

NASA Planetary Science Division's Instrument Development Programs, PICASSO and MatISSE. J. R. Gaier, NASA Glenn Research Center, 21000 Brookpark Road, Cleveland OH 44135; james.r.gaier@nasa.gov.

Introduction: Historically, the NASA Planetary Science Division (PSD) had three instrument development programs that were solicited through the Research Opportunities in Space and Earth Sciences (ROSES) annual proposal call. These were the Planetary Instrument Definition and Development Program (PIDDP), the Astrobiology Science and Technology for Instrument Development (ASTID) Program, and the Mars Instrument Development Project (MIDP). As of ROSES-2011, the PIDDP and ASTID programs supported technology readiness levels (TRL) 1-6 development maturation. TRLs are summarized in Table 1, and described more fully below. The MIDP program supported the development of Mars instrument systems that would achieve TRL 6; however the last call for MIDP proposals was solicited in ROSES-2007. In order to have a more integrated instrument development pipeline the PSD combined the PIDDP, ASTID and MIDP programs into two new instrument development programs; the Planetary Instrument Concept Advancing Solar System Observations (PICASSO), a TRL 1-4 program, and the Maturation of Instruments for Solar System Exploration Program (MatISSE), a TRL 3-6 program.

PICASSO: PICASSO is a PSD program specifically designed to support the development of spacecraft-based instrument systems that show promise for use in future planetary missions. The goal of the program is to conduct planetary and astrobiology science instrument feasibility studies, concept formation, proof of concept instruments, and advanced component technology development to the point where they may be proposed in response to the MatISSE Program.

The PICASSO program is competed every year at a nominal level of \$3.5M. Efforts typically are funded at the \$250k-\$300k per year level for two or three years, so about a dozen awards per year are expected.

MatISSE: The MatISSE Program supports the advanced development of spacecraft-based instruments that show promise for use in future planetary missions. The goal of the program is to develop and demonstrate planetary and astrobiology science instruments to the point where they may be proposed in response to future announcements of flight opportunity without additional extensive technology development (approximately technology readiness level TRL6). The proposed instrument must address specific scientific objectives of likely future planetary science missions.

The MatISSE program is competed in even numbered years at a nominal level of \$6M. Efforts typical-

ly are funded at the \$1M per year level for three years, so about a six awards per cycle are expected.

Instrument Development Strategy: The nominal mode for PSD instrument development is to progress through the TRLs. First a new principle or technology is developed that has the potential to be the basis of a new instrument or a significant improvement in a current instrument. (TRL 1). From that, new instrument or instrument component is conceived based on it and an application is formulated (TRL 2). Then experiments are carried out to demonstrate proof-of-concept or critical function – that the idea works. (TRL 3). Instrument concepts at this early stage of development are eligible for support through the PICASSO program. Instruments may enter PICASSO at TRLs 1-3, and must advance at least one TRL during the course of the program which can be for up to three years. Components or instruments that start out at low TRL could be selected for more than one PICASSO award.

After proving the concept, the next step is to validate the instrument in a laboratory environment, that is, to build hardware that makes the measurement (TRL 4). Then an integrated breadboard instrument is developed and validated in a relevant environment (TRL 5). To achieve TRL 6, the instrument must have the form, fit, and function of a flight-like instrument that is validated in a relevant environment. Instruments may enter the MatISSE program at TRL 3-5 and expected to achieve TRL6 within three years.

After an instrument reaches TRL 6 it can be proposed to individual mission programs for further development and placement on a spacecraft, lander, or rover. So the instrument development flow is:

PICASSO → MatISSE → Mission

Interested parties are referred to the latest ROSES call for current details, proposal due dates, and points of contact of the PICASSO and MatISSE programs.

Table 1. Technology Readiness Levels

TRL 1	Basic principles observed and reported
TRL 2	Technology concept/application formulated
TRL 3	Critical function/proof of concept
TRL 4	Breadboard validation in lab
TRL 5	Breadboard validation in relevant environment
TRL 6	Prototype validation in relevant environment
TRL 7	Demonstration in space environment
TRL 8	Space qualified
TRL 9	Flight proven through successful mission ops

