

SUMMARY SORPTION CRYOCOOLER AT UNIVERSITY OF TWENTE

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We presented an alternative cooling strategy for the ET-payload, based on the ultra-low vibration sorption cooler for ET-PathFinder.

The concept is modular and scalable (with parallel lines) to meet the ET cooling demands and consist of Joule-Thomson cooler to be placed in the space between the cryoshields, which is powered by a sorption compressor to produce no vibrations.

A room-temperature transfer-system allows for non-cryogenic feedthroughs, the use of off-the-shelf instrumentation and positioning of the compressor far away from the interferometer (up to hundreds of meters).

The ETPF cooler is currently being constructed and based on 30 years development, where we will reach TRL-7 for the cooler in the end of 2026 from which we can start vibration level measurements to demonstrate the suitability of the sorption cooler for ET.

The consortium of the University of Twente and the two companies Cooll and Demcon ensure a successful development path towards reaching TRL-9 in the mid 2030's.

- The system optics are cooled with a low, laminar gaseous Helium mass flow, minimizing potential vibrations
 - LN2 backend cooling source allows for a low Helium mass flow close to the optics
- No actively moving components in the complete system, including the compressor
 - Low vibration
 - Low maintenance/high reliability, essential for continuous operation for a large-scale underground observatory
- The sorption compressor design is scalable to meet cooling requirements ET
- Compressor and Cooler transfer gas lines operated at room temperature
 - Flexibility in tube length
- No interfacing with suspension framework necessary
 - Required volume budget fits in radiation shields
- Cold interface is independent of orientation and location in the cryostat
- The concept passed the safety assessment according to European law for ETPF
- System is designed to be Fluid-Induced Vibrations neutral
- Cooldown within 7 days for ETpathfinder, 9 days for ET
- High TRL (6/7 (with mirrors) in 2026, aim: 9 in 2035)
 - Technology benchmarking in ETpathfinder facility in 2026/2027