

UN FELLOWSHIP PROGRAM - DROPTES

@THE BREMEN DROP TOWER

Dr. Thorben Könemann
ZARM Drop Tower Operation and Service Company
UNOOSA Webinar, June 09, 2021

Content

- ▶ Bremen Drop Tower
- ▶ Drop Tower Experiment Series (DropTES)
- ▶ GraviTower Bremen Pro

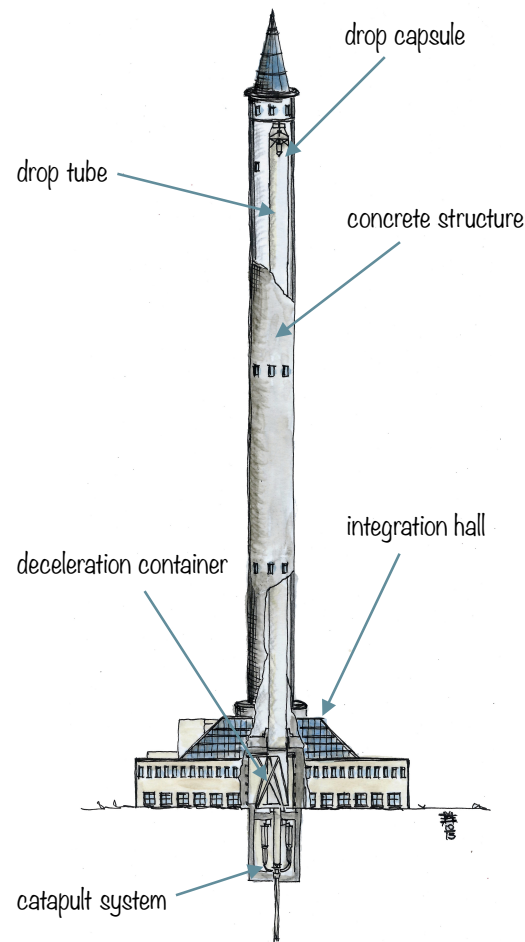


BREMEN DROP TOWER

ZENTRUM FÜR
ANGEWANDTE RAUMFAHRTTECHNOLOGIE
UND MIKROGRAVITATION



Bremen Drop Tower



FACTS ABOUT THE DROP TOWER BUILDING

- **height of the Bremen Drop Tower: 146 m**
- diameter of the concrete structure: 8 m
- stairs: about 600 steps until the top

FACTS ABOUT THE DROP TUBE

- height of the drop tube: 120 m
- distance of free fall: 110 m
- diameter of the drop tube: 3.5 m
- deceleration container: filled with 15 m³ of polystyrene pellets up to a height of 8.20 m
- **experiment duration in microgravity:**
 - drop experiment - 4.7 s**
 - catapult experiment - 9.3 s (worldwide unique)**
- maximum capsule speed: 168 km/h
- **gross weight of standard capsule: 500 kg**
- vacuum: 18 pumps draw out 1,700 m³ of air in 1.5 to 2 h
- pressure after evacuation: 10 Pa (0.1 mbar)
- **achievable microgravity quality: 10⁻⁶ g**
- **number of drops or catapult launches: up to 3 times a day**



BREMEN DROP TOWER

Bremen Drop Tower



- ▶ Experimenter's Integration Area / Payload Services

Bremen Drop Tower

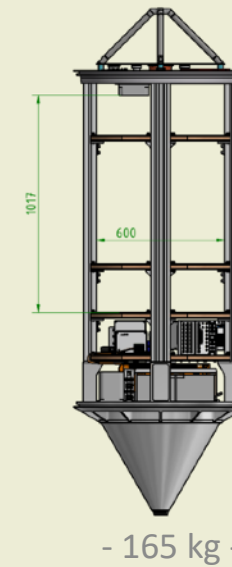


Jonas Ginter

- ▶ Experimenter's Integration Area / Payload Services

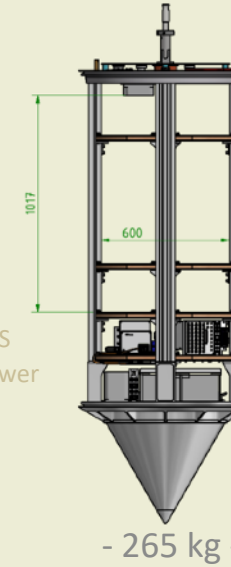
- ▶ Standard Capsule Versions:
- payload masses -

- catapult



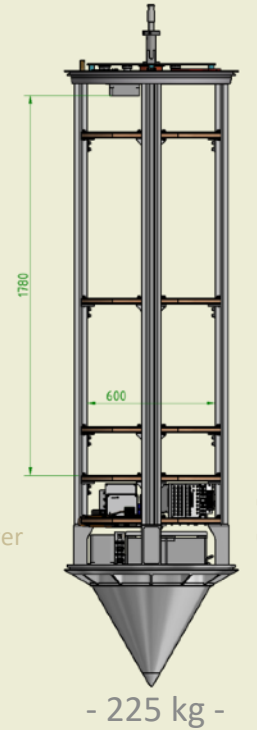
▶ CCS
▶ power

- short



▶ CCS
▶ power

- long



▶ CCS
▶ power

Bremen Drop Tower

FACTS AND FIGURES

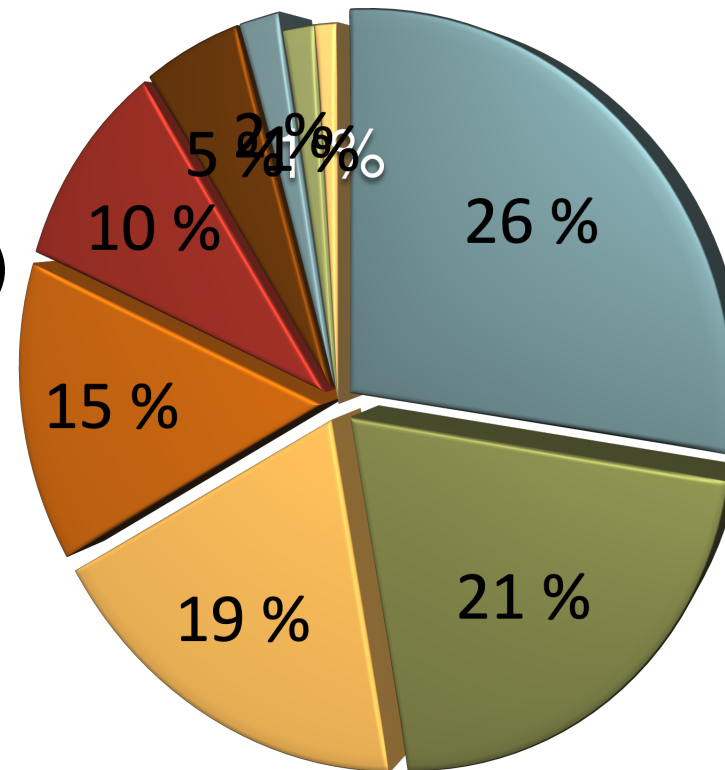
- *start of operation: September 1990*
- *number of drops / catapult launches:
over 9000 performed*
- *number of drop tower projects:
over 230 assisted*
- *framework contractor of*



► RESEARCH AREAS

- Combustion
- Fundamental Physics
- Fluid Dynamics
- Astrophysics (Planet Formation)
- Materials Sciences
- Biology
- Hardware Tests
- Student Programs
- Chemistry

- *fundamental research*
- *technology development
(mission preparations)*



BREMEN DROP TOWER

Bremen Drop Tower

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DROPTES

- DROP TOWER EXPERIMENT SERIES -



UNITED NATIONS
Office for Outer Space Affairs



DROP YOUR THESIS!

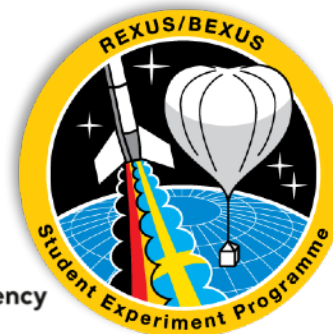


drop your
thesis!

REXUS / BEXUS



Rymdstyrelsen
Swedish National Space Agency



Bremen Drop Tower



Bremen Drop Tower



Kiruna, Sweden



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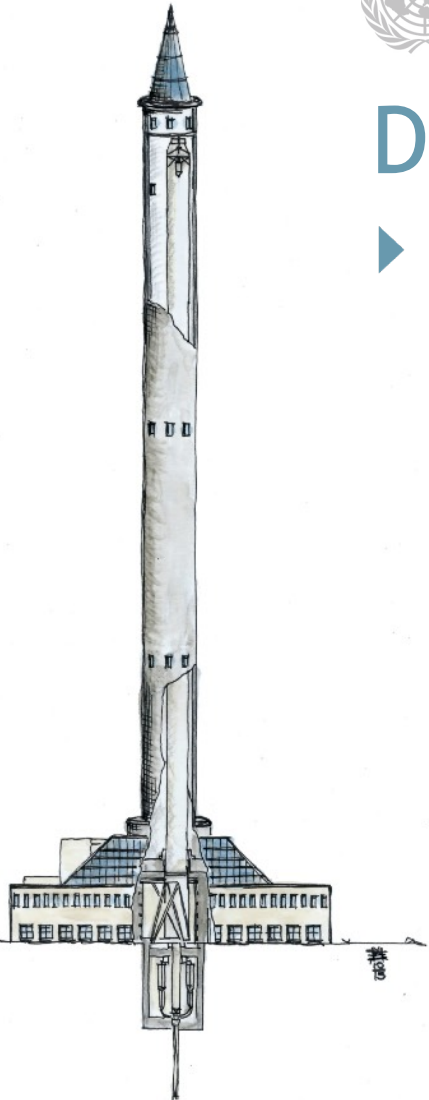
BREMEN DROP TOWER



Drop Tower Experiment Series (DropTES)

► General Program Information

- UNOOSA - Access to Space for All Initiative
- Annual Science Activity at the Bremen Drop Tower, Germany
- First Cycle was initiated by UNOOSA, DLR, and ZARM in 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)





Drop Tower Experiment Series (DropTES)

► General Program Information

- open to student research teams from entities that are Member States of the United Nations
- allows to realize a real microgravity research project
- shall be an integral part of the student's syllabus, e.g. as Bachelor, Master and/or PhD theses
- follows space project guidelines (proposal, reports, reviews)
- each drop tower experiment series consists of five drops or catapult launches
- travel, accommodation, and drop tower utilization are sponsored
- program language: English / program duration: usually 1 year
- technical support by ZARM

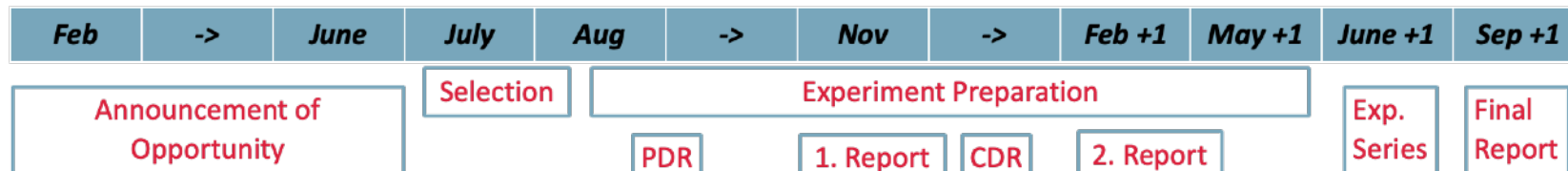




Drop Tower Experiment Series (DropTES)

► DropTES - Schedule

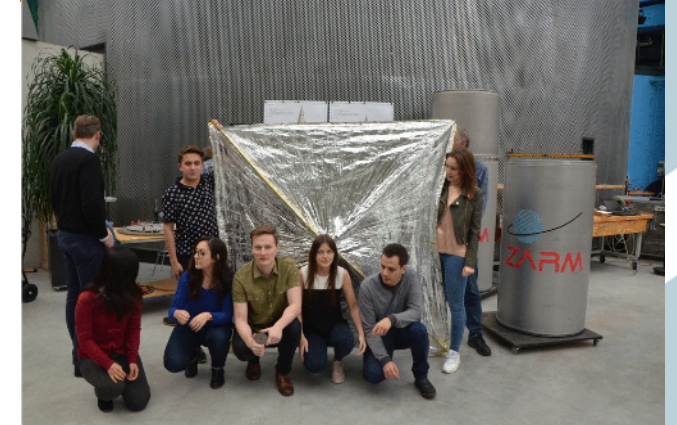
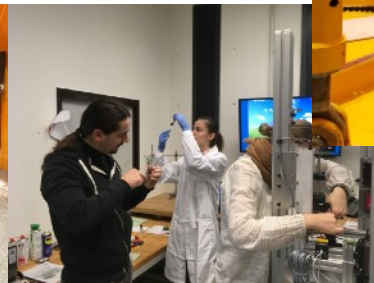
- ▶ Selection Process:
 - ▶ proposal evaluation by selection board (UNOOSA, DLR, and ZARM)
 - ▶ one research team per DropTES cycle will be selected each year
- ▶ Experiment Preparation (Home Laboratory):
 - ▶ assisted by ZARM (consulting, drawings, manufacturing of hardware)
- ▶ Experiment Series (Bremen Drop Tower):
 - ▶ experiment integration (drop tower capsule) - first week
 - ▶ experiment drops or catapult launches - second week



20 June 2022 - 01 July 2022

Drop Tower Experiment Series (DropTES)

► DropTES - Impressions (2014 - 2019)





Drop Tower Experiment Series (DropTES)

► DropTES - www.zarm.uni-bremen.de



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ABOUT US | RESEARCH | STUDIES | **DROP TOWER** | TEST CENTER | PRESS | VISIT | OUTREACH | EVENTS

GENERAL INFORMATION | EXPERIMENT SUPPORT | **PROJECTS** | TEAM



An efficient combustion with the lowest possible emissivity is essential for future engine developments. Combustion research at the drop tower provides new measurement and diagnostic tools in order to support numerical simulations. [more...](#)

► DROPTES

Your opportunity to conduct your own scientific experiment in microgravity conditions as part of your Bachelor's, Master's and/or PhD thesis by participating in a Drop Tower Experiment Series (DropTES) at the Bremen Drop Tower organized by the United Nations Office for Outer Space Affairs. [more...](#)



► DROP YOUR THESIS!

Your opportunity to conduct your own scientific experiment in microgravity conditions as part of your Bachelor's, Master's and/or PhD thesis by participating in the Drop Your Thesis! - Program at the Bremen Drop Tower organized by the ESA Education Office. [more...](#)



► FLUID DYNAMICS

How can a spacecraft tank supply gas-free propellant without the



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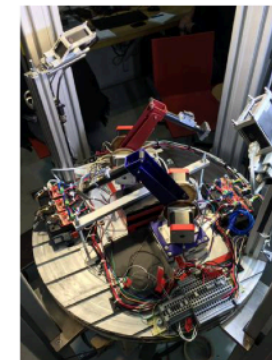
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BEHAVIOR OF A REDUCED-SCALE ROBOTIC ARM MANIPULATOR UNDER MICROGRAVITY CONDITIONS (DROPTES 2016)



research area: technology tests

experiment title:

Behavior of a Reduced-Scale Robotic Arm Manipulator under Microgravity Conditions

experiment acronym: DropTES

funding agency:

United Nations / DLR / ZARM

grant number:

DropTES - Program

performing organization:

Instituto Tecnológico de Costa Rica (ITCR) / Universidad de Costa Rica (UCR), Costa Rica

prime investigator:

Prof. Renato Rimolo-Donadio

(Nicole Chaves Jiménez, Ernesto Corrales Corrales, Meadir Fonseca Becker, Carlos Mayorga Espinoza)

DROPTES

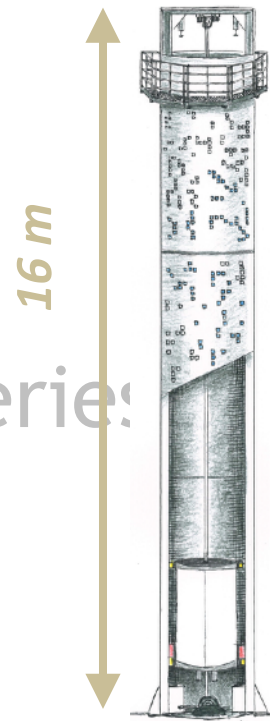
- ASTROPHYSICS
- BIOLOGY
- CHEMISTRY
- COMBUSTION
- DROPTES

DROPTES 2014
DROPTES 2015
DROPTES 2016
DROPTES 2017
DROPTES 2018
DROPTES 2019

- DROP YOUR THESIS!
- FLUID DYNAMICS
- FUNDAMENTAL PHYSICS
- MATERIALS SCIENCES

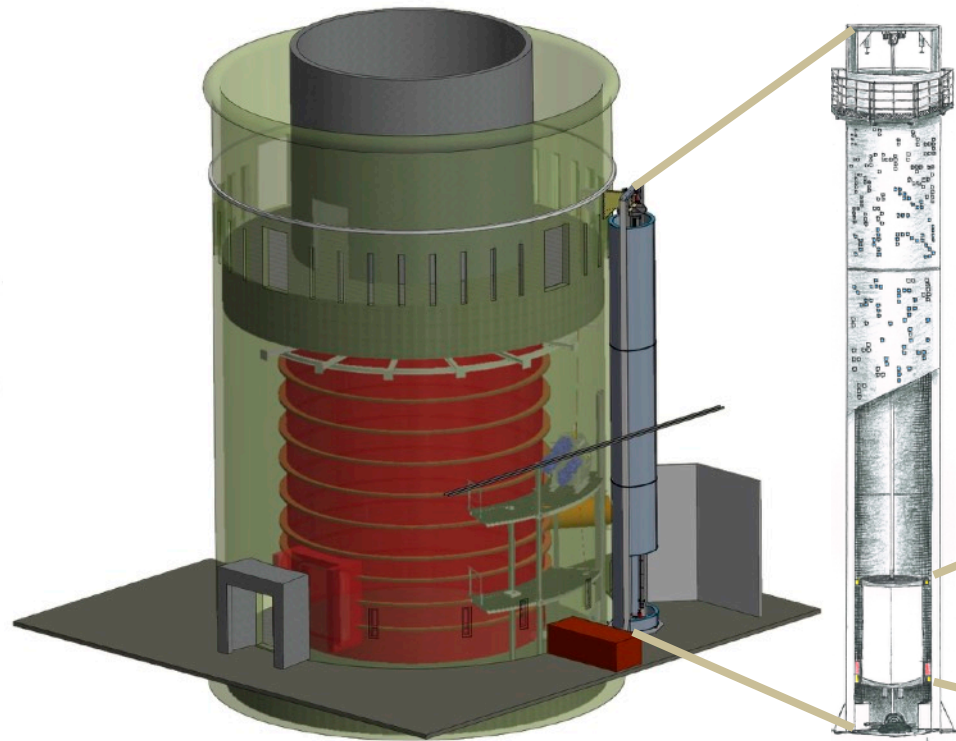
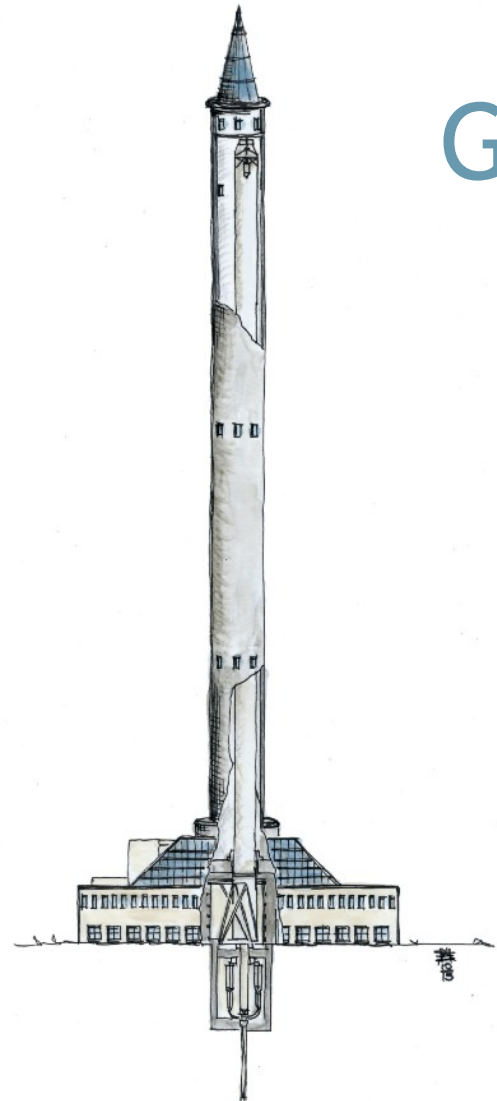
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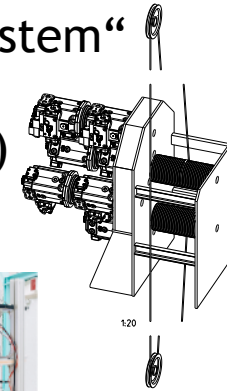


BREMEN DROP TOWER

GraviTower Bremen Pro (GTB Pro)

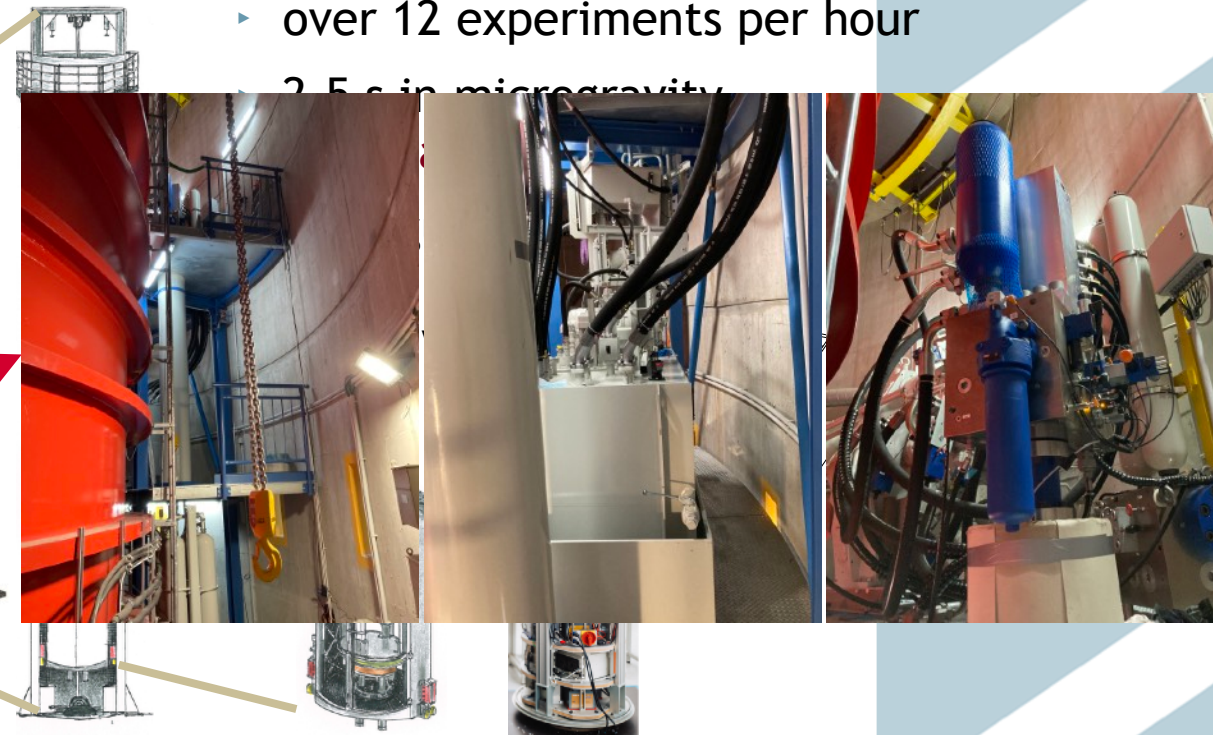
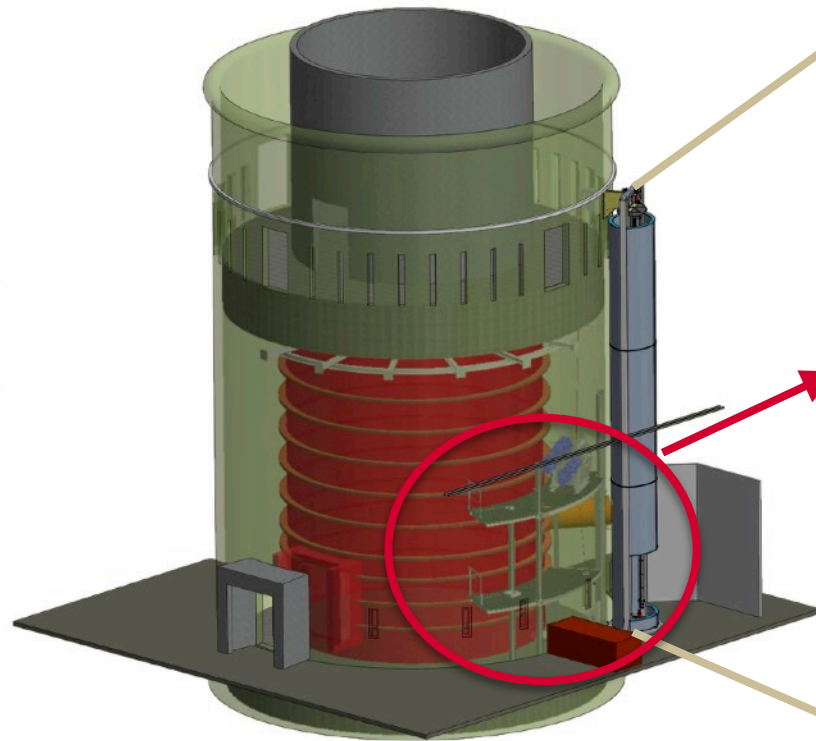
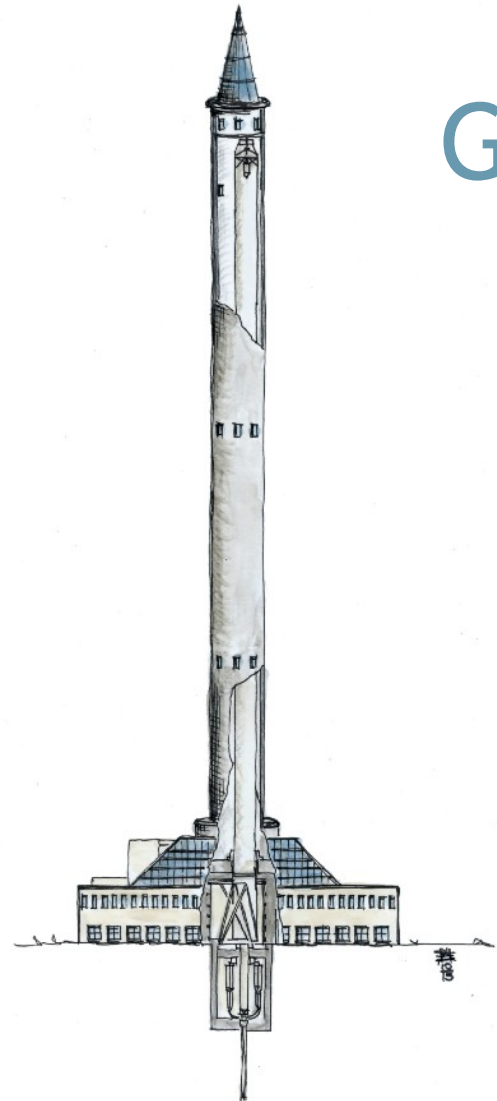


- ▶ over 12 experiments per hour
- ▶ 2.5 s in microgravity
 - **partial-g: Moon / Mars**
- ▶ „rail-guided system“
 - rope drive (hydr. winches)



- ▶ standard capsule
 - synergy with Bremen Drop Tower

GraviTower Bremen Pro (GTB Pro)

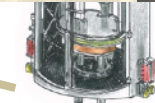
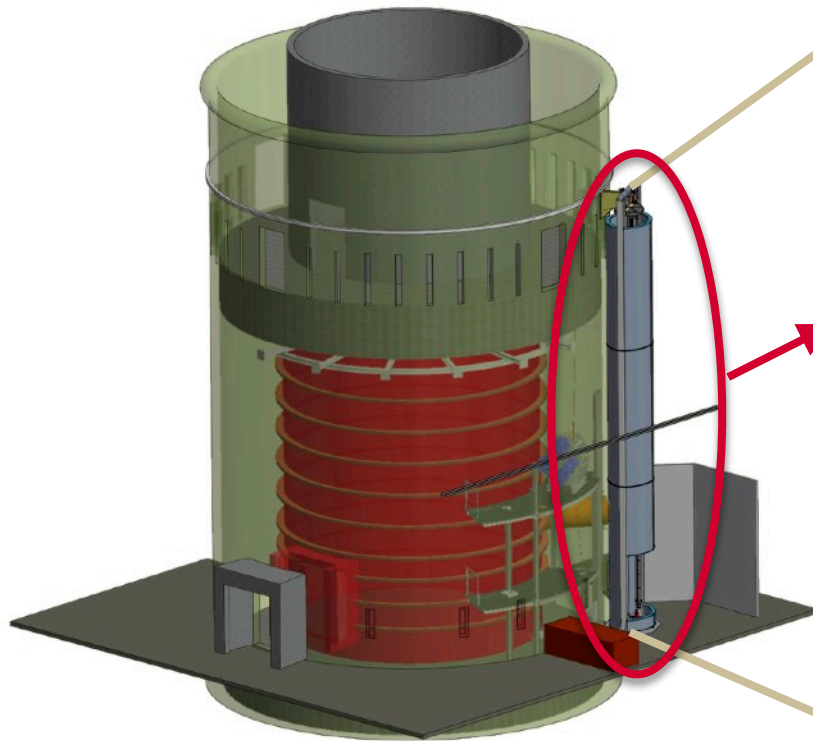


- ▶ over 12 experiments per hour

2.5 s in microgravity

- ▶ standard capsule
- synergy with Bremen Drop Tower

GraviTower Bremen Pro (GTB Pro)



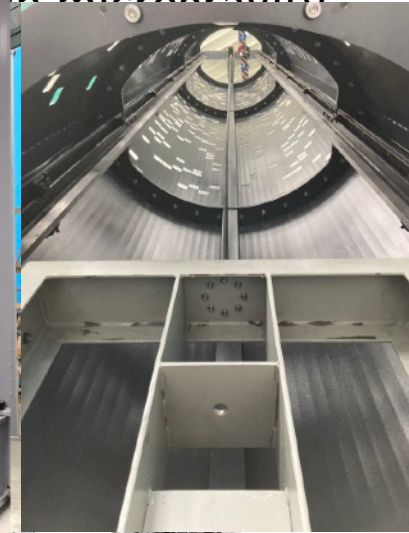
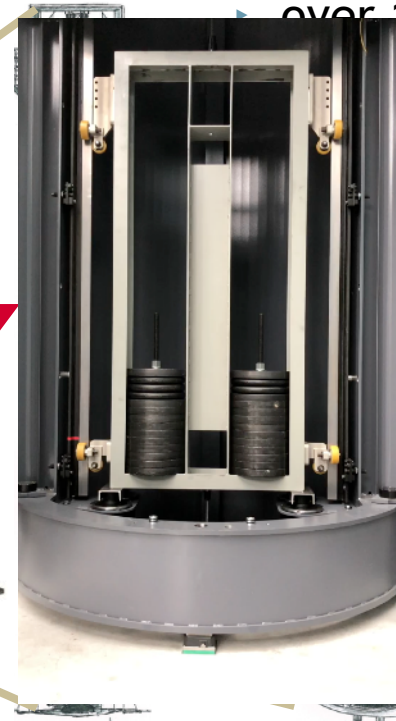
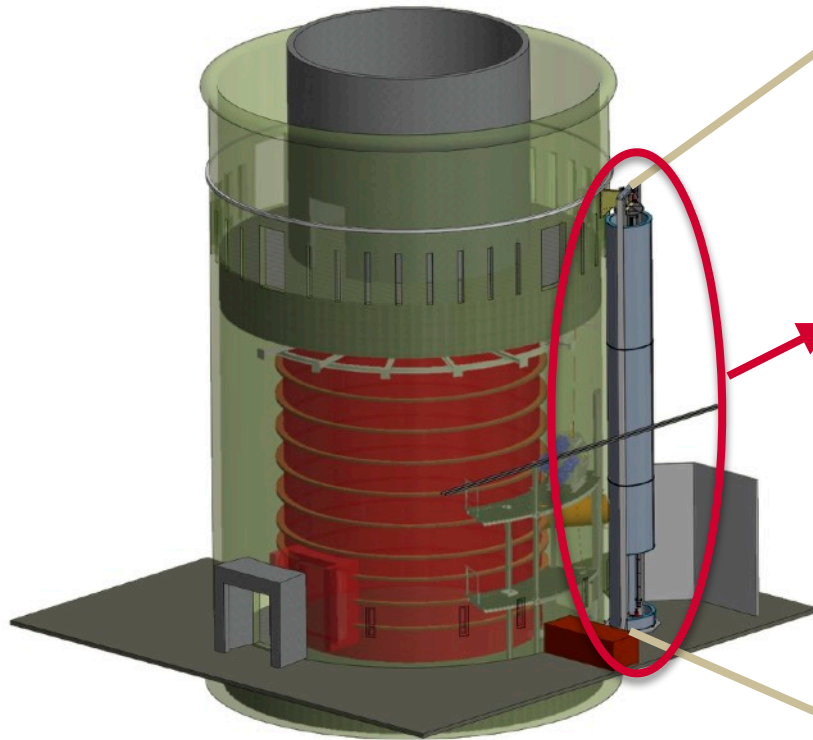
- ▶ over 12 experiments per hour
- ▶ 2.5 s in microgravity

- ▶ standard capsule
- synergy with Bremen Drop Tower

GraviTower Bremen Pro (GTB Pro)

▶ over 12 experiments per hour

in microgravity



- ▶ standard capsule
- synergy with Bremen Drop Tower

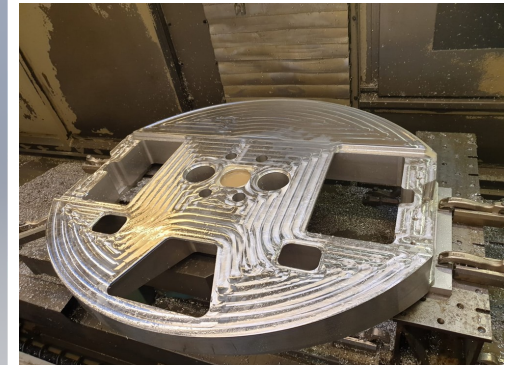
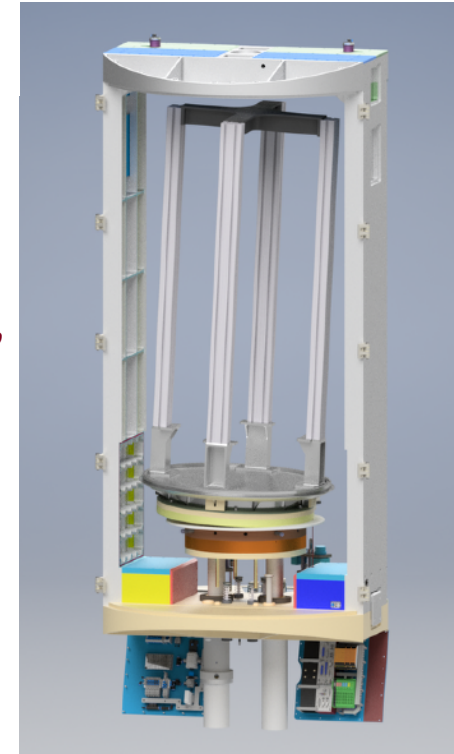
GraviTower Bremen Pro (GTB Pro)

► Next Steps

- finalizing software, May - June, 2021
- assembling slider and subsystems, integration of slider and subsystems, June - August, 2021
- testing completed GTB Pro, September, 2021
- expected availability, end of Q3 / beginning of Q4, 2021

➔ *available for DropTES 2022*

➔ *apply until June 30, 2021*



➔ *drive dynamics better as simulated*


Thank you very much for your Attention



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Acknowledgements



Geördert durch:
 Bundesministerium
für Wirtschaft
und Energie
aufgrund eines Beschlusses
des Deutschen Bundestages



UNITED NATIONS
Office for Outer Space Affairs

