

**TOWARD CANADIAN CONTRIBUTIONS TO INTERNATIONAL LUNAR MISSIONS.** Eric Martin<sup>1</sup>, Jean-Claude Piedbœuf<sup>1</sup>, Alain Ouellet<sup>1</sup>, Martin Picard<sup>1</sup>, Christian Lange<sup>1</sup> and Vicky Hipkin<sup>1</sup>, <sup>1</sup>Canadian Space Agency, 6767 Route de l'Aéroport, St-Hubert, Québec, Canada, J3Y 8Y9, Eric.Martin@asc-csa.gc.ca.

**Introduction:** Canada is one of the fourteen signers of the Global Exploration Strategy that establishes in 2007 an international framework for the exploration of our Moon, Mars and beyond. The Canadian Space Agency (CSA) is evaluating potential participation in this renewed worldwide exploration effort building on its current expertise in space exploration. Canada has been involved in space exploration for more than 25 years with its robotics, science and astronaut corps contributions.

**Planetary Exploration:** The CSA's focus in planetary exploration is the robotic exploration of Mars, as well as participation in the robotic and human exploration of the Moon and the space between Earth and Moon (cis-lunar space). We also consider robotic asteroid missions and opportunistic missions to other destinations that are aligned with our signature technologies and our science expertise.

**Lunar Exploration:** The Moon is our nearest and most accessible neighbour; it is an extraordinary repository of the history of the Solar System, and could be a base to prepare for future human missions to Mars. The Moon represents an important opportunity for the Canadian scientific community to participate in planetary missions to prepare for the ultimate goal of Mars exploration.

Lunar missions will initially be robotic, but will eventually include astronauts. The Moon is the most likely destination to establish the first sustainable human base on a planetary body. Astronauts will be able to carry out investigations that are more complex and acquire the experience needed for human exploration of Mars.

Canadian scientists have an interest and expertise in several niche areas of lunar research including: impact processes and formation of the regolith (surface rock and dust layer); the structure and evolution of the lunar interior; and testing theories about heavy bombardment of the lunar surface by asteroids. The Canadian geology community is also interested in lunar exploration for the purpose of extracting resources, both minerals and ice.

Space agencies around the world are planning several missions to the Moon through the end of the decade. These missions combine precursor activities for human space flight with scientific objectives. The CSA is particularly interested in contributing key robotic infrastructure (such as rovers) for astronaut transportation or scientific investigation; robotic technologies for

resource extraction; sub-systems for landing and navigation; and science instruments related to areas of Canadian expertise.

**Exploration Core Program:** To ensure its readiness for such future planetary exploration missions, in 2007, the CSA has launched an Exploration Core program. This program is developing the requirements for future space missions and deploys prototypes in terrestrial missions reproducing some of the characteristics of planetary missions. The Exploration Core is preparing both the scientific community and Canadian industry, enabling them to make scientific and technological advances that will position Canada to make informed decisions on a participation in the global exploration. When a mission of interest to Canada arises, the existence of the Exploration Core will ensure that the required science and technologies have matured to the appropriate level, minimizing risk and cost of a mission. The results of this broad effort will allow Canada to make more informed decisions concerning its contributions to, and participation in, the implementation of the Global Exploration Strategy.

Since its creation this program has funded more than 30 concepts studies, 15 prototyping contracts and 5 analogue deployments, all of them outside the Exploration Surface Mobility (ESM) project described below.

**Exploration Surface Mobility:** The Government of Canada Budget 2009 provided the CSA with \$110 million over three years so that it can contribute to the development of terrestrial prototypes for space robotic vehicles, such as the Mars Lander and Lunar Rover. This funding was part of an overall strategy of establishing a Canadian capability to develop, build and eventually operate rovers on the Moon and Mars. Under the Exploration Surface Mobility (ESM) project, CSA has initiated more than 25 contracts to demonstrate the capabilities of prototypes of rovers and associated payloads for the Moon and Mars through field deployments. Terrestrial prototypes of three integrated rovers, two for Lunar Exploration and one for Mars, are being developed and are planned for analogue field deployments. These field deployments will evolve into one or more integrated analogue missions, where science, technical, and operational elements of a space mission will be simulated, tested, and validated in appropriate analogue field settings.