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## **SESSION 2: JT & Sorption Coolers**

Paper 2.3

Tuesday ORAL Session

11:15 AM

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### ***Sorption Compressor Developments for the ETpathfinder 10K Cryochain***

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The ETpathfinder (ETPF) is a scaled prototype of the Einstein Telescope Gravitational Wave Observatory, developed to test and advance the necessary technologies for gravitational wave detection. ETPF features two Fabry-Perot Michelson Interferometer arms with cryogenically cooled mirrors. Both arms are cooled using LN<sub>2</sub>, while one arm requires further cooling to approximately 10 K using an additional cooling system. This additional cooler is critical as the precision measurements of third-generation laser-interferometry detectors in ETPF necessitate a cooling system that minimizes vibrations during operation. To address this, the University of Twente has proposed a modular cryochain design, employing a combination of sorption-based compressors and Joule-Thomson (J-T) cold stages. This design implements a parallel cascade configuration with stages at 40 K (neon), 15 K (hydrogen), and 8 K (helium), offering cooling powers of 2.5 W, 0.5 W, and 0.05 W, respectively. The performance and compactness of the cryocooler system are significantly influenced by the sorption compressor. The design and operation of the individual sorption cells constituting the sorption compressor unit (along with other passive components), needs to be studied and optimized for the realization of an efficient sorption cryocooler. Recent advancements in the predictive models of the sorption cell, along with further design considerations crucial for the system's realization to be installed at the ETpathfinder, are discussed.