



Experimental research on LH2 leakage into a TCS and potential for O2 enrichment and condensed phase explosions

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Introduction

- 4.1 Oxygen enrichment and condensed phase explosions (HSE)
- 4.2 Consequences of foreseeable leakage into connection spaces (HSE)
- 4.3 Performance of LH2 components and explosion consequences (KIT)
- 4.4 Material testing against unignited and ignited LH2 jets (KIT)
- 4.5 Modelling in support of WP 4 experimental activities (NCSRD, UNIBO, UU, NTNU, HSE)

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4.1 Oxygen enrichment and condensed phase explosions



Research Question:

What is the composition of the condensed material generated when LH2 comes into contact with air?

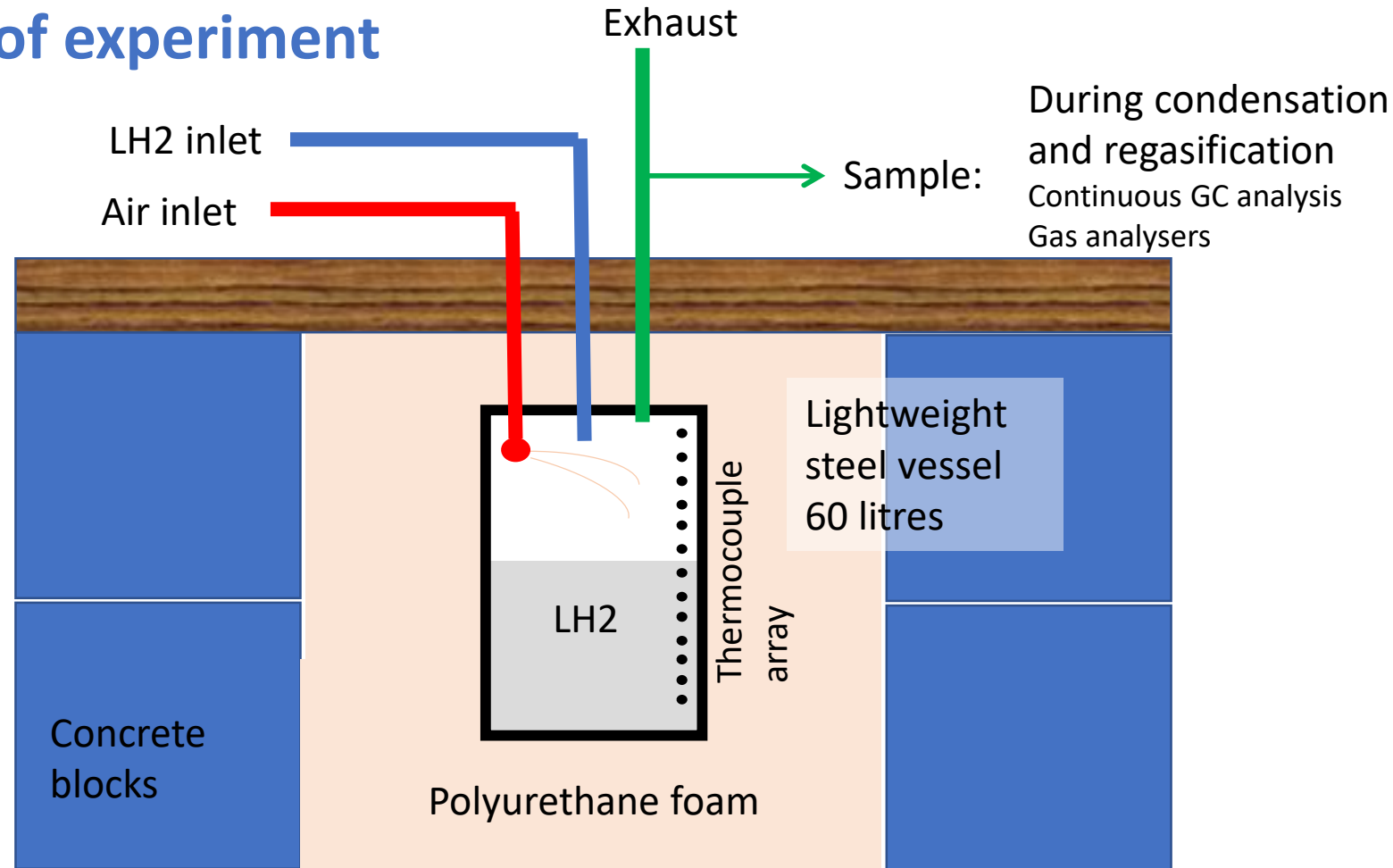
Can it be a condensed phase explosive?



4.1 Oxygen enrichment and condensed phase explosions



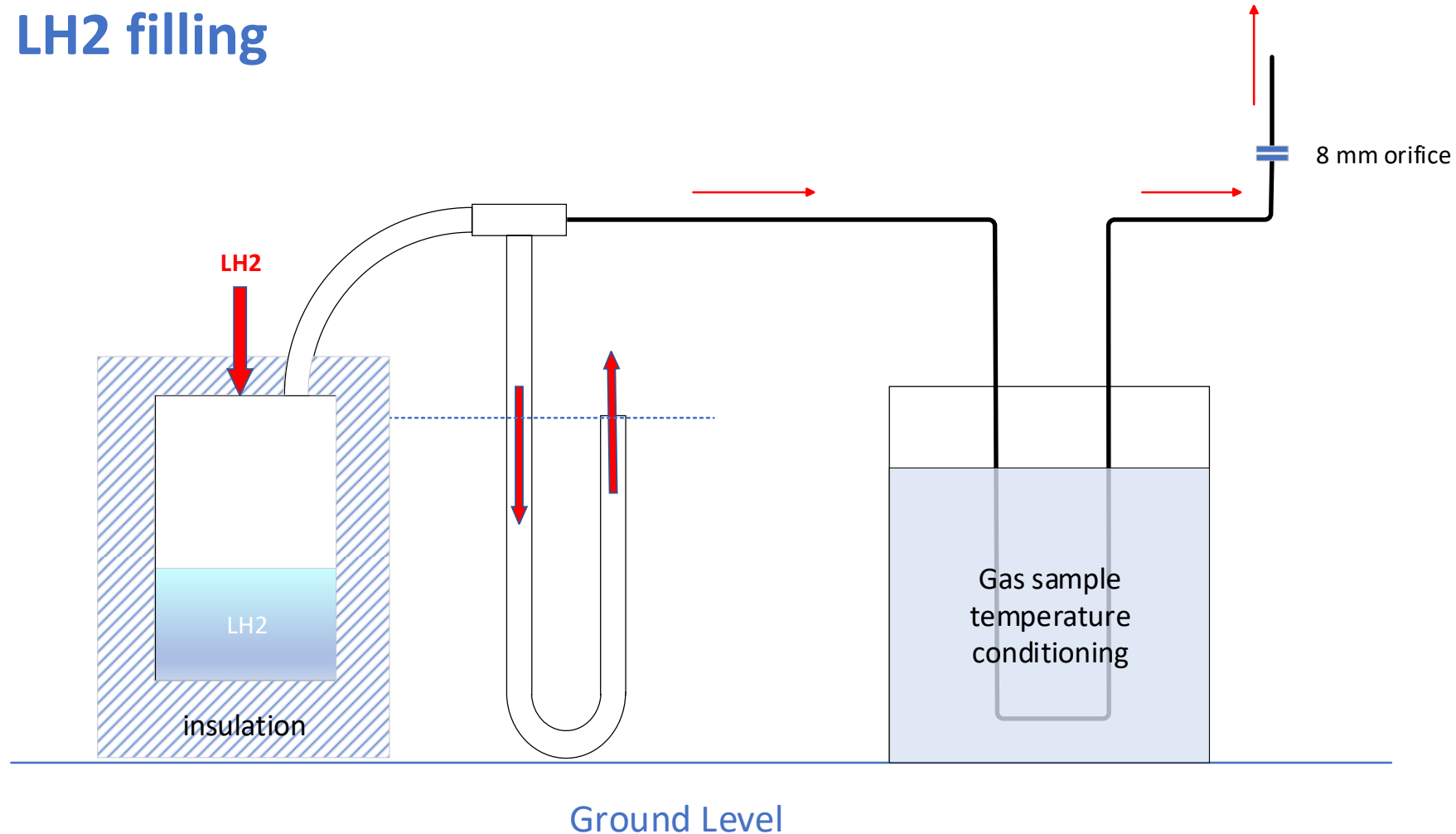
Schematic of experiment



4.1 Oxygen enrichment and condensed phase explosions



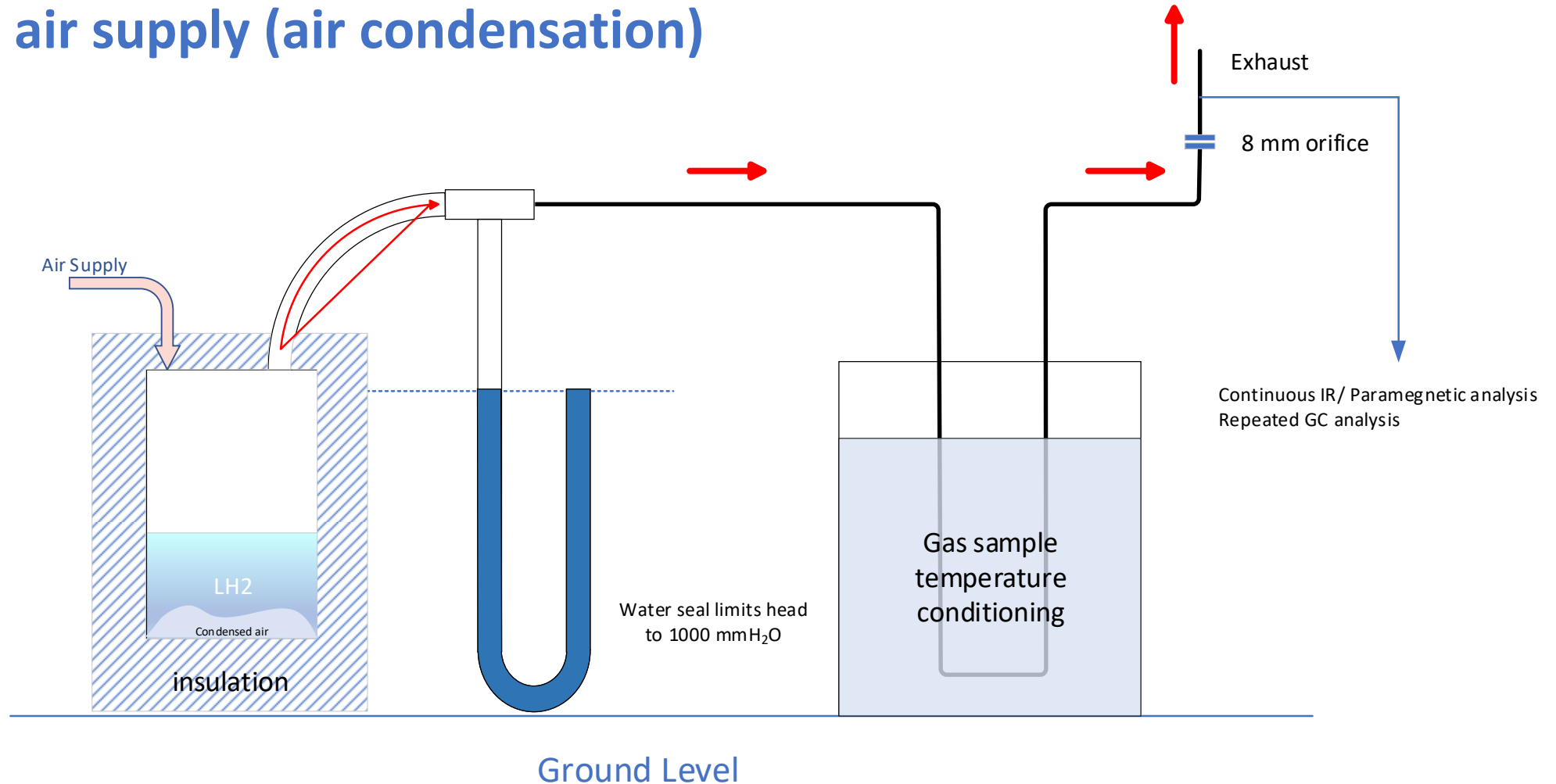
During LH2 filling



4.1 Oxygen enrichment and condensed phase explosions



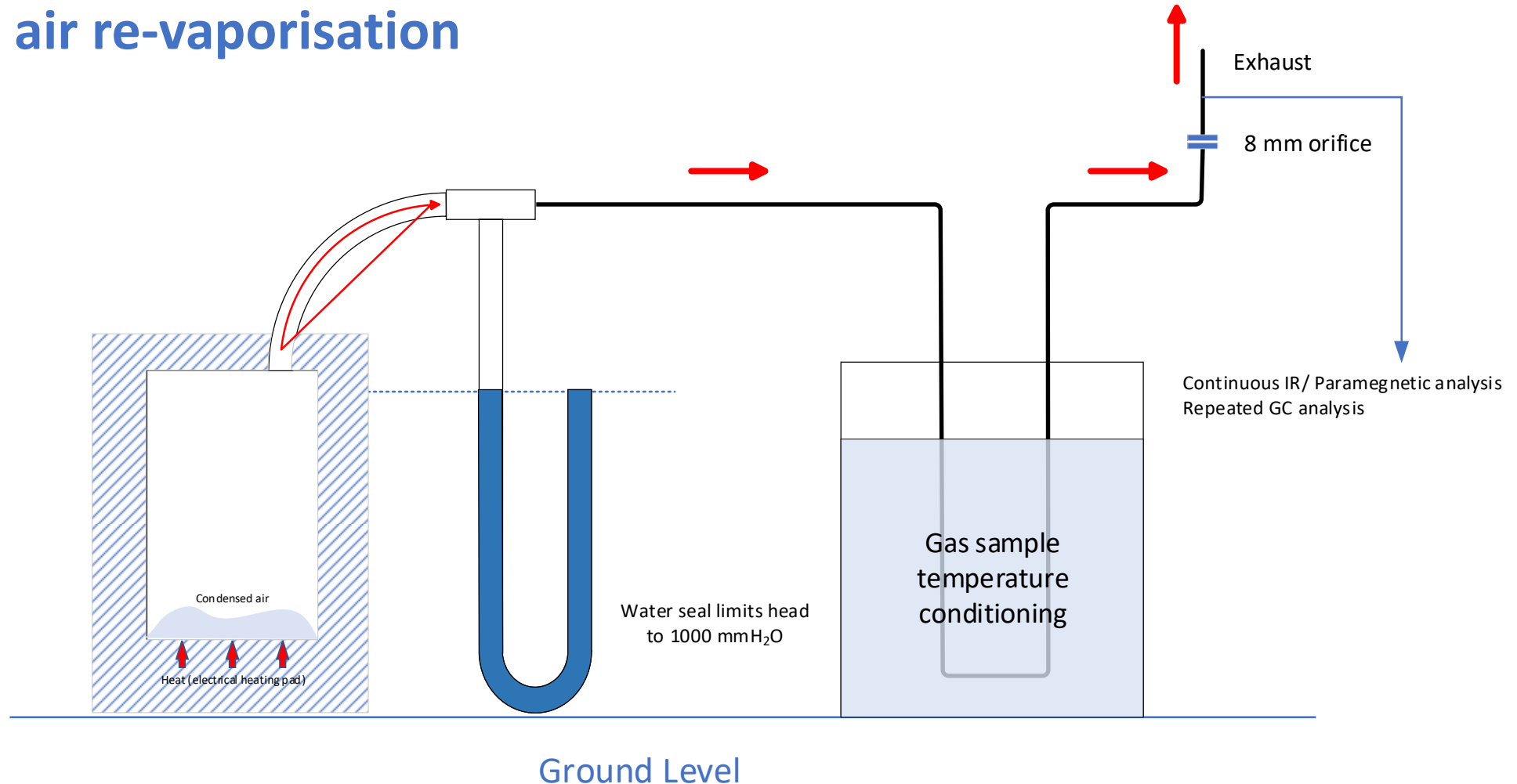
During air supply (air condensation)



4.1 Oxygen enrichment and condensed phase explosions



During air re-vaporisation



WP4.1 – Oxygen Enrichment & Condensed Phase Explosions



Current Status

- The rig is designed and built and partially commissioned.
- The instrumentation is calibrated and installed
 - Air flow controller
 - Gas analysis
 - LH2 level gauge
- Final commissioning will take place next week once LH2 tanker arrives



WP4.2 – LH2 Releases in Transfer Connection Spaces



Introduction

- Consider realistic foreseeable leaks from transfer equipment i.e., hoses, couplings and pipework.
- Pressure peaking phenomena (PPP)
- Ignited releases

WP4.2 – Experimental Rig

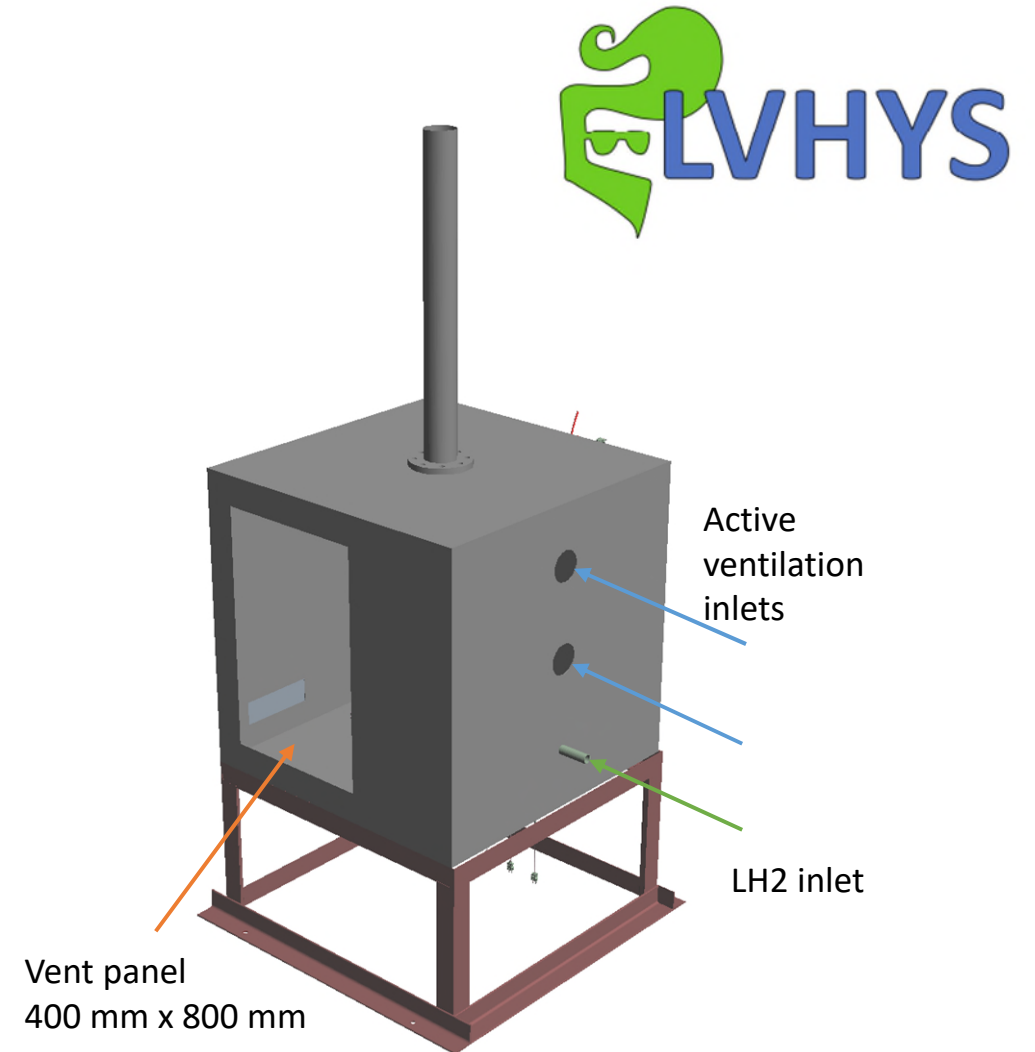


- Stainless steel 1m³ box
- LH2 supply up to 1"
- Ventilation
 - Passive
 - Active
- Sensors
 - Hydrogen concentration
 - Temperature
 - Pressure



WP4.2 – Experimental Rig

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WP4.2 – Dispersion releases



Test Matrix

24 tests

- 2 LH2 delivery pressures (2 and 8 bar)
- 4 nozzle sizes (0.2, 0.5, 1.0 & 1.8 mm)
- 2 ventilation regimes
 - Passive
 - Active (500 l/min and 2500 l/min)
- Further tests
 - Orientation (vertical, horizontal)
 - Non-round leak geometries



WP4.2 Pressure Peaking Phenomena



Test Variables

- LH2 delivery pressures (2 and 8 bar)
- 4 nozzle sizes (0.2, 0.5, 1.0 & 1.8 mm)
- Passive ventilation area



WP4.2 Ignited Releases



Test Variables

- LH2 delivery pressures (2 and 8 bar)
- 4 nozzle sizes (0.2, 0.5, 1.0 & 1.8 mm)



Future work



- Experimental work
 - WP4.1 7th October 2024
 - WP4.2 28th October to 18th November
- Data analysis & report
- ELVHYS project due to complete December 2025



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Thank you for your attention

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