

# Community Workshop on Cold Atoms in Space

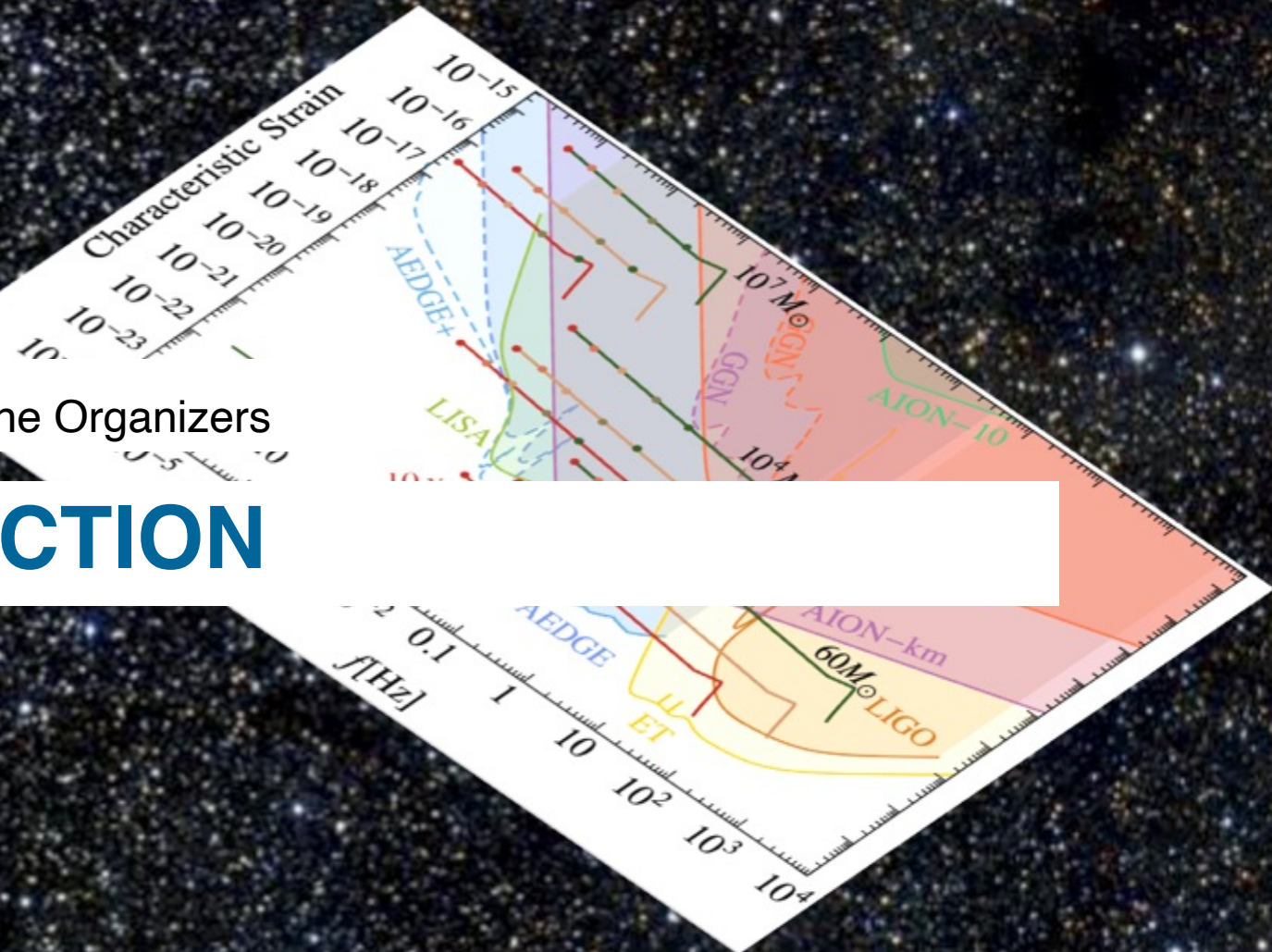
Oliver Buchmueller and John Ellis on behalf of the Organizers

## WORKSHOP INTRODUCTION

Virtual Workshop

September 23/24 2021

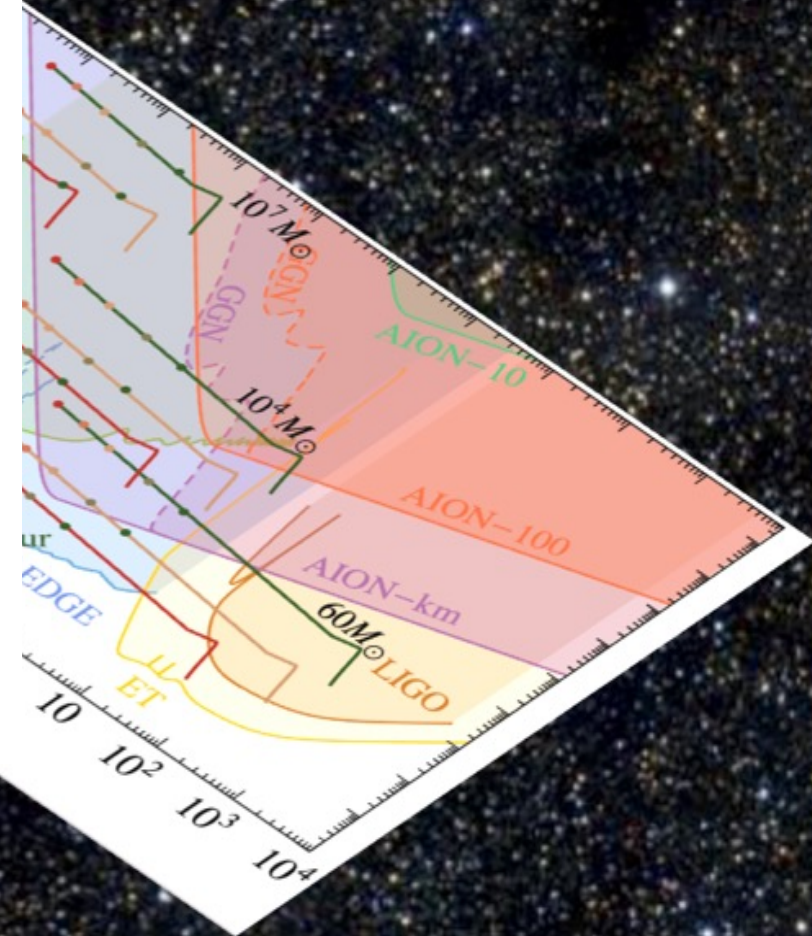
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# Community Workshop

## Atoms in Space

*Angelo Bassi, University of Trieste, Italy*  
*Kai Bongs, University of Birmingham, UK*  
*Philippe Bouyer, CNRS, Institut d'Optique, France*  
*Oliver Buchmueller, Imperial College London, UK*  
*Luigi Cacciapuoti, European Space Agency*  
*Marilù Chiofalo, University of Pisa and INFN Pisa, Italy*  
*Albert De Roeck, CERN, Geneva, Switzerland, and University of Antwerp, Belgium*  
*Michael Doser, CERN, Geneva, Switzerland*  
*John Ellis, King's College London, UK*  
*Rene Forsberg, DTU Space, Denmark*  
*Thomas Lévêque, Centre National d'Etudes Spatiales, France*  
*Christian Lisdat, Physikalisch-Technische Bundesanstalt, Germany*  
*Federica Migliaccio, DICA, Politecnico di Milano, Italy*  
*Ernst Rasel, Leibniz Universität Hannover, Germany*  
*Stephan Schiller, Heinrich-Heine-Universität Düsseldorf, Germany*  
*Christian Schubert, Leibniz Universität Hannover, Germany*  
*Carla Signorini, INFN Pisa, Italy*  
*Guglielmo Tino, Università di Firenze and LENS, Italy*  
*Wolf von Klitzing, IESL-FORTH, Greece*  
*Peter Wolf, CNRS, Observatoire de Paris-PSL, Paris, France*



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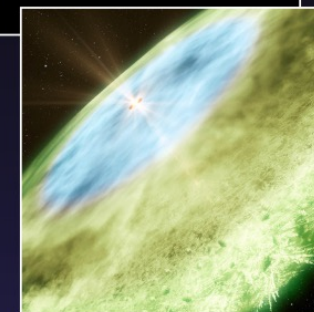
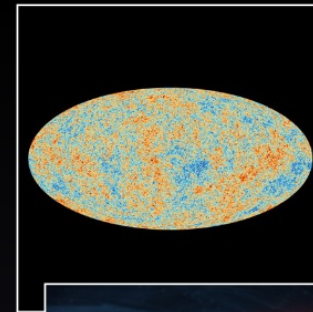
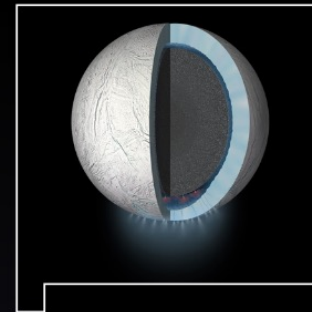
# Voyage 2050

Final recommendations from  
the Voyage 2050 Senior Committee



SCIENCE & EXPLORATION

## Voyage 2050 sets sail: ESA chooses future science mission themes



## Recommendations of ESA Senior Committee for Voyage 2050

### Include:

**Possible large missions**

**Possible medium missions**

**Possible contributions to international missions**

**Priorities for technology development:**

**Cold Atoms (Mike Cruise, Olivier Carraz)**

**X-rays**

**Technologies for solar system exploration**

**...**

## ***A coordinated two-fold response of the community to the Voyage 2050 recommendations:***

- **A letter to ESA’s Director of Science, Guenther Hasinger:**
  - to raise awareness in ESA that the community is prepared to organise itself and to work actively with ESA, as it shapes a roadmap for a Cold Atom technology in space development programme – Done [see workshop page for further info]
- **A community workshop in September:**
  - to formulate a roadmap for the development programme, which would provide input to ESA on how to structure it and what priorities could be established – **Now**

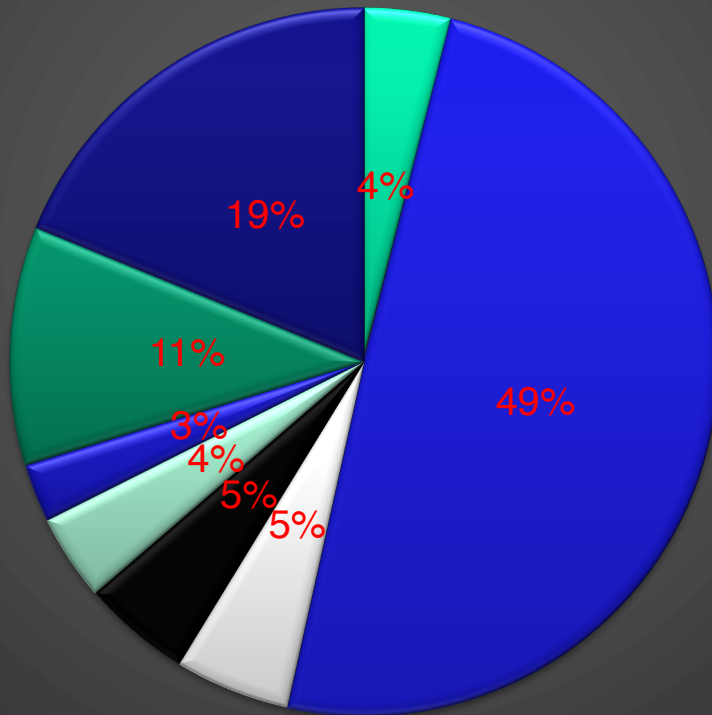
# Participant Analysis

321 people from 36 countries have registered for the Workshop and/or to follow the Community Roadmap process

Community Workshop on Cold Atoms in Space

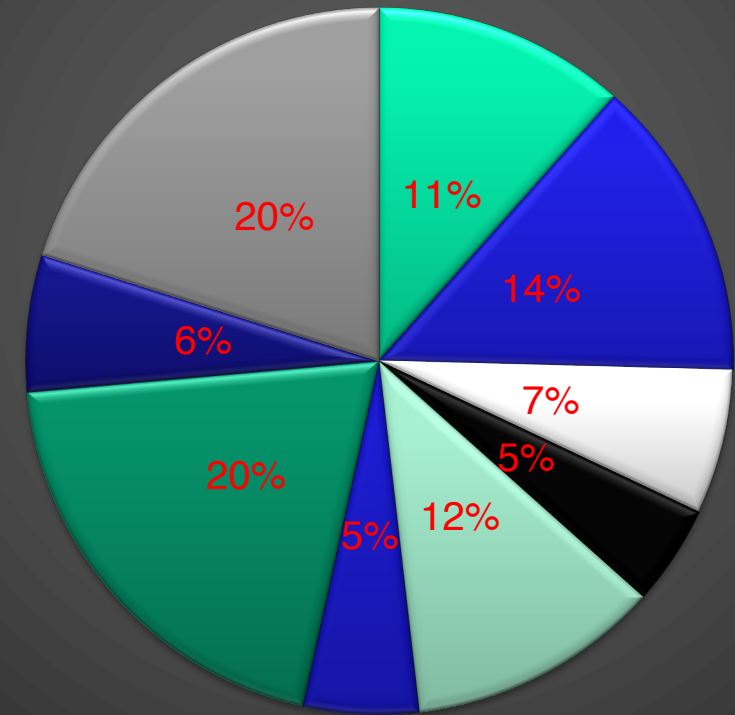
## Main Research Area

- Astrophysics
- Earth Observation
- Others
- Cold Atom Technology
- Gravitational Waves
- Particle Physics
- Cosmology
- Industry



## 2nd Reserach Area

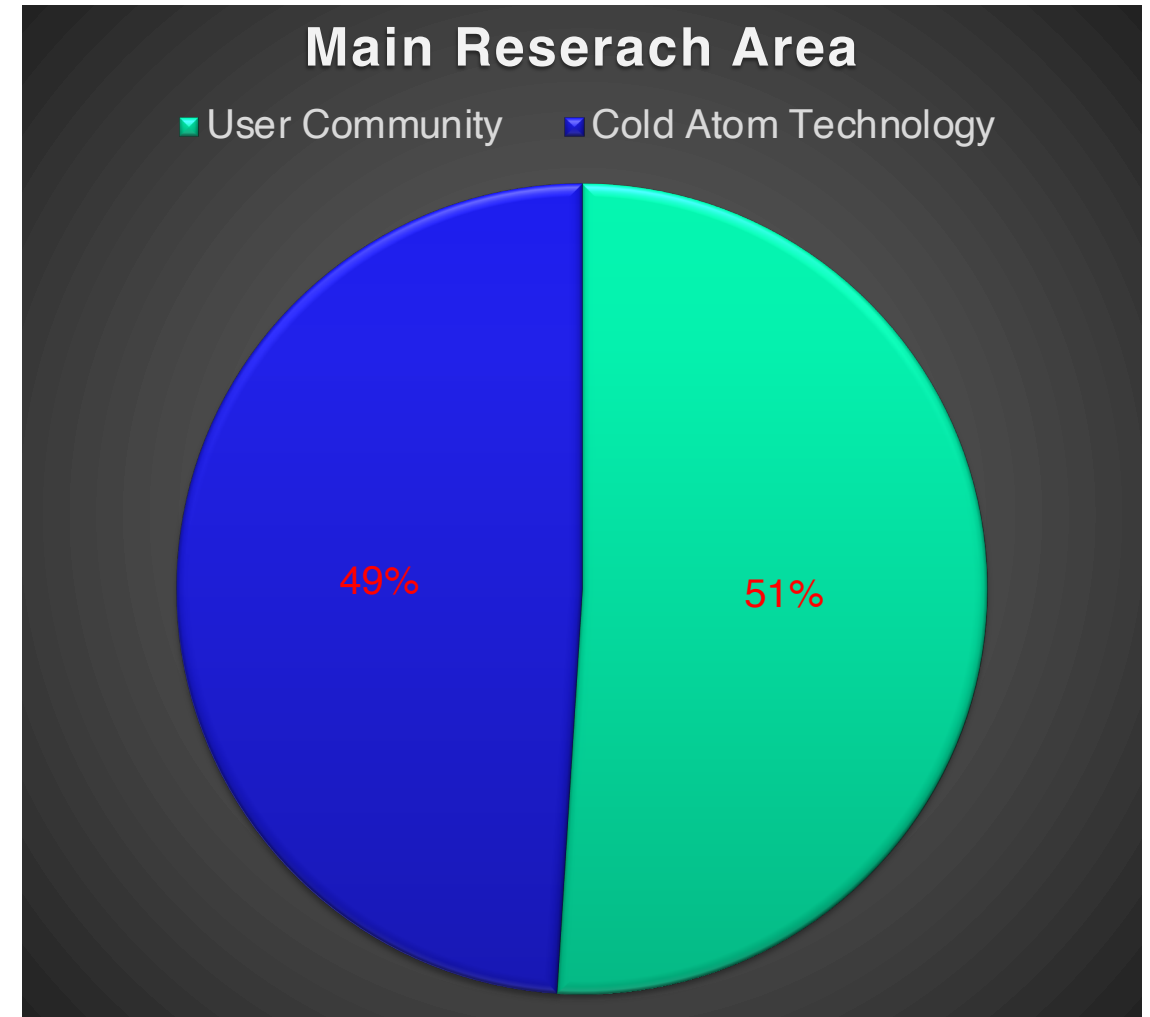
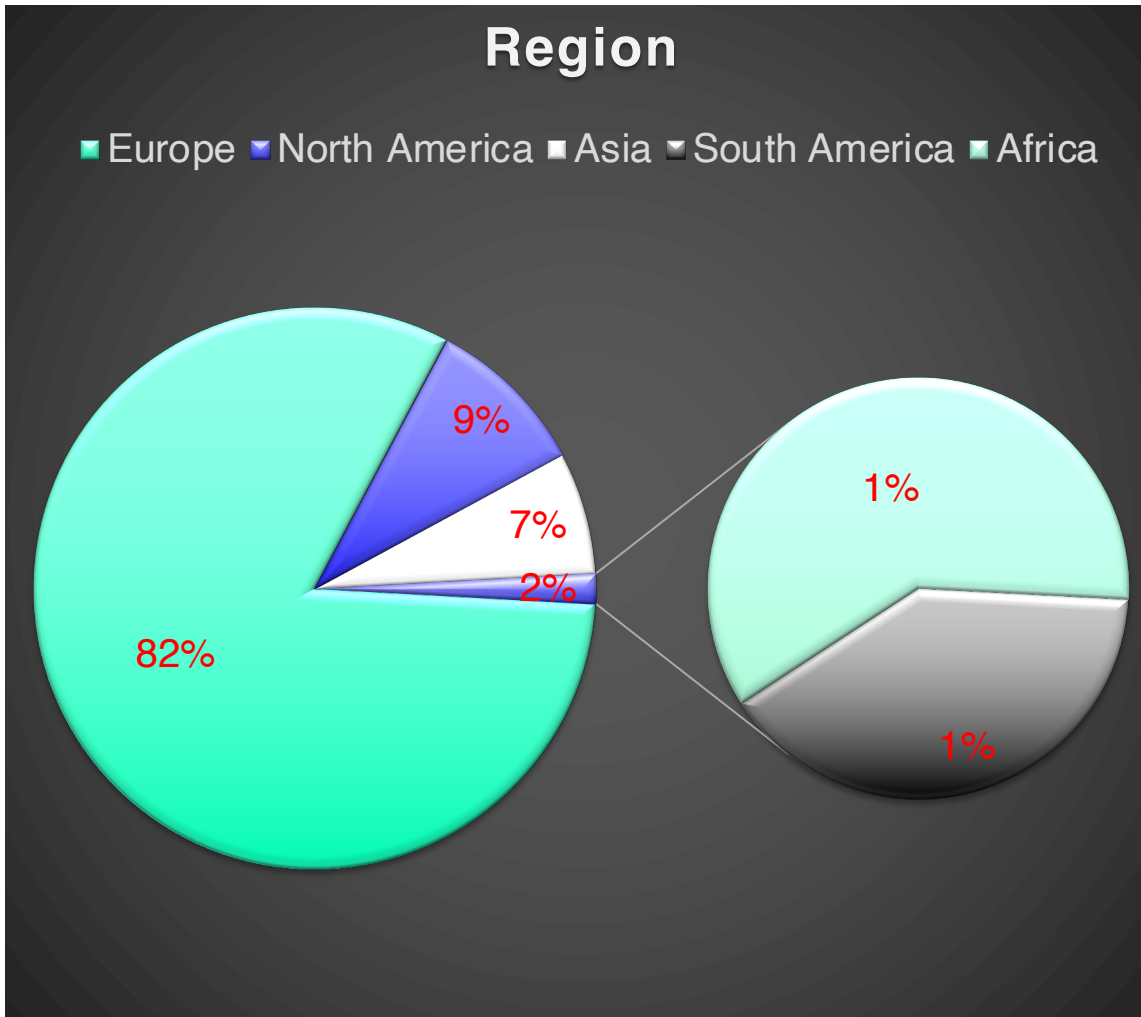
- Astrophysics
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- Industry
- Non



# Participant Analysis

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Community Workshop on Cold Atoms in Space



# Breakout Sessions

**We have 3 breakout sessions today and 2 tomorrow, each 30 min.**

- there are 5 breakout rooms you can choose from (see list on the right)
- 4 sessions have session leaders to stimulate discussion and to summarise the discussion in the last session tomorrow
- You can join one breakout session per 30min slot
- the first breakout session you choose will be automatically remembered for the following. However, you can change to another session by declining the invitation and then choosing the session you prefer

**Atomic Clocks Breakout Session**  
*Christian Lisdat*

**Earth Observation Breakout Session**  
*Federica Migliaccio, Rene Forseberg*

**Fundamental Physics Breakout Session**  
*John Ellis*

**General Perspectives Breakout Session**  
*Marilù Chiofalo, Rosa Poggiani*

**Coffee Chat**



# Agenda Today (Part 1)

## 09:00 → 10:10 Workshop Introduction

- 09:00 **Introduction** ⌚ 10m  
Speaker: Oliver Buchmueller and John Ellis
- 09:10 **Senior Committee Recommendations for Voyage 2050** ⌚ 30m  
Speaker: Mike Cruise
- 09:40 **ESA Perspective on Cold Atoms in Space** ⌚ 30m  
Speaker: Olivier Carraz

## 10:10 → 11:00 Voyage2050 White Paper Reviews

- 10:10 **Exploring the Foundations of the Physical Universe with Space Tests of the Equivalence Principle** ⌚ 10m  
Speaker: Peter Wolf
- 10:20 **AEDGE: Atomic Experiment for Dark Matter and Gravity Exploration** ⌚ 10m  
Speaker: John Ellis
- 10:30 **Quantum Technologies in Space** ⌚ 10m  
Speaker: Mauro Paternostro
- 10:40 **The Missing Link in Gravitational-Wave Astronomy** ⌚ 10m  
Speaker: Shimon Kolkowitz
- 10:50 **The local dark sector** ⌚ 10m  
Speaker: Joel Berge

# Agenda Today (Part 2)

**11:00** → 12:40 **Atomic Clock Reviews**

- 11:00** **Space Clock Projects China** 🕒 15m  
 Speaker: Yu-Ao Chen
- 11:15** **Space Clock Projects US** 🕒 15m  
 Speaker: Kurt Gibble
- 11:30** **Atomic Clocks Review** 🕒 15m  
 Speaker: Sebastien Bize
- 11:45** **Atomic Clocks for SI Second Redefinition** 🕒 15m  
 Speaker: Helen Margolis
- 12:00** **Atomic Clocks for Geodesy** 🕒 15m  
 Speaker: Hu Wu
- 12:15** **Space Clock Projects Europe** 🕒 15m  
 Speaker: Kai Bongs

**12:30** → 13:00 **Break with Virtual Breakout Rooms for Discussion**

**13:00** → 14:30 **Earth Observation Reviews**

- 13:00** **User requirements as a basis for a future quantum space gravimetry mission** 🕒 15m  
 Speaker: Federica Migliaccio
- 13:15** **Methods for atom interferometry in space in the context of earth observation** 🕒 15m  
 Speaker: Christian Schubert
- 13:30** **Quantum space gravimetry at European Commission** 🕒 15m  
 Speaker: Frederic Doms
- 13:45** **Earth Observation: ESA perspective** 🕒 15m  
 Speaker: Olivier Carraz
- 14:00** **CAI and GRICE Studies** 🕒 15m  
 Speaker: Franck Pereira dos Santos

## Agenda Today (Part 3)

**14:30** → 15:00 **Break with Virtual Breakout Rooms for Discussion**

**15:00** → 16:30 **Fundamental Science Review**

**15:00** **Wave Function Collapse**

Speaker: Sandro Donadi

**15:15** **Atom interferometry for testing the equivalence principle in space**

Speaker: Naceur Gaaloul

**15:30** **Dark Matter and Gravitational Waves**

Speaker: Oliver Buchmueller

**15:45** **Dark Energy**

Speaker: Nan Yu

**16:30** → 17:00 **Break with Virtual Breakout Rooms for Discussion**

## Agenda Today (Part 3)

**14:30** → 15:00 Break with Virtual Breakout Rooms for Discussion

**15:00** → 1

**We have an interesting but also tight agenda.**

**Therefore, we would like to remind speakers to please stay in the time allocated.**

**We will also have plenty of discussion time in the breakout sessions (2.5h in total)**

**16:30** → 17:00 Break with Virtual Breakout Rooms for Discussion