



Artist's impressions of JUICE in space (left and top right) © ESA / ATG Medialab

University of Bern engineers in a clean room with the NIM mass spectrometer (bottom right) © University of Bern, Image: Thierry de Roche

## University of Bern Seeks Life on Jupiter's Moons

“An Ariane 5 rocket blasted the European Space Agency’s JUICE probe into space, starting the probe on its 8-year journey to Jupiter, where it will scan for life under the ice of the planet’s moons. The complex instruments on board the JUpter ICy moons Explorer include one that uses a Neutral & Ion Gas Mass Spectrometer (NIM) from the University of Bern, who selected XJTAG to verify key solder joints on the control board were fault-free.”

The Space Research & Planetary Sciences department of the University of Bern’s Physics Institute is at the forefront of space research. It has an excellent international reputation and was chosen to design and build the mass spectrometer for the project. The department develops scientific instruments for spacecraft for planetary exploration for missions led by several major space agencies, and maintains complex facilities for testing and calibrating those scientific instruments.

The NIM contains a central control and processing PCBA with an AMD-Xilinx™ Virtex™-4 FPGA, an ADC, DC/DC converters, power filtering, an analogue frontend, and electronics to control the motors. During the spectrometer’s development, the team found that the board failed after working for a while. XJTAG’s XJAnalyser boundary scan software was used to debug the assembled board and it rapidly located a defective solder joint under the FPGA, which was packaged on a Ceramic Column Grid Array. Matthias Lüthi (Systems Engineer, Electronics) said, “It gave us easy low-level access to the FPGA’s individual pins. After successfully locating the faulty solder joint, XJTAG testing became part of the standard bring-up procedure for all future NIM Control PCB assemblies.”

The speed with which XJAnalyser was running and being used to test the board was a key contributor to why XJTAG was selected. “Of the different tools tested, XJTAG

provided the quickest approach to verifying that a particular solder joint of our FPGA was faulty,” Matthias explained. “It took literally a few minutes to output a signal on the pin in question and monitor the



voltage level on a multimeter. Quickly toggling and reading a specific pin can be done in a few seconds once the JTAG chain has been set up.” XJAnalyser is now used on every build to check the connectivity between the FPGA and the board-to-board connectors.

XJAnalyser provides a real-time visualisation of a board’s JTAG devices and is targeted at board bring-up and debugging. Its intuitive graphical representation of those ICs provides an easy way to control individual pins, and it colours the pins to clearly show the digital values read back from them. Matthias Lüthi praised XJAnalyser’s intuitive GUI, the quick set-up, and the simple licencing.



© University of Bern, Image: Audrey Vorburger

The completed spectrometer was integrated into the space probe’s Particle Environment Package, which will spend at least three years characterising the plasma environment of the Jovian system and studying its three large ocean-bearing moons, Ganymede, Callisto, and Europa.

### opinion

Matthias Lüthi  
Systems Engineer, Electronics  
University of Bern

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<b>Data Bank</b>	 <small>UNIVERSITÄT BERN</small>
<b>Company</b>	Space Research & Planetary Sciences Department, Physics Institute, University of Bern
<b>Nature of business</b>	Space research
<b>Main products</b>	Scientific instruments for spacecraft for planetary exploration
<b>Customers</b>	Major space agencies including ESA and NASA
<b>Founded</b>	1834
<b>Employees</b>	Approx. 100 people
<b>Location</b>	Bern, Switzerland
<b>Web site</b>	www.space.unibe.ch