



# Western

Institute for Earth  
& Space Exploration

**2021 Annual Report**

*To launch Western into space and bring space down to Earth for the benefit of all Canadians.*

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### List of Abbreviations

Western Space	The Institute for Earth and Space Exploration	CSA	Canadian Space Agency
BOG	Governing Board	NSERC	Natural Sciences and Engineering Research Council
PLANETSCI	Collaborative Training Program in Planetary Science and Exploration	RAC	Research Advisory Committee
CFI	Canadian Foundation for Innovation	Schulich	Schulich School of Medicine & Dentistry
CRC	Canadian Research Chairs Program	SGPS	School of Graduate and Postdoctoral Studies
EXEC	Executive Committee	NASA	National Aeronautics and Space Administration
ESA	European Space Agency	WRC	Western Research Chair
STEM	Science, Technology, Engineering, Math	EO	Earth Observation
IQAP	Institutional Quality Assurance Process		

## Section 1.0 – The Institute at a Glance

The Institute for Earth and Space Exploration at Western University is the leading organization for Earth and space exploration research and research training in Canada. The mission of the Institute is to collaboratively address the grand challenges faced by humanity and, through research and innovation, generate solutions using space technologies and breakthroughs.

Vision	To launch Western Into space and bring space down to Earth for the benefit of Canadians.
Mission	To advance the scientific understanding of space from the Solar System to the Universe beyond and to address humanity’s grand challenges using space systems and technologies.
Mandate	To support and develop an environment that fosters collaborative research, innovation, and capacity development in the space domain.

To learn about Western Space’s past accomplishments or its current strategic plan please visit: <https://space.uwo.ca/>.

## Section 2.0: Acceleration of Research Success & Innovation

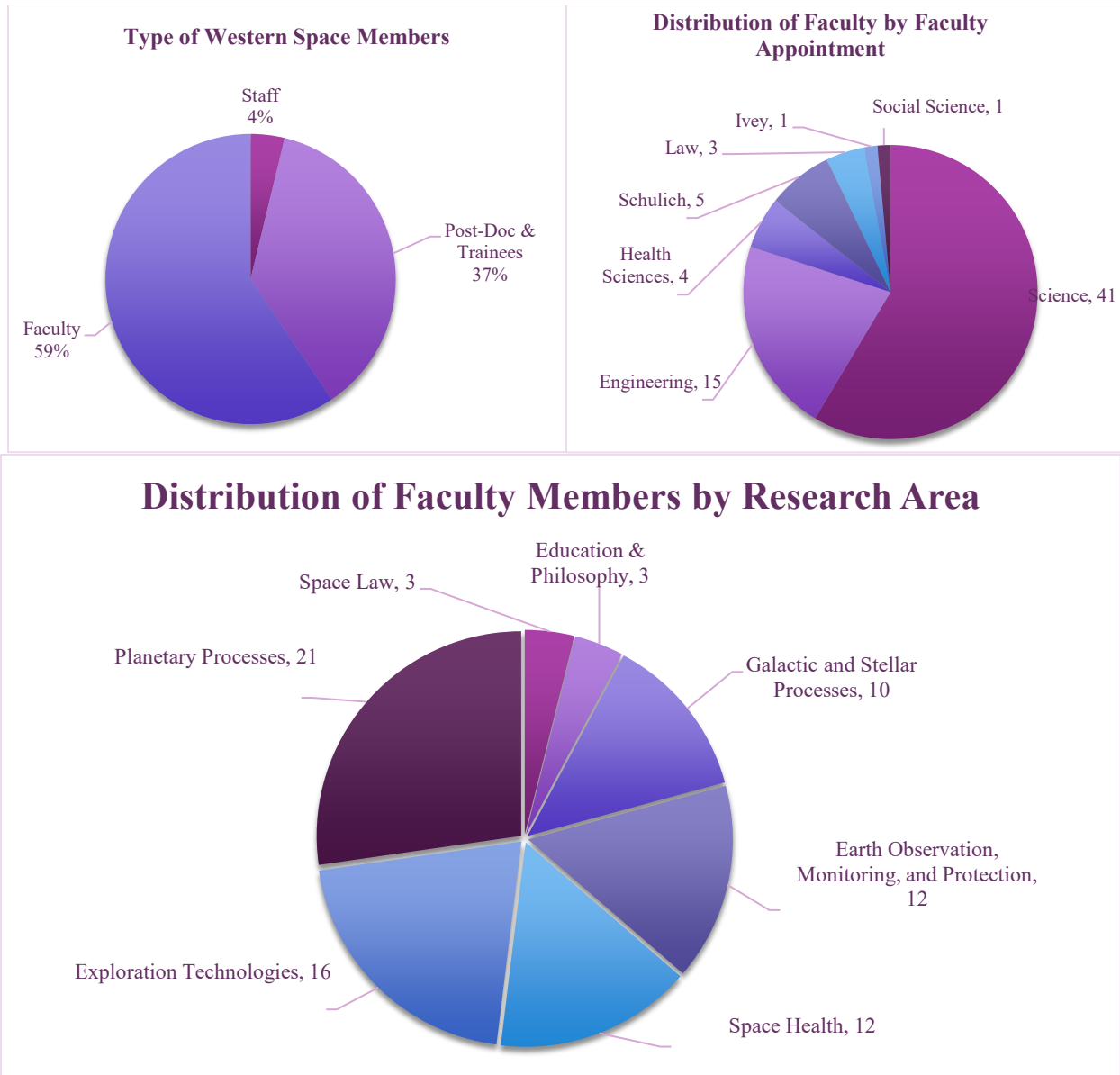
The 5-year strategic goals for acceleration of research success and innovation are to:

- a) Remotely explore and characterize the Solar System and the Universe beyond.
- b) Contribute to the sustainable human exploration of the Moon, Mars and beyond.
- c) Bring the benefits of space science and technology down to Earth.
- d) Ensure that the Canadian space program has the human capacity to deliver Canada’s Space Strategy and expand opportunities in Canada for our trainees.
- e) Inspire the next generation of Canadians to develop their space science literacy and to pursue careers in STEM fields.

### 2.1 – Strength Through Interdisciplinarity - Our People

#### Membership Description

Welcome packages were distributed to 4 new faculty members. The Western Space membership grew from 100 people in 2020 to 109 in 2021 including 66 faculty, 38 trainees, and 5 other members including: partners, collaborators, and staff (<https://space.uwo.ca/people/index.html>). The graphics below display the types of members, distribution across partner Faculties, and alignment to Western Space research areas.



### Prestigious Awards & Recognitions

Western Space members holding prestigious awards include: 6 Research Chairs (3 Endowed/Industry-funded), 4 Fellows of the Royal Society of Canada, 3 Distinguished University Professors, and 3 Faculty Scholars.

### Recruitment of New Stakeholders/Experts

The Western Space research environment continues to support the recruitment of Earth and Space Exploration experts to Western. In addition, we are building relationships with existing faculty members whose research activities are well aligned with space-enabled methodologies. Two research areas targeted for development are Global Animal Migration and Severe Weather. Both domains require extensive and ongoing data collection, particularly in light of changing climate-change impacts. Satellite Earth observation (remote sensing from space) is a powerful tool for

these and other grand societal challenges. This will be a focus for further development going forward.

## **2.2 – Balancing Established & Emerging Priorities – Our Research Initiatives**

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### **Seed Grants Program**

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The purpose of the Western Space Seed Grants Program is to support the initiation of innovative, high-impact, and early-stage projects and enable the leveraging of external funding. All projects in progress were granted an extension to account for challenges created by the COVID-19 pandemic. For a more detailed description about the Seed Grants Program, please visit: [https://space.uwo.ca/research/seed\\_grants.html](https://space.uwo.ca/research/seed_grants.html). In 2020/21, there were 8 submissions to the program. The review committee chose 4 high quality applications (50% success rate).

## **2.3 – Creating Opportunities Today for Tomorrow – Our Growth & Development**

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### **Collaborative Networks & Events**

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#### **Interdisciplinary Research Forum Series**

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The monthly Interdisciplinary Research forums replaced the more traditional weekly academic research seminars approach this year in order to enhance Western Spaces members' knowledge of current research, missions, and opportunities for local and international collaboration. Research Forums typically lasted one hour with one 30 to –40-minute presentation followed by Q&A. All presenters were encouraged to use plain language to support cross-disciplinary engagement. Speakers' goals varied from introducing research priorities/expertise (new members) to providing new perspectives on missions and exploration technology, exploring emerging areas of space study, gaining new perspectives on a problem or methodology, creating new collaborative opportunities, celebrating successes and/or exploring future study ideas. With 8 research forums held in 2021, over 10 presenters had the opportunity to share their work with the Western Space community. A list of topics and presenters is available at <https://space.uwo.ca/events/Western%20Space%20Webinars%20.html>. On average, 17 audience members attended with 10% investigators, 86% trainees, and 4% partners/staff.

#### **Interdisciplinary Research Training**

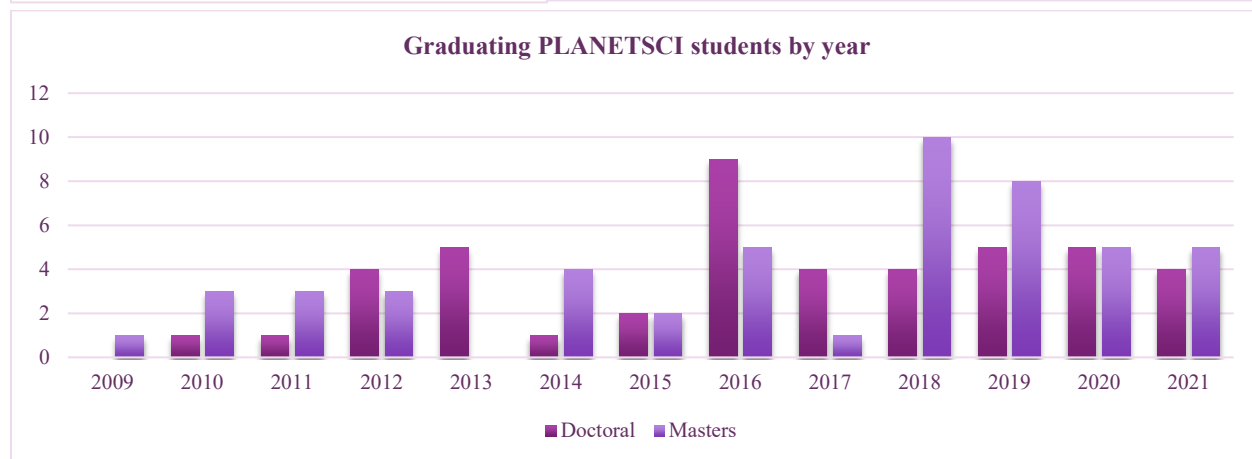
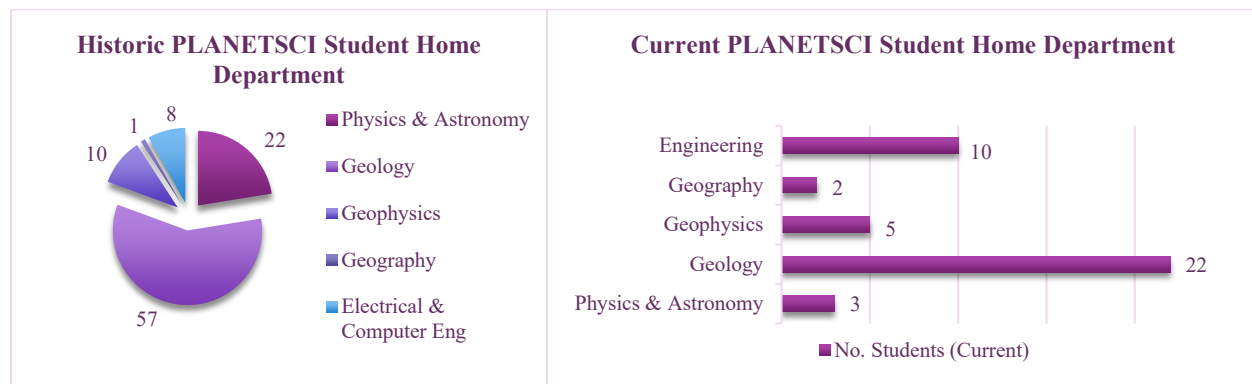
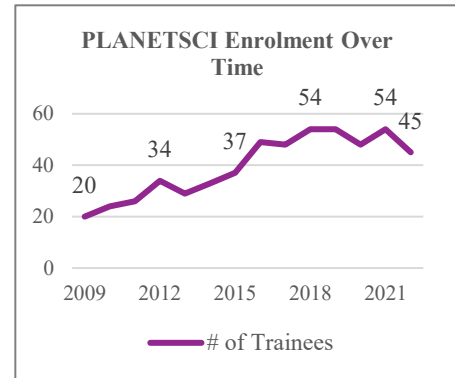
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Western Spaces' mandate to support and develop an environment that fosters collaborative research, innovation, and capacity development in the space domain at the graduate level is accomplished primarily through Western's Collaborative Specialization in Planetary Science and Exploration (PLANETSCI; [https://space.uwo.ca/training/graduate\\_students/index.html](https://space.uwo.ca/training/graduate_students/index.html)). In 2021, despite COVID-19 pandemic-related limitations, PLANETSCI continued its steady growth, bringing its total active students to 38. PLANETSCI also initiated its periodic IQAP (Institutional Quality Assurance Program) review by Western's School of Graduate and Postdoctoral Studies (SGPS) in 2021. This process is comprised of a full program self-study and a review by multiple external consultants that included meetings with trainees, mentors, and the Western Space leadership. The final Senate Subcommittee will meet in the fall of 2022, to consider the program's self-study, the external reviewer's report and the Program's responses. Once approved, recommendations will be considered by the Training and Education Committee and used to inform and amend the Collaborative Specialization's approach. In the meantime, Western Space continues

to proudly support the development of the next generation of Interdisciplinary Space researchers at the postdoctoral, graduate and undergraduate levels. Specific strategic goals identified in 2021 include redesigning student support models to more strategically support experiential learning opportunities for students who would otherwise be unable to experience these enhanced research mission and training activities; and developing an improved plan to offer expanded postdoctoral programming to accelerate trainee career progression post-PLANETSCI (academic and non-academic sectors) and increasing trainees' success rate in external funding competitions.

### PLANETSCI Enrolment & Mentorship

A total of 23 trainees were admitted to PLANETSCI in September 2021. With these new members, program enrolment remains over 42 trainees, indicating continued success in both recruitment and program completion. Notably, over half of the trainees are at the PhD level. Please refer to the graphics in this section for more details about the number and career levels of trainees enrolled in the program over time, as well as information about the location of their previous training and home Faculty. Trainees are enrolled in one of 4 participating home graduate programs. For more information on this specialization please visit the Graduate Student webpage at: [https://space.uwo.ca/training/graduate\\_students/index.html](https://space.uwo.ca/training/graduate_students/index.html).



## Planetary Science Courses

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Western Space has partnered with the Department of Earth Sciences to offer two graduate courses that are mandatory for program completion: PLANETSC 9603 – Planetary Science Short course and PLANETSC 9600 – Planetary Science Graduate Seminar. For a more detailed description including all courses offered through department collaboration please visit: [https://space.uwo.ca/training/graduate\\_students/index.html](https://space.uwo.ca/training/graduate_students/index.html)). Western Space administration, Department faculty and support staff, and the various course instructors worked diligently to modify the curriculum and convert course content delivered traditionally in person to engaging online modules to address student learning and skill development on a virtual platform due to the COVID-19 pandemic.

## Western Space Summer Internship Program

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A full program description including goals, awards, and requirements is available at <https://space.uwo.ca/training/2022%20Summer%20Internship%20Opportunities%20.html>. In 2021, the summer internship program was operated in a remote capacity due to the COVID-19 pandemic. Ten students were chosen from over 150 applicants to participate in supervised individual projects in their area of expertise as well as to collaborate as a larger team on a mission-planning project for Canada's return to the Moon. These students originated from the Earth Science, Law and Policy, Medical, and Engineering fields and brought unique perspectives that resulted in a formal mission plan and subsequent publication from the Faculty of Law. Support for Western Space summer interns will continue to be offered on an annual basis.

## Space Resources Interdisciplinary Development Initiative

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In 2021, Western Space faculty and students from the departments of Law, Business, Earth Science, Electrical and Computer Engineering, and Civil and Environmental Engineering initiated the Space Resources Interdisciplinary Development Initiative (IDI). The purpose of the IDI was to bring together a cross-disciplinary group to conduct initial activities that would lay the groundwork to ensure that Western plays a leadership role in future Canadian space resource development activities. Space resource activities specifically refer to the exploration for and extraction of materials such as water and minerals from the Moon, asteroids, or other planets. A kick-off workshop to discuss the future of space resources and to make connections was hosted virtually. The workshop included speakers from the Canadian Space Agency (CSA), Natural Resources Canada (NRCAN), the Centre for Excellence in Mining Innovation (CEMI), and multiple Canadian industry participants. Students at Western then conducted a detailed SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) framed around the goal of establishing a Canadian equivalent of the European Space Resources Innovation Centre (ESRIC) at Western. Six interns conducted this analysis focusing on the following 4 themes: 1) scientific opportunities and challenges; 2) technology opportunities and challenges; 3) the business case; and 4) law and policy implications. The results of this work are currently being collated into a white paper.

## Section 3.0 – All About the Numbers & Reach

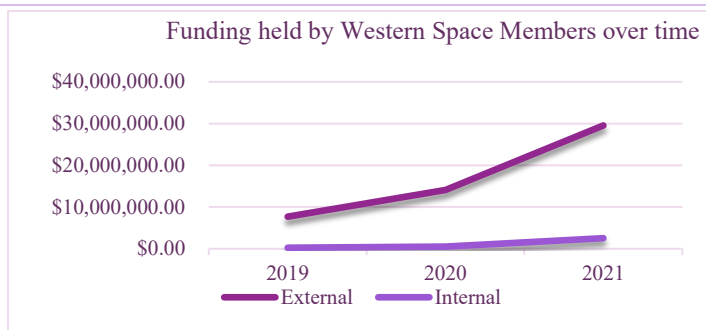
The 5-year strategic goal for knowledge translation is to inspire the next generation of Canadians to develop their space science literacy and to pursue careers in STEM fields. To accomplish this, Western Space has transitioned from a traditional “outreach activities” model toward a wide-

reaching social media driven engagement model while still engaging in high impact events, both as hosts and as partners with the community. In 2021, Western Space ran its “Space Explorers Program” Camps virtually for the second year involving 31 students from 3 provinces in Canada as well as 2 international students during the March break session. The Summer version of this program was also run in a virtual format, to comply with the evolving COVID-19 situation, attracting 108 students from 2 provinces and 2 international students. To maximize impact and best utilize staff resources for 2022 and beyond, Western Space has partnered with Discovery Western <https://www.eng.uwo.ca/outreach/pre-university-programs/summer-camp/index.html> to continue providing this program to a wider audience. Western Space will continue to develop and update the curriculum and materials (as available), while Discovery Western will be managing the delivery of the programming.

### 3.1 – Funding

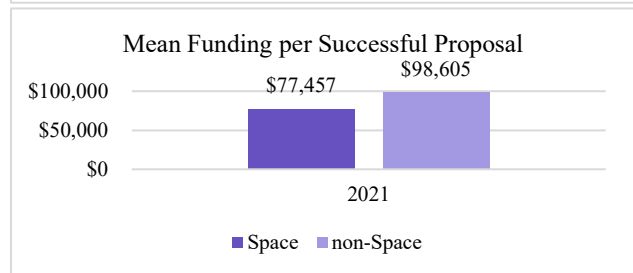
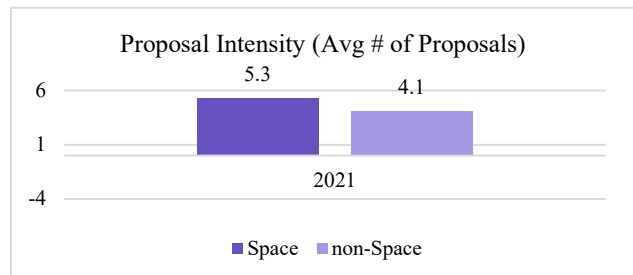
#### All Funding Sources

Despite the COVID-19 pandemic, Western Space members held over 403 external grants and over 127 internal grants totaling over 530 grants. These totaled nearly \$33M in multi-year funding, with over \$29.5 M in external funds and over \$2.5 M in internal funds. *These data do not include grants located at or shared with other Institutions or Institutes.*



#### Tri-Agency Funding Overview

Western Space members submitted a total of 251 Tri-Agency applications in 2021 (5% of all Western submissions), 118 of which were successful for a 47% success rate. Institute members held an average of 3.8 grants/PI compared to 4.1 grants/PI for non-institute faculty with total funding per institute PI at nearly 140K. Western Research funding data for 2021 is incomplete, as several major programs including NSERC Discovery Grants, NSERC Research Tools & Instruments, NFRF Exploration and some CIHR Project Grants are still pending decisions or updates in ROLA (Western’s Research Database).



### 3.2 – Publications & Impact

#### All Member Publications

In 2021, Western Space members published a total of 14 papers associated with Western Space (i.e., an average of 0.2 publication per Western Space member). Six of the total 14 publications

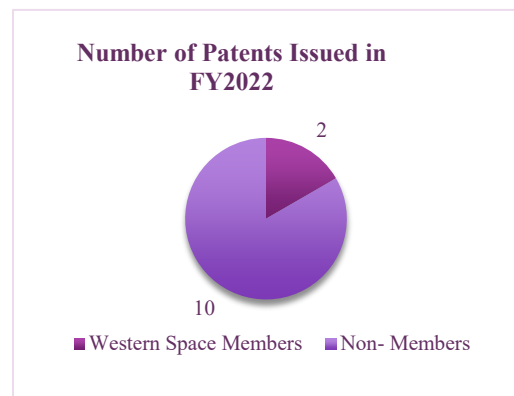
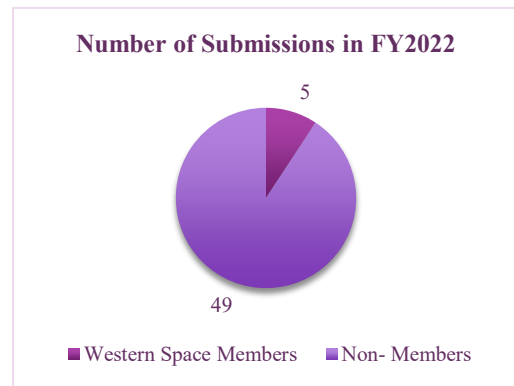
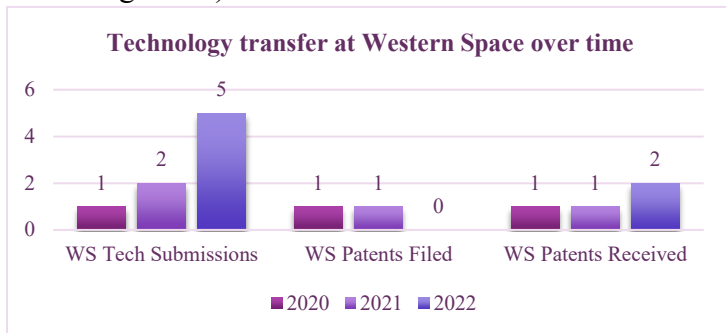


are captured in InCites. Of these 6 publications, 4 publications (66.7%) were co-authored with international scholars across USA, Netherlands and Austria, with an average category normalized citation impact at par with the world average at 1.02. Collaboration occurs externally as well as internally with 2 publications (33.3%) being co-authored by 2 or more Western Space members in 2021 – these 2 publications have not been cited yet. The average category normalized citation impact of the 6 publications available in InCites is 0.68 times the world average benchmark, with citation counts higher than or equal to 25% of the publications published in 2021 in the Web of Science database in their respective research area and document type, on average. The contribution made by Western Space members through these scholarly works was demonstrated by 14 different countries/regions around the world and 2 different research areas citing these publications. Of the 6 publications available in InCites, 1 publication (16.7 %) is listed among the top 10% most cited publications in the Web of Science database. With 3 publications (50%) identified as open access, the knowledge created by Western Space members in 2021 supported more equitable access - an average category normalized citation impact of 1.36 for open access publications, with citation counts higher than or equal to 51% of the 2021 publications in Web of Science database in their respective research area and document type, on average. A total of 9 publications produced by Western Space members in 2021 are tracked in Altmetric, all of which have attracted attention with a total of 69 mentions in Twitter, 48 references in news stories, 13 mentions in blogs, 8 references in Wikipedia and 1 mention in a video.

### 3.3. – Technology Transfer, Commercialization & Contracts

#### Technology Submissions, Patent Applications & Patents Issued

Based on fiscal reporting by the technology transfer office – WORLDdiscoveries® at Western [www.worlddiscoveries.ca](http://www.worlddiscoveries.ca), the total number of technology submissions, patent applications filed, and patents issued by Western Space members has fluctuated annually. Since fiscal year (FY) 2020, there has been a total of 1, 2 and 5, respectively. In FY 2022, this represents 10% of all technology submissions and 20% of all patents issued via WORLDdiscoveries® by Western/ Robarts/ Lawson faculty members. These data do not include submissions, applications or patents issued independently of Western (i.e., other Institutions and/or Agencies).



## Industry Contracts

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Western Space members held/received 43 industry or private contracts/donations at Western totaling over \$5,900,000 in multi-year funding.

## 3.4 – Raising Our Profile

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### Media & Communications (News Stories): 2021

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Members of Western Space were featured in over 45 news stories in 2021, Many of which appearing in accredited national and international newspapers and reports from media outlets such as the Globe and Mail, Global News, CBC, People Magazine, and The New York Times.

### Social Media, Website & Newsletter Analytics

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In 2021, Western Space created 202 Tweets resulting in 489,354 impressions. These tweets focused on amplifying researchers and trainee accomplishments as well as supporting the overarching research stories created by Western research and partnered faculties. Facebook and Instagram were also employed to support engagement activities and events that totalled 146 posts, 28,852 Impressions, and 98 stories. The Western Space newsletter also provided an audience of over 200 subscribers with Institutional updates, space-related news, research, and trainee opportunities. In the 52-week period, 41 newsletters were published. Western Space's website features projects, researchers, news, events, and opportunities for students. It had a total of 29k page views for that time period.

## Section 5.0 – Financial Report

Western Space received written confirmation in June 2019 that Institute funding from central was awarded at 250K for FY (fiscal year) 2020-24 to sustain operations with the possibility of renewal for FY 2024-25 and beyond. Below is an updated summary table of the Western Space financials including actuals and projections of available funds and their sources as well as expenses from Year 3 (FY 2021-22) to Year 5 (FY 2023-24).

### Revenues

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Not all revenues listed in the projections are confirmed including decanal and partner support, conference fees, and event sponsorships. The amount entered for projection purposes is based on estimates from previous years or initial discussions. They are meant to serve as a demonstration of how funds would be used to support core programming. Due to the uncertainty with respect to fundraising, donations, and internal grants unconfirmed amounts were not included, though such support would be instrumental in growing and expanding Institute impact. Should any of the unconfirmed revenue sources included in these projections fail to materialize, we would be forced to cut programming. Seed grants, innovation and training support could be reduced or put on hold temporarily to accomplish this until additional funding can be secured. It is important to note that advancement activities will be crucial to grow the success of the Institute and to, at minimum, maintain programs beyond Year 5 (2024-25).

### Expenses

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Expenses enable the Institute to implement supports and services that bring experts from different disciplines together to start to examine grand challenges from new perspectives. This includes: a) Member Initiatives & Events such as Think Tanks, Showcase Series, workshops, seminars, research retreats, other events; b) Strategic and Innovation Research Awards such as catalyst/seed grants for new early-stage and high risk research project ideas and a strategic funding program to enable timely action related to priority initiatives; c) a Future Leaders Program to develop the next generation of interdisciplinary space researchers using graduate research awards, and undergrad student research internships; d) Research Meetings and Conferences to expand our reach and profile via national/international planning meetings, hosting conference events, conference sponsorships, and trainee travel awards; e) Communications (website, advertisement, news items, outreach events) and Operating (equipment, services, supplies, governance meetings) to maintain necessary workflow and presence; and f) Staff Compensation to make it all possible to offer these support and services (associate director allowances, admin officer, research officer).