# UNISEC-Global

# Mission Idea Contest

## for Deep Space Science and Exploration with Micro/Nano Satellites

With support from

International Academy of Astronautics

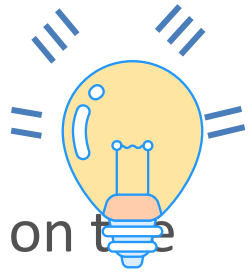
Collaborator

The University of Tokyo, Institute for Open Innovation

Sponsor

# UNIversity Space Engineering Consortium

- **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.





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## 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.



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# Activites

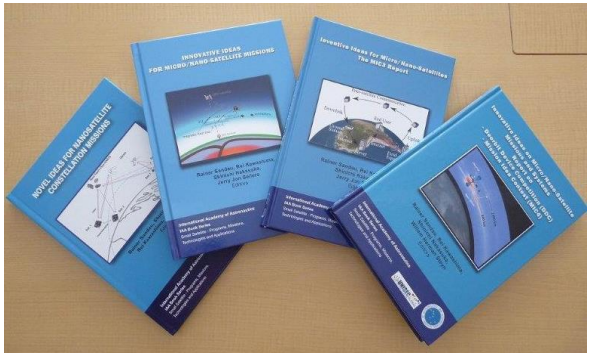
| | Year/Activity | CLTP | DMC/DDC | MIC | Nano-satellite Symposium | UNISEC-Global Meeting |
|---|---|---|---|---|---|---|
| UNISEC-JAPAN | 2010 | | | | 1st | |
| | 2011 | 1st and 2nd | | 1st | 2nd and 3rd | |
| | 2012 | 3rd | | 2nd | 4th | |
| | 2013 | 4th | | Pre 3rd | 5th | 1st (Japan) |
| | 2014 | 5th | | 3rd | - | 2nd (Japan) |
| | 2015 | 6th | | Pre 4th | 6th (ISTS30) | 3rd (Japan) |
| UNISEC-GLOBAL | 2016 | 7th | 1st | 4th | 7th | 4th (Bulgaria) |
| | 2017 | 8th | 2nd | Pre 5th | 8th (ISTS31) | 5th (Italy) |
| | 2018 | 9th | | 5th | - | 6th (France) |
| | 2019 | 10th | | 6th | 9th (ISTS32) | 7th (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<br>Cat 2: Mission and Business Model | Cat 1: SOLARA/SARA:Solar Observing Low-frequency Array for Radio Astronomy/Separated Antennas Reconfigurable Array<br><br>Cat 2: Underground and surface water detection and monitoring using a microsatellite | USA (student)<br>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<br>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<br>Cat 2: i-SEEP | Cat1 : MUSA: An ISS Experiment for research of a dual culture for Panama Disease<br>Cat 2: Spectrum Monitoring from Space with i-SEEP (SMoSiS) | Costa Rica (student)<br>Philippines (professional) |
| Key | **Workshop** | | | |
| | **MIC** | | | |

# Mission Idea Contest - Background (2)


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

**Publication:** Five books were published as IAA book series.


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

**MUSA mission contact:**
**Carlos Rodríguez**
crodriguez@orbitalspace.tech

- 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.

# The 7th Mission Idea Contest
## Lecture Series
For Deep Space Science and Exploration

UNISEC GLOBAL
University Space Engineering Consortium

***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"***



The University of Tokyo, Institute for Open Innovation

# Process and timeliine

**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)**

# Reasons for joining MIC



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).

# 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.

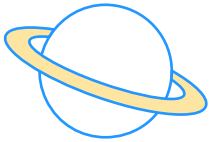
5. Deep-dive literature review
   Begin addressing the required aspects of the selection criteria and specifying the details, challenges, and technical description of your design (Use resources, calculations, simulations, models, graphs, precedents, etc.).

6. Submit your abstract! (5 pages max)

**Due: July 7 2021**

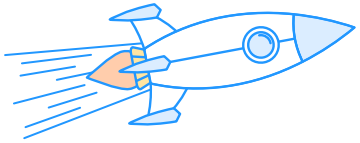


JOIN US!



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

**—R. Buckminster Fuller**





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# Thank you!

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**c/o UNISEC Office**

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http://www.spacemic.net

# Additional resources

# Requirements

- Propose an innovative experiment idea which contributes to deep space science and exploration.
- Other requirements:
  - 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.

# 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.

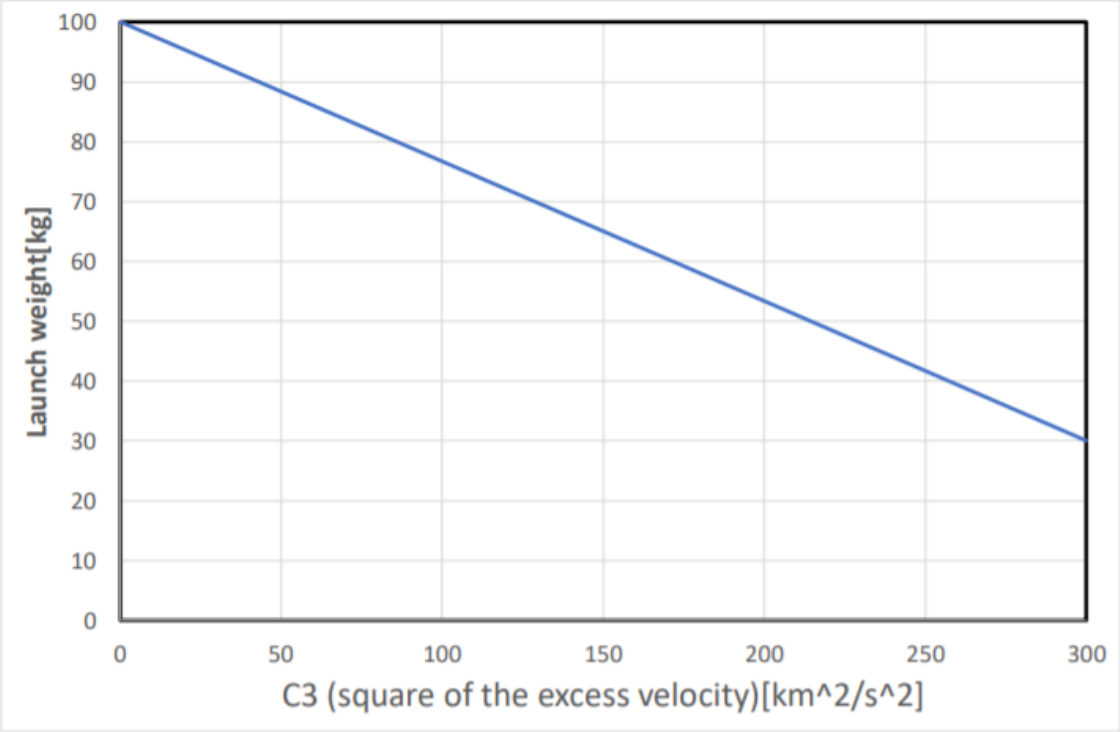



Figure 1 C3 vs. Launch Weight (TBD)

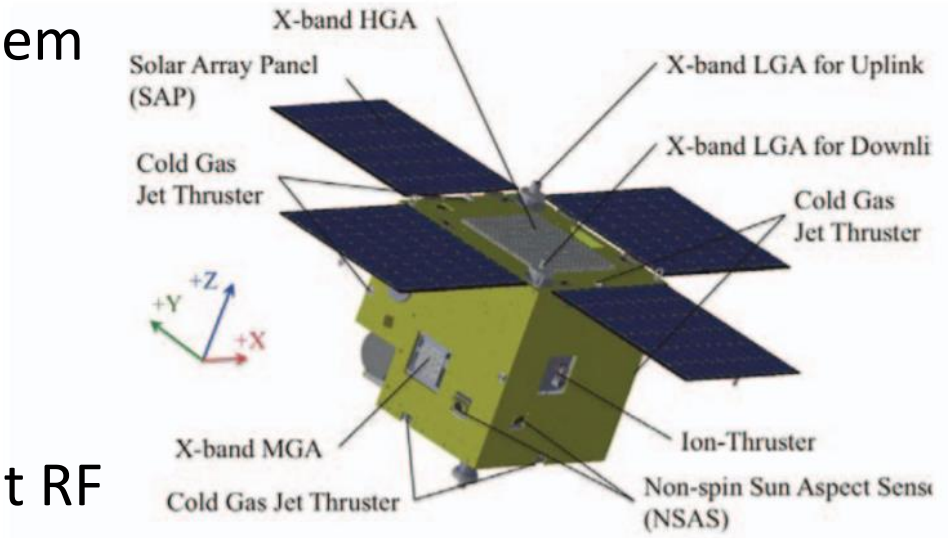
# Communication System

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)



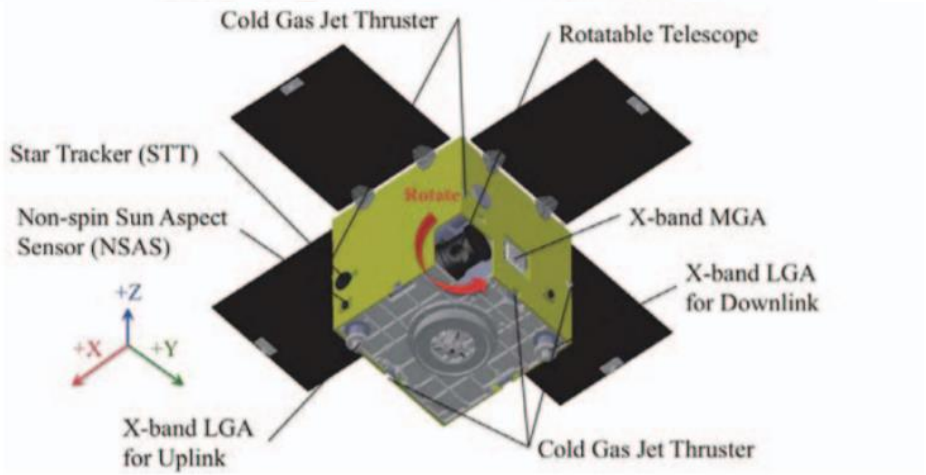




Image source: Kobayashi, Y., Tomiki, A., et al., "Low-cost and ultimately-downsized X-band deepspace telecommunication system for PROCYON mission", IEEE Aerospace Conference, MT, USA, 2016. DOI: 10.1109/AERO.2016.7500745 https://ieeexplore.ieee.org/document/7500745

# 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**<br>**HEPTA – Sat Training**<br>**CanSat Leader Training Program** | **Forum, Conferences, Technical competitions**<br>**Mission Idea Contest**<br>**Nano-satellite Symposium**<br>**CanSat Competition** |
| **VISION 2030-ALL** | |
| **Debris Awareness and Solutions**<br>**Debris Mitigation Competition**<br>**IAA Study Report: A Handbook for Post-Mission Disposal of Satellites less than 100kg** | **Support Global Space Projects initiated by member universities**<br>**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** | Technical description and solutions (20).<br><br>Operational (protocol, communication and interaction during experiment) (15). |
| **Feasability** | 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 requiredand 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).