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EOS

Earth & Space Science News

Finding the Pulse of Climate Change

Cyclists' Exposure to Air Pollution

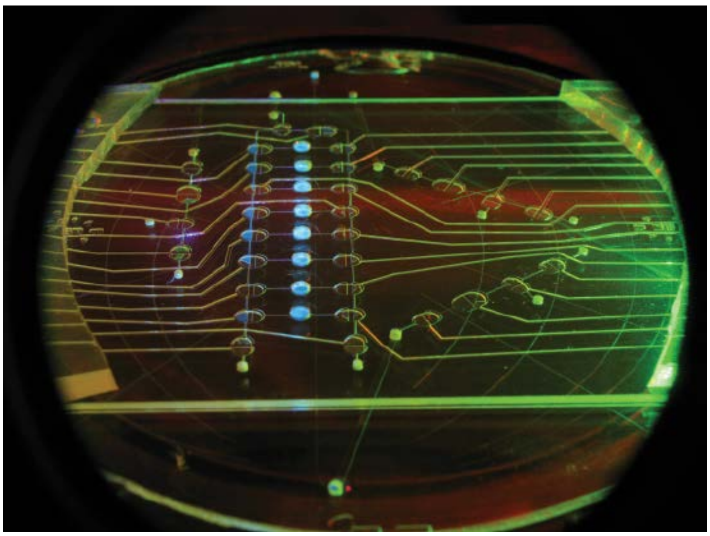
Data Set for Land–Air Exchanges

NEW GULF OF MEXICO SEAFLOOR MAP

AGU
American Geophysical Union

Instrument Development Enables Planetary Exploration

Third International Workshop on Instrumentation for Planetary Missions
Pasadena, California, 24–27 October 2016



This laser-interrogated microfluidic chip (10 centimeters in diameter) is one of the new planetary instrument technologies that NASA and other space agencies are developing to search for chemical indicators of life on other planets. In this lab-on-a-chip device, a laser excites labeled amino acid molecules as they pass through a microchannel. Different amino acid types pass through the channel at well-defined speeds, enabling their identification. Credit: Fernanda Mora and Amanda Stockton, Microdevices Laboratory, JPL/Caltech

The scientific knowledge gained from future planetary exploration missions will depend critically on the capabilities of instruments (cameras, spectrometers, magnetometers, thermal sensors, seismometers, remote laboratories, and other robotic tools) rather than human explorers to acquire sensory information. The flight opportunities available to planetary instrument developers depend on a complex interplay among mission science requirements; technology capabilities; mass, power, and volume constraints; planetary geometries; and funding availability.

Last October, more than 195 engineers, scientists, technologists, and program managers representing 12 countries met in California for the third workshop in a series that began in 2012 at NASA Goddard Space Flight Center and has been held every 2 years since.

The workshop provided a forum for collaboration, team building, exchange of ideas and information, and presentation of status reports for instruments, subsystems, and other payload-related technologies needed to address planetary science questions. Oral and poster sessions were based on 136 submitted abstracts.

Panel sessions were organized around three themes:

- perspectives on the future of planetary exploration
- bridging the gap between planetary scientists and instrument developers
- lessons learned for instrument development at various technology readiness levels (TRL 1–9)

The perspectives panel addressed planetary science priorities and opportunities over the next several decades for planetary instruments on missions to Mars, the Moon, Mercury, Venus, small bodies, and the outer planets. Panel participants strongly supported existing technology development programs, including NASA's Planetary Instrument Concepts for the Advancement of Solar System Observations and Maturation of Instruments for Solar System Exploration (PICASSO and MatISSE; see https://go.nasa.gov/2tFCawJ).

The panel emphasized that innovative approaches enhance mission science return, but new technology development efforts must effectively address cost and technical risk concerns, provide clear advantages over currently existing capabilities, and take into account mission schedules. Panel members agreed that emerging low-cost demonstration platforms (e.g., planetary CubeSats and SmallSats) provide invaluable opportunities to help new planetary instrument technologies mature and reduce the development risk in transitioning them to larger missions.

The panel on bridging the gap emphasized the importance of scientists, technologists, and engineers connecting at meetings. These groups must be willing to consider partnerships with private industry, learn new roles, and become fluent in disciplines outside of their formal training.

The panel on lessons learned covered past instrument development efforts for technology readiness levels (TRLs) from stage 1 (conceptual) to stage 9 (flight proven). These lessons included the importance of development teams beginning to think early in the development process (TRLs 3–5) about planetary protection considerations, environmental and operational constraints, systems engineering, and data analysis and operational constraints. Instrument development teams at all TRL stages should include scientists (to provide the "why") and engineers (to provide the "how") on instruments and missions.

The panels also highlighted the value of strong teams with a mixture of backgrounds in science, technology, management, and components design, as well as experience with working on various types of teams. Mentoring programs are vital to passing this knowledge along to early-career scientists. Finally, the panels noted that instrument development is becoming more international; thus, researchers must learn to function within one another's cultures.

End-of-workshop feedback mentioned the difficulty in getting scientists and instrument engineers together at traditional conferences and recommended that the community seek ways to expand networking opportunities. For example, instrument talks could be incorporated into the annual Lunar and Planetary Science Conferences.

More details on the presentations are available in the workshop abstracts (see http://bit.ly/IPM-2016). The workshop also produced an open-source online instrument database (http://bit.ly/IPM-database) to facilitate ongoing input from developers.

The workshop was sponsored by the Lunar and Planetary Institute. The next workshop in this series is tentatively scheduled to take place in Berlin, Germany, in fall 2018.

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