

# ESA's SciSpace programme

November 13<sup>th</sup>, 2018

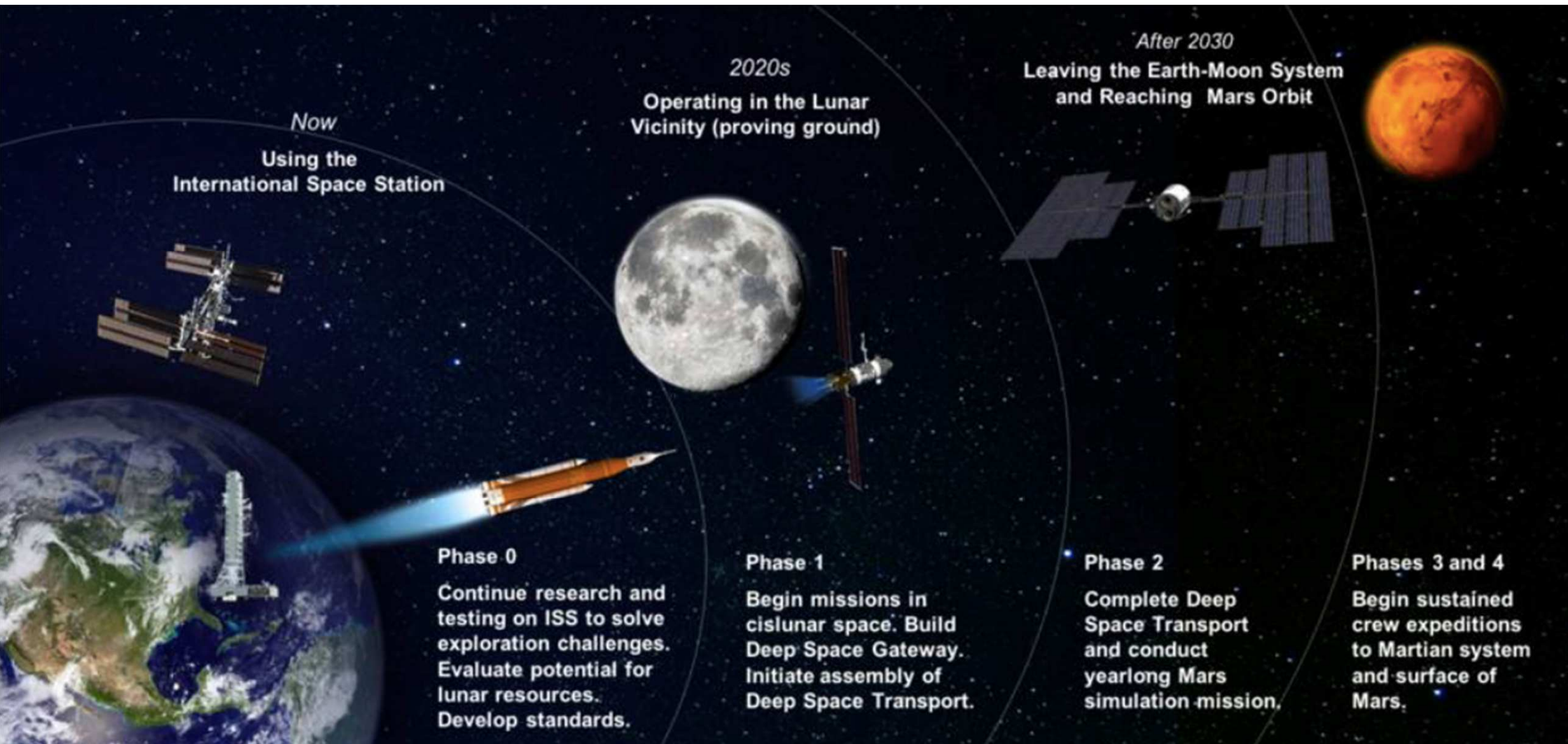
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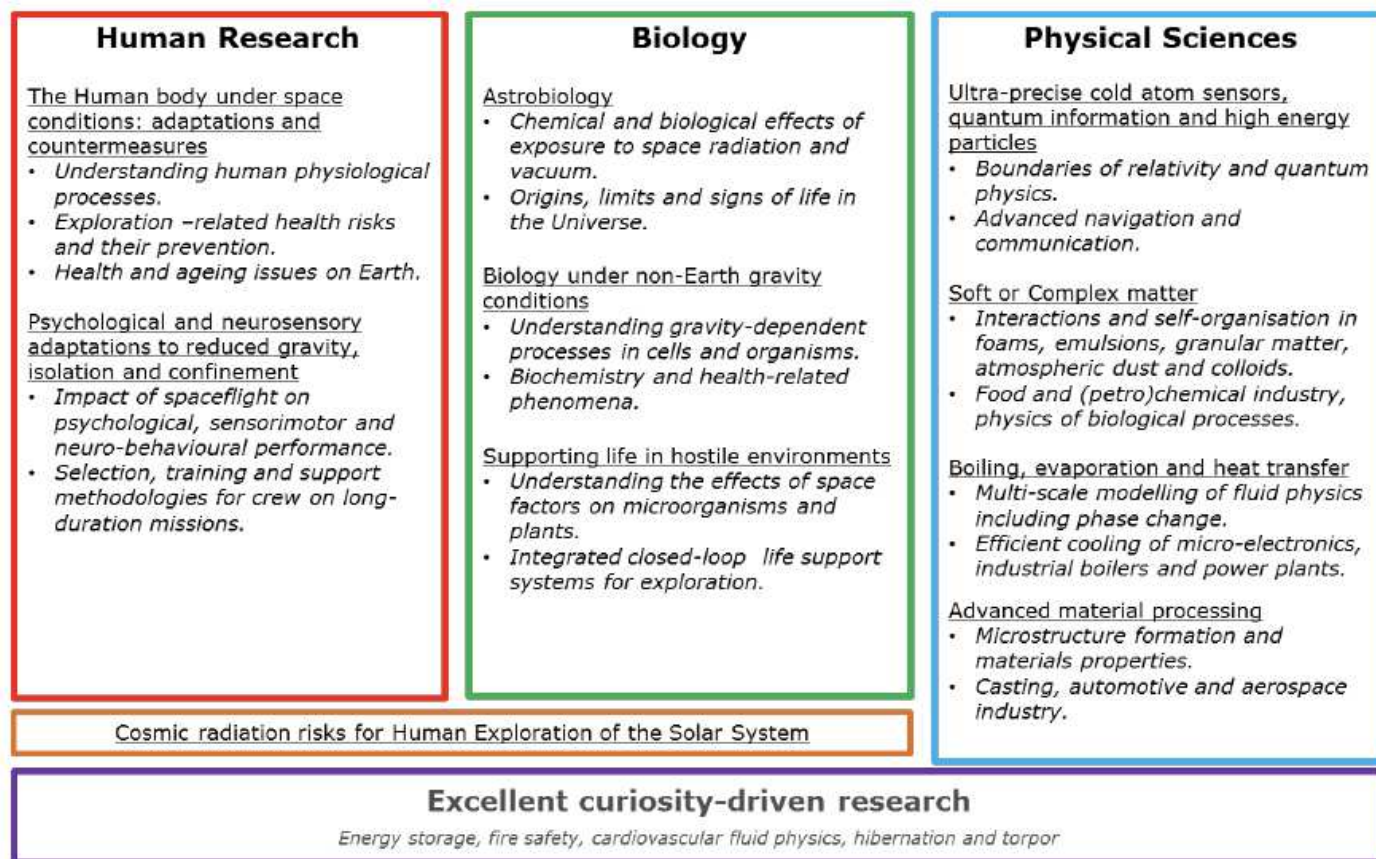


# THE GLOBAL EXPLORATION ROADMAP



# ESA's EUROPEAN EXPLORATION ENVELOPE (E3P) UTILIZATION AND RESEARCH PROGRAMME

ENABLING FUTURE HUMAN AND ROBOTIC EXPLORATION OF THE SOLAR SYSTEM  
WHILE BRINGING BACK TO EARTH KNOWLEDGE AND OPPORTUNITIES.





# ESA RESEARCH ON-BOARD THE ISS



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ESA | 06/11/2018 | Slide 4



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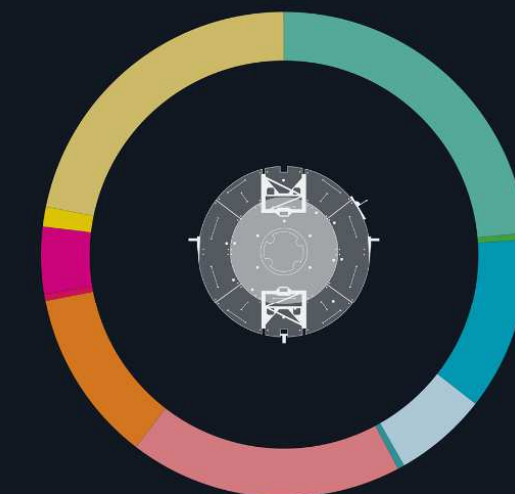


## → COLUMBUS

### Experiments

# 227

EXPERIMENTS  
HAVE RUN  
IN COLUMBUS  
SINCE LAUNCH

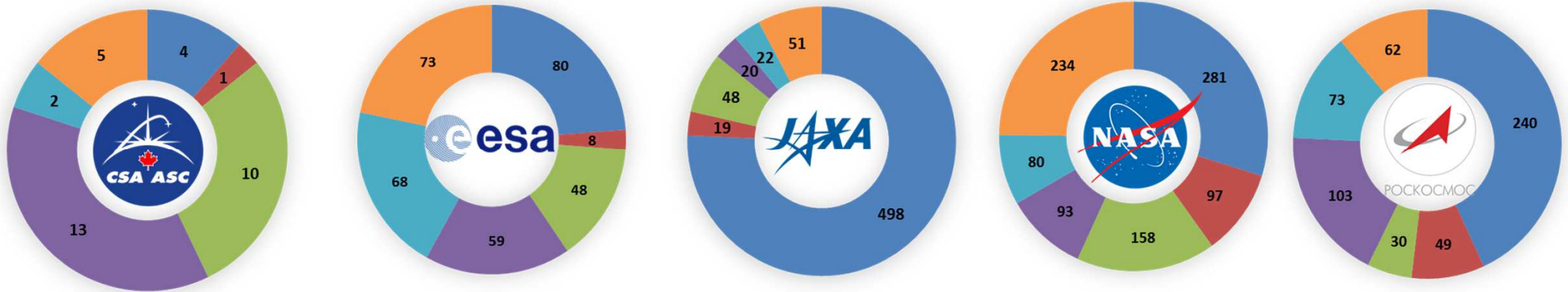


53 Biology	1 Earth Observation	28 Education	18 Fluid Physics
1 Fundamental Physics	41 Human Physiology	26 Material Science	1 Plasma Physics
10 Radiation	3 Solar Physics	49 Technology Demonstrations	

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# RESEARCH DISCIPLINES OF ISS INVESTIGATIONS BY PARTNER AGENCIES EXPEDITIONS 0 – 54 DECEMBER 1998 – FEBRUARY 2018



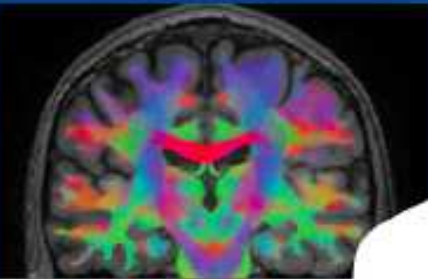
*NASA utilization includes 67 investigations by the Italian Space Agency (ASI), an ISS Participant Agency*





# ESA's HUMAN RESEARCH PROGRAMME ON-BOARD THE ISS

Ageing  
Cardiovascular  
Immunology  
Muscle and bone  
Neurophysiology  
Nutrition  
Respiratory system  
Thermoregulation



↑ Brain scan (University of Antwerpen)



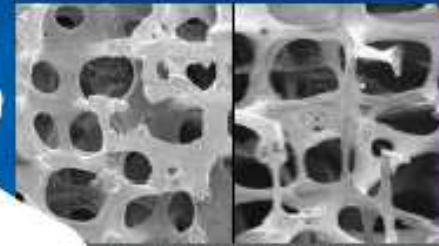
↑ Testing GRIP prototype on weightless parabolic flight



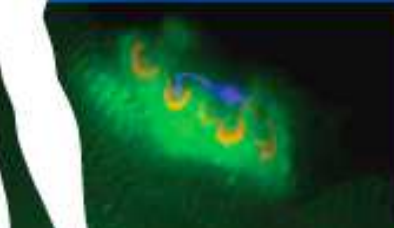
↑ Space food for the Energy experiment



↑ ESA astronaut Alexander Gerst with a thermometer on his forehead to measure his temperature continuously (ESA/NASA)



↑ Comparison of normal (left) and osteoporotic (right) bone architecture (University College London - T. Amet)



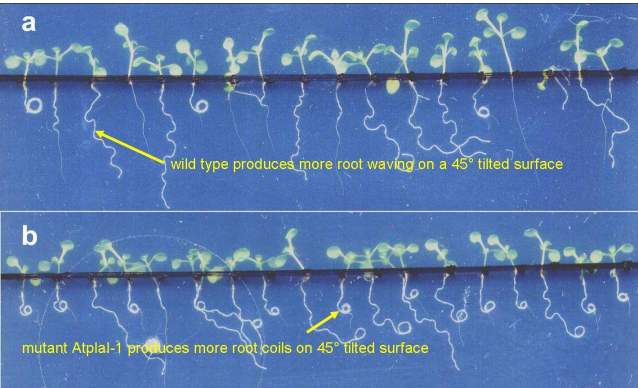
↑ Laser image of a calf muscle (Charité)



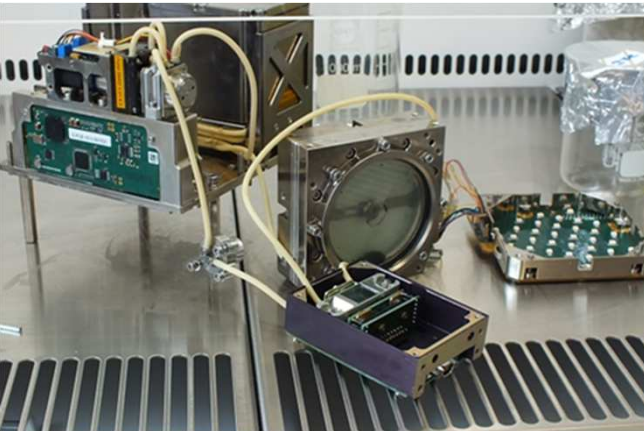
↑ ESA astronaut Samantha Cristoforetti running the Skin-B experiment (ESA/NASA)



# ESA's BIOLOGY PROGRAMME ON-BOARD THE ISS



WAICO experiment

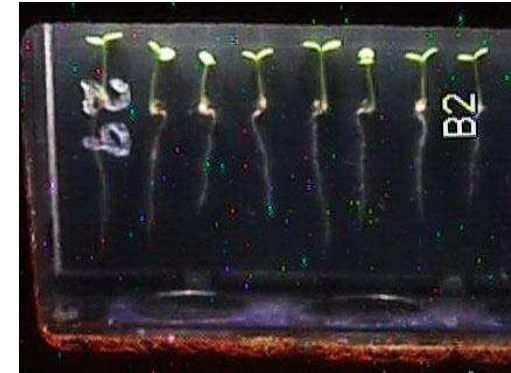
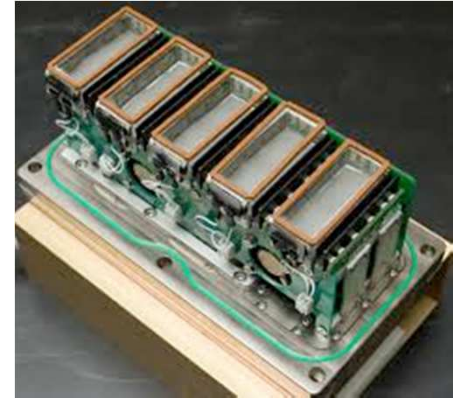


Arthrospira-B experiment

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KUBIK container



Seedling  
Growth-3

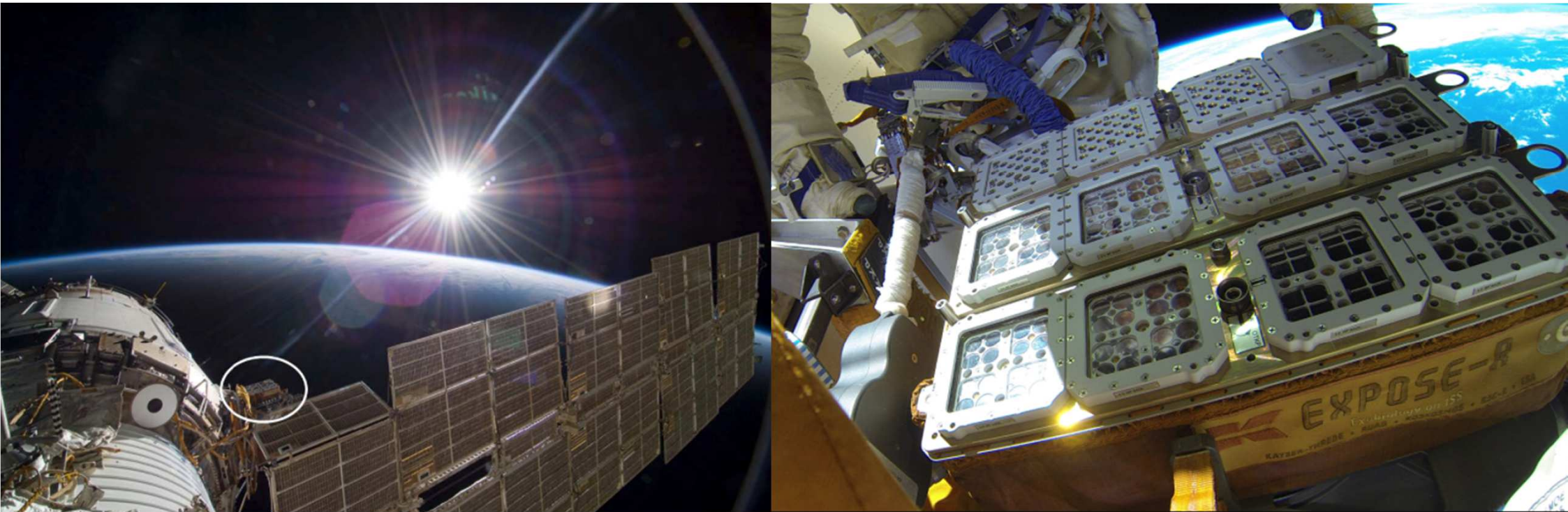
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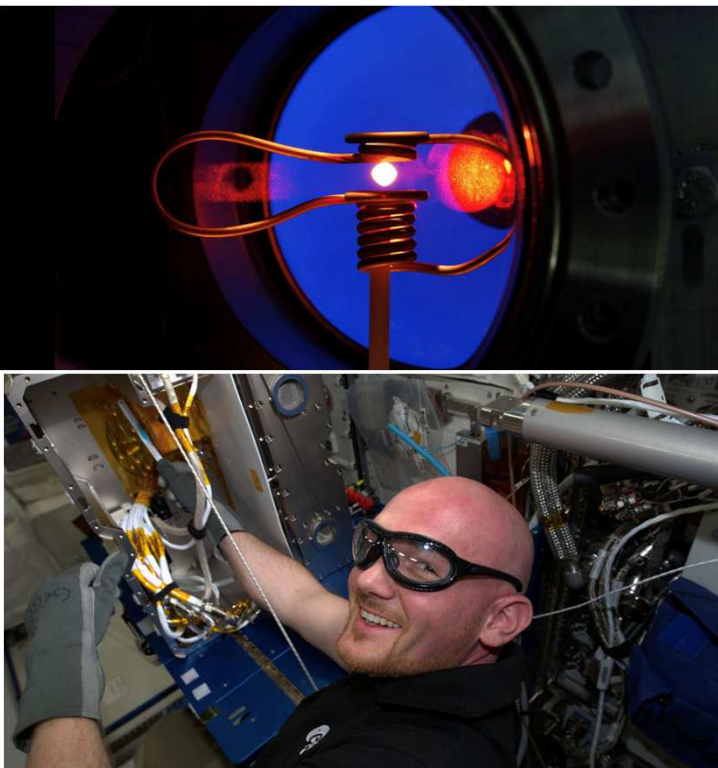


# ESA's ExoBIOLOGY PROGRAMME ON-BOARD THE ISS

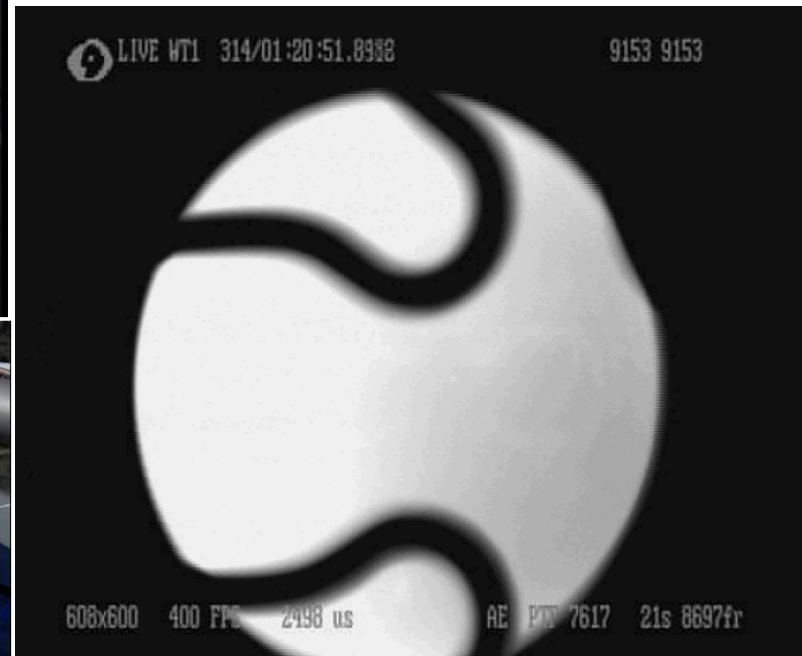


EXPOSE facility

# ESA's PHYSICAL SCIENCES PROGRAMME ON-BOARD THE ISS



ElectroMagnetic Levitator (EML)



Transparent Alloys  
instrument



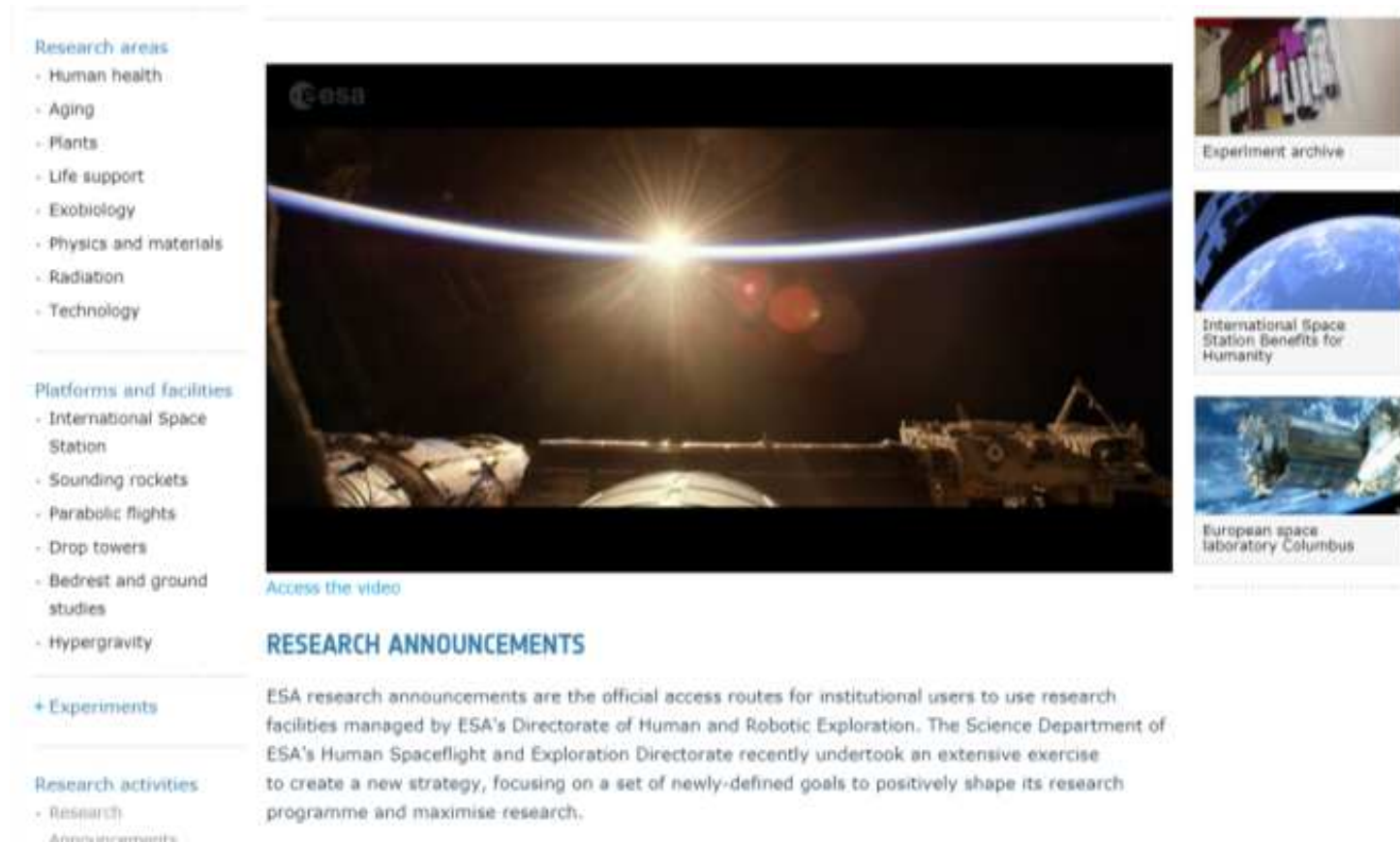
# ESA's CONTINUOUSLY OPEN RESEARCH ANNOUNCEMENTS



**Released** on 1 October 2018

Individual CORAs for

- Sounding Rockets
- Drop Towers
- Parabolic Flight Campaigns
- Ground-Based Facilities
- IBER
- MAP programme



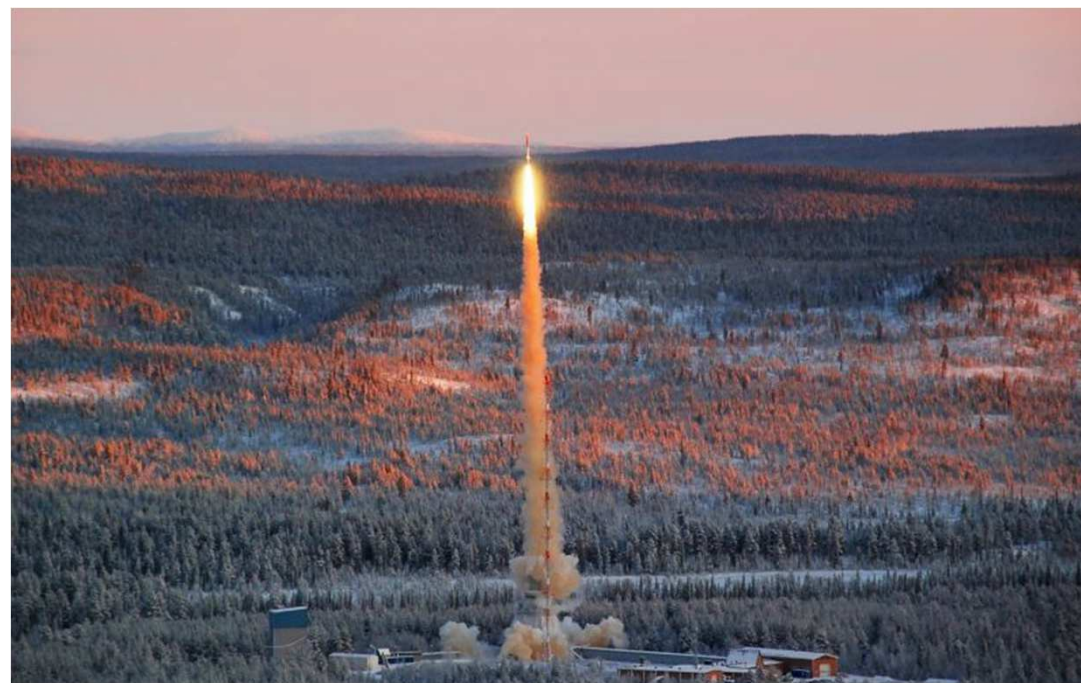
# SOUNDING ROCKETS

## ACHIEVEMENTS IN SciSPACE PERIOD 1

- MAXUS-9:  
GRADE CET, EUGRAPHO, XRMON-DIFF,  
Perwaves
- *MASER-14 (target launch 2019):*  
*XRMON-GF, ARLES*
- *Texus-56 (target launch 2019):*  
*Perwaves, ICAPS*

## PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Future solicitation and implementation of experiments through dedicated  
**Continuously Open Research  
Announcement**





## DROP TOWER

### ACHIEVEMENTS IN SciSPACE PERIOD 1

- 118 drops serving 7 experiments

### PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Future solicitation and implementation of experiments through dedicated **Continuously Open Research Announcement**



## PARABOLIC FLIGHT CAMPAIGNS

### ACHIEVEMENTS IN SciSPACE PERIOD 1

- 3 ESA parabolic flight campaigns in 2017  
18 Physical, 8 Life Sciences experiments
- 2 ESA parabolic flight campaigns in 2018  
12 Physical, 7 Life Sciences experiments
- ISLSWG parabolic flight campaign in 2018  
4 ESA Life Sciences experiments
- *2,5 ESA Parabolic Flight campaigns in 2019*

### PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Future solicitation and implementation of experiments through dedicated **Continuously Open Research Announcement**
- 2 ESA parabolic flight campaigns per year, not limited to microgravity levels.

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# GROUND-BASED FACILITIES PROGRAMME

## ACHIEVEMENTS IN SciSPACE PERIOD 1

- Re-start of programme in January 2017 after temporary discontinuation since 2015
- Selection and implementation of 5 proposals

## PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Future solicitation and implementation of experiments through dedicated **Continuously Open Research Announcement**



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# BEDREST STUDIES

## ACHIEVEMENTS IN SciSPACE PERIOD 1

- 60d Reactive Jump Study “RSL”
- 60d “Cocktail” Study
- Joint ESA/NASA 60d Bedrest study “AGBRESA”
- ESA Bedrest Call for Ideas 2017
- Database for Bedrest Core Data under preparation

## PLANNED ACTIVITIES IN SciSPACE PERIOD 2

### :envihab

AGBRESA    AGBRESA  
+RSL        +RVE

### MEDES

AGBRESA    AGBRESA  
+PAP        +PAP+BE

### Planica (normobaric hypoxia)

AGBRESA    AGBRESA  
                  +RVE

### Dry-immersion validation

DI   -6° HDT   +8.5° HUT

### Dry-immersion + AGBRESA

- Announcement of Opportunity for Bedrest Core Data datamining

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## HUMAN RESEARCH ON ANTARCTIC STATIONS

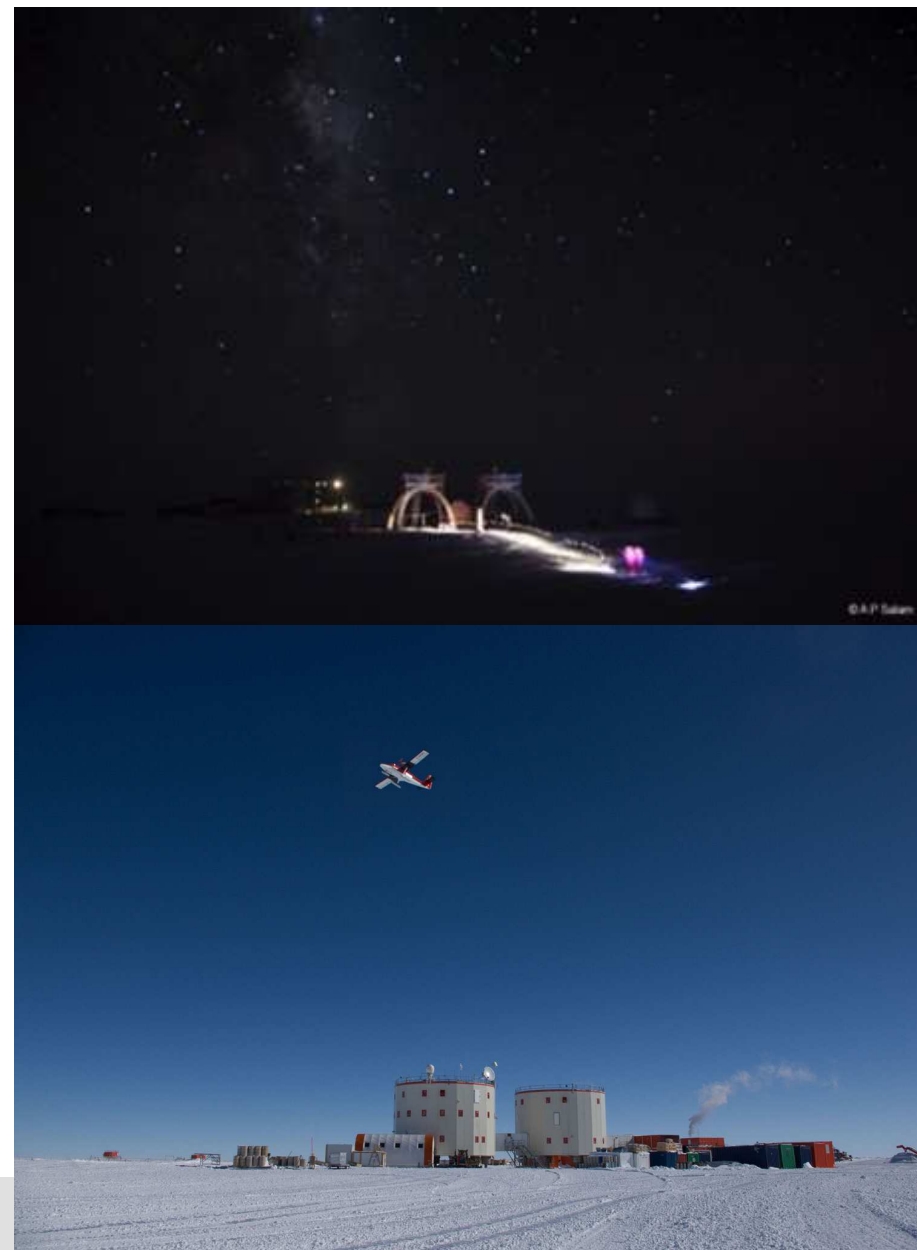
### ACHIEVEMENTS IN SciSPACE PERIOD 1

- Implementation of experiments solicited from AO-2013-Concordia
- Release of AO-2017-Concordia
- First science results workshop stemming from ESA-selected experiments

### PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Implementation of experiments solicited from AO-2017-Concordia

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## SPACE RADIATION STUDIES

### ACHIEVEMENTS IN SciSPACE PERIOD 1

- Resumption of science activities through traditional IBER programme: AO-2017-IBER (11 proposals)
- Release of complementary **Continuously Open Research Announcement**

### PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Science activities through traditional IBER programme at GSI
- Continuation of complementary **Continuously Open Research Announcement**
- Preparation for ground-based space radiation activities with future FAIR facilities
- *Focussed research opportunities on-board ISS under preparation.*



The Universal Linear Accelerator (Unilac) at GSI



# MICROGRAVITY APPLICATION PROMOTIONS PROGRAMME

## ACHIEVEMENTS IN SciSPACE PERIOD 1

- Completion of MAP project “Eristo” with ISS experiment “In Vitro Bone”
- Future solicitation and implementation of projects through **Continuously Open Research Announcement**
- Foster incubation and establishment of MAP projects across all science areas

## PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Implementation of MAP projects across all science areas

### SCANCO Equipment

XtremeCT II

### Scan parameters

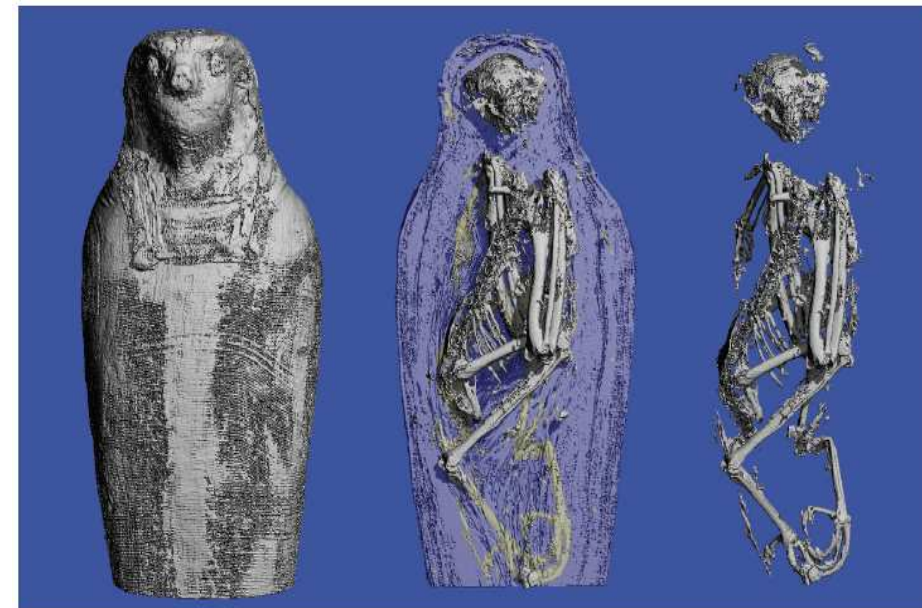
Energy: 68 kVp

Field of View: 140 mm

Resolution: 60.7  $\mu\text{m}$

Integration time: 200 ms

Projections: 1800/180°



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## TOPICAL TEAMS

### ACHIEVEMENTS IN SciSPACE PERIOD 1

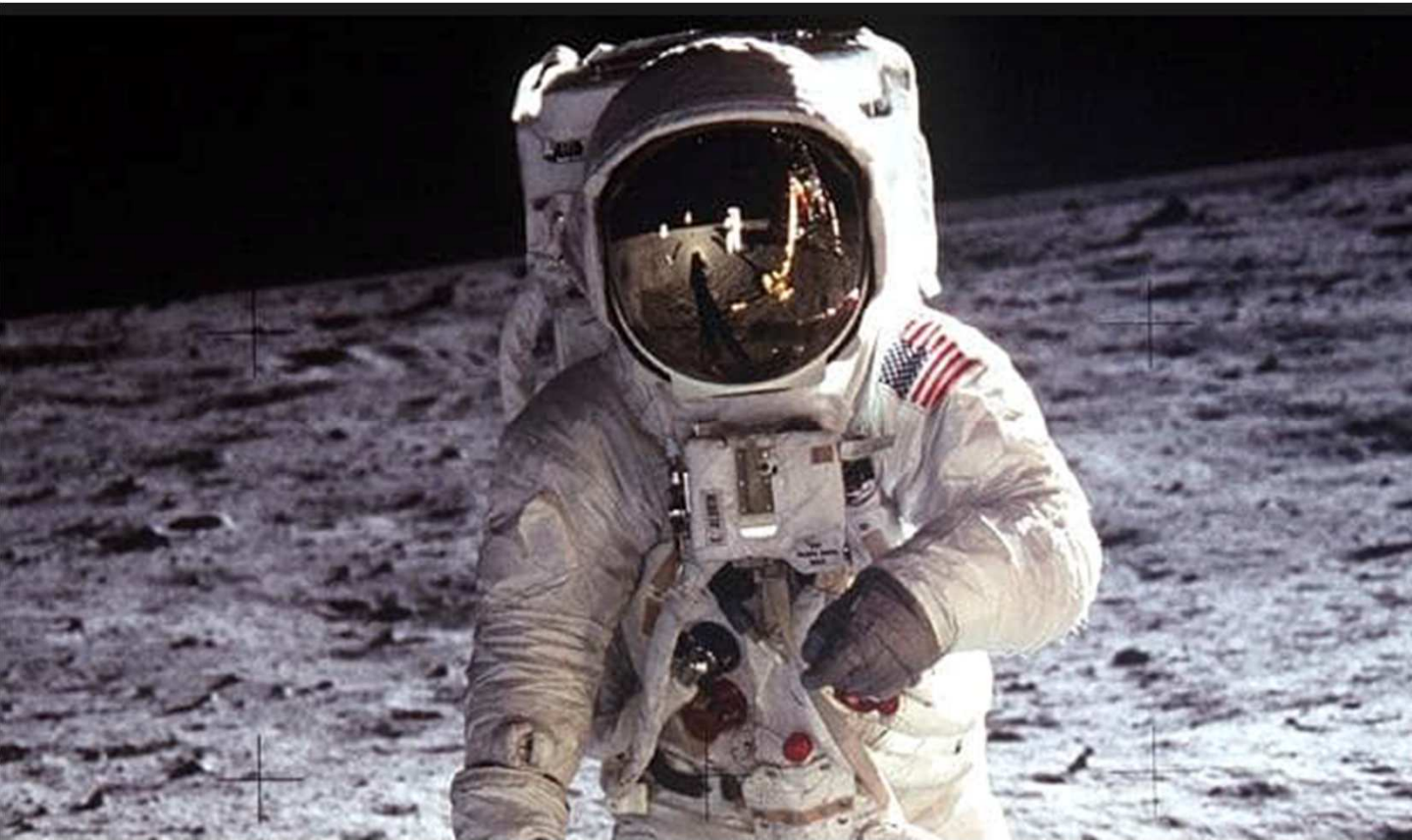
- Support to new Topical Teams (*status September 2018*):
  - Ageing
  - Flavour
  - Nutrition
  - Personalized Medicine
  - Tissue Healing in Space
- Start of FTAP-recommended "Hibernation and Torpor" activity

### PLANNED ACTIVITIES IN SciSPACE PERIOD 2

- Incubation of potential MAP projects
- Identification and support of innovative new research areas

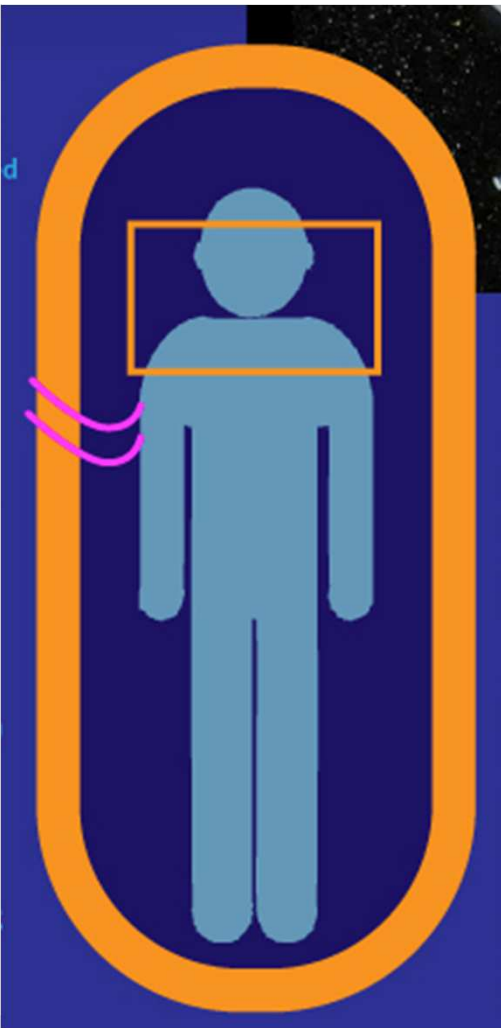


# MOON DUST



Eugene Cernan in the Lunar Module Challenger. (Image credit: NASA)

# HIBERNATION AND TORPOR



Space trips to the other planets would require months of travel through the vacuum of space. Maintaining the crew's health is a vital concern. If the crew could be induced to hibernate, the problems of survival become easier to solve.

## HIBERNATION, NOT FREEZING

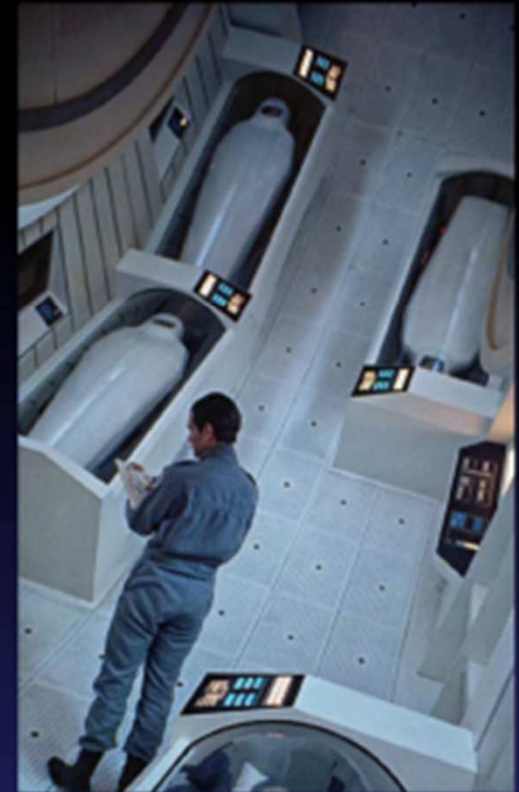


Hibernation is a type of torpor, or reduced metabolism caused by hypothermia. Unlike in cryogenics, the body does not actually freeze.

A 10 degree drop in body temperature reduces metabolic rate by 50 to 70 percent.



Preble's Mouse hibernates during the colder half of the year. (CREDIT: U.S. Fish and Wildlife Service)



Astronaut Dave Bowman monitors hibernating crew members on the voyage to Jupiter in "2001: A Space Odyssey." (1968)



## → RESEARCH OPPORTUNITIES ON THE DEEP SPACE GATEWAY

- Decision on ESA participation expected in 2018
- Identification of high-importance research areas benefitting from the Deep Space / Lunar Orbital Platform Gateway which cannot be performed in Low Earth Orbit, e.g.:
  - Radioprotection research
  - Radiation risk models
  - Exobiology



**we explore. you benefit.**

Human Spaceflight and Robotic Exploration

