

UNISEC-Global



Mission Idea Contest for Deep Space Science and Exploration with Micro/Nano Satellites

With support from



*International
Academy of
Astronautics*

Collaborator



The University of Tokyo,
Institute for Open Innovation

Sponsor

- Established in 2002.
 - Promote **practical space projects** such as micro/nano satellites and hybrid rockets at university level in Japan.
- **UNISEC-Global** was established in 2013.
 - **International nonprofit, non-governmental organization.**
 - Consisting of local-chapters around the globe.
 - Building on the activities of UNISEC-Japan.
- **Permanent observer** of The United Nations Committee on the Peaceful Uses of Outer Space (**UNCOPUOS**) in 2017.



Vision

To enhance our world for all humankind through the creation of thriving networks, engaging programs, accessible assets, and fundamental capabilities such that **anyone around the globe can utilize space science and technology.**

Mission

UNISEC-Global will create an environment that will promote the **free exchange of ideas, information, and capabilities** relating to space engineering and its applications, especially for young people, including those in developing countries and emerging economies.

Activites

Year/Activity	CLTP	DMC/DDC	MIC	Nano-satellite Symposium	UNISEC-Global Meeting
					
2010				1 st	
2011	1 st and 2 nd		1 st	2 nd and 3 rd	
2012	3 rd		2 nd	4 th	
2013	4th		Pre 3rd	5th	1st (Japan)
2014	5 th		3 rd	-	2 nd (Japan)
2015	 6 th		Pre 4 th	6 th (ISTS30)	3 rd (Japan)
2016	7 th	1 st	4 th	7 th	4 th (Bulgaria)
2017	8 th	2 nd	Pre 5 th	8 th (ISTS31)	5 th (Italy)
2018	9 th		5 th	-	6th (France)
2019	10 th		6 th	9 th (ISTS32)	7 th (Japan)
2020	Postpone		Postpone	Postponed	Virtual (monthly)
2021	Postpone		7th	Postpone Feb 2022	Virtual (monthly)

Mission Idea Contest - Background (1)

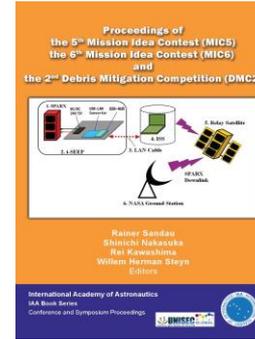
	Year	Category	Winning idea	Country/Region
MIC 1	2011	Nano-satellite constellation	Integrated Meteorological / Precise Positioning Mission Utilizing Nano-Satellite Constellation	Japan (professional)
MIC 2	2012	Cat 1: Mission and Satellite Design Cat 2: Mission and Business Model	Cat 1: SOLARA/SARA: Solar Observing Low-frequency Array for Radio Astronomy/Separated Antennas Reconfigurable Array Cat 2: Underground and surface water detection and monitoring using a microsatellite	USA (student) South Africa (student)
Pre MIC 3	2013	Satellite User and Satellite Developer		
MIC 3	2014	Mission and satellite design	Clouds Height Mission	Germany, Italy, Slovenia (professional)
Pre MIC 4	2015	Cat 1: Mission proposer Cat 2: Resource provider		
MIC 4	2016	Mission and satellite design	Cubesat constellation for monitoring and detection of bushfires in Australia	Australia (student)
Pre MIC 5	2017	Mission and satellite design satisfying SDGs		
MIC 5	2018	Mission and satellite design satisfying SDGs	Smallsat Ionosphere Exploration at Several Times and Altitudes,	Taiwan, USA, India (student)
MIC 6	2019	Cat 1: ICECUBE Cat 2: i-SEEP	Cat1 : MUSA: An ISS Experiment for research of a dual culture for Panama Disease Cat 2: Spectrum Monitoring from Space with i-SEEP (SMoSiS)	Costa Rica (student) Philippines (professional)
Key	Workshop			
	MIC			

Mission Idea Contest - Background (2)



MIC 6 Category 1: MUSA, ICECubes 1st Place winners.

MUSA mission contact:
Carlos Rodríguez
crodriguez@orbitalspace.tech



Publication: Five books were published as IAA book series.



FUSARIUM OXYSPORUM RACE 4.
 Produced the denominated Panama Disease

AROUND 80%
 Of the Banana crops are at risk.



MUSA: Part of the MUSA presentation delivered at the 7th UNISEC-Global Meeting



The 7th

Mission Idea Contest

For Deep Space Science and Exploration

Overview



- Propose an innovative experiment idea which contributes to deep space science and exploration.
- Other Constraints:
 - Spacecraft envelope size is less than 1.0 m x1.0 m x1.0 m size with less than 100 kg in weight (Multiple satellites are acceptable within the envelope area).
 - cis-lunar orbit or deep space trajectory orbit with the relative velocity to the Earth (excess velocity) greater than 0 km/s and the deliverable spacecraft mass is shown in Fig. 1.
 - You can use a transponder onboard of PROCYON.
 - You can assume you can use earth ground stations for deep space missions like DSN (Deep Space Network).
 - You can take continuous 8 hours for spacecraft operation every day.
 - The lifetime is a free parameter. But you should consider the effect of radiation for the proposed lifetime.
 - The proposed launch date should be before 2030.

<http://www.spacemic.net>



The 7th

Lecture Series



Mission Idea Contest

For Deep Space Science and Exploration



Professor Ryu Funase,
ISAS/JAXA and the University of Tokyo.
Lecture 1, February 15th 2021
“New Challenges for Deep Space Exploration with Micro/Nano Satellites”



Professor Munetaka Ueno,
JAXA and Kobe University.
Lecture 2, February 18th 2021
“Science operations of Space missions”



Professor Hiroyuki Koizumi,
University of Tokyo.
Lecture 3, February 25th 2021
“Deep space exploration and micropropulsion”



Assistant Professor Naoya OZAKI,
JAXA.
Lecture 4, March 1st 2021
“Trajectory Design for Deep Space Exploration Missions”



Professor Atsushi TOMIKI,
JAXA.
Lecture 5, March 19th 2021
“Ultra-Small Deep Space Mission Telecommunication Systems Design”

Application Submission : Deadline July 7, 2021

Submitted abstracts will be evaluated by review team



Notification of Finalist: August 18, 2021

Title of paper and finalist(s)' name and affiliation will be published on the website.



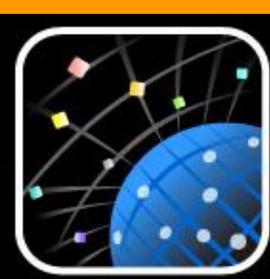
Final Paper Submission: September 30, 2021

Submitted final paper will be distributed to review team for evaluation



Presentation in Japan on November 13, 2021
in-person or online meeting (TBD)

- 1) Capacity building via training opportunities.
- 2) Seek meaningful mission ideas.
- 3) Access free lectures on deep space exploration.
- 4) Make a difference in the real-world. MIC can function as catalyst and result in projects which are innovative, affordable and technically reachable.
- 5) Receive exposure for your ideas. Develop your career profile and find potential future collaborators among a worldwide network.
- 6) Recognition of excellence; awards/prizes (TBA).



The 7th

Mission Idea Contest

For Deep Space Science and Exploration

Participation (1)



INSPIRE OTHERS AND CHALLENGE YOURSELF

Practical Next steps:

1. Download the abstract template:
<http://www.spacemic.net/>
2. Decide on individual/group submission
If group, approach: colleagues, peers, MIC Coordinator, UNISEC chapter.
3. Create a schedule/plan
Detail the stages of your mission design and abstract submission use calendars/gantt chart to keep on track.
4. Brainstorm mission ideas (where and why)
Consider a basic literature review / determine feasibility and innovation.
5. Deep-dive literature review
Begin addressing the required aspects of the selection criteria and specifying the details, challenges, and technical description of your design (Use resources, calculations, simulations, models, graphs, precedents, etc.).
6. Submit your abstract! (5 pages max)

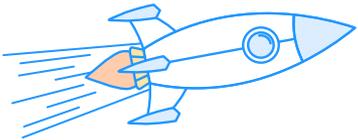
Due: July 7 2021



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“The most important thing about Spaceship Earth - an instruction book didn't come with it.”

—R. Buckminster Fuller



Thank you!

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Additional resources

Requirements

- Propose an innovative experiment idea which contributes to deep space science and exploration.
- Other requirements:
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 - cis-lunar orbit or deep space trajectory orbit with the relative velocity to the Earth (excess velocity) greater than 0 km/s and the deliverable spacecraft mass is shown in Fig. 1.
 - You can use a transponder onboard of PROCYON.
 - You can assume you can use earth ground stations for deep space missions like DSN (Deep Space Network).
 - You can take continuous 8 hours for spacecraft operation every day.
 - The lifetime is a free parameter. But you should consider the effect of radiation for the proposed lifetime.
 - The proposed launch date should be before 2030.

Launcher delivery

The launcher shall deliver the spacecraft into cis-lunar orbit or deep space trajectory orbit with the relative velocity to the Earth (excess velocity) greater than 0 km/s, and the relation between C3 (square of the excess velocity) and the deliverable spacecraft mass as shown in Figure 1.

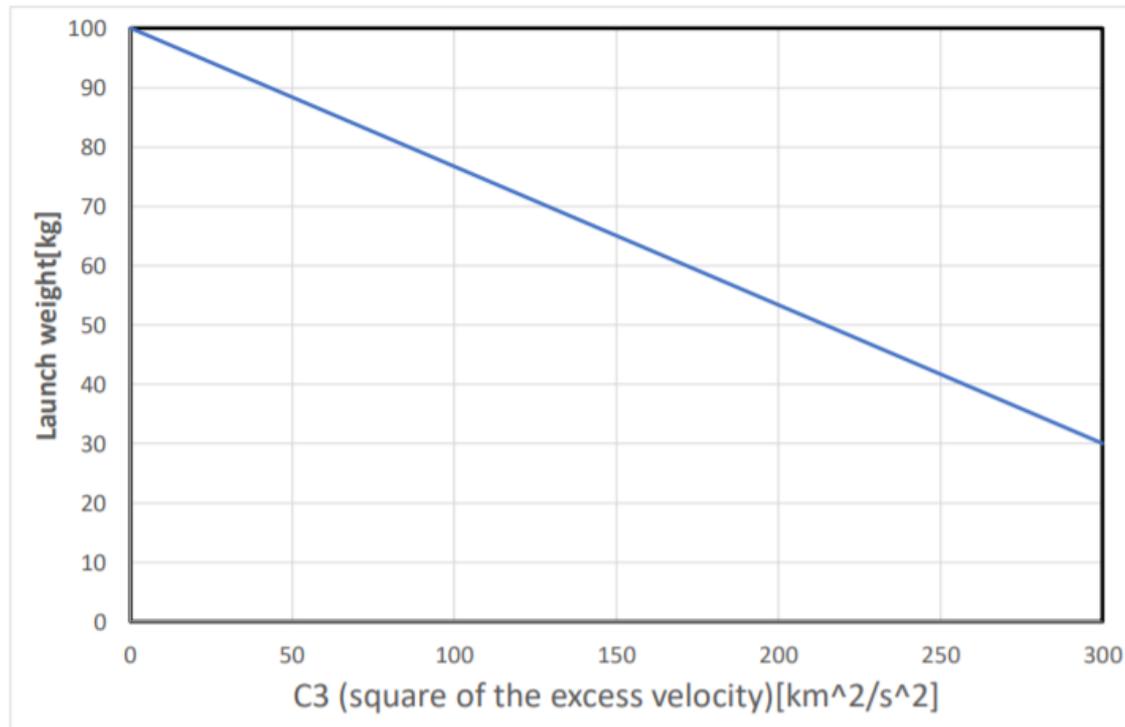


Figure 1 C3 vs. Launch Weight (TBD)

Communication System

PROCYON's communication system includes:

- XTRP (transponder)
- XSSPA (power amplifier)

Total required power and output RF power of the communication system is roughly 50 W and 15W respectively.

Assume you can use earth ground stations for deep space missions like DSN (Deep Space Network)

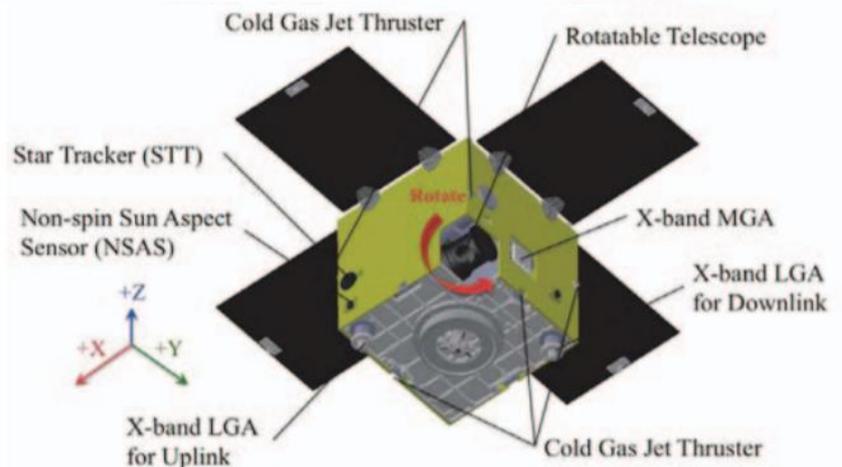
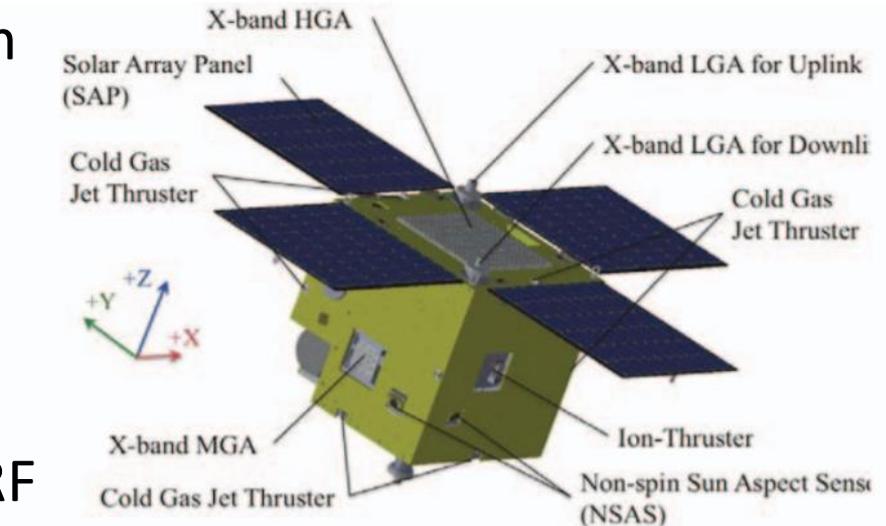


Image source: Kobayashi, Y., Tomiki, A., et al., "Low-cost and ultimately-downsized X-band deepspace telecommunication system for PROCYON mission", IEEE Aerospace Conference, MT, USA, 2016. DOI: 10.1109/AERO.2016.7500745 <https://ieeexplore.ieee.org/document/7500745>

Considerations for MIC7

Consider how your proposal may satisfy any of the SDGs.



<https://sustainabledevelopment.un.org/sdgs>

Considerations for MIC7

Consider how your proposal may contribute towards Vision 2030-ALL.

Training Program

HEPTA – Sat Training

CanSat Leader Training Program

Forum, Conferences, Technical competitions

Mission Idea Contest

Nano-satellite Symposium

CanSat Competition

VISION 2030-ALL

Debris Awareness and Solutions

Debris Mitigation Competition

IAA Study Report: A Handbook for Post-Mission Disposal of Satellites less than 100kg

Support Global Space Projects initiated by member universities

UNISEC-Global Meeting

<http://www.unisec-global.org/whatwedo.html>

Evaluation Criteria

Originality	Novel concept not yet realized or proposed, or a new implementation of an existing capability or service (25).
Impact	Impact on society / Potential to expand scientific knowledge / Strengthen deep space mission motivation (25).
Engineering	<p>Technical description and solutions (20).</p> <p>Operational (protocol, communication and interaction during experiment) (15).</p>
Feasibility	Programmatic (realistic- cost, development schedule, infrastructure requirements) (15).

Note: Inclusion of a budget and a development schedule is not required for MIC7, however, your proposal should be demonstrably financially and temporally feasible.

Function of MIC Coordinators

- **Mentor:** Offer advice and expertise, as well as facilitate the coordination of potential applicants, within your region and beyond.
- **Coordinate:** Liaise with the MIC Office to develop effective ways for participants to engage and apply for the MIC7 (e.g. organizing a regional seminar, using a space event in your region or disseminating information through existing network).
- **Network:** Develop methods to help link students, researchers, policy makers, and business people in your region for the realization of mission ideas with an implication of contributing to a better future of your society or country/region.

Worldwide Network of MIC Regional Coordinator



Awards

- 1st and 2nd Place awards
- Student Prize
- IAA award (TBC)
 - Typically requires demonstration of international collaboration and meeting theme requirements.

Further details regarding awards will be announced at a later date.

How to write abstract (1)

- **Mission Objectives (where and why?)**
Describe the target planet and/or asteroid to be observed and why you want to go there (scientific objectives). Describe the scientific basis for the proposed mission, and what impact/s exist in gaining new knowledge or solving social problems.
- **Concept of Operations including orbital design**
Describe the mission scenario (from launch to realization of the final objectives, etc.) and describe the orbital design to realize the mission. Use diagrams, figures and/or tables if required. Formation flight of multiple explorers are also allowed if the mass restriction (relationship between total mass and V -infinity) is not violated.
- **Additional considerations**
If you have some originality of analyzing and/or designing this mission, please describe it. It may be considered as “a bonus point.”

How to write abstract (2)

- **Key Performance Parameters**

Explain the required key technologies and all important performance parameters (accuracy, bit rate of data transmission, etc.) essential to realize your mission. Indicate if new technologies are required and how it may be achieved for R&D success (e.g. advancement in high precision orbit change, deep-space communication, observation sensors, power in deep space, and/or autonomy).

- **Space Segment Description**

Describe the conceptual design for your satellite system or systems. List key specifications (e.g. mass, volume, peak and average power, link budget, attitude control accuracy, delta-V for mid-course maneuver, etc.). Diagrams or simple CAD drawings are encouraged.

- **References**

– List any technical references for your idea.

Advice from Reviewers

- Do some *literature research* (using the internet) on their proposed ideas before preparing their proposal to make sure that it has not already been done.
- If you are not experienced with space technology, please read one of the introductory books to *confirm the basic feasibility of your ideas*.
- Seek an experienced *advisor or mentor* who can review your ideas at an early stage and provide guidance on the preparation of your proposal.

Call for proposals!

- Abstract
 - Due: **July 7, 2021**
 - Length: 5 pages max
 - Template can be downloaded at:
<http://www.spacemic.net>

Note: Online system for abstract submission will be set up in June.
- Important date:
 - **August 18, 2021**: Notification of acceptance
 - **September 30, 2021**: Final Paper (12 pages max) Due
 - **November 13th, 2021**: Final presentation at UNISEC-Global Meeting (in-person or online TBD).