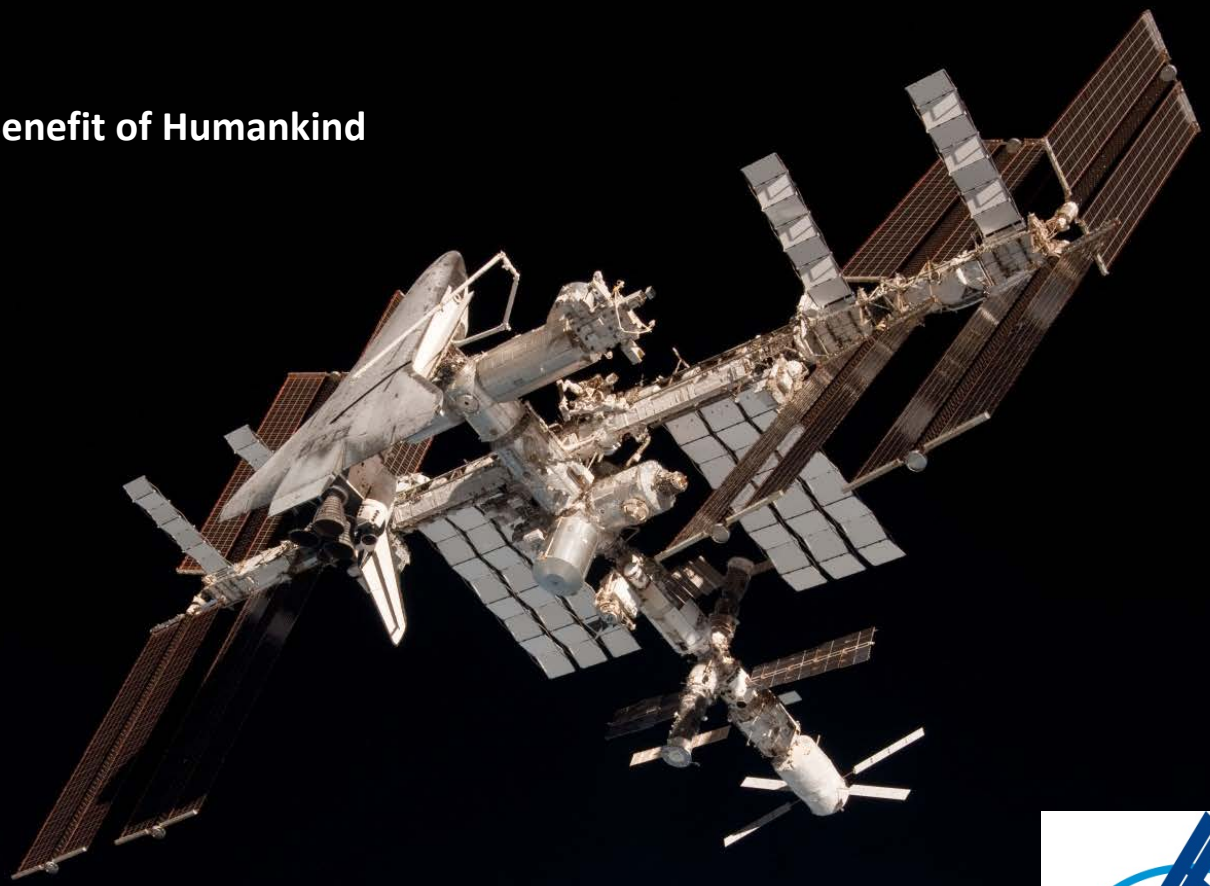
European ISS Research Strategy

human spaceflight

ISS Symposium 2012
Research in Space for the Benefit of Humankind
4 May, 2012
Berlin, Germany



Christer Fuglesang
Head of Science and Applications Division
ISS Utilization and Astronaut Support Department
Directorate of Human Spaceflight and Operations
ESA – ESTEC

berlin ISS symposium 2012
RESEARCH IN SPACE FOR THE BENEFIT OF HUMANKIND

European ISS Research Strategy

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- Utilize the **outstanding base for unique science** that has been created by substantial investments over the last decades
- Continue with the established science programme in **Life and Physical Sciences (ELIPS)**
- Look for **further research and technology domains**
- **~150 projects** are on-going, in planning or in preparation, but there is room for **new solicitations** in the future
- Support **applied research and industrial R&D**
- Prepare for **Human Exploration**
- Work with our partners to utilize ISS as efficiently as possible and **build strong international science teams**

“Space for Science, Science for Earth”

Europe's ISS Assets

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- **Columbus On-orbit Laboratory**, attached to ISS since Feb 2008
- **ATV transport vehicle** for logistic support of ISS
- **ISS science facilities** for dedicated research disciplines
- **Columbus Control Center** and 9 dedicated User Support Operation Centers

Internal Payload Facilities

ELIPS - European Programme for Life and Physical Sciences in Space

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- ELIPS is since 2002 ESA's key programme to conduct research on ISS

- To augment efficiency and impact of ISS experiments, also using other platforms

- Support Industrial applications and involvement

Sounding Rockets

ESA Research - Main Areas on ISS

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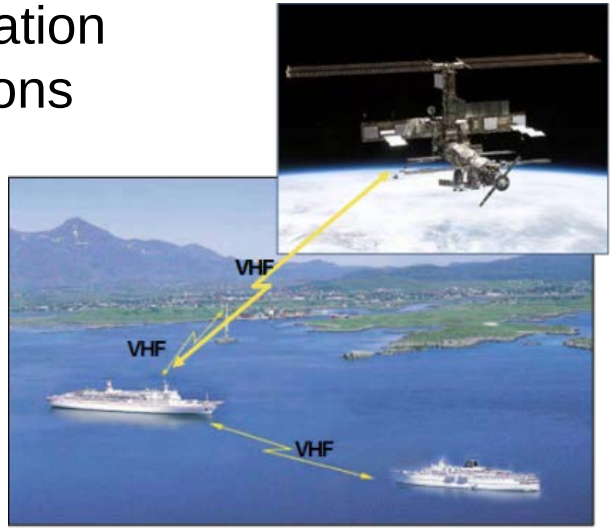
- **Based on consultations with users and recommendations of science advisors**
- **Primarily utilizing the unique condition of long-term weightlessness (microgravity)**
- **Also exploiting the superb views on both Earth and Space**
- **7 “Cornerstones” in Life and Physical Sciences**

elips

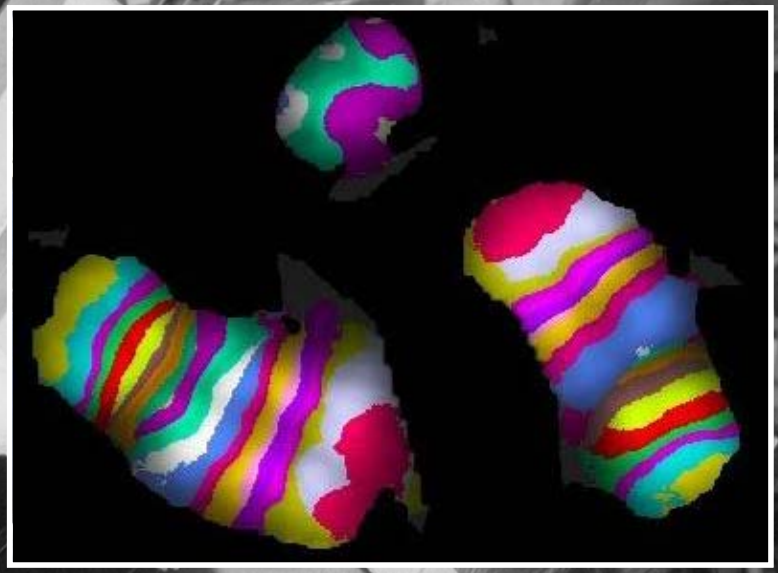
+ Human Exploration Preparation
+ Technological Demonstrations
+ Climate Change Studies
+ Education and Outreach



Key Research Topics

HUMAN PHYSIOLOGY AND PERFORMANCE

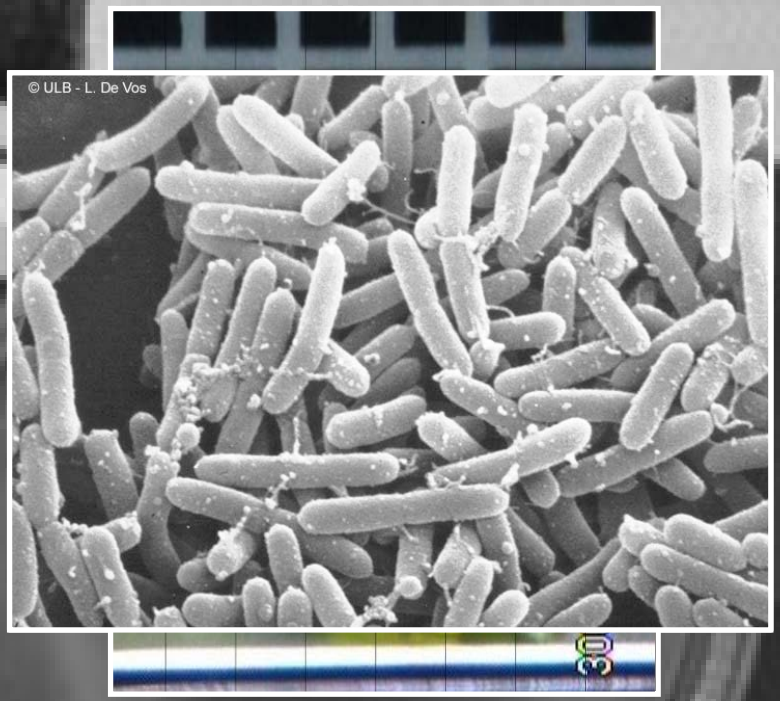
- Mechanisms orchestrating organ systems interaction and recovery under variable gravitational levels (system homeostasis)
- Factors impairing physical and cognitive performance
- Countermeasure strategies
- Radiation



Key Research Topics

BIOLOGY

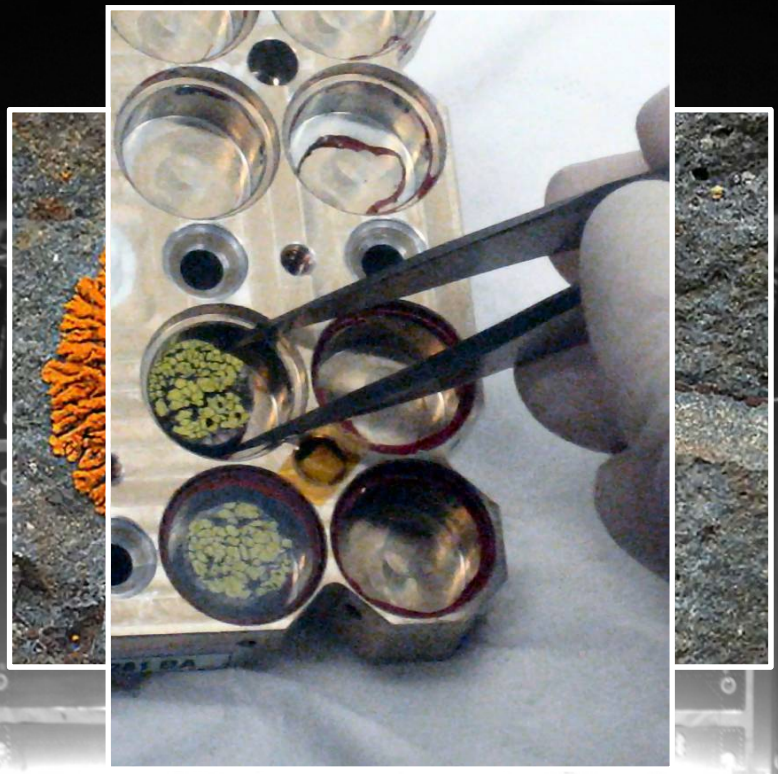
- **Sensitivity to Gravity of cells, plants and animals**
  - Molecular mechanisms for sensing and adaptation
  - Multicellular structure formation
  - Development and performance of organ systems
  - Lifecycle from embryonic development to senescence
- **Biological responses to multiple stressors**



Key Research Topics

ASTROBIOLOGY

- Organic compounds and mineral interactions
- Polymerisation, stability and replication studies
- Response of pre-biotic building blocks to extra-terrestrial conditions
- Mechanisms of survival and adaptation of extremophiles



Key Research Topics

ATMOSPHERIC AND ENVIRONMENTAL RESEARCH

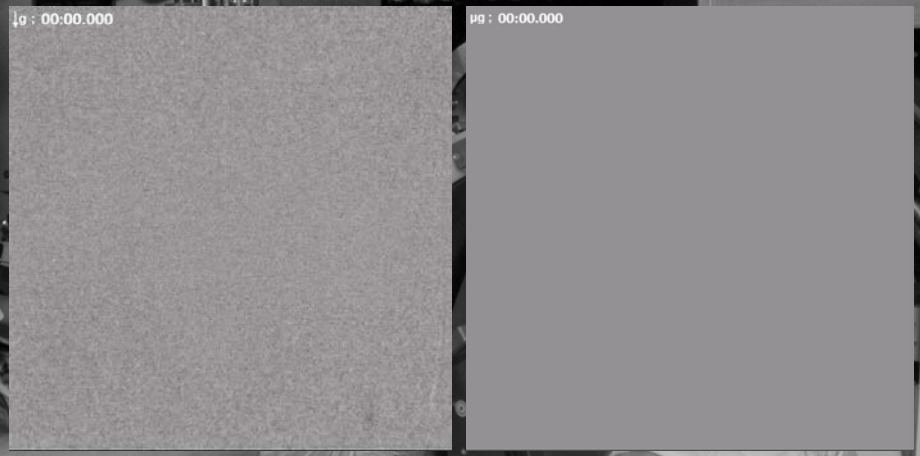
- Novel data understanding global climate change
- Global animal migrations
- Space-atmosphere interactions
- Solar spectral irradiance

Key Research Topics

MATERIAL SCIENCES

- Thermophysical properties
- Microstructures in alloys – convection influence
- Influence of the processing conditions on features of crystalline and amorphous phases and of biological, organic and inorganic materials.
- Links: materials processing - structure - properties of new light-weight structural metallic or intermetallic materials.

In situ Solidification

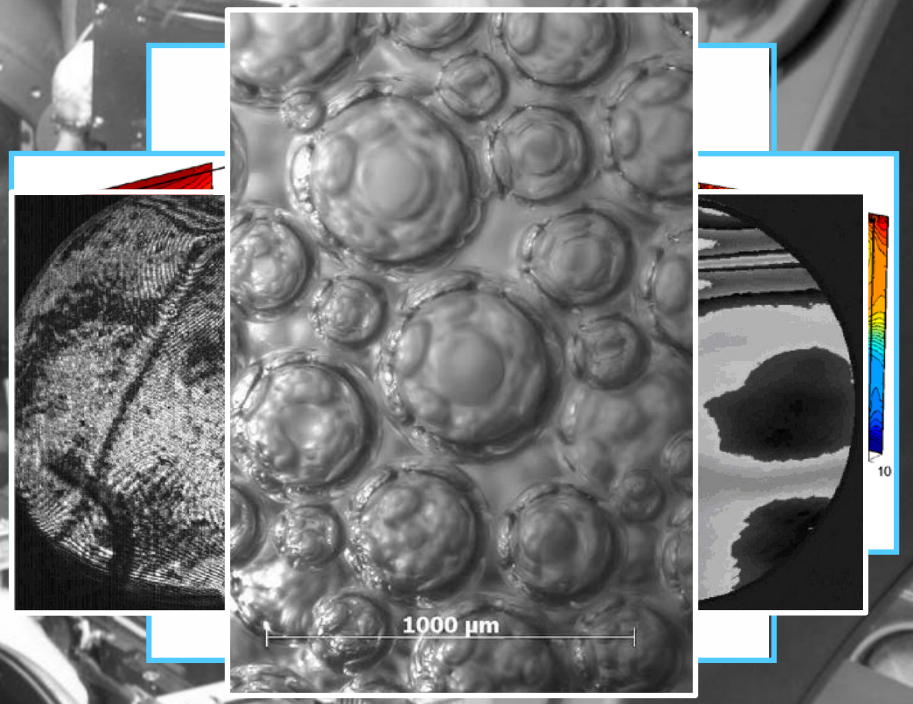


Ground *Space*

Key Research Topics

PHYSICS OF FLUIDS AND COMBUSTION

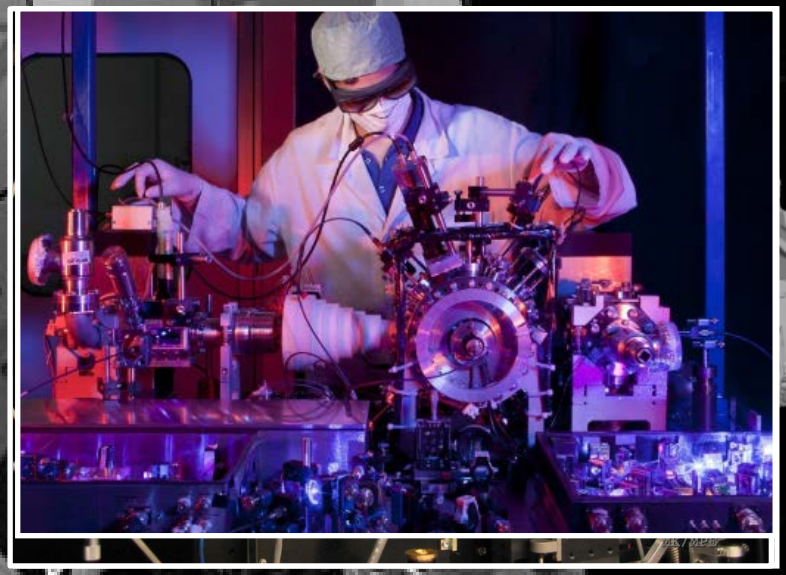
- Dynamics and properties of interfaces
- Convective instabilities under conditions not realisable on Earth
- Phase separation, evaporation and heat transfer
- Complex fluids: coarsening and stability
- Combustion processes of dispersed systems



Key Research Topics

FUNDAMENTAL PHYSICS

- Fundamental Constants of Nature
- Universal time scales and clock comparison at global scale
- Dynamics of degenerate quantum gases
- Test Einstein's Weak Equivalence Principle
- Mimic molecular interactions



Research Implementation Strategies

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- **Science driven bottom-up approach**
  - Build strong science teams by supporting Topical Teams in dedicated scientific areas of interest
- **Announcement of Opportunities (AO) have been "open", but some focus might be needed in future**
  - Current pool of ELIPS experiments completed around 2017
  - Likely new AOs in 2013/2014 timeframe
  - Coordinate internationally as far as possible
- **ESA provides research hardware development, launch and operations; Scientists funded by national sources.**

Working Internationally and engaging Industry

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- Involve international teams of theorists, modellers, experimentalists and communicators
- Optimise ISS resources by cooperation with other ISS partners through joint experiments
- Associate non-space R&D industry wherever possible
- Embed space projects into larger ground-based, application-oriented projects often funded by the EC

Transfer of Knowledge

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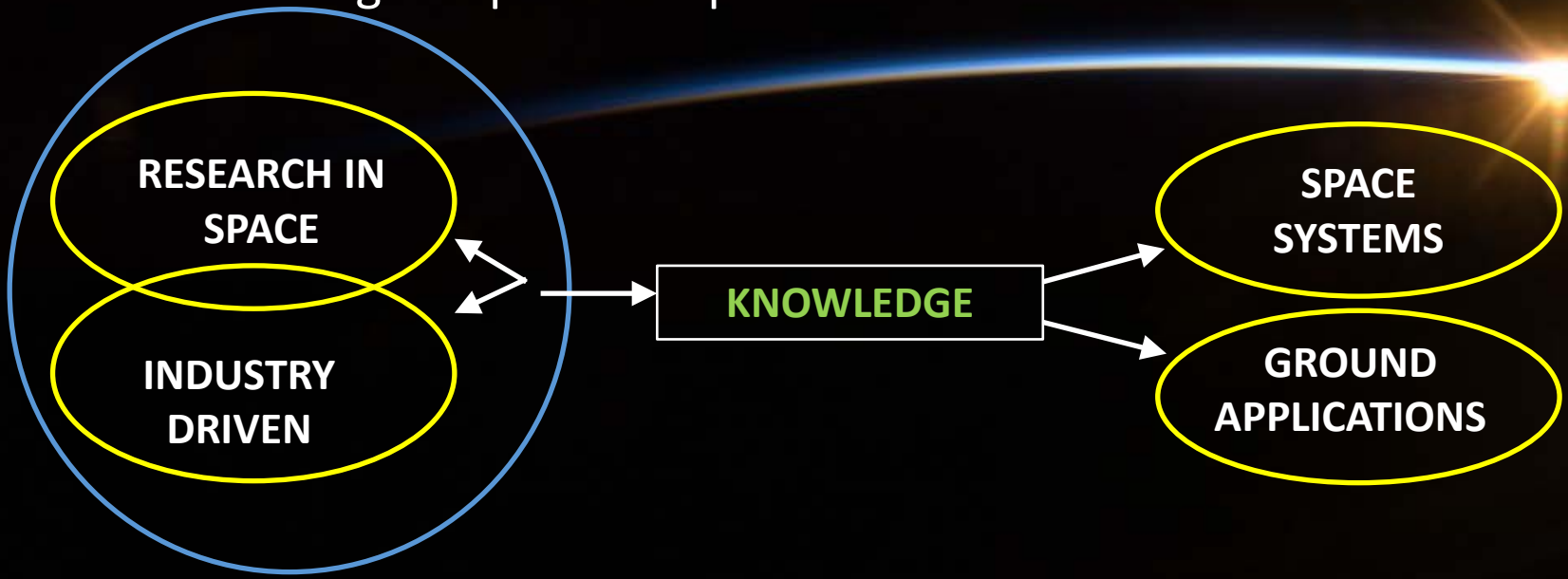
Support and accelerate the transfer of knowledge generated by research in space into industrial processes or products

- Research in space - production of benchmark data - most useful if supported by a large body of ground based research
- Performing space experiments as part of industrial R&D projects is an effective way of providing industry with knowledge acquired in space



“Space for Science, Science for Earth"

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THANK YOU!