26 January 2017

English only

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Fifty-fourth session
Vienna, 30 January-10 February 2017

International cooperation in the peaceful uses of outer space: activities of Member States

I. Introduction

1. In the report on its fifty-third session, the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space recommended that the Secretariat continue to invite Member States to submit annual reports on their space activities (A/AC.105/1109, para. 36).

2. In a note verbale dated 29 July 2015, the Secretary-General invited Member States to submit their reports by 17 October 2016. The present note was prepared by the Secretariat on the basis of a report received in response to that invitation.

II. Reply received from a Member State

Canada

[Original: English]
[26 January 2017]

International Space Activities 2016

2016 marked a year of notable achievements for the Canadian Space Agency (CSA). Some highlights from Canada's year in space include: the launch of our Maritime Monitoring and Messaging Microsatellite (MsMSat); the 15th anniversary of Canadarm2; the selection of David St-Jacques for Canada's 3rd long-duration mission to the ISS; the kick off of our 4th astronaut recruitment campaign; Canada's 1st participation in an asteroid sample return mission; and the announcement of Canada's national Space Strategy set to launch in June 2017.

National Space Policy and Governance

Canada will launch a national Space Strategy in June 2017. This future Strategy will clearly articulate the role of the space sector in the Government of Canada's broader plan to drive innovation and socio-economic growth. It will also set out the

direction of Canada's future space program, with the aim to drive broader economic growth and leverage the benefits of space for all Canadians through space research and innovation. The publication of the Space Strategy is a clear expression of Canada's aspirations and ongoing commitment to advancing space exploration, science and technologies today and into the future.

The International Space Station (ISS)

Canada's contribution of the Mobile Servicing System (Canadarm2, Dextre and the Mobile Base System) continues to perform a variety of operations ranging from resupply, maintenance and service tasks critical to the operations of the ISS, including the replacement of two full banks of batteries. Canadarm2 was also used to capture, manoeuvre, unload and release four U.S. commercial vehicles (Orbital-06,SPX-8, SPX-9, Orbital 5) and one Japanese (HTV-6) cargo vehicle.

Human health and medical science remain Canadian priorities for the utilization of the ISS. Canada's study, the Life Science Research System (LSRS) consists of a new research platform composed of space health technologies that will be deployed on the International Space Station to support the identification, characterization and mitigation of risks associated with human spaceflight. The system includes two bio-diagnostic technologies:

- Bio-monitor: an instrument which can perform real-time and on-orbit monitoring of crewmember's physiological parameters, and
- Bio-analyzer: an instrument which can perform near real-time and on-orbit analysis of molecules and cells from biological samples.

The deployment of these payloads on the ISS is scheduled for 2018 and 2019 respectively.

In addition, Canada is currently operating four scientific studies on the ISS:

- T-Bone — uses state-of-the-art imaging methods to study the microstructure of the bones of ISS crew, in order to better understand the effects of weightlessness on bone strength,
- Marrow — study of red blood cell metabolism; it uses pre- and post-flight magnetic resonance imaging to understand dynamics of the cells that produce red blood cells, and also measures several parameters of red blood cell formation and destruction,
- At Home in Space — social psychology study that determines how study participants develop their own space culture during their tenure as ISS crew. This question is relevant to the mechanisms of adaptation to the isolation of space, and
- Vascular Echo — measures changes in the structure and function of the heart and blood vessels during space-flight, to better understand potentially dangerous changes in blood vessel structure and in cardiovascular metabolism.

In 2016, Canada also implemented an operational space medicine study named RadiN2. This study uses Canadian technology to measure the incidence of energetic neutrons within the ISS.

Human Space Flight

In May 2016 Canada announced the selection of Dr. David Saint-Jacques as the Canadian astronaut assigned to Canada's 3rd long-duration mission to the ISS. Dr. Saint-Jacques will be a member of Expedition 58/59, planned to launch in

November 2018 on a Soyuz vehicle from Baikonur, Kazakhstan. This will be his first mission and the 17th Canadian spaceflight.

In June 2016, Canada launched its fourth astronaut recruitment campaign. The CSA is seeking to recruit two new astronauts by the summer of 2017, bringing the Canadian astronaut corps to four active astronauts. The new recruits will join the National Aeronautics and Space Administration (NASA) Astronaut Candidate (ASCAN) Course in August 2017.

Space Atmospheric Sciences

The CSA continues to support Canada's SCISAT satellite and instrument operations. Its two instruments (ACE) continue to produce high-quality data to better understand and quantify global ozone chemistry, and ozone-depleting substances in the Earth's atmosphere. SCISAT continues to be used as a space monitoring asset for the UN Montreal Protocol that bans ozone-depleting substances. Data from the satellite have been used by the Intergovernmental Panel on Climate Change (IPCC) in their Fifth Assessment Report, contributing important information leading to the Paris Climate Change Agreement signed by the Government of Canada in 2016. With over 70,000 orbits completed and over 100 international institutions referencing SCISAT data in their publications, SCISAT remains an essential source of data for climate scientists worldwide.

The CSA also continues to support Canada's Optical Spectrograph and InfraRed Imaging System (OSIRIS) instrument on board the Swedish Odin satellite. It measures stratospheric ozone, aerosols in the upper troposphere and stratosphere, and nitrogen dioxide (NO2) in the stratosphere to improve air quality forecasting. The data quality of OSIRIS has become internationally recognized, is highlighted in United Nations Ozone Assessment Reports, and is also used to monitor effects of the United Nations Montreal Protocol on eliminating ozone depleting substances (ODSs).

In June 2016, Canada's Greenhouse Gas Satellite (GHGSat) was launched, providing innovative new space-based capability to monitor greenhouse gas and air quality gas emissions from industrial sites. The privately-owned and operated satellite has already made over 500 measurements and should contribute to the global fight against climate change.

Planetary Exploration

In September 2016, NASA launched the Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-REx), which will study the asteroid "Bennu" and bring a sample back to Earth. Canada is providing the OSIRIS-REx Laser Altimeter (OLA) — a sophisticated laser-based mapping system designed and manufactured by Canadian companies MacDonald, Dettwiler and Associates Ltd. (MDA) and Optech. OLA will be used to create unprecedented 3D maps of the asteroid to help the mission team select a site from which to collect the sample.

In October 2016, the CSA approved a second mission extension for operation of Canada's Alpha Particle X-Ray Spectrometer (APXS) on-board NASA's Curiosity rover, which has been on the surface of Mars since August 2012. The APXS instrument continues to support scientists in determining the chemical composition of Martian rocks and soil.

The CSA continued to actively participate in the International Space Exploration Coordination Group (ISECG). This included the development of a document entitled "Scientific Opportunities Enabled by Human Exploration Beyond Low-Earth Orbit"

and the release of two detailed technology gap assessment reports related to implementation of the ISECG Mission Scenario.

Space-Based Astronomy

The Government of Canada continues its support for the James Webb Telescope project, a partnership between NASA, the European Space Agency (ESA) and the CSA. The partners are working towards a 2018 launch date. Canada is providing the Fine Guidance Sensor (FGS), a critical element of the mission used for extremely precise pointing of the telescope, and the Near-Infrared Imager and Slitless Spectrograph (NIRISS).

The CSA continued its collaboration with the Indian Space Research Organisation on ASTROSAT. Canada led the development of Canadian detectors for UVIT, the twin UV and visible imaging telescopes on India's ASTROSAT, which was successfully launched in September 2015.

Canada is a partner in BRITE Constellation with Austria (University of Vienna and Graz University of Technology) and Poland (Copernicus Astronomical Center). The constellation observes the most luminous stars, including massive blue stars. As of 2017, five of the six BRITE satellites are operational.

Space Weather

Canada’s proximity to the magnetic North Pole makes it vulnerable to space weather while also making its landmass among the best places in the world to study the effects of space weather. Space weather science is still in its infancy and requires world-wide ground and space-based observations to develop models that will ultimately contribute to detection and mitigation of risks.

The Geospace Observatory (GO) Canada initiative takes advantage of Canada’s geographic access to the auroral oval to observe geospace using ground-based instruments deployed throughout Canada. The data acquired by these instrument arrays is openly available to scientists worldwide.

Canada is a partner in European Space Agency’s Swarm mission (launched in 2013), designed to precisely measure the magnetic fields generated by the Earth’s core, mantle, crust, oceans, ionosphere and magnetosphere. Canada contributed the Electric Field Instruments (EFI) for the three satellites. The instruments were designed and built by COM DEV based on previous work done by the University of Calgary. Supported by the CSA, the University of Calgary continues to use measurements from the EFIs to learn about the influence of space weather on the Earth’s space environment.

Successful launched in 2013, the Canadian satellite CASSIOPE, with its Enhanced Polar Outflow Probe (ePOP) mission aboard, observes the Earth’s ionosphere to study space weather effects. The ePOP mission is driven by the University of Calgary in close collaboration with other Canadian Universities, the Japanese Space Agency (JAXA) and the US Naval Research Laboratory. In 2016, the ePOP team continued to measure particle densities in the ionosphere, observe the aurora in the infrared, measure the magnetic field, and carry-out a number of radio propagation investigations in partnership with more than 20 countries. Starting in 2017, the CASSIOPE spacecraft will coordinate its observations with the 3 Swarm satellites to better understand the mechanisms that drive the Earth’s magnetic field.

Finally, Canada is leading discussions/negotiations among the new expert group on space weather reporting to the Science and Technology Subcommittee of the Committee on the Peaceful Uses of Outer Space.

Space Situational Awareness

Canada's Department of National Defense (DND) continues to operate the Sapphire satellite, an operational space-based space situational awareness (SSA) sensor. It currently contributes 2000-3000 metric observations per day on deep-space objects to the larger US-led Space Surveillance Network which helps to ensure the safety of objects in Earth orbit. Sapphire's performance has been better than expected and it is quite likely that it will continue to be operated well beyond its designed lifespan of 2018.

Private SSA-related initiatives based in Canada include upgrades to the Algonquin Radio Observatory to add radar capability for tracking of deep space objects out to geostationary orbits, an activity led by Canadian company Thoth Technology Inc. In addition, the Resolute Bay Observatory — home to University of Calgary's Resolute Bay Incoherent Scatter Radar (RISR-C) — provides detailed measurements to support the study of coupling of space environment and atmospheric phenomenon while also having applications in space object tracking. Finally, several Canadian universities are collaborating with international colleagues in "all-sky camera networks", collecting observations on incoming debris/meteorites for logging and recovery purposes.

Canada collaborates with the international community through participation in the Inter-Agency Debris Coordination (IADC) committee international Space Situational Awareness Workshops, and several Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee subgroups, including on the Working Group on the Long-Term Sustainability of Outer Space Activities.

Earth Observation

In addition to the systems mentioned Space Atmospheric Sciences section of this document, in June 2016, the Canadian Maritime Monitoring and Message Microsatellite, M3MSat, was launched, a joint collaboration between Defense Research and Development Canada (DRDC) and the CSA. The mission provides space-based automatic identification system (AIS) to improve Canada's ability to detect and manage marine traffic. The technology supports the monitoring of maritime borders, facilitates search-and-rescue and reduces the risk of collisions at sea.

The CSA continues to support a large number of R&D activities using RADARSAT-2 data at both national and international levels through various CSA's Earth Observation applications development initiatives. Canada also provides unique datasets from RADARSAT to support GEO flagship programs in agriculture, forest and also disaster and polar-related initiatives.

Canada, through the CSA, continues to contribute to the Committee on Earth Observation Satellites (CEOS). In addition to contributing its expertise, Canada chairs the Working Group on Disasters and, under Canada's leadership, the overarching goals of this group are to increase and strengthen satellite EO contributions to disaster risk management and to inform decision-makers and major stakeholders on the benefits of using satellite EO.

Planning for the future, SAR Data continuity remains priority. Canada's RADARSAT Constellation Mission (RCM) is undergoing assembly, integration and testing of the three-satellite suite, ready to launch in 2018. RCM represent an evolution of the RADARSAT Program and aims to ensure C-Band Synthetic Aperture Radar (SAR) data continuity to national and international users and to provide new applications enabled by the constellation approach.

Collaborative Agreements

Canada has collaborative agreements to further develop bilateral and multilateral cooperation in space activities with other countries. In 2016, Canada established or renewed a number of collaborative arrangements.

Canada and CNES (France) signed several agreements to collaborate on the provision of Tracking, Telemetry and Control (TT&C) services for launches from French Guyana.

Canada renewed its contribution to NASA's Themis Mission (2016-2018), which provides scientific data about the Earth's magnetosphere. The Canadian contribution consists of ground-based measurements which are used to calibrate results obtained through the satellite mission.

Canada and the US renewed an Umbrella Agreement to provide mutual crew support services to astronauts. This agreement has allowed Canadian and American astronauts to work in close collaboration.