National Aeronautics and Space Administration

NASA's Participation in ESA's JUICE mission

Curt Niebur
JUICE Program Scientist, NASA Headquarters
Committee on Astrobiology and Planetary Science
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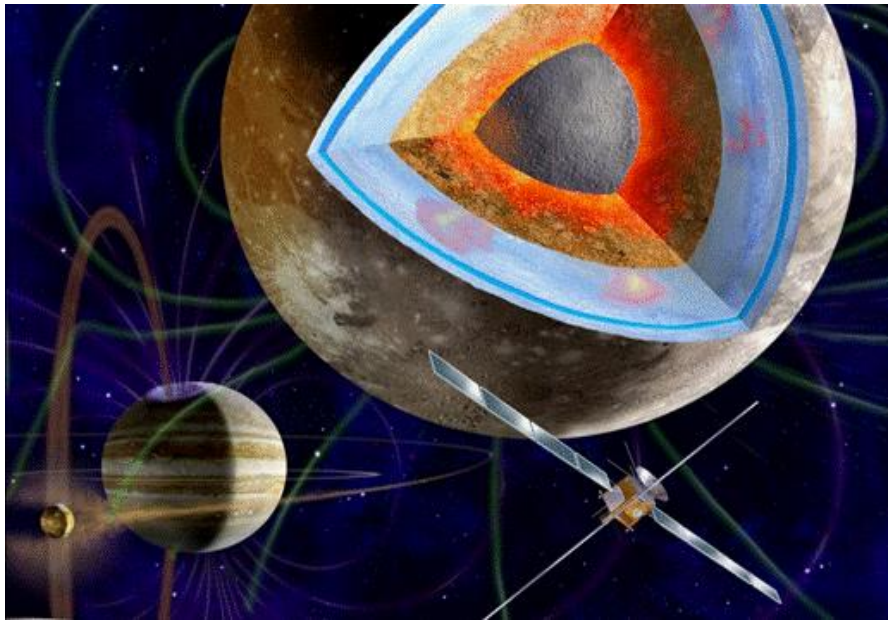
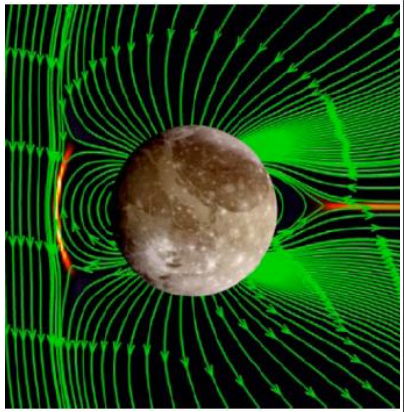
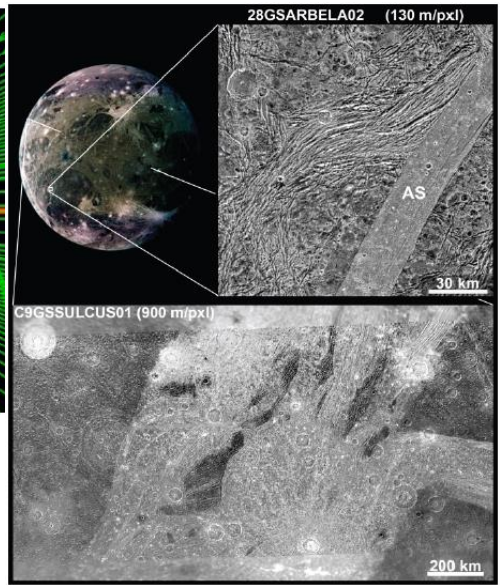
The JUpiter ICy moons Explorer Mission

- On May 2, 2012, the ESA SPC formally selected JUICE as the first Large-class mission in ESA's Cosmic Vision Program
- The JUICE mission will investigate the emergence of habitable worlds around gas giants, characterizing Ganymede, Europa and Callisto as planetary objects and potential habitats, and will also explore the Jupiter system as an archetype for gas giants.
- JUICE will first orbit Jupiter for ~2.5 years, providing 13 flybys of Callisto and 2 of Europa, and then will orbit Ganymede for 9 months
- Launch is scheduled for 2022 with Jupiter arrival in 2030, Ganymede orbit insertion in 2032, and Ganymede impact in 2033
- NASA and ESA released coordinated AOs in June 2012 to solicit the JUICE payload







ESA/NASA Partnership

- NASA offered to collaborate with ESA on its JUICE mission with up to a total of $100M of contributions consisting of:
  1) NASA-funded instrument investigations led by a U.S. PI,
  2) NASA-funded instrument component(s) provided to non-U.S.-led instrument(s)
  3) NASA-funded U.S. Co-Is on non-U.S.-led instrument(s).
- Within this budget cap, NASA expected to select a mixture of these three types of contributions.
- NASA and ESA negotiated a coordinated AO process
  - NASA released PEA K to the SALMON-2 AO for U.S.-led proposals
  - ESA released its own AO for non-U.S.-led proposals
  - NASA and ESA evaluation process were independent but shared review results
- This NASA AO and evaluation process was concerned with only the first type of contribution
  - NASA performed a limited technical evaluation of US contributions to European-led proposals

Coordinated & Linked Proposal Review & Selection Processes

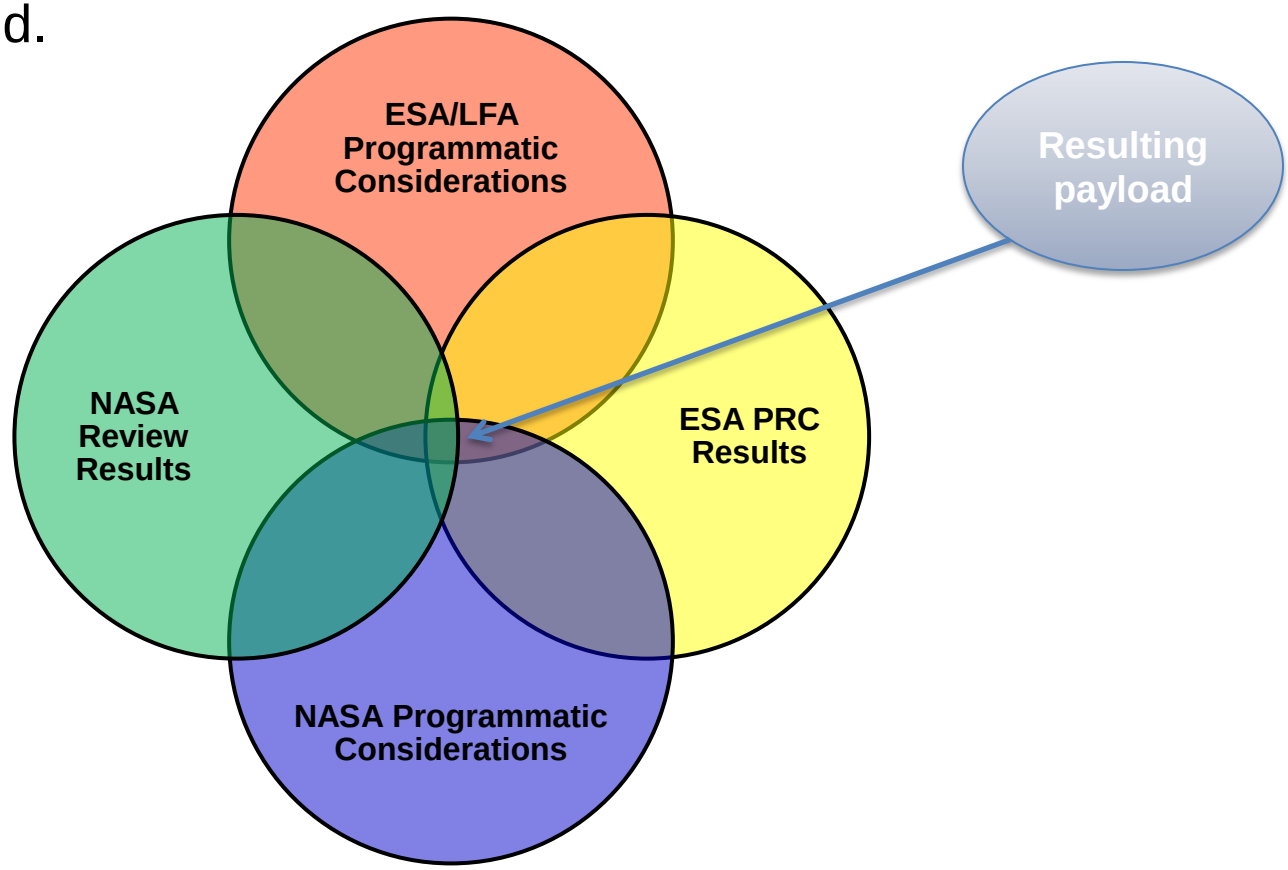
ESA Process	NASA Process	Links
ESA will form a Proposal Review Committee (PRC) and perform a Technical Program Evaluation by ESA staff.	NASA will form a Science Panel, a Technical/Management/Cost Panel, and a Categorization Committee.	NASA and ESA will each be invited to observe the other's evaluation process and share information.
ESA will provide to NASA ESA's final evaluations of proposals seeking NASA funding.	NASA will share final evaluations and results with ESA.	NASA and ESA will consult on proposal evaluations.
The PRC will formulate a payload recommendation for the entire payload suite for ESA's SRE Director.	NASA SMD will determine which contributions they are willing to support.	NASA and ESA will consult on potential payload.
Contributions selected by NASA and accepted by ESA will be included in ESA's final recommended payload proposal to their governing body (SPC).	NASA SMD AA makes selection decision on NASA offerings for supported contributions to ESA, provides Letter of Commitment to ESA.	NASA and ESA will consult on final JUICE payload.

NASA Evaluation Overview

- Proposals submitted to NASA underwent the NASA evaluation and single step selection process described in the SALMON-2 AO and JUICE PEA.
  - These proposals were provided by NASA in their entirety to ESA and additionally underwent the ESA evaluation process.
- Proposals were assessed against criteria given in Section 7.2 of the SALMON-2 AO (supplemented by JUICE PEA K) by panels of individuals who are peers of the proposers in the relevant scientific areas. The evaluation criteria are:
  - Intrinsic Science Merit of the Proposed Investigation
    - Evaluated by Science Panel and documented on Form A with ratings from Excellent to Poor. Weighted 40% at selection.
  - Science Implementation Merit and Feasibility of the Investigation
    - Evaluated by Science Panel and documented on Form B with ratings from Excellent to Poor. Weighted 30% at selection.
  - Feasibility of the Investigation Implementation, including Cost Risk
    - Evaluated by TMC Panel and documented on Form C with ratings of Low, Medium or High Risk. Weighted 30% at selection.

Negotiations Supporting Selection Process

- NASA and ESA observed each other's reviews, discussed review results and programmatic considerations. These discussions informed the deliberations of the ESA PRC.
- These negotiations continued as the payload and its contributors were determined.



Some Statistics on Proposals

- Nine proposals were submitted in response to the NASA PEA K for US PI-led instrument investigations
  - These proposals totaled $413M (RY) with an average budget of $46M (RY)
- ESA selected a payload of 11 instruments (1 US led, 10 European led)
  - 8 of the 10 European-led instruments contained US contributions totaling ~$189M with an average of ~$24M
- Recall NASA allocated up to a total of $100M of contributions
  - Ultraviolet Spectrograph instrument investigation (PI Randy Gladstone, SWRI)
  - Radar for Icy Moon Exploration (PI Bruzzone of Italy, US Lead Jeff Plaut of JPL)
  - Particle Environment Package (PI Barabash of Sweden, US Lead Pontus Brandt of APL)

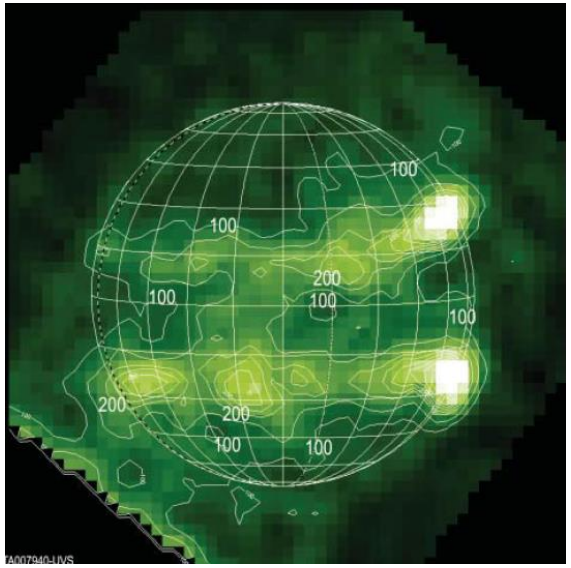
Selected JUICE Payload

Instrument		LFA	NASA Contribution
UVS (Ultraviolet Spectrograph)	UV spectrograph	NASA	Instrument lead
3GM	Radio science	ASI	MGA, USO, DSN passes, Co-Is
JANUS (Jovis, Amorum ac Natorum Undique Scrutator)	Camera	ASI	Focal plan assembly, detectors, Co-Is
MAJIS (Moons And Jupiter Imaging Spectrometer)	IR imaging spect	ASI	Major portion of instr.
RIME (Radar for Icy Moon Exploration)	Radar	ASI	Xmtr & Recvr, Co-Is
SWI (Submillimetre Wave Instrument)	Heterodyne recvr	DLR	Recvr, Co-Is
GALA (Ganymede Laser Altimeter)	Laser altimeter	DLR	None
PEP (Particle Environment Package)	Particles	Sweden	JoEE, JoEE, JENI, Co-Is
RPWI (Radio and Plasma Wave Investigation)	Plasma & fields	Sweden	FRODO, RWI; electronics; Co-Is
JMAG (Jupiter Magnetometer)	Magnetometer	UK	Boom, GS equip, expertise, Co-Is
PRIDE	VLBI experiment	Consort.	None

JUICE-UVS Science

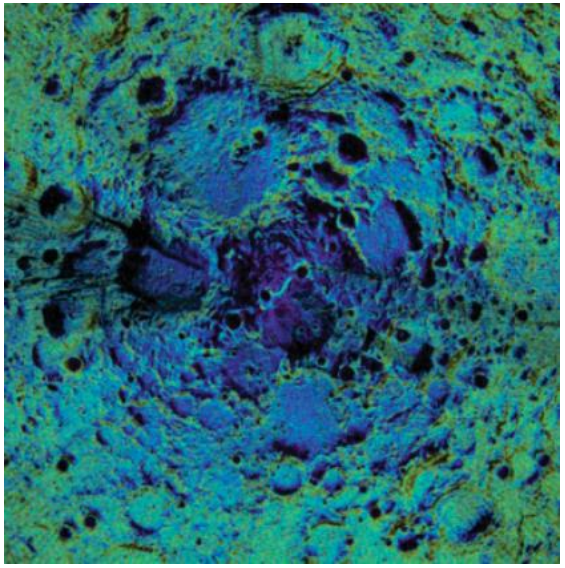
JUICE-UVS addresses 16 of the 19 top JUICE project objectives using the powerful technique of photon-counting spectral imaging of:

1) UV Emissions



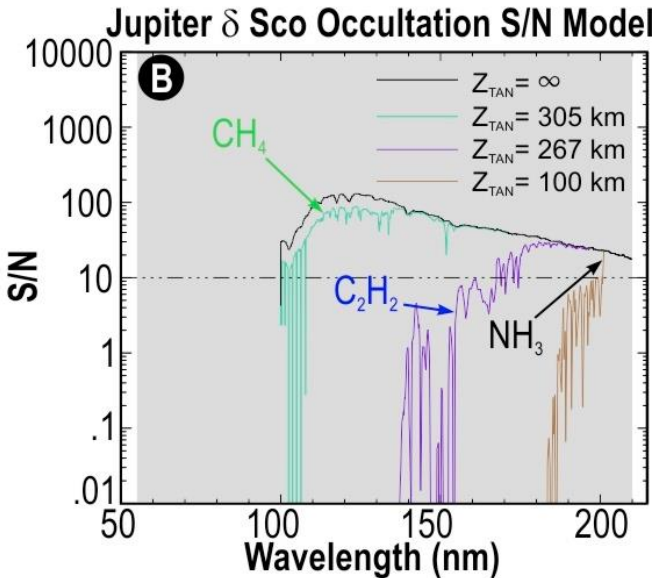
Aurora & Airglow

2) UV Reflections



Surface Albedos

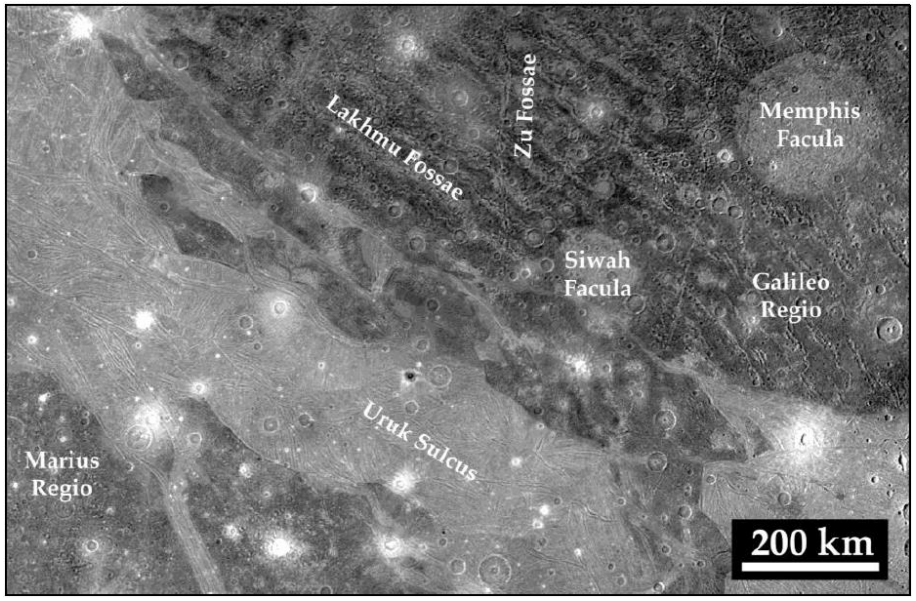
3) UV Transmissions



Stellar & Solar Occultations

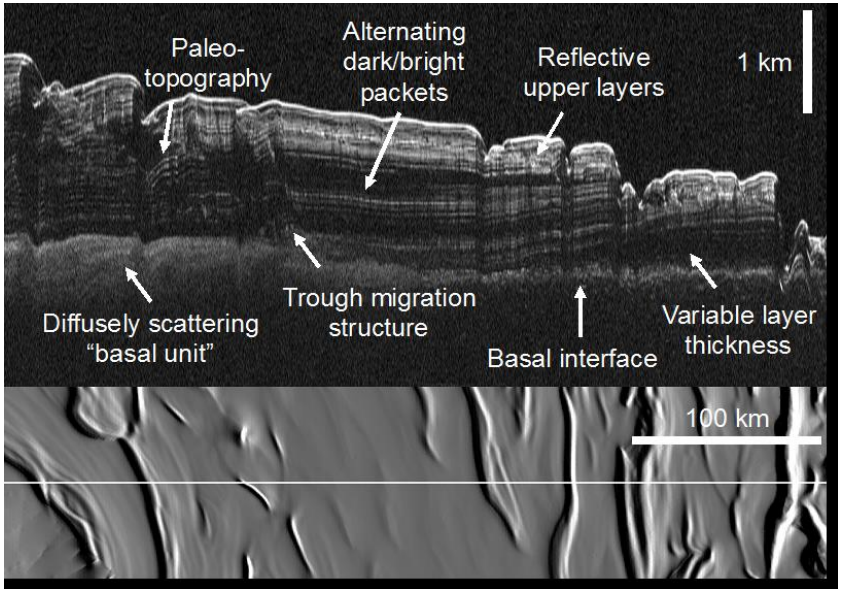
JUICE-UVS will study the physics occurring at ***the interfaces between the magnetospheres, atmospheres and surfaces in the Jovian system***

RIME – Radar for Icy Moon Exploration



Scientific Goals

- Investigate the potentially habitable zones of Jupiter's icy moons
- Probe and characterize the icy shells of Ganymede and Callisto
- Explore Europa's recently active zones, including possible direct detection of shallow melt zones



Radar sounding of Mars ice caps by MRO SHARAD degraded to RIME resolution of 30 m. RIME builds on experience of joint development and operations by ASI and NASA of Mars sounders MARSIS and SHARAD.

Partnerships

- Jupiter Icy Moon Explorer (JUICE) is an ESA mission with European and NASA contributions
- RIME is a joint development of Italian Space Agency and NASA: PI L. Bruzzone, Univ. of Trento, Co-PI J. Plaut, JPL
- U.S. will contribute radar hardware (transmitter and receiver)
- RIME Science Team includes 4 NASA-funded U.S. Co-Is

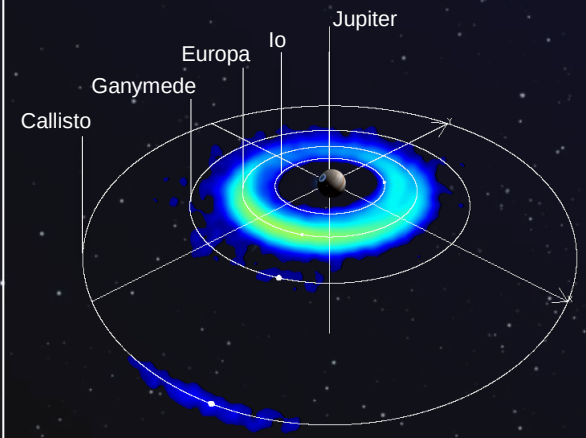
PEP

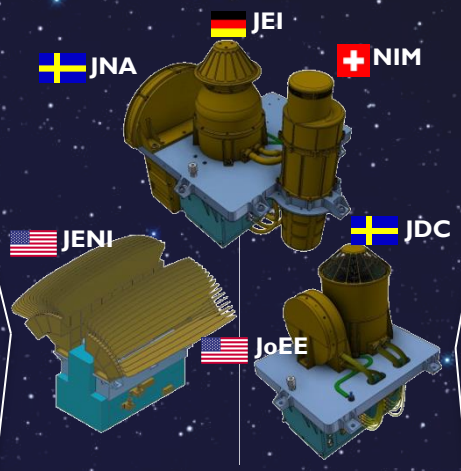
Particle Environment Package

JENI

Jovian Energetic Neutrals and Ions

- Combined high-resolution, high-sensitivity ENA camera and energetic ion and electron imaging spectrometer
- Based on Cassini and IMAGE cameras for Saturn's and Earth's magnetospheres
- Global imaging of hot plasma (energetic particles) energization critical to understanding the creation and stability of magnetodiscs
- Global imaging of neutral gas torus to constrain Europa's and Io's surface release to space





PEP PI
Stas Barabash
The Swedish Institute of Space Physics

PEP Co-PI
Peter Wurz
University of Bern

US PI
Pontus C. Brandt
APL

	Ions, ENAs
	Neutrals
	Electrons
	DPU
	Power
	Electronics
	Detectors
	Detectors
	Planetary prot.
	Science
	Science

Dpt PI: *C. P. Paranicas*
D. G. Mitchell
G. Ho
J. Westlake
D. Haggerty
B. H. Mauk
K. K. Khurana
X. Jia
C. Paty
N. Andre
G. Jones

JoEE

Jovian Energetic Electrons

- High-time resolution, multi-directional energetic electron spectrometer
- Based on Galileo and Cassini designs
- Sub-second angular energetic electron distributions to understand the Jupiter's giant accelerator
- Uses electron measurement to probe Ganymede's magnetic field topology remotely

Galileo Ganymede 28 Encounter