



# Status – Space Exploration at the Canadian Space Agency

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# Profile

Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information

2010-2011 Budget of about \$400 million  
(incl. Robotics/Lander Stimulus Initiative & RADARSAT Constellation funds of ~\$100M)

672 employees; 100 contract workers; 200 students

Headquarters: John H. Chapman Space Centre

David Florida Laboratory

Satellite offices: Ottawa, Washington, Paris, Houston



# CSA Context

■ Strategic Outcome

Canada's exploration of space, space services and space capacity address the nation's needs for knowledge, innovation and information

■ Program Activities

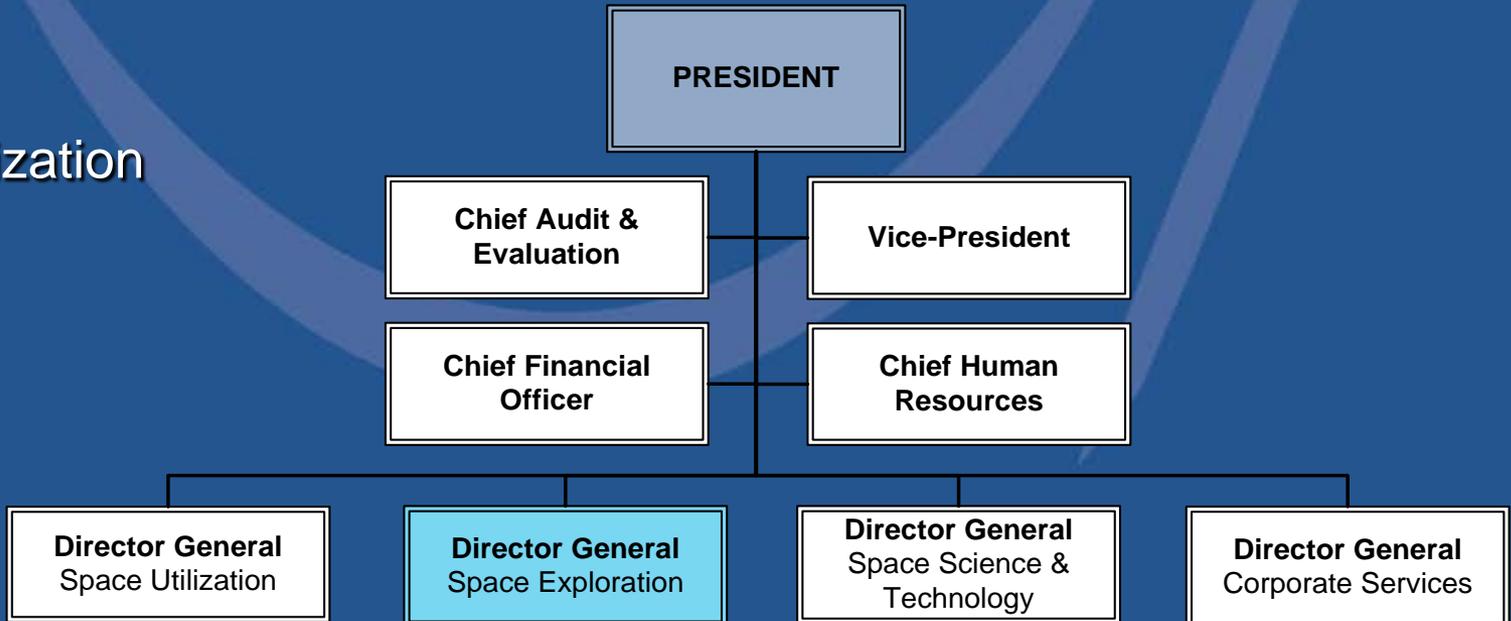
Space Data, Information and Services

Space Exploration

Future Canadian Space Capacity

Internal Services

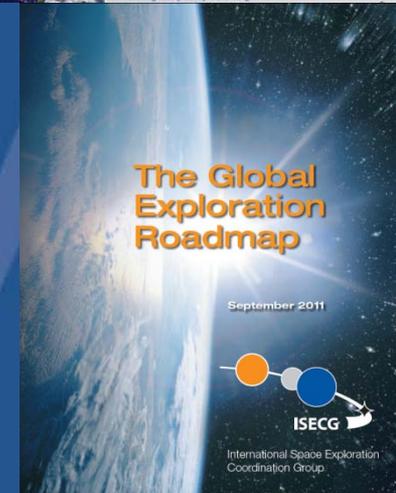
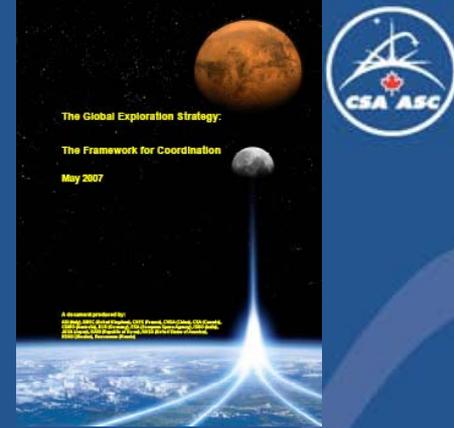
■ CSA Organization





# International Context

- Global Exploration Strategy 2007
  - ◆ Human and science exploration
    - ◆ Moon, Mars, Asteroid, Lagrange's Point
- Int'l Space Expl. Coord. Group (ISECG)
  - ◆ Mainly human exploration but include science objectives
  - ◆ Extend human presence beyond LEO
    - ◆ Long-term goal: human on Mars
- Convergence of robotic and human exploration
- Budget constraints in most countries
  - ◆ Demonstrate benefits to peoples



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# Space Exploration in Canada

Economic prosperity and terrestrial use of innovations developed for space exploration

Inspiration of Canadians and pride in Canada

Strengthened international reputation as an advanced nation in science and technology



Greater knowledge of space through science

Greater capacity to use and develop space peacefully



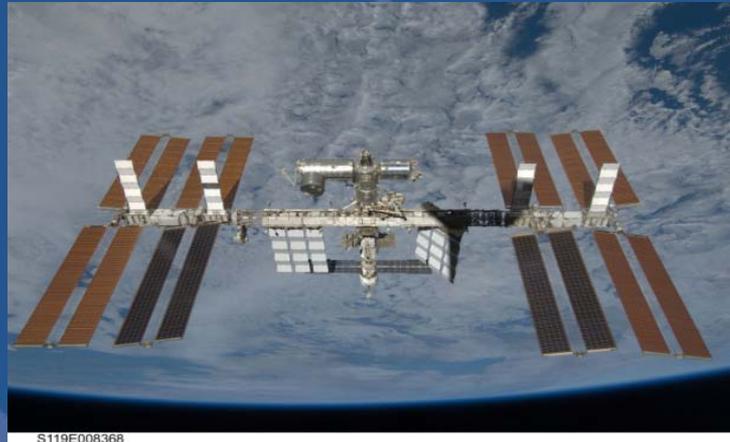
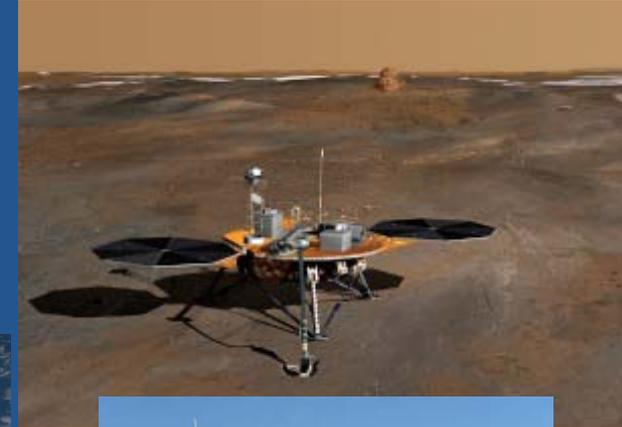
Space Exploration Missions

## ■ To gain knowledge

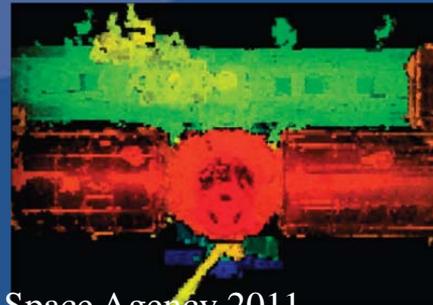
- ◆ about the solar system and the universe
- ◆ to support the expansion of human presence in the solar system

## ■ How?

- ◆ With robots
- ◆ With humans



# 30 YEARS OF INVESTMENTS





# Int'l Space Exploration Missions

LEADS: Canada China Europe India Finland (FMI) Japan Russia US US (comm.)

**Space Astronomy**

GAIA HXMT TANSUO Euclid Cosmic Vision (M-class) Cosmic Vision (L-class) JWST NuSTAR SAMURAI GEMS ASTRO-H Plato Cosmic Vision (M-class) SPICA Spektr R NEOSat AstroSat Spektr RG Spektr UV Millimetron Gamma 400 BRITE BRITE BRITE BRITE BRITE

**Planetary Exploration**

**Moon**

LADEE Luna-Globe Luna-Resource 2 Selene 2 Lunar Lander Lunnyi Polygon GRAIL Chang'e 3 Google Lunar X-Prize Chandrayaan-2/Luna-Resource Chang'e 4 Chandrayaan-3 Chang'e 5 Selene 3 New Frontiers 4

**Mars**

MSL MAVEN ExoMars (TGM, EDM) ExoMars (Lander, MAV) MetNet MELOS Mars-Grunt Phobos-Grunt/Yinghuo-1

**Asteroids**

Hayabusa 2 OSIRIS-Rex (New Frontiers 3)

**International Space Station**

Human spaceflight missions (~ 4 launches/year)

ISS Utilization

Canadian Astronaut



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# Canada Exploration Destinations

- Near Earth Orbit
  - ◆ Focus on ISS & on-orbit robotics
- Beyond Earth Orbit
  - ◆ Robotic exploration of Mars
  - ◆ Robotic and human exploration of the Moon
  - ◆ Opportunistic missions to asteroids & other planetary bodies
- Solar System & the Universe
  - ◆ Using astronomy



# Canada Expl. Objectives (1/3)

## ■ Full use of ISS

- ◆ Operate MSS and support astronaut flights
- ◆ Life & health science to support human space flights
- ◆ Advance technologies & Ops for exploration

## ■ Space Robotic Servicing

- ◆ Perform in space maintenance and assembly
- ◆ Prepare for future large exploration mission
  - ◆ e.g. Mars Sample Return, human exploration



# Canada Expl. Objectives (2/3)

## ■ Planetary Exploration

- ◆ Mars 2016 (Matmos), 2018 (vision, manipulator), Mars Sample Return (>2020)
- ◆ Moon: Lunar Lander, Sample Return, ISRU
  - ◆ Robotic technologies: rover, manipulator, vision, drilling
- ◆ Asteroid: Sample Return (Osiris-REX)

## ■ Space-Based Astronomy

- ◆ JWST, UVIT, ASTRO-H, Euclid
- ◆ Dark Matter



# Canada Expl. Objectives (3/3)

- Human Exploration Beyond Leo
  - ◆ Work through ISECG
  - ◆ Focus on the Moon – permanent presence
- Public Participation
- Signature Technologies
- Commercial Activities





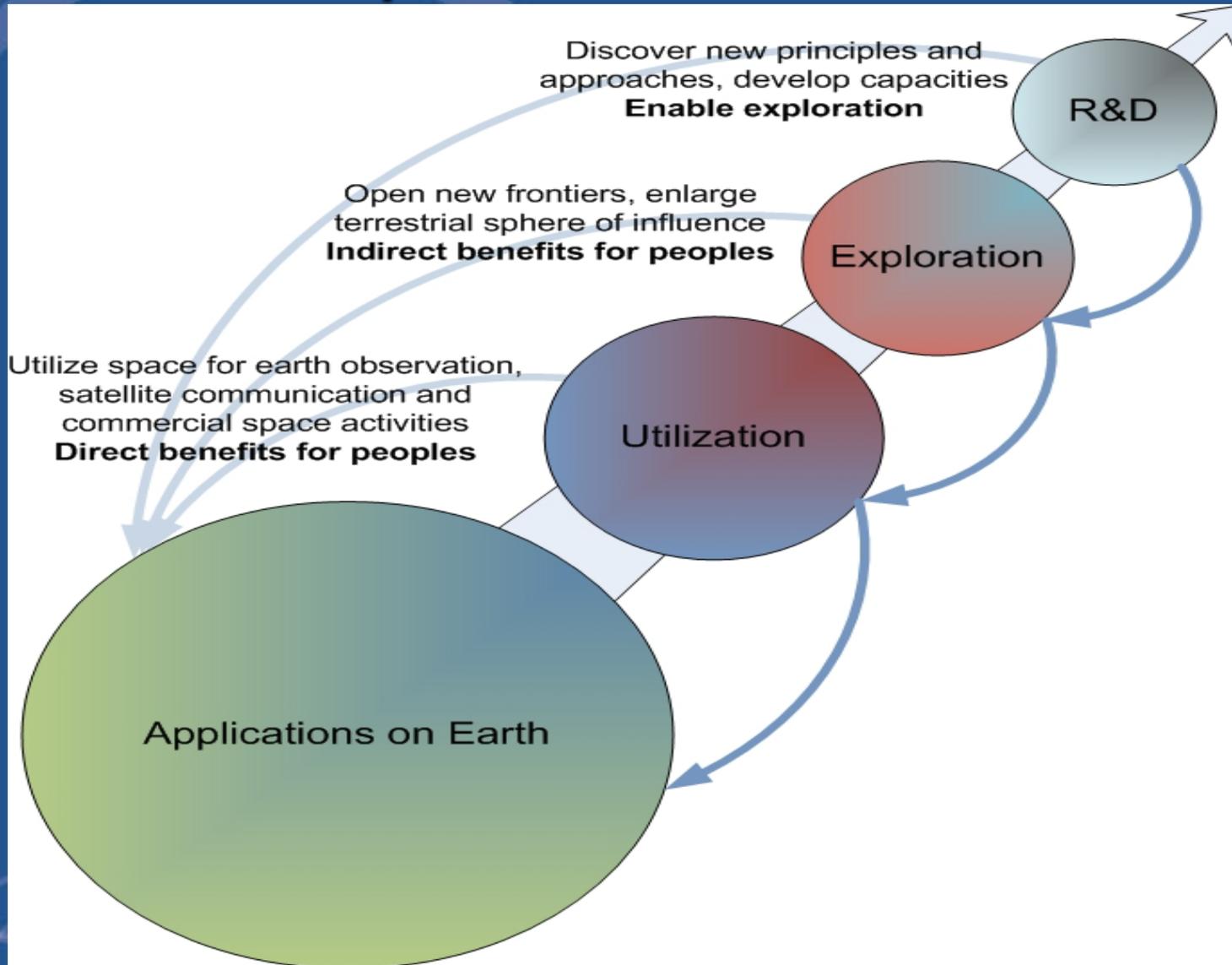
# Guiding Principles

- Generate Benefits for Canadians
- Goal Driven
- Technology Enabled
- Partnership
- Robustness and Sustainability
- Visibility and Pride
- Balance Portfolio.





# From Exploration to Utilization

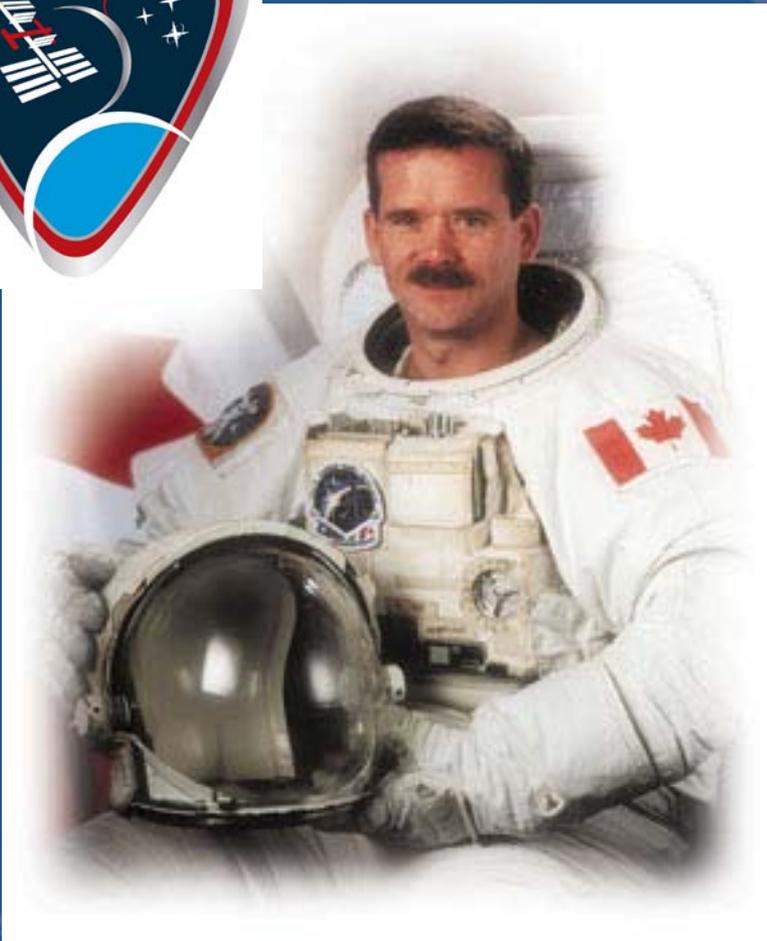


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SPACE EXPLORATION



# Canadian Astronauts

Chris Hadfield  
ISS Nov 2012 – 6 months



New Astronauts  
Jeremy Hansen,

David Saint-Jacques **Canada**





# Final remarks

- CSA focus on Space Exploration
  - ◆ Combine science and human exploration
  - ◆ Strategic Exploration Plan under development
  - ◆ Signature Technologies help to focus
  - ◆ Preparatory activities are essential
- CSA active in developing terrestrial prototypes for space exploration
  - ◆ Strong involvement from Cdn industry and academia
- Contributing to int'l space missions
- International collaboration is key
  - ◆ Analogue mission is a starting point