LUWEX Lunar Water Extraction and Purification

Space resources at DLR Bremen

DLR

Synergetic Material Utilization - SMU

Combining Environmental Control and Life Support System (ECLSS) and In-situ Resource Utilization (ISRU) engineering, exploiting the synergies among both fields to enable sustainable exploration of the solar system.

SMU Research Topics Overview

Regolith Beneficiation and Utilization

SMU Research Topics Overview

Regolith Beneficiation and Utilization

In-Situ Propellant and Consumables Production

LUWEX

Validation of Lunar Water Extraction and Purification Technologies for In-Situ Propellant and Consumables Production

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The development, integration and validation of lunar water extraction and purification technologies for in-situ propellant and consumables production for future space exploration missions

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LUWEX

Validation of Lunar Water Extraction and Purification Technologies for In-Situ Propellant and Consumables Production

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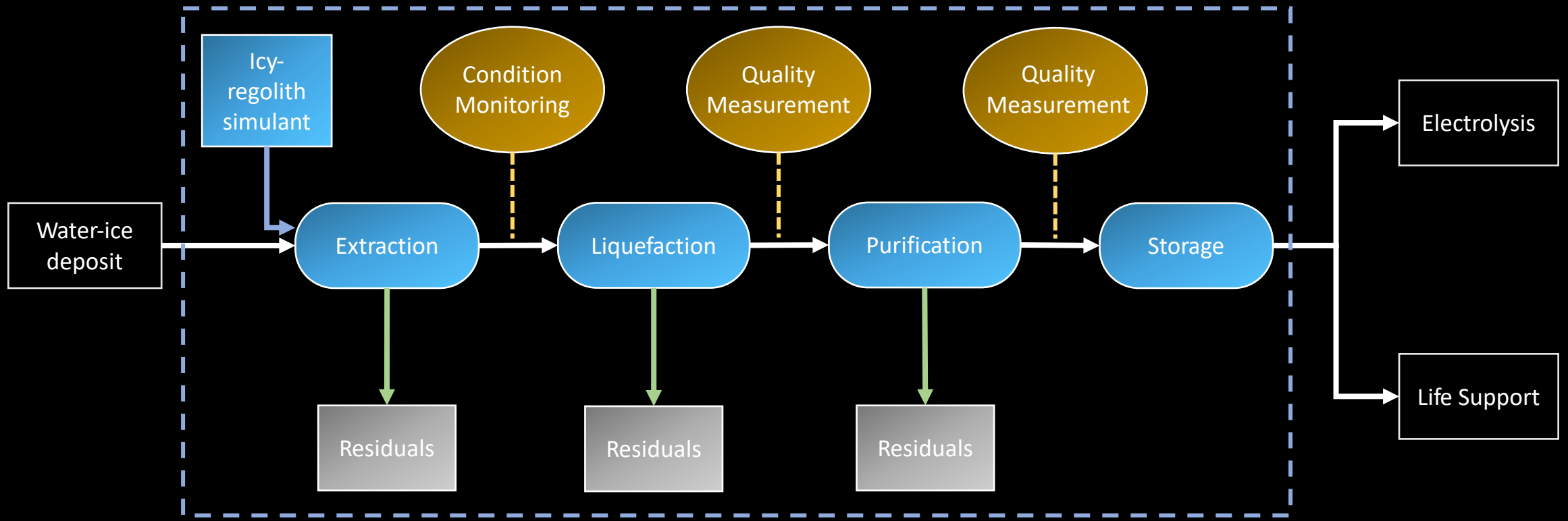

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LUWEX

Validation of Lunar Water Extraction and Purification Technologies for In-Situ Propellant and Consumables Production

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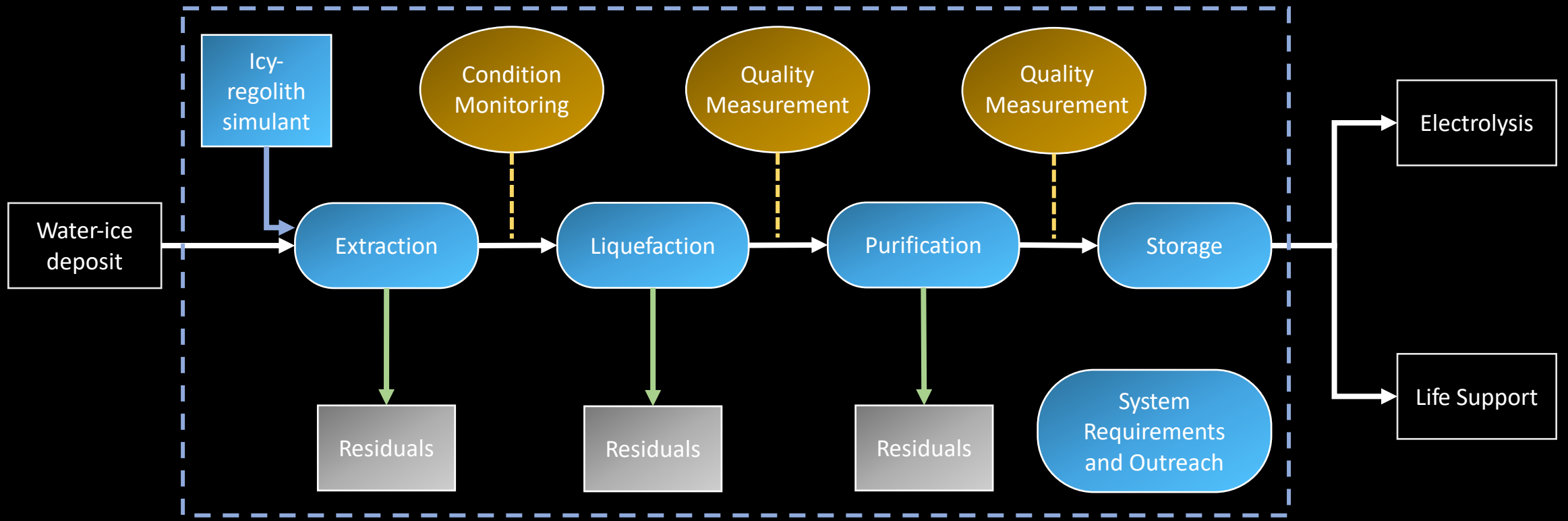

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Technische Universität Braunschweig

ThalesAlenia Space

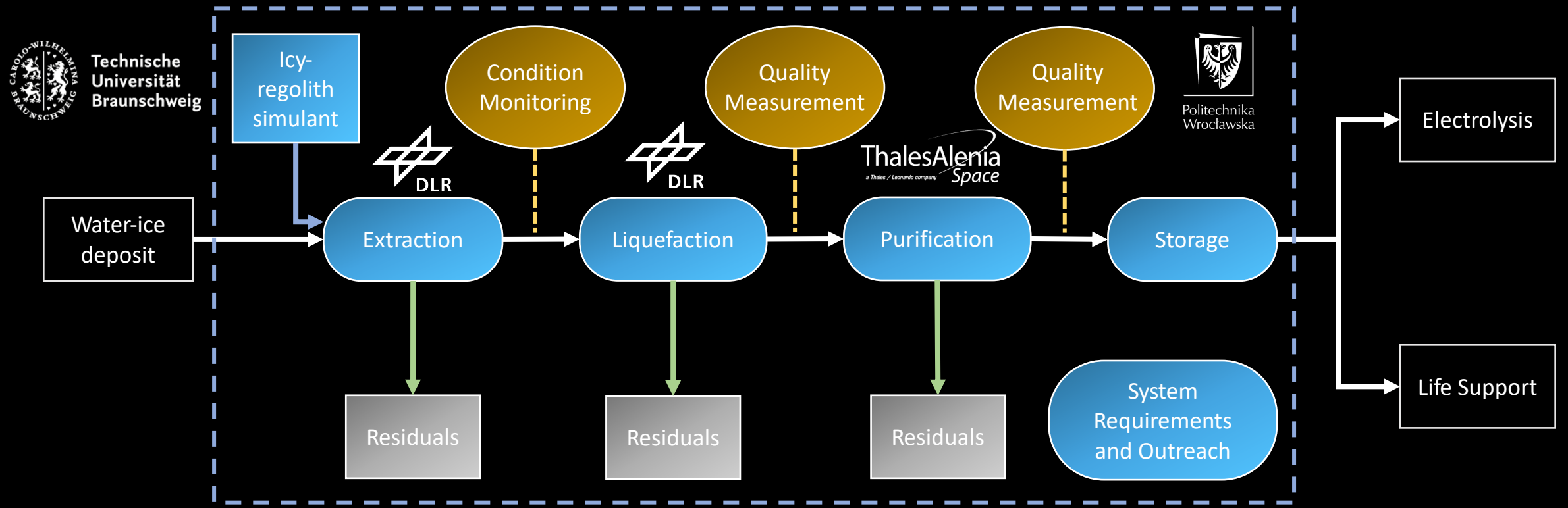
LIQUIFER SYSTEMS GROUP

Politechnika Wrocławska

Scanway space

LUWEX

Validation of Lunar Water Extraction and Purification Technologies for In-Situ Propellant and Consumables Production



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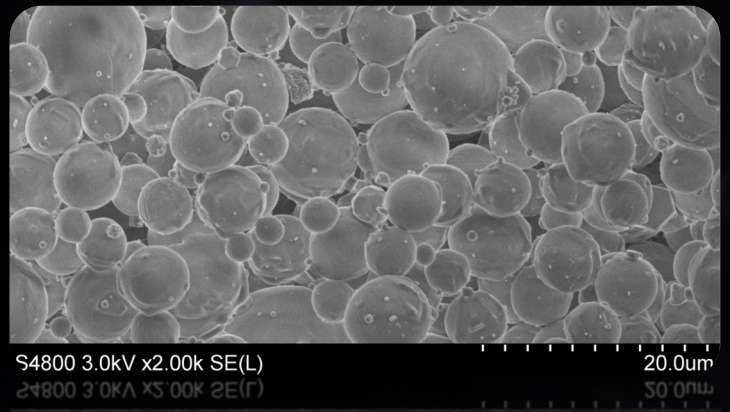
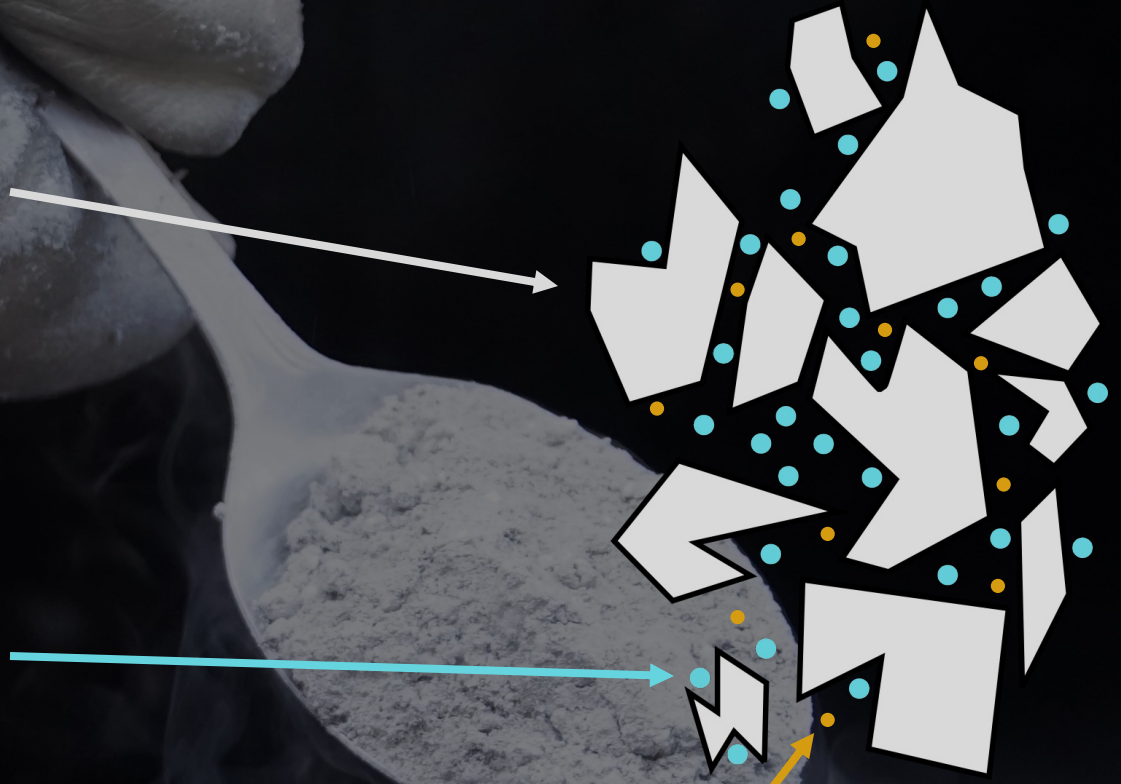
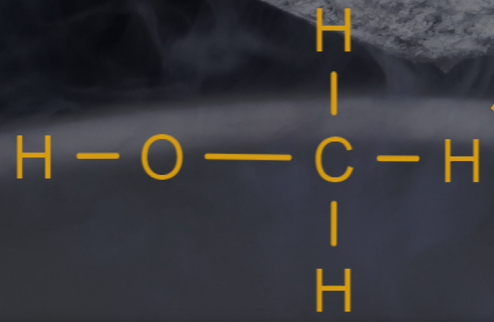
Icy-Regolith Simulant







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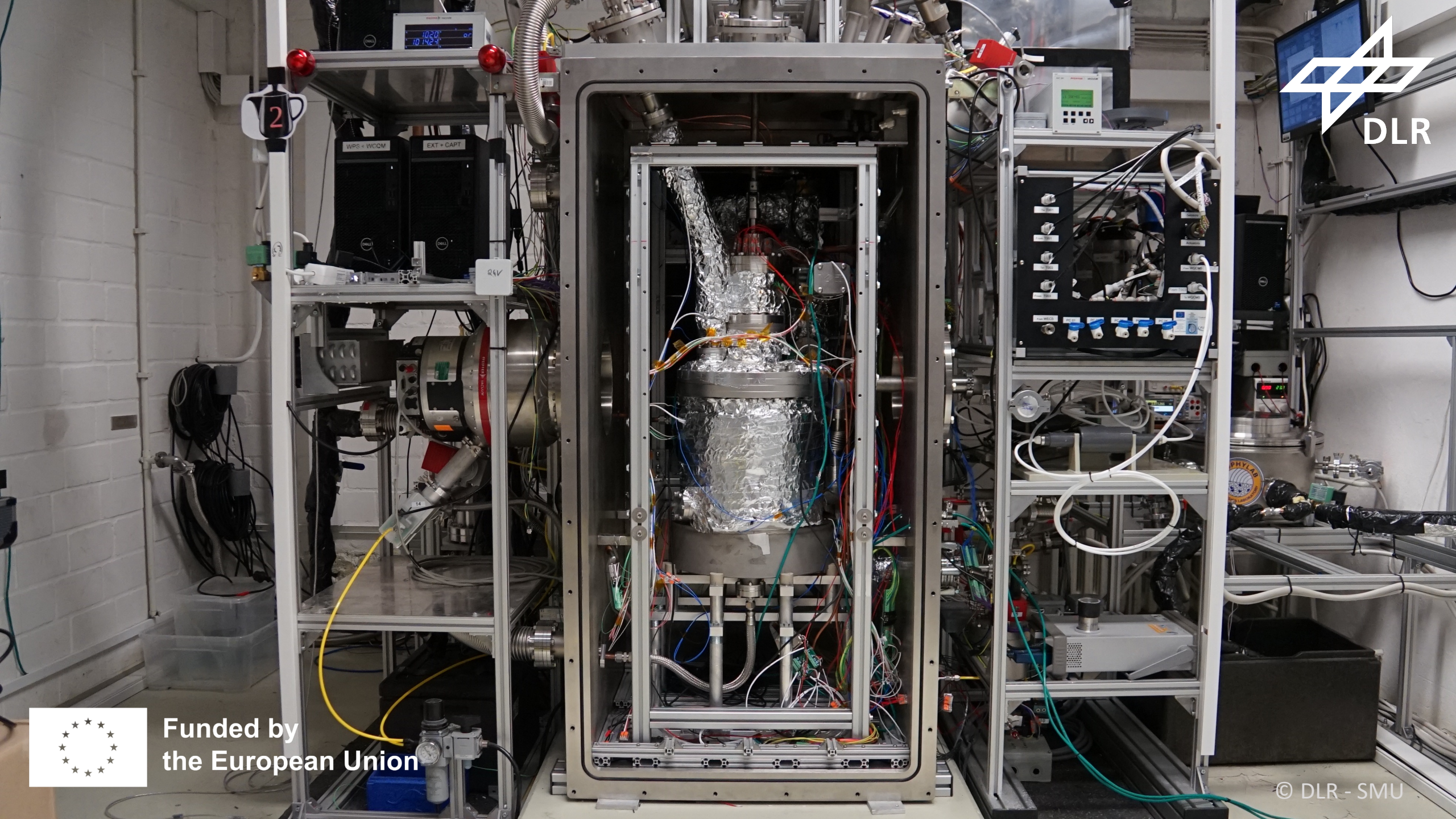
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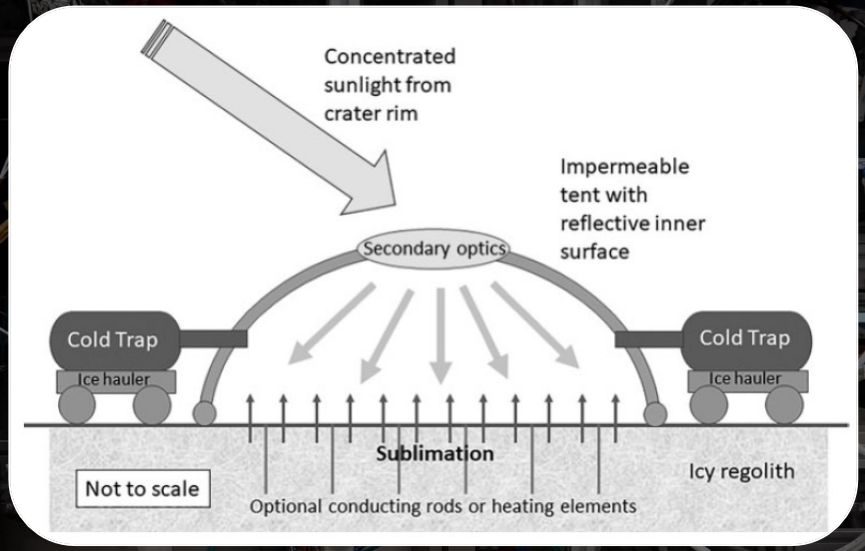
Design choices for extraction

In-Situ Extraction
(Heated Dome)

Excavated Extraction



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Design choices for extraction

In-Situ Extraction (Heated Dome)

Dynamic Stirring

Excavated Extraction

No Stirring

© Purrington et al. 2022

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Design choices for extraction

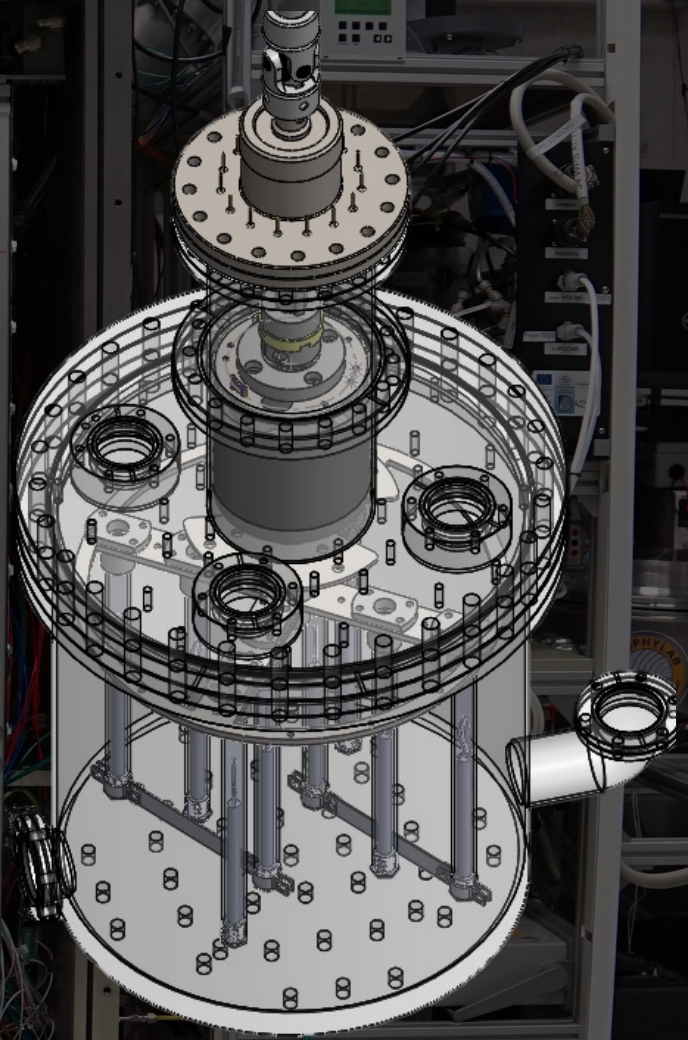
In-Situ Extraction (Heated Dome)

Dynamic Stirring

Excavated Extraction

No Stirring

Sizing according to purification subsystem)



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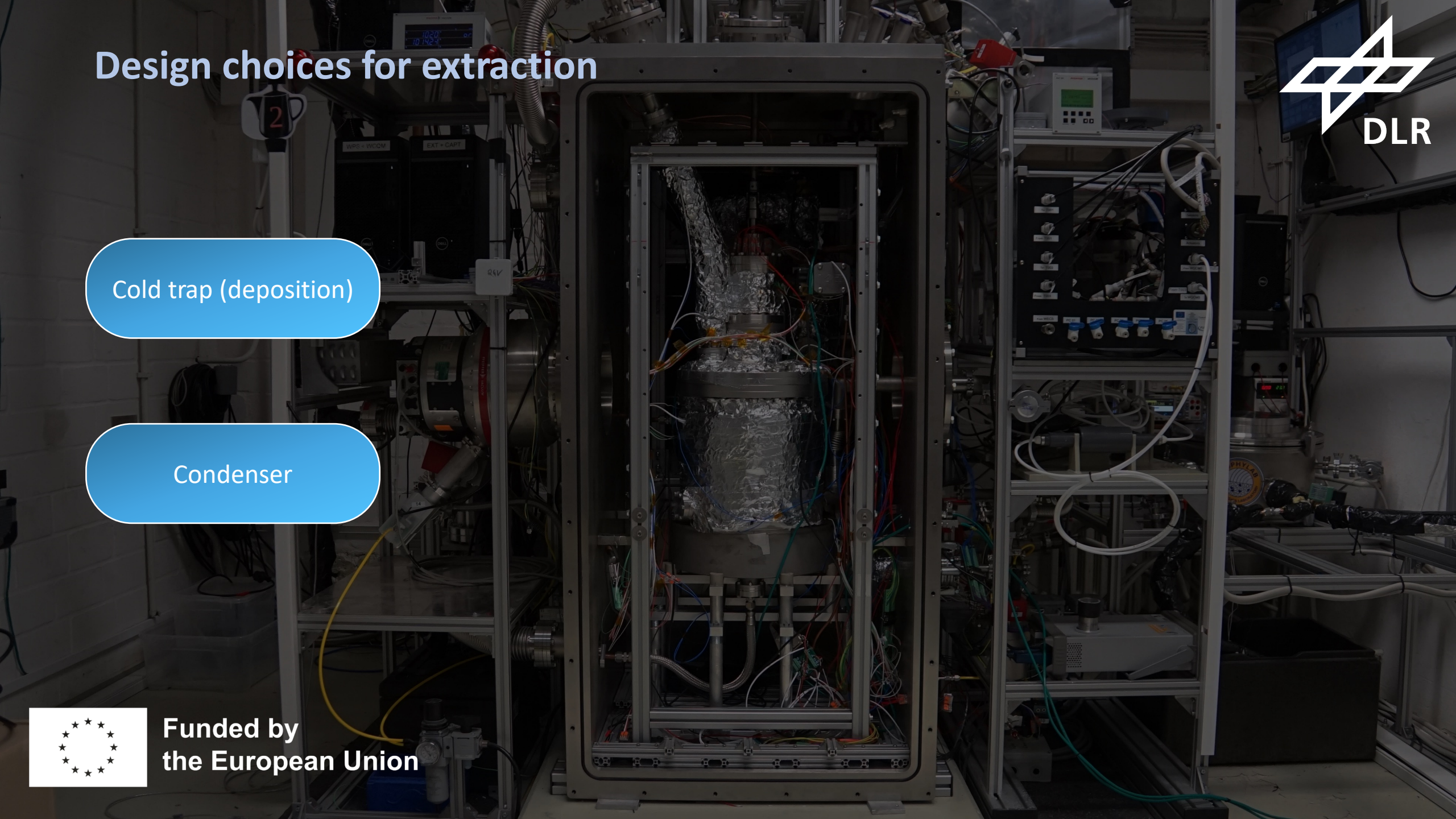
Design choices for extraction



Cold trap (deposition)

Condenser

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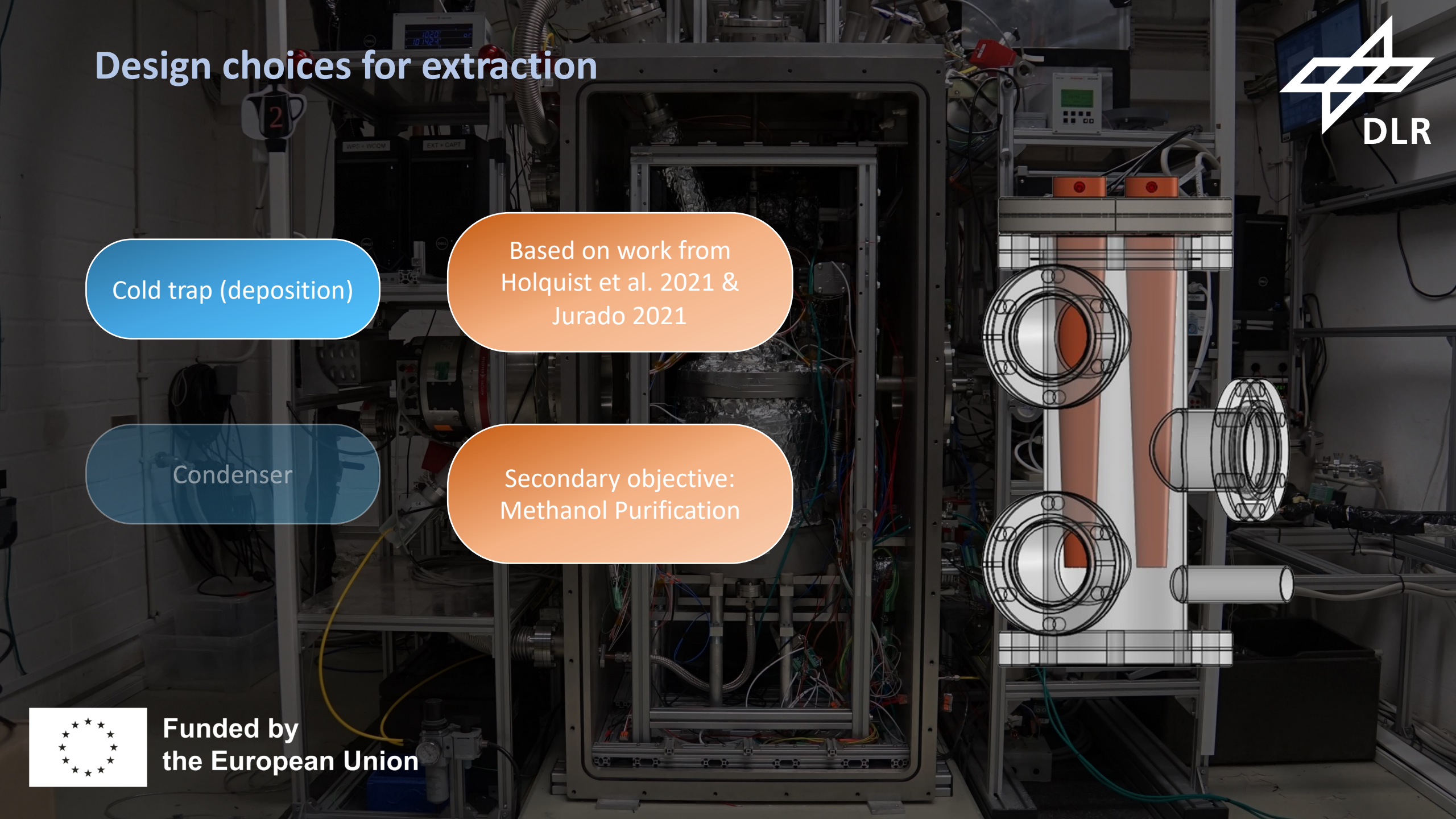
Design choices for extraction

Cold trap (deposition)

Condenser

Based on work from Holquist et al. 2021 & Jurado 2021

Secondary objective: Methanol Purification



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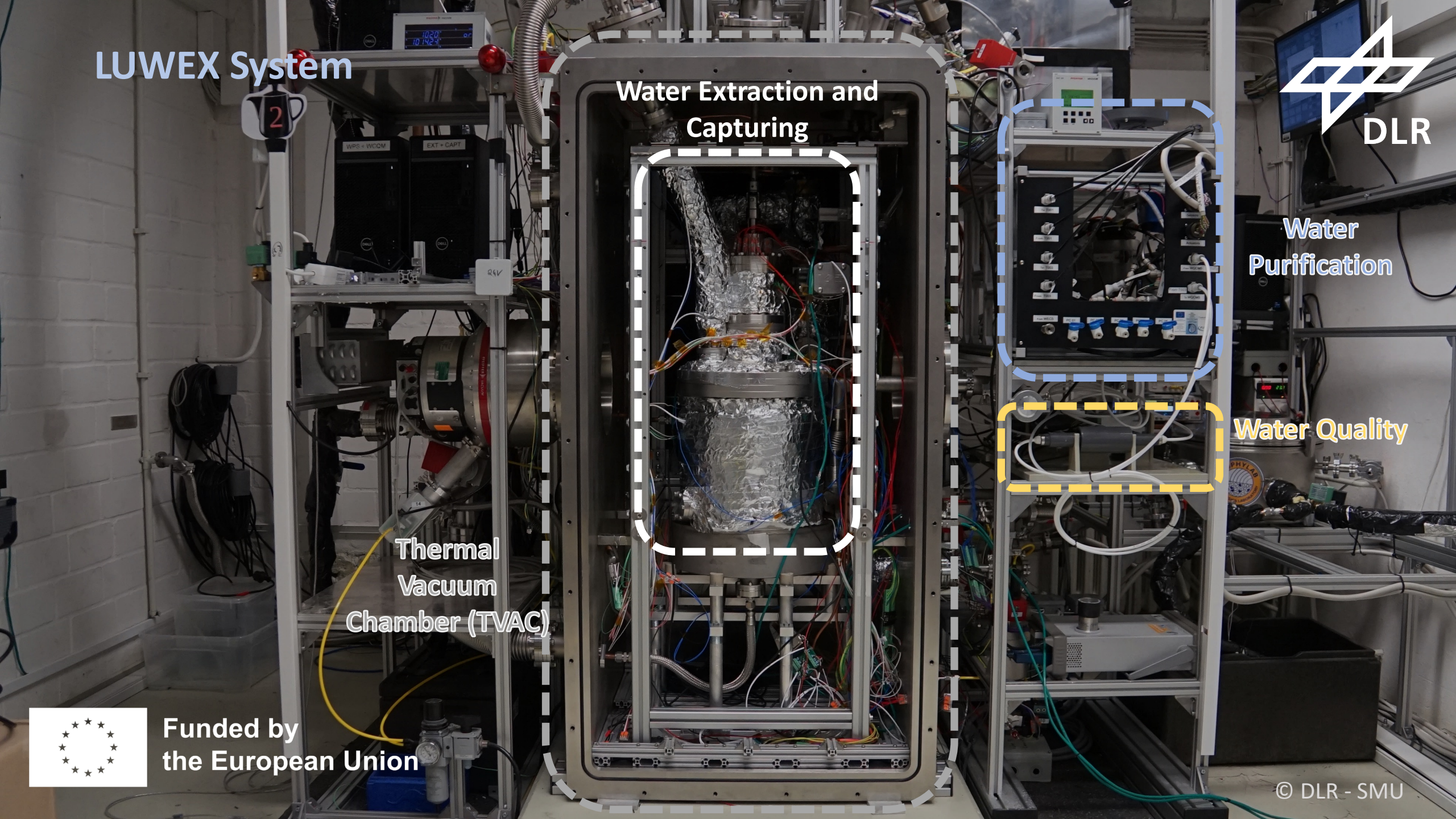
LUWEX System
Water Extraction and Capturing
Water Purification
Water Quality
Thermal Vacuum Chamber (TVAC)
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Water Extraction and Capturing

- Dusty TVAC
- Temperature ≈ 80 – 100 K
- Pressure ≈ 10e-6 mbar
- Icy regolith simulant mass up to 15 kg
- Amount of water present 5 wt.%, 750 mL (baseline)
- Presence of volatiles: CO_2 & Methanol

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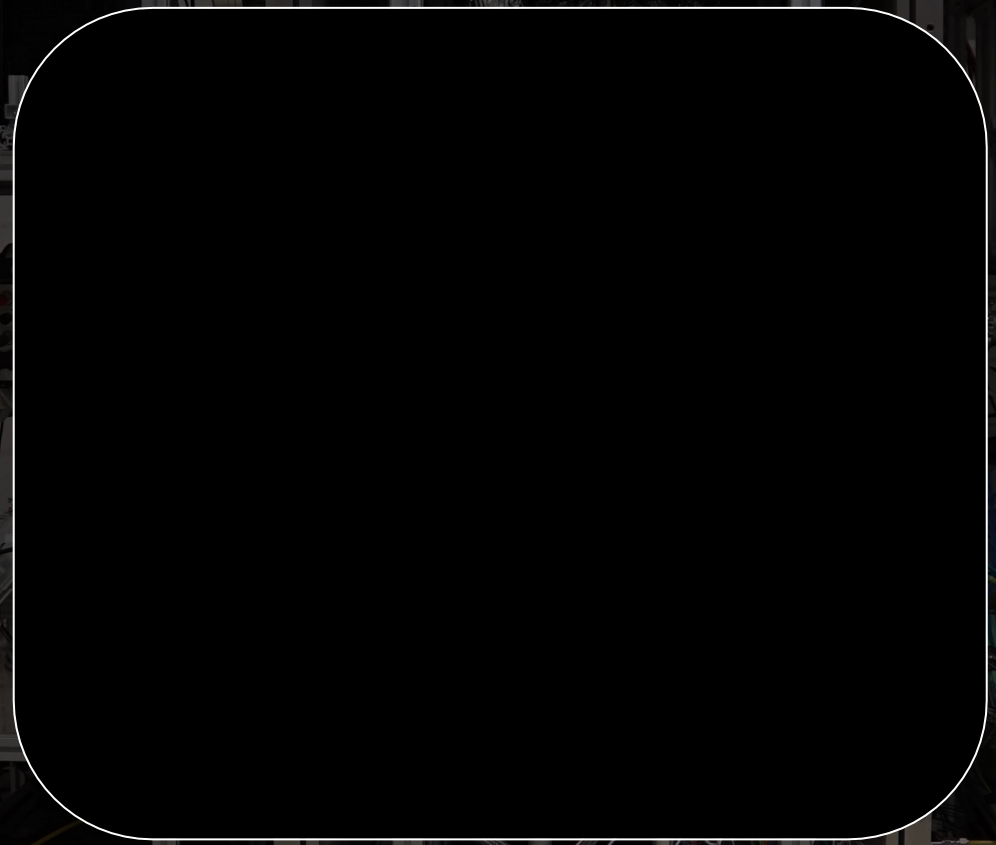
Water Extraction and Capturing

- (Re)filled crucible for 12 experiments
- Successfully sublimated ice during 14 attempts
- Regolith simulant or glass beads



Crucible

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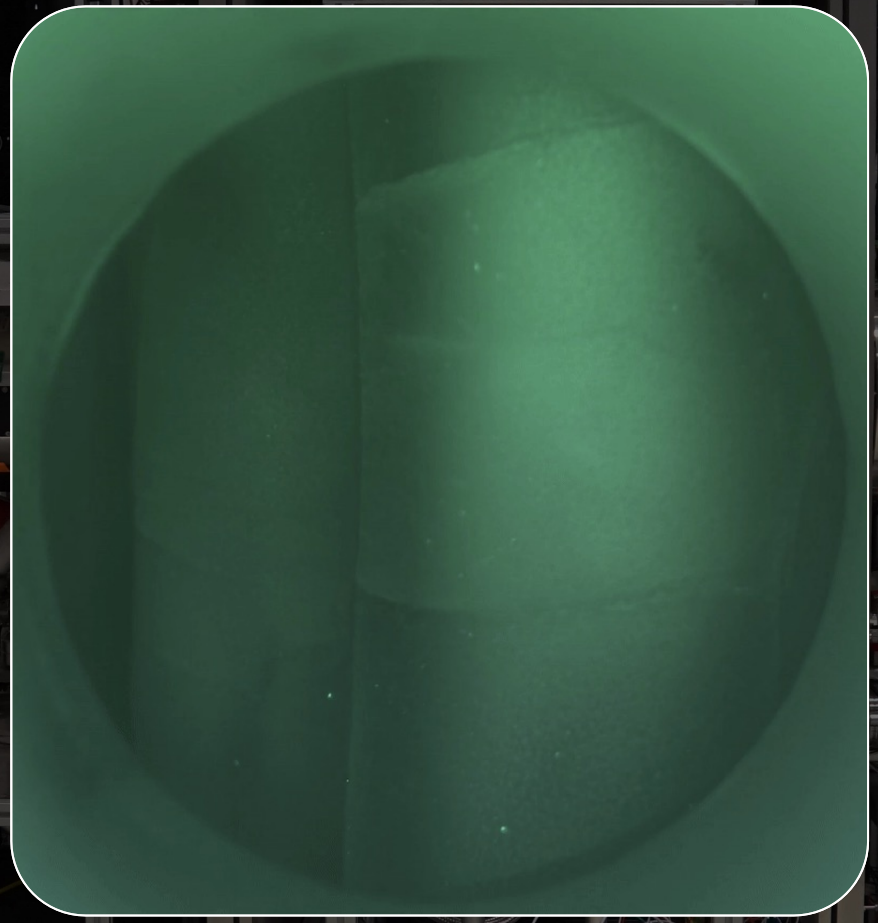
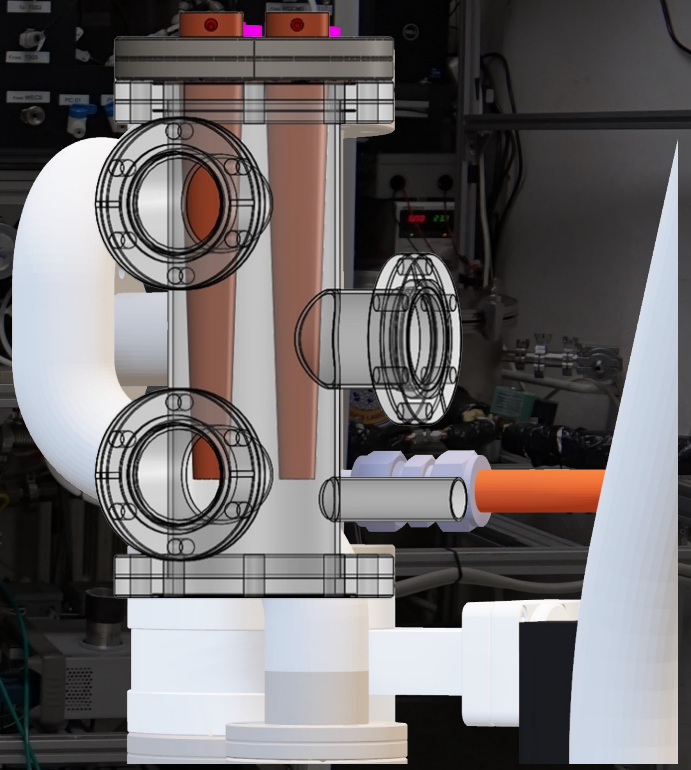
Water Extraction and Capturing

- Captured ice 14 times
- Capturing efficiency relatively high (around 90%)
- Methanol severely reduced efficiency



Cold trap



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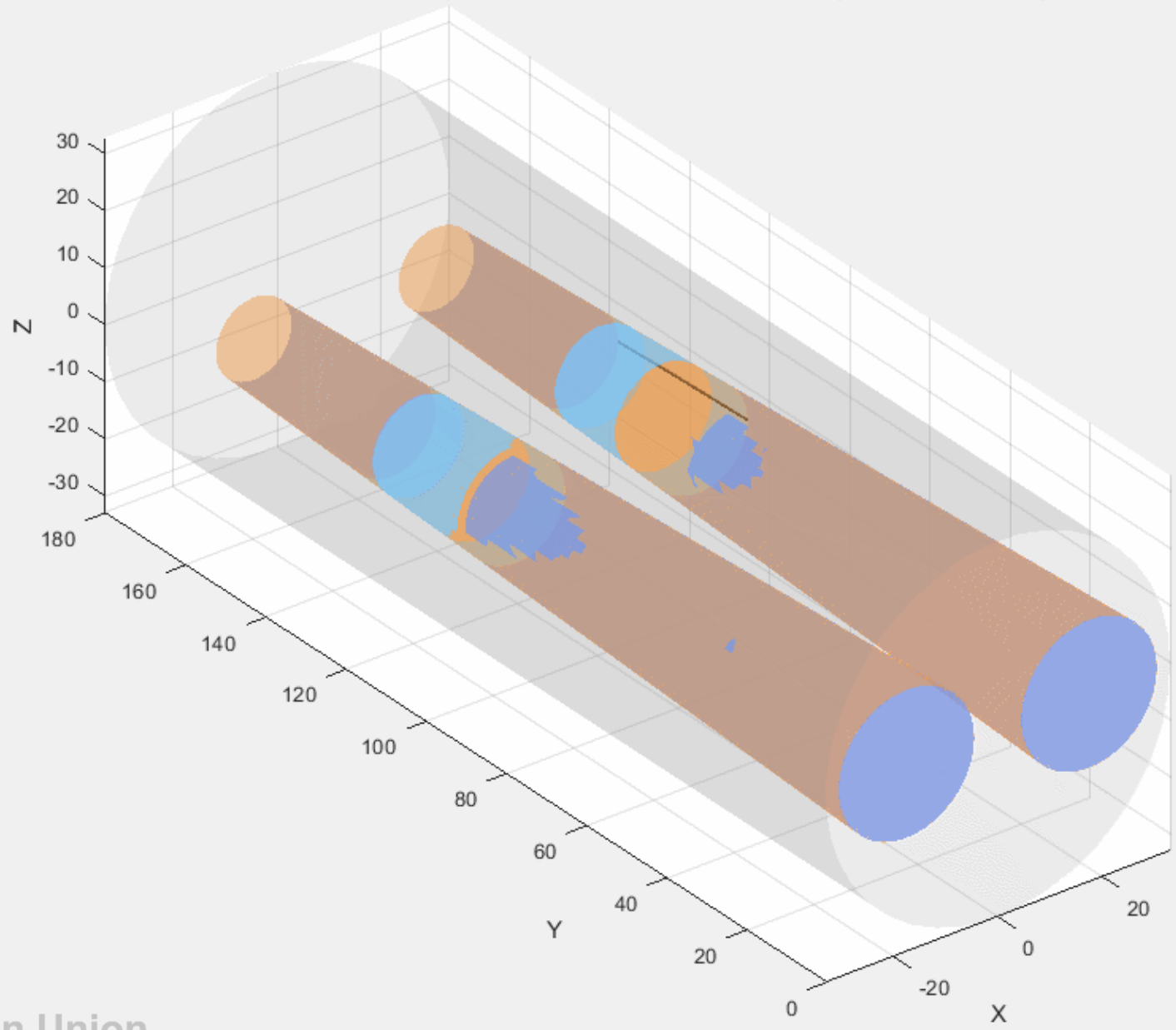

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Water Extraction and Capturing

60 kg of produced simulants

20 - 50 g of water per kWh

50 - 70% recovery efficiency

2,4 kg of water recovered

3,7 kg of ice sublimated

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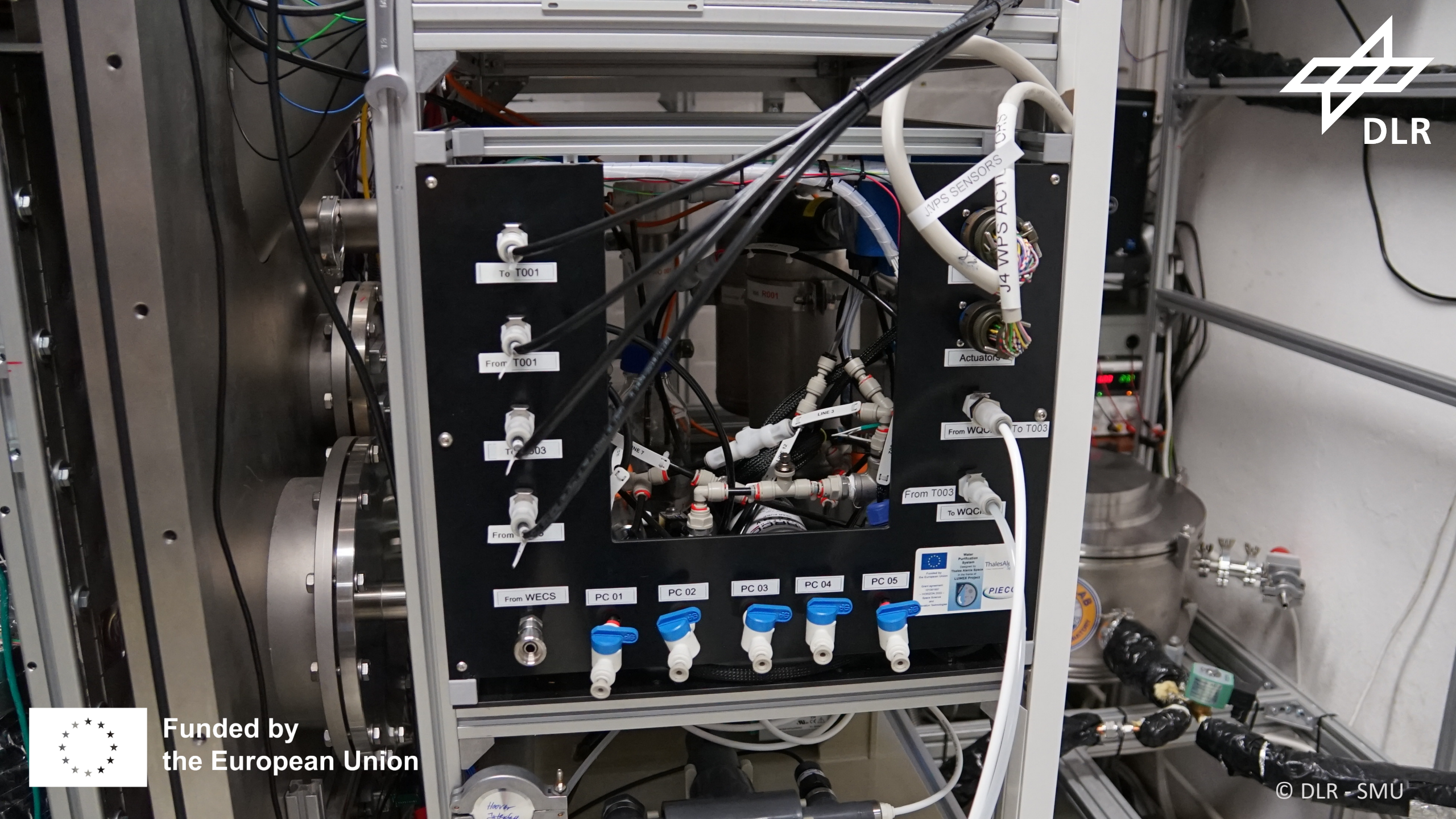
Full results yet to be published


To T001
From T001
From WECS
PC 01
PC 02
PC 03
PC 04
PC 05
Actuators
From T003
To T003
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Water Purification - Requirements

Consuming less than 1 g of consumables per kg of product water

Target product water to feed ratio > 95%

Target product water quality for electrolysis and potable water

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a Thales / Leonardo company

Water Purification - Requirements

Target product water quality for electrolysis applications and drinkable water

- TOC < 0,5 ppm ✅
- Methanol < 0,5 ppm ✅
- EC < 1 µS/cm ✅
- pH < 7 ✅

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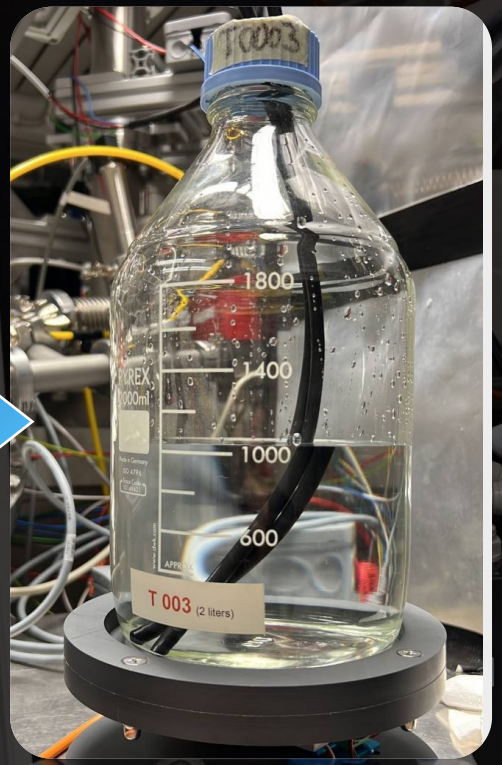
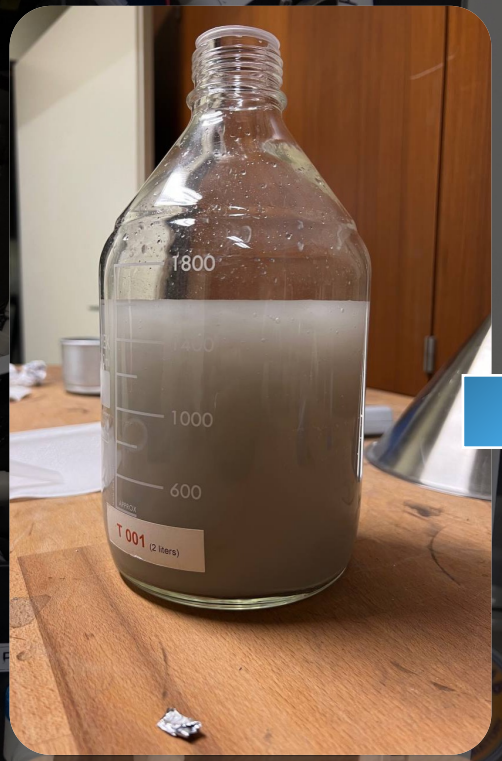
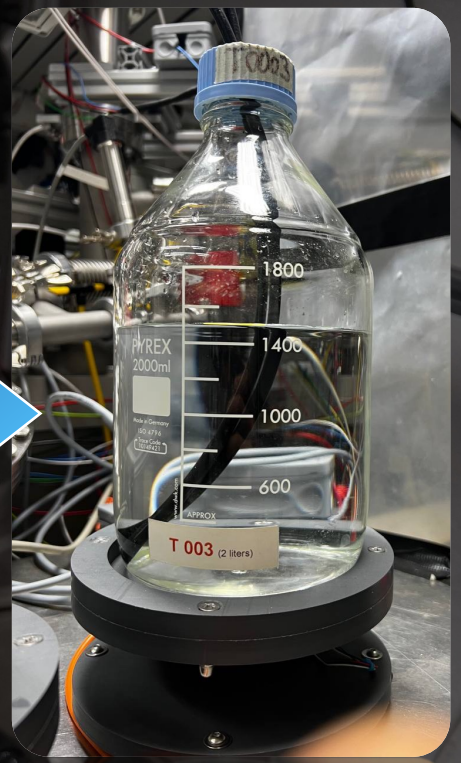
Water Purification Results

Glass beads and ice

Icy-regolith simulant







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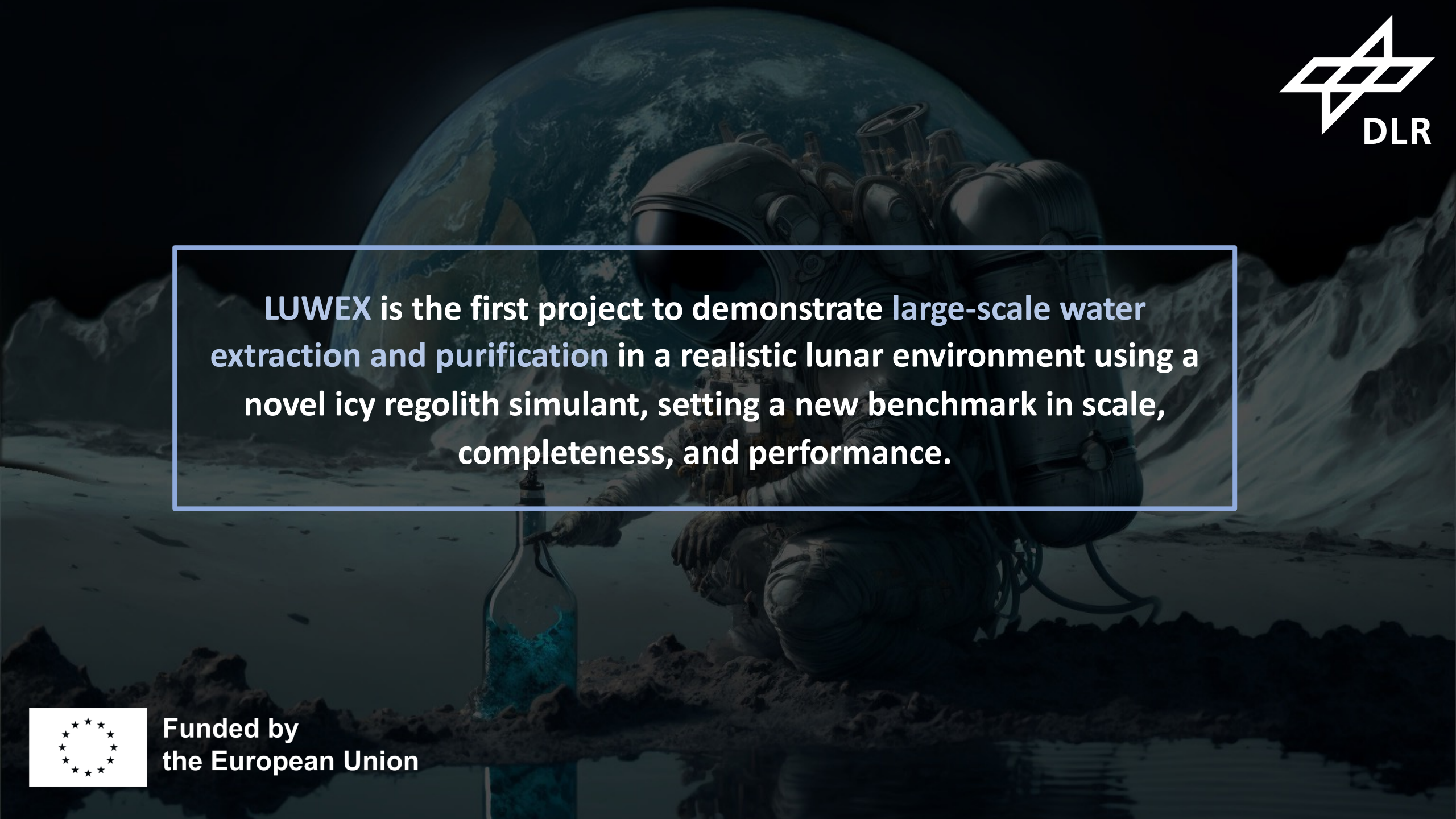

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LUWEX is the first project to demonstrate large-scale water extraction and purification in a realistic lunar environment using a novel icy regolith simulant, setting a new benchmark in scale, completeness, and performance.

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Thank you!

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Brochure

Podcast