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Go Pro: ISM Balloon Launch 2017

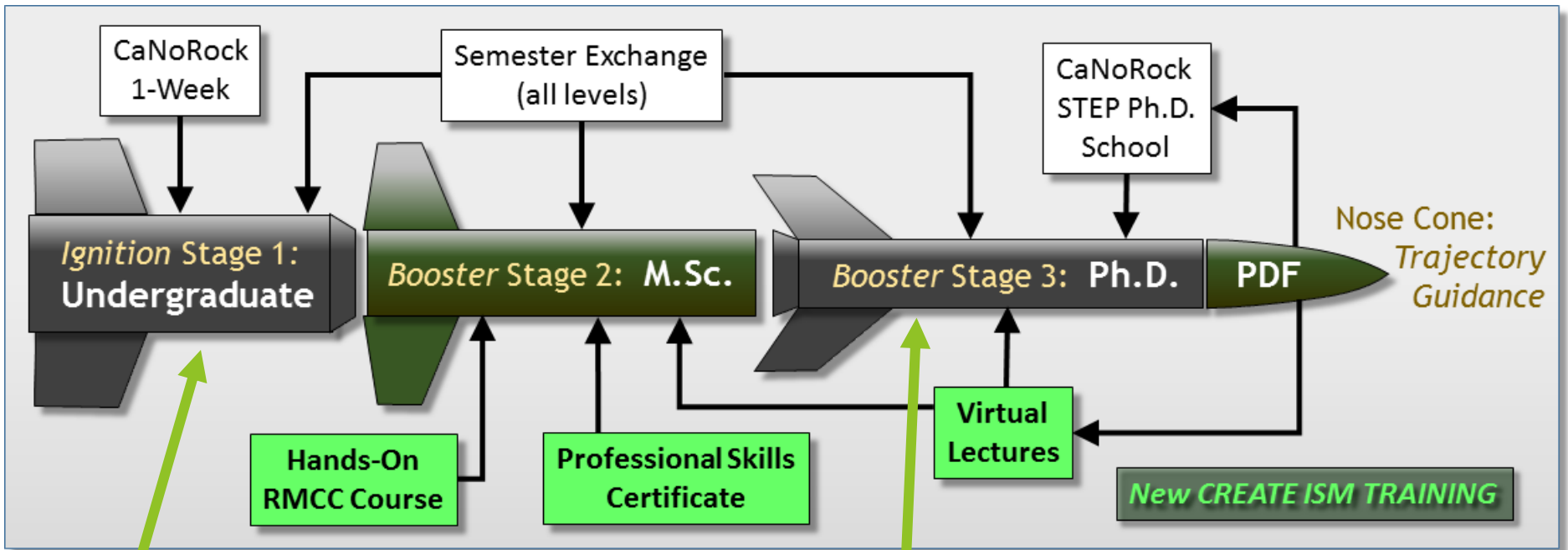
# The International Space Mission: A Canada-Norway Collaborative Training Program

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# International Space Mission Training:

## A Ladder of Training Opportunities



CaNoRock Undergrad poster ED43C-1110

CaNoRock STEP PhD poster ED43C-1111

# Overview of Program



NSERC CREATE Funding for Innovative HQP Training

## International Space Mission Training Program

Space Mission Training

RMC 547

RMC 549

Professional Skills Certificate

GSR 974

GSR 984

# Typical ISM Program

## 2 Year M.Sc. Degree

Term 1 (fall)	Term 2 (winter)	Term 3 (spring)	Year 2
<p>Thesis research courses</p> <p>Canadian student exchange option to Norway</p>	<p>RMC 547: Space Mission Analysis</p> <p>Norwegian Student exchange option to Canada</p> <p>Professional Skills</p>	<p>RMC 549: Space Mission Design and Balloon Launch at U. Saskatchewan</p> <p>Professional Skills</p>	<p>Additional Course work as required</p> <p>Thesis Research and Writing</p> <p>ISM CREATE Support for Conference Attendance</p> <p>ISM CREATE Support for Field work travel</p> <p>Internship opportunities...</p>

# Space Mission Analysis (PH 547)

- **Technical Learning Objectives:**
  - Satellite design is iterative process
  - Design driven by scientific objectives but constrained by budgetary and technological requirements
  - Systems design modules: power, propulsion, attitude determination and control, thermal control, navigation and communications, ground station.
- **Non Technical Skill Development:**
  - Scientific writing (Deliverables: 6 research reports)
  - Literature review
  - Option analysis
  - Group work
  - Integration of professional skills development

# Space Mission Design (PH 549)

- **Intensive and immersive 3-weeks course**
- **Overarching Technical Themes:**
  - Implement satellite design studied in Space Mission Analysis (PH547)
  - Simulate cubesat mission using strat. balloon; payload weight < 2 kg
  - Architecture based on Arduino type micro-controllers and sensors
- **Non Technical Skill Development:**
  - Scientific writing
  - Problem solving, ranging from technical to group dynamics
  - Integration of professional development skills
  - Self-directed learning
  - Peer mentorship



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launched third [@NSERC\\_CRSG](#) [#CREATE](#) International Space Mission Training Program payload just outside [#yxe](#) [@usask](#) [#infinityandbeyond](#) [#outstandinginourfield](#) [#STEM](#) [#rocketscience](#)



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# Launch & Recovery

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# Professional Skills Certificate Integrated into ISM Training:

- **Ten Skills Domains:**
  - Critical and Creative Thinking
  - Reflection and Intrapersonal Skills
  - Professionalism, Ethics, Integrity
  - Communication
  - Interpersonal Skills
  - Intercultural Competence
  - Leadership
  - Career Development
  - Wellness and Life Balance
  - Research and Project Management

# ISM Pedagogical Goals:

- Simulate challenges and responsibilities faced during a space mission
- Integrate space mission theory and professional skills into practical space mission
- Give students control over the management of their project
- Create a less grade-oriented atmosphere
  - encourage creativity and reduce fear of failure
- Use feedback from previous students to improve course delivery and student learning

# Professional Skills: Final Presentations



GPS 974-984  
 CREATE Professional Skills Program  
 Final Poster



### Mission Statement:

From the ever exciting infinite variety and complexity observed in the universe, my perspective allows patterns to emerge. I collect information to then distill and share it through strategic and creative communication, which it is my mission to improve. Connections through capable communication allow new ideas to flow from others to myself and back, improving upon each iteration. Innovation then energizes me to overcome barriers, both internal and external, in continually creative ways so that the cycle can continue...



...The skills in absorbing information and refining through intellection I already possess can only further the ideas they beget, as long as I turn them into action through application of the professional skills I've chosen to focus on: critical and creative thinking, communication, and work-life balance. These shall ensure that I stay moralized, find purpose, and never stop learning, except during times of necessary recharging. Ignorance to competence to finesse is a path I intend to follow again and again, not just in my field but in my life philosophy, so that I am able to guide others in doing the same and accept their guidance in return.

**Summer Seminar**

Presented by the Faculty, June 2-4 in Phoenix AZ for our 100th celebration. It was a great experience with speakers from various fields.

The seminar had a lot of interesting speakers and topics. I was able to learn a lot from the speakers and the topics were very relevant to my field.

I will be looking forward to the next seminar and will be sure to bring a poster to share with everyone.

### Mission Success?

"This was a great learning experience with communication, but through it I also learned about what could possibly be leadership."

"Despite being my longest solo presentation ever given, it went by without a twinge of panic from me"

"I've found how to express my awe at the beauty of what I study in a creative but practical way."

"Although in a different context than my usual university work, it nevertheless applies the same skills as say, a poster presentation for example."



# Successes, Strengths and Weaknesses

- Student feedback extremely positive, overall
- 40% of trainees have been women
- CREATE grads have gone on to start businesses in space and other industries
- Student learning and growth has been considerable
- Students are resistant to take risks
  - (c.f. traditional Physics/Engineering course experiences)
- Students struggle with written communication in Space Mission Analysis course - scientific writing
- Time management by students continues to be an issue (both for analysis and design courses)

# Conclusions: For Students

- Student feedback and our teaching experiences show:
  - Degree programs provide students with adequate “technical” skills
  - But “soft” skills required to be an effective professional (academia or industry) are missing from their training
  - Traditional graduate programs are lacking in holistic training
- Through the ISM students:
  - Are given opportunity to develop these skills
  - Gain experience working in multi-national group of students with a variety of undergraduate backgrounds and technical skill levels

# Conclusions: For Instructors

- From a teaching standpoint this program has been both rewarding and challenging.
- It has highlighted the challenge of finding pedagogical resources and training for science and engineering faculty.
- This program has highlighted that students are not usually given a chance to fail, in both their undergraduate and graduate degrees.
- Learning through failure is a keystone of the scientific and design process.
- **Reducing fear of failure and encouraging student creativity has become a central goal of this program.**

# Space Mission Training Opportunities

NSERC CREATE provides \$1.65 million over 6 years, with 80% for student stipends (for all ISM partner universities)

Additional stipend support provided by  
University of Saskatchewan

Opportunity for semester exchange with Norway  
and other countries

<http://spacemissiontraining.ca>







# Space Landscape

## Space Environment

- Space weather
- Space debris
- Communications
- Near-Earth Objects (asteroids)
- Space situational awareness

## Access to/Use of Space

- GPS
- Earth Observation
- Communication

## International Cooperation

- Scientific satellites
- International Space Station (ISS)
- Mitigates risk of high cost, complex missions
- "The Global Exploration Strategy: The Framework of Coordination"

## Funding Priorities for Space

- Government funding increasing
- Ongoing commitments to exploration and ISS
- Spin-offs, technological developments

## Public-Private Ventures

- Need for national security
- Need for competitive industrial base
- Increasing reliance on commercial flights for military

## Space Policies & Laws

- 1967 *Outer Space Treaty*
- National policies to support socioeconomic, research and technical improvements
- Focus on cooperation
- National space policies developed
- Multilateral forums for governance

## Commercial Space Industry

- Growing
- Satellite market
- SpaceX supplies ISS
- Space tourism (*SpaceShipTwo*)
- Asteroid mining

## Military Systems in Space

- Integrated into nearly all military operations
- Real-time tactical
- Weapons guidance
- Communications

## Security of Space Systems

- Vulnerable communications (broadcast and ground stations)
- Direct threats to satellites
- Requires capability to rebuild (faster, smaller, cheaper)

adapted from 2013 *Space Security Index Report* (<http://swfound.org/resource-library/space-security-index/>)