OUR EXPERTISE
FOR YOUR EXPERIMENT
INTERNATIONAL COMMERCIAL EXPERIMENT SERVICE

Making access for space research fast, simple and affordable

Our expertise for your experiment

ICECubes@spaceapplications.com
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What is ICE Cubes?

International Commercial Experiment Cubes service

Provides **fast, simple and affordable access to space**

For your practical **space** project in **research, technology, STEAM, capacity building**.
Why ICE Cubes in ISS? Why Microgravity?

Micogravity as a scientific tool
- Fluids, Foams
- Materials
- Proteins
- Nano particles
- Micro biology
- Medicine
- 3D Tissue engineering

Micogravity as a strategic business tool and research advantage
- Biotech
- Agriculture
- Food
- Pharmaceutical
- Petroleum
- Cosmetics

Micogravity as a manufacturing resource
- Medicines
- Optical fibre
- Organs

Micogravity for technology demonstration
- Future technologies
- Commercial products

Microgravity as STEAM resource

User

Credits: Swansea Univ
Credits: NASA
Credits: ESA
Credits: GRASP, ULG
How ICE Cubes?
How ICE Cubes?

=> Allows **any organization** to directly develop and conduct their innovation project in space

=> **Fast**: 9 to 12 months to launch for new setups and faster for recurring setups.

=> **Simple & direct**: processes streamlined and unique point of contact. Service takes care of: certification, safety, manifesting, interface testing, interface with agency & launcher,…

=> **Regular launches**: 3 times per year, every ~4 months. The ICE Cubes service can provide for **return** from space

=> **Real-time interaction** with space experiments. Users are provided with the tools to create their own control center. High data rate (downlink up to 4Mbps).

=> **Catalogue** of space-qualified H/W. Commercial-of-the-shelf H/W & adaptations
How ICE Cubes?

Standard Service includes:
> Basic Experiment Cube development guidance,
> Interface testing
> Arranging experiment certification,
> Launch
> On-orbit installation
> Standard type operations support

Additional Service can include:
> Engineering support for mission success
> Hands-on training possibility
> Conditioned stowage
> Return of the hardware
> Late access to launch vehicle
> Early access to return vehicle
> Dedicated crew activities
....
How ICE Cubes on ISS?

Size of the Experiment Cubes set to mimic the CubeSat standard, i.e. 10x10x10cm (1 litre) for a 1U Cube, 20x10x10cm for a 2UCube, etc, with a max of ~45 x ~35 x ~30cm

Modularity
Flexibility
Standard interfaces
How ICE Cubes on ISS?

External Wired Experiment Cubes
(images courtesy ESA-NASA)

External Wireless Experiment Cubes
(images courtesy NASA Spheres)

Modularity
Flexibility
Standard interfaces
ICE Cubes - Real-time interaction

> ICE Cubes Mission Control Centre powers on-off the various experiments and opens the communications lines

> Users directly interact with their experiments from their premises via Internet

To control their Experiments, users are provided with an out-of-the-box software suite composed of VPN client, FTP client, Web browser, Mission Control System client and User Manual.
ICE Cubes – Use cases / areas

Needs of final user:
Demonstration and validation of technologies, processes and systems in relevant space environment

Examples:
• Heat exchangers / heat pipes
• Radiation hardened electronics
• High performance computer systems / miniature space computers
• Delay-and disruption-tolerant networks testing
• Autonomous navigation capabilities / autonomous rendezvous & docking / constellation flying
• Miniaturized space robotics and servicing

Needs of final user:
Validated space technologies for cubesats / satellites

Key features of solution:
Use space environment (with standardized form factor) to validate space technologies to raise TRL level
ICE Cubes – Use cases / areas

Needs of final user:
**Reduction of pre-clinical testing time for drugs**

Create infrastructure and operational flow allowing to test drugs in a relevant environment not possible on earth

Generation of value:
Faster drug testing

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Needs of final user:
**Produce plants with highest nutrient density / produce food with highest lifetime**

Use space environment to iteratively select those plants / seeds with most optimal characteristics. Research on food stability

Generation of value:
Address food availability & lifetime

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Needs of final user:
**Manufacturing technologies and new materials**

Key features of solution:
Use space environment for manufacturing and novel materials, e.g.:
- 3D printer validation in space
ICE Cubes - funding possibilities

• Space Agencies or institutional funding
• Collaborative setups
• Collaborations with companies
• Sponsors
• Crowdfunding
• Etc...
ICE Cubes - Future Evolution

**Internal ISS Experiments**
- Specialized sub-facility labs with diagnostic capabilities
- Crew interaction applications

**External ISS Experiments**
- Facility for exposure and deployment of external payloads

**Free flying and sub-orbital Experiments**
- Facility for pressurized payloads in e.g. Dream Chaser, Space Rider,
- Facility for utilization in balloons and/or Sounding Rockets

**Post ISS and beyond LEO**
- Possible collaborations with commercial platforms
- Possible commercial exploitation of the Cis-lunar Station

*Image Courtesy of Airbus D&S*
*Image Courtesy of NASA*
*Image Courtesy of Siera Nevada Corporation*
ICE Cubes Service - Summary

- Enabling end-to-end service
- Fast, simple, direct
- Regular launches
- Long-duration, high-quality microgravity
- Flexible and modular accommodation
- Real-time interaction capability
- Return possibility
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