International Commercial
Experiments Service

COPUOS Scientific and Technical
SubCommittee 55th session

spaceapplications SERVICES

Making access for space
experiments
FAST
SIMPLE
ATTRACTIVE
and AFFORDABLE
for research, technology, education
and capacity building

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ICE Cubes Introduction

The **International Space Station** (ISS) is a great international achievement, designed as a flexible laboratory able to support research in a wide range of disciplines.

Based on a public–private partnership agreement with the European Space Agency (ESA) the

International Commercial Experiment (ICE Cubes) service

is providing **fast, simple and affordable access for experiments** to the International Space Station, creating **capacity-building** opportunities **for any country or any entity / user**.

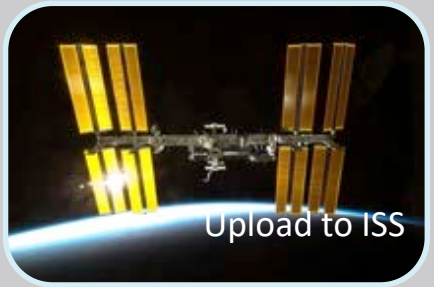
ICE Cubes Introduction

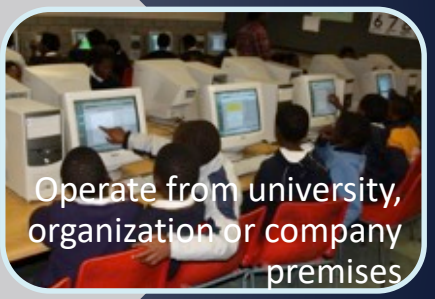
The ICE Cubes service is suitable to provide access to space for many uses:

- Fundamental and applied **research / university** studies (Bachelor, Master and Doctoral theses)
- **Industrial R&D** for e.g. pharmaceutical, biotechnology & food, cosmetics, soft matter & coatings and petroleum industry allowing to address sustainability-oriented R&D areas
- In-orbit testing and validation of **technologies** and processes
- Participating in human spaceflight **exploration** preparation activities
- **Educational** experiments and demonstrations in the science, technology, engineering and mathematics (**STEM**) areas

ICE Cubes Introduction

ICE Cubes service allows any country, any institute or any entity to directly **develop and conduct their experiment on the International Space Station**, the only laboratory in space.



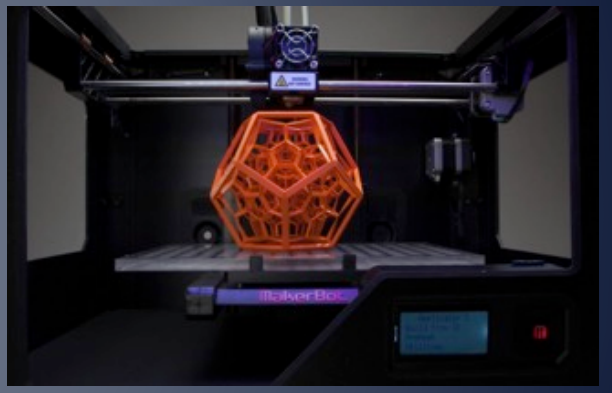


Users can develop their own Experiment Cubes according to a specific set of interface and safety requirement documents. They will remain owners of their experiments and results.

ICE Cubes Microgravity Research

This platform allows for **microgravity / space research** in areas relevant to **sustainable development**. Microgravity research allows the study of phenomena and processes that cannot be observed on Earth, hidden by the gravity vector factor.

Some examples:



- **Additive manufacturing / 3D (bio-)printing**
- **Drugs R&D optimisation and testing**
- Investigation of **food production & processes**

- Increased understanding of **plants and micro cultivation systems** behaviour in space to increase production / improve quality of food on Earth
- microfluidic **lab on a chip applications** in cell, molecular, plant biology / microbiology, pharmaco-chemical research

ICE Cubes in the context of capacity building

1. Offer the **opportunity to address research goals** related to **sustainable development** and to be informed on its potential in space / microgravity.

2. Offer **capacity building opportunity specifically in R&D experiment** development and execution with ad-hoc fine-tuned support for development.

3. Allow **to position in the economic Low Earth Orbit (LEO) ecosystem** of organizations / companies / start-ups. Lower cost enables lower entry barrier.

4. Offer a **platform of appropriate / affordable size** to be used **for start-ups / pilot projects / university** projects.

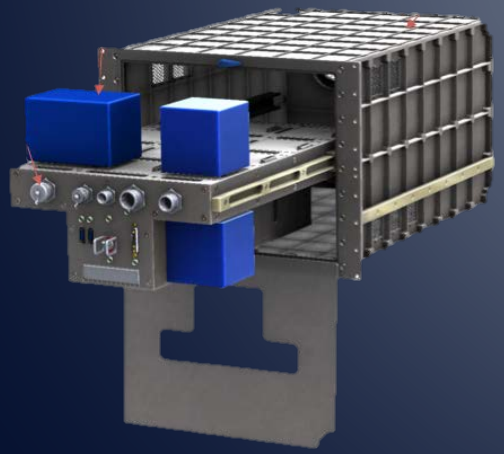
5. Short **time from signing flight agreement to receiving results**.

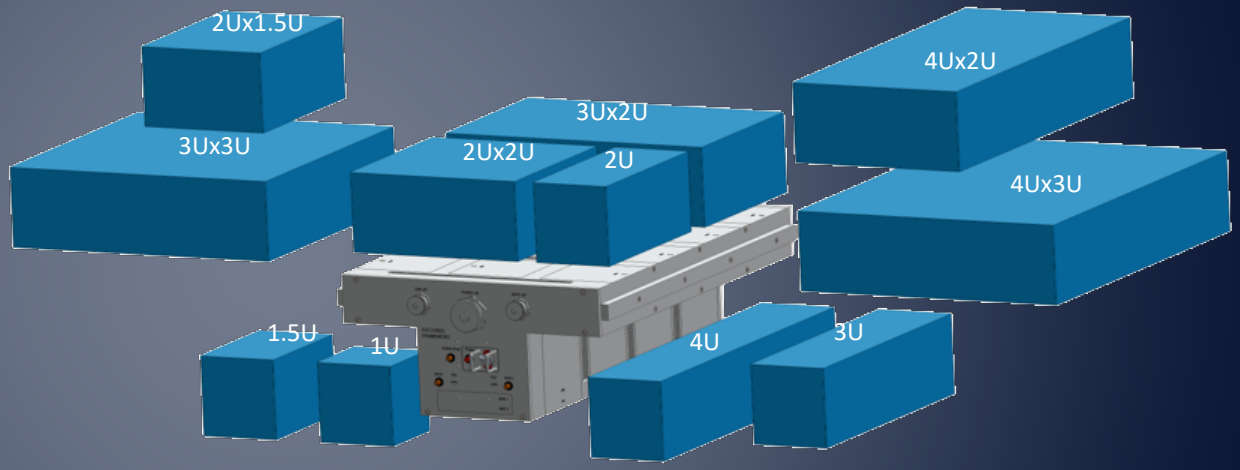
6. Allow for **match-making collaborations**.

ICE Cubes Facility and Experiment Cubes

The launch of the ICE Cubes internal facility is planned in **spring 2018**.

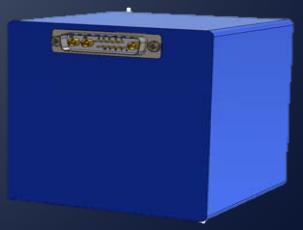
ICE Cubes Facility (ICF)





Experiment Cube Standard Form Factors

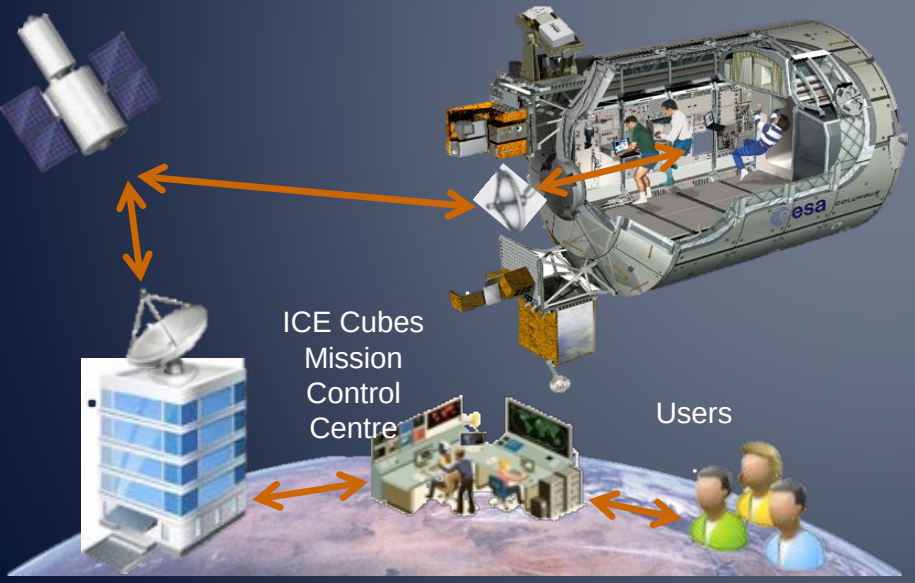
Experiment Cubes using one single connector for both power and data



Demo Model can be visited today in front of Boardroom D

ICE Cubes Service characteristics

- **Near real-time telemetry and telecommand**
- Commanding and data reception directly from/to the various **user home bases**



- To control their Experiment Cubes, 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 Service characteristics

Time from agreement signature to launch	**12 Month** (typ)
Launch / return frequency	**Every 4 months** from spring 2018

Standard Service includes:

- basic Experiment Cube development guidance,
- interface testing,
- arranging experiment certification,
- launch,
- on-orbit installation,
- standard type operations support,
- as well as disposal after operation.

Additional Service can include:

- engineering support for development
- conditioned stowage
- late access to launch vehicle
- return of the hardware
- early access to return vehicle
- dedicated crew activities
- ....

The ICE Cubes service is willing to help less experienced organizations/countries, a.o. by arranging **info days and workshops** in situ.

ICE Cubes Service Future Evolution

With same focus of making **access** for space experiments **fast, simple and affordable** for **research, technology, education and related capacity building**

ICE Cubes impact

Socio-Economics	Allows for capacity building and innovation
	Competence in a high tech sector of scientific / technical innovation value
	Spin-in / Spin-offs opportunities Industrial competitiveness
	Inspiring young generations for STEM and space
Industry – Non Space	Prompt access to space and microgravity environment
Industry – Space	De-risk innovation and accelerate development
Future Space Exploration	Enabling endeavour and participation to explore

Conclusion

- Through this way, the ICE Cubes service allows any entity **to stimulate their capability to achieve research, social & economic goals**.
- This allows for **technological leap-frogging for emerging space countries**.
- As such the ICE Cubes service provides for a very appealing **key technological solution and innovative approach for capacity building** by providing direct access to space for the broad community.

THANK YOU FOR LISTENING

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Back-up slides

ICE Cubes Service Characteristics

The ICE Cubes programme will establish:

- A permanent multipurpose facility (**ICE Cubes Facility**) on board the International Space Station allowing for the accommodation and exploitation of small payloads and experiments (**Experiment Cubes**)
- A set of special-purpose or repeated-use multi-unit Experiment Cube which can be used by multiple users (e.g. fluorescent microscope special cube)
- The ground infrastructure for the management of the ICE Cubes Facility and the Experiment Cubes
- The end-to-end service allowing utilization of the ICE Cubes Facility and of the aforementioned multi-unit Experiment Cube
- Ad-hoc engineering services (e.g. design, development, assembly, testing), as needed / desired.

ICE Cubes Facility and Experiment Cubes

Experiment Cubes characteristics

- **Power** profiles: 5V and 12 V, 10W per liter, up to 40.5 W max per Cube
- **Thermal** cooling: Forced air ventilation
- Operations: **Real-time** telemetry/telecommand to/from ground
- **Data**: Downlink up to 4 Mbps
  Uplink up to 0.5 Mbps
- Communications: standard **internet protocols (IPs)**

ICE Cubes special diagnostic cubes

In the frame of the ICE Cubes Service special purpose Experiment Cubes will be developed provided with diagnostics to support different areas or research. The special cubes will remain on board the ISS and will temporary host replaceable experiment containers/cartridges. This approach aims at providing solutions for Cube level mini-facilities that may reduce cost of the development and launch of the various branches of experiments.

Currently undergoing a survey of the possible interests/requests by the potential users or at start of development are:

- Fluorescent microscope
- X-Ray diffractometer
- Organ-on-a-chip technology testbed
- Others under investigation

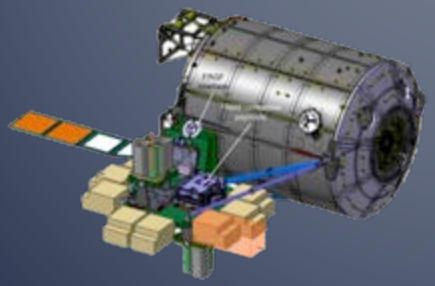
ICE Cubes Service Future Evolution

Internal ISS Experiments

- Specialized sub-facility labs with diagnostic capabilities
- Crew interaction applications

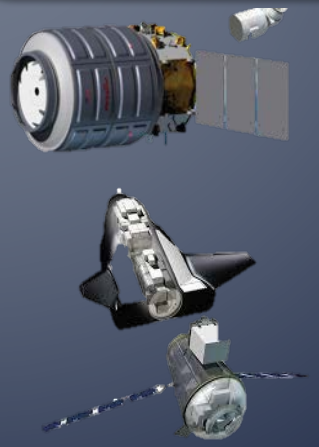
External ISS Experiments

- Facility for deployment of external payloads through ISS Airlock(s)



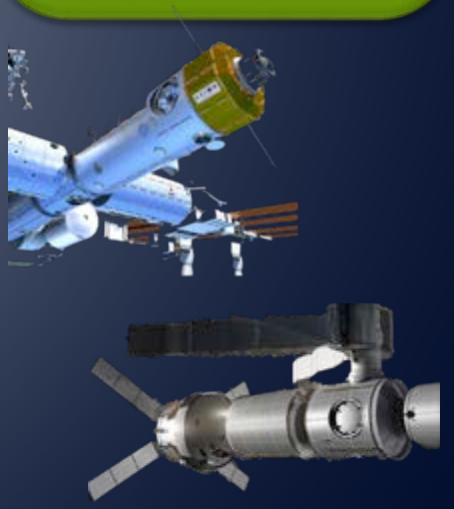
Free flying and sub-orbital Experiments

- Facility for pressurized payloads in e.g. Orbital Cygnus, 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 a Cis-lunar Station



About Space Applications Services

Space Applications Services NV/SA is an independent Belgian company founded in 1987, with a subsidiary in Houston, USA and an office in The Netherlands. Staff of 90, and growing.

Our aim is to research and develop innovative technology, solutions and services for the aerospace and security markets and related industries:

- Research and develop technologies for specific domains or subsystems which may be used stand alone or integrated within an overall system.
- Services to design, develop and integrate scientific and technology payloads, mission critical systems, facilities and command and control centres. Including laboratory, workshop and clean room.
- Services to operate facilities and command and control centres and to train persons to perform operations.

The company capabilities cover system, software and operations engineering and our activities include manned and unmanned spacecraft, launch/re-entry vehicles, monitor and control, robotics and information systems.

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