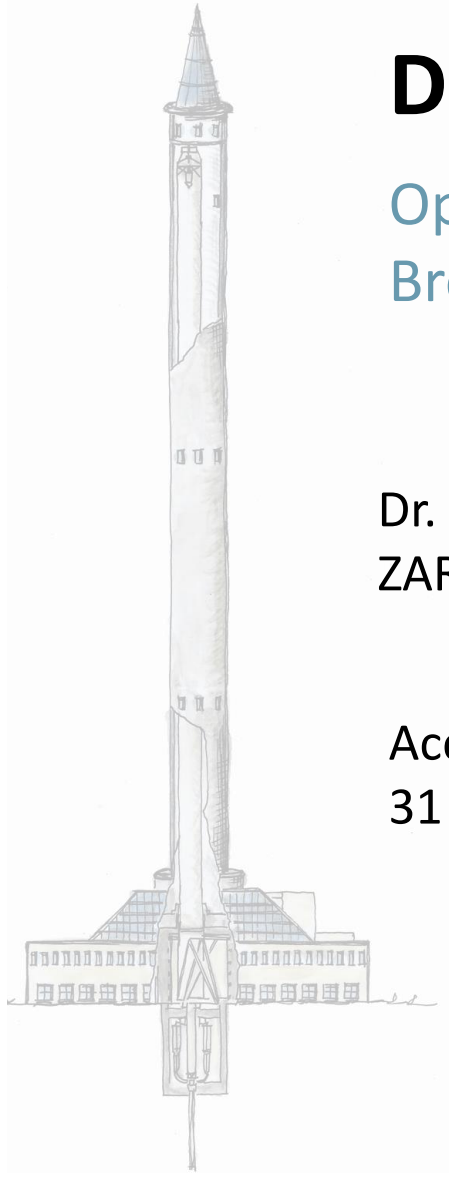
University of Bremen

CENTER OF APPLIED SPACE TECHNOLOGY AND MICROGRAVITY

ZARM



DROPTES — *DROP TOWER EXPERIMENT SERIES*

Opportunity for Microgravity Experiments at the Bremen Drop Tower & GraviTower Bremen Pro

Dr. Merle Cornelius - Dep. Head of Science and Operation
ZARM Drop Tower Operation and Service Company

Access to Space for All, COPOUS STSC Side Event
31 Jan 2024

ACCESS • TO • SPACE • 4 • ALL
DROPTES

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DropTES

- Opportunity to perform experiments in microgravity at one of ZARM's drop tower facilities
- UN Fellowship Program: Access to Space for All Initiative – Hypergravity/Microgravity Track

UNITED NATIONS Office for Outer Space Affairs DLR ZARM

- Program running since 2014
  - Executing Agency: United Nations Office for Outer Space Affairs (UNOOSA)
  - Supporting Agency: German Aerospace Center (DLR) Space Agency
  - Hosting Institution: Center of Applied Space Technology and Microgravity (ZARM)

ZARM - Center of Applied Space Technology and Microgravity

c/o Universität Bremen
Am Fallturm 2, 28359 Bremen, Germany
www.zarm.uni-bremen.de

ZARM - University of Bremen

Research Institute - Faculty 04 Production Engineering

Prof. Dr. Marc Avila
(Executive Director)

- FLUID DYNAMICS
- SPACE SCIENCE
- SPACE TECHNOLOGIES
- HUMANS ON MARS

Research / Teaching

ZARM FAB mbH

ZARM Drop Tower Operation and Service Company

Prof. Dr. Marc Avila
Peter von Kampen
(Executive Board)

Dr.-Ing. Thorben Könemann
(Head of Science & Operation)

Dr. Merle Cornelius
(Dep. Head of Science & Operation)

Technical Support

ZARM Technik AG

Supplier of Attitude Control Equipment for Satellites

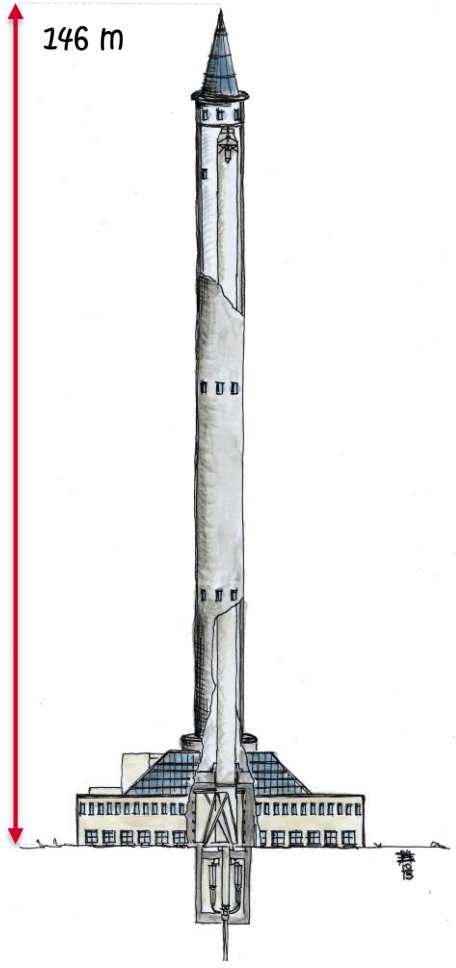
Holger W. Oelze
(Chief Executive Officer)

Peter von Kampen
(Chief Financial Officer)

Marco R. Fuchs
(Chairman of Supervisory Board)

Space Hardware

Bremen Drop Tower



Drop

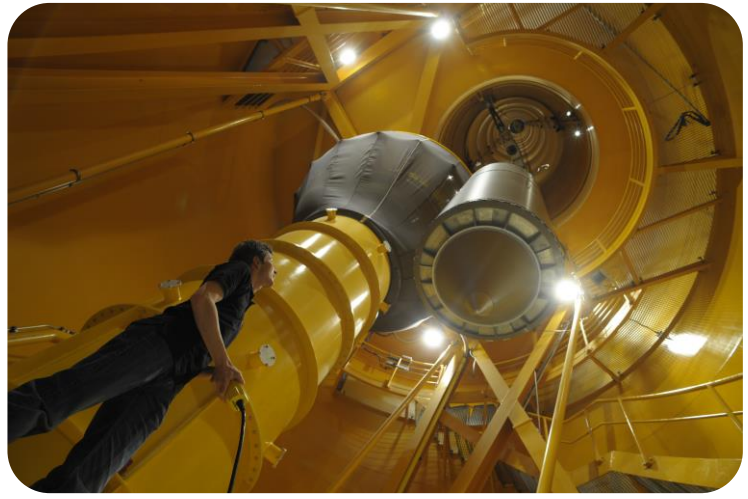
- 110m Free Fall distance
- Microgravity time $4.7\ s$

Worldwide unique catapult

- Launch on vertical parabola
- Microgravity time $9.3\ s$

Vacuum in inner tube to reduce air drag

- High microgravity quality $(\Delta g < 10^{-6}\ \mathrm{g})$
- Limited to 3 experimental runs per day (due to vacuum)



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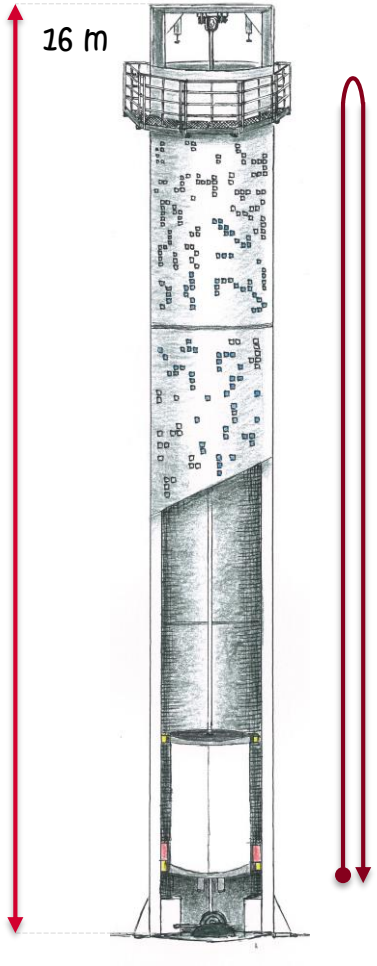
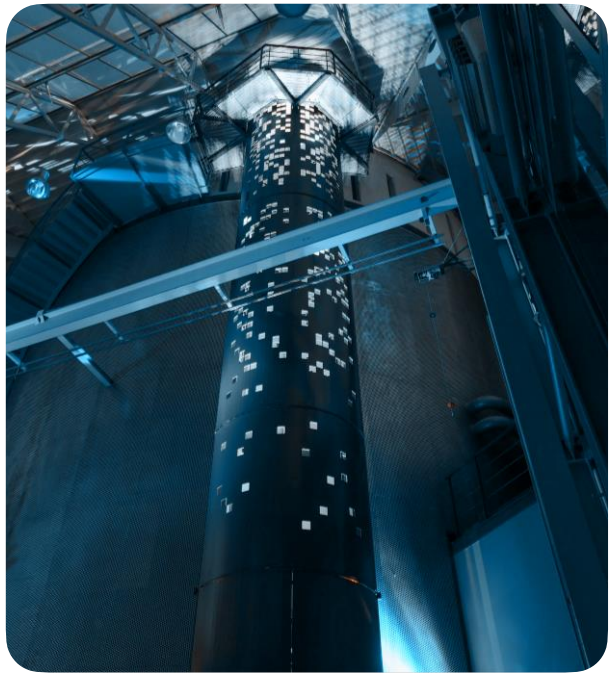
GraviTower Bremen Pro



Guided movement on vertical parabola

- Decoupling experiment from slider
  - Slider acts an air shield
  - No vacuum needed
- Microgravity time up to 2.5 s
- High microgravity quality $(\Delta g < 10^{-4}\mathrm{g})$
- High repetition rate of > 20 runs per hour
- Partial-gravity option



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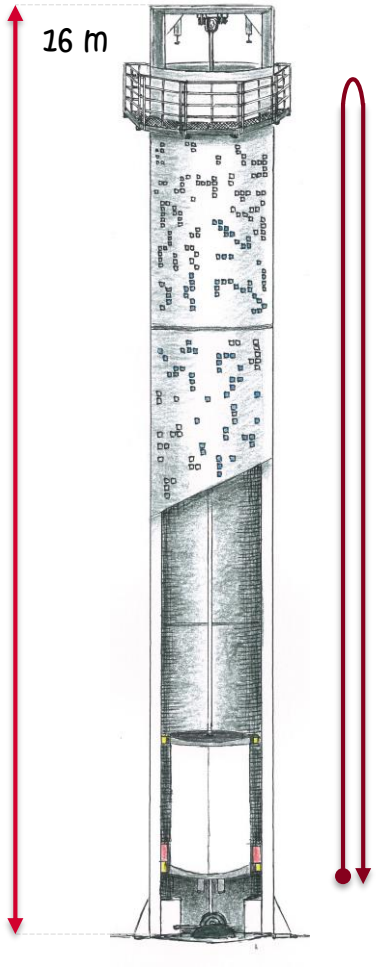
GraviTower Bremen Pro



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  - Like gravitational acceleration of Moon and Mars

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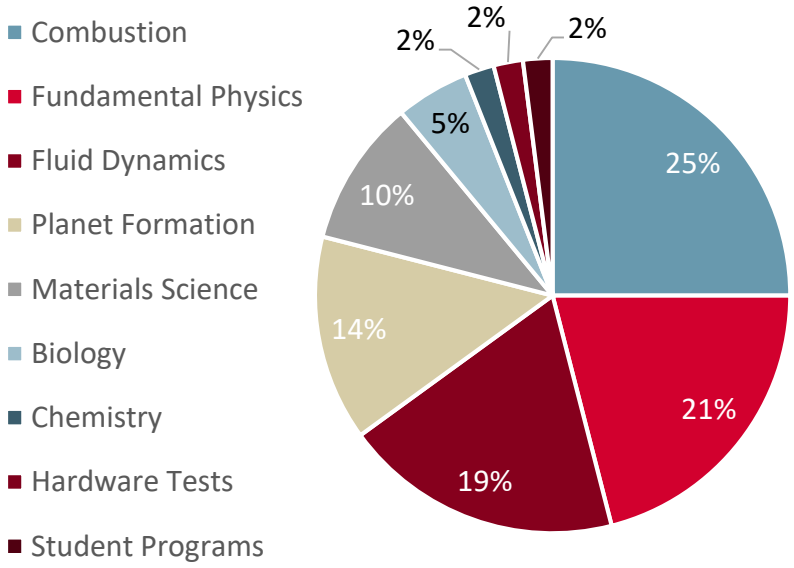
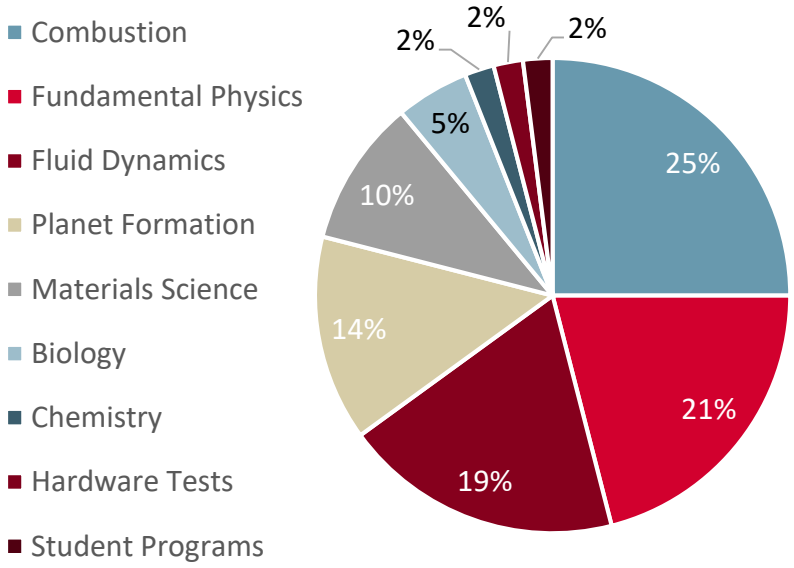
Drop Tower Experiments



- Scientific experiments in various research field
- Hardware tests for space missions
- Student programs
  - DropTES
  - ESA Academy
  - REXUS/BEXUS

Drop Tower Experiments



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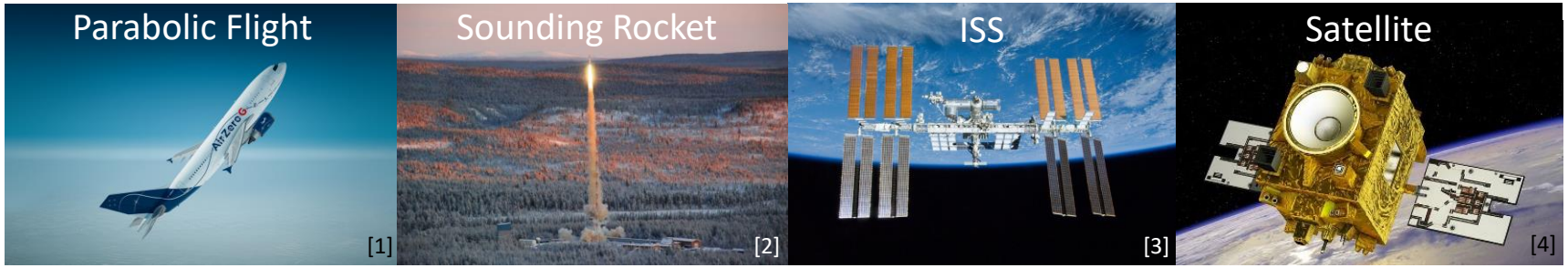

[1] https://www.airzerog.com/de/bildergalerie-der-zero-g-fluege/ [2] https://www.esa.int/ESA_Multimedia/Images/2011/11/Texus_48_launch
[3] https://www.esa.int/ESA_Multimedia/Images/2010/06/ISS2 [4] https://www.esa.int/ESA_Multimedia/Images/2016/04/Microscope

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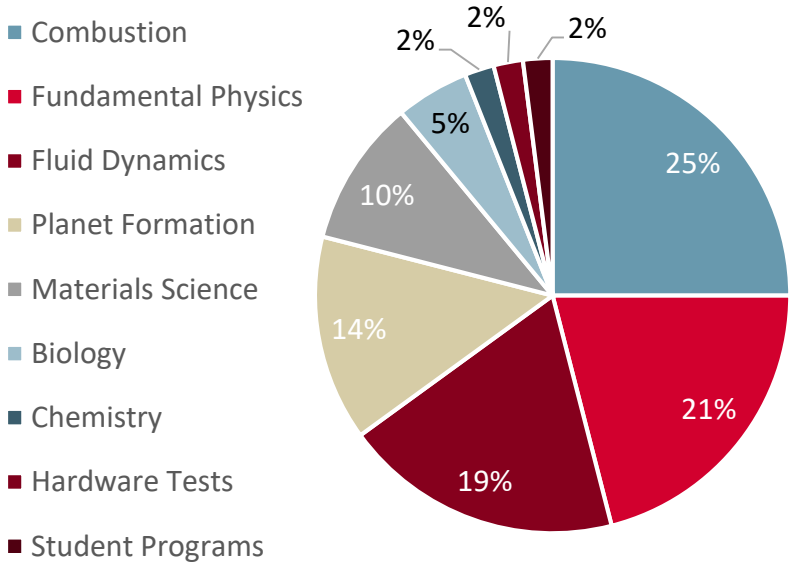
Drop Tower Experiments



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Stepping-Stone into Space!

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UNITED NATIONS
Office for Outer Space Affairs

DLR

DropTES

Goal

- Realization of a scientific/technological experiment under short-term conditions of weightlessness
- Successful campaign at the Bremen Drop Tower and/or GraviTower Bremen Pro in Germany

→ Capacity-building

Guideline for Application

- Government organizations, research institutes, universities, and other public and non-for-profit organizations
- Number of selected and supported applicants: One team leader with up to four team members who are from Member States of the United Nations
- Program language: English

Program content

- Following space project guidelines (proposal, reports, reviews)
- Technical consulting during preparation phase
- Two weeks at ZARM in Germany to conduct microgravity experiments
  - Five drops or catapult launches in the Bremen Drop Tower or five half-days in the GraviTower Bremen Pro
- Travel, accommodation, and drop tower utilization are sponsored
- Duration: about 1 year

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Former Awardees

- Experiments in the fields of science and technology developing

9. Round 2023/24 – **Universidad Central de Venezuela** (Venezuela)
8. Round 2022/23 – **Universidad de Antioquia** (Columbia)
7. Round 2020 – **Universidad Católica Boliviana San Pablo** (Bolivia)
6. Round 2019 – **Politecnico de Milano** (Italy)
5. Round 2018 – **University of Bucharest and Politehnica University of Bucharest** (Romania)
4. Round 2017 – **Warsaw University of Technology** (Poland)
3. Round 2016 – **Instituto Tecnólogico de Costa Rica and Universidad de Costa Rica** (Costa Rica)
2. Round 2015 – **Universidad Católica Boliviana San Pablo** (Bolivia)
1. Round 2014 – **German Jordanian University** (Jordan)

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1. Round 2014 – **German Jordanian University** (Jordan)

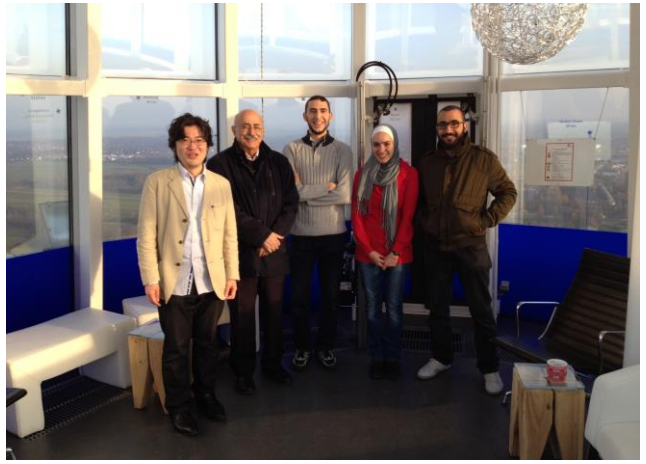
DropTES – 1th round 2014

German Jordanian University (Jordan)

- Technology Development
- “Tether dynamics for satellites”

Capacity-building example

- One year internship at ZARM to further increase the level of experience



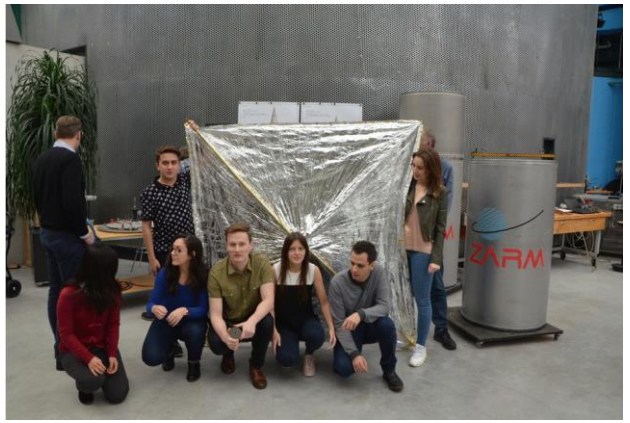
DropTES – 4th round 2017

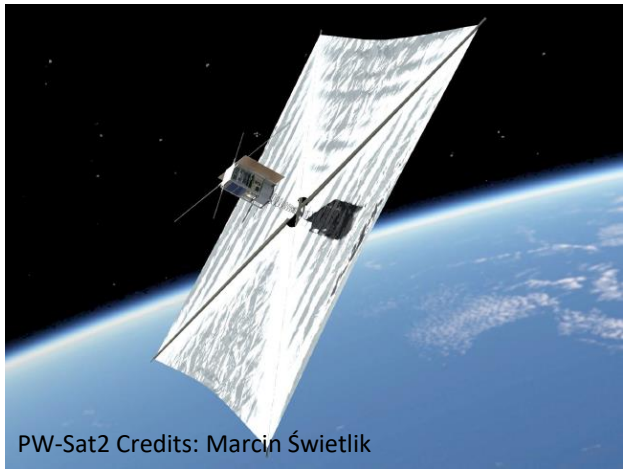
Warsaw University of Technology (Poland)

- Technology development
- “Deorbit deployment of a solar sail”

Capacity-building example

- Successful hardware test during DropTES campaign
- PW-Sat2 launched on December 03, 2018 on a SpaceX Falcon-9 rocket





PW-Sat2 Credits: Marcin Świetlik

DropTES – 6th round 2019

Politecnico de Milano (Italy)

- Technology development
- “Sloshing of magnetic liquids (ferrofluids) in microgravity”

Capacity-building example

- Cooperation between Álvaro Romero Calvo and Prof. Dr. Katharina Brinkert (University of Warwick, UK)

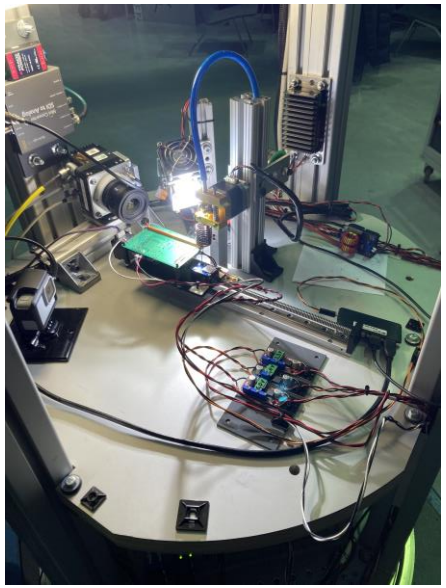
DropTES – 8th round

Universidad de Antioquia (Columbia)

- Technology development / Material science
- “Soldering in microgravity”

Capacity-building example

- During campaign week: Identifying and fixing weak points of their experimental step
  - Starting point for further development and measurement campaigns in the future
- Networking at the Space Tech Expo



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Benefits for the DropTES Awardees

- Promotion of education in the field of space and research
  - Developing an experiment and passing the necessary review process
  - Gaining skills and knowledge
- Enhancement of capacity-building activities
  - Laying the base for future experiments and projects
  - Foster cooperation
- Increasing the “Technology Readiness Level” (TRL)
- Link to further Access to Space for All Tracks

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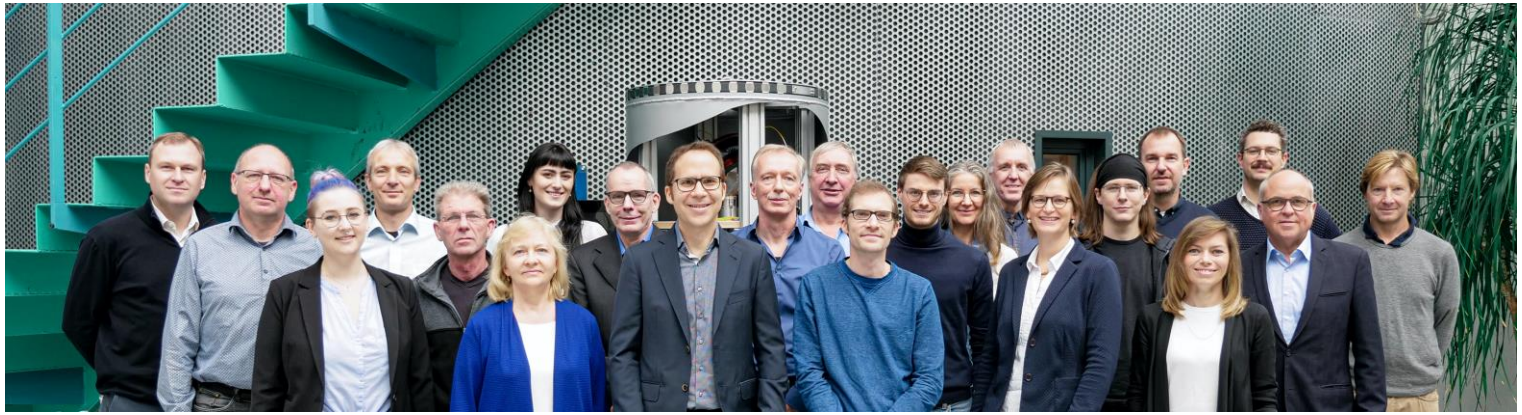
Thank you!



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Payload User‘s Guide

Acknowledgements

DLR

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Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

UNITED NATIONS
Office for Outer Space Affairs

esa