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Measurement of trace impurities in ultra pure hydrogen and deuterium at the parts-per-billion level using gas chromatography

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Abstract

A series of muon experiments at the Paul Scherrer Institute in Switzerland deploy ultra-pure hydrogen active targets. A new gas impurity analysis technique was developed, based on conventional gas chromatography, with the capability to measure part-per-billion (ppb) traces of nitrogen and oxygen in hydrogen and deuterium. Key ingredients are a cryogenic admixture accumulation, a directly connected sampling system and a dedicated calibration setup. The dependence of the measured concentration on the sample volume was investigated, confirming that all impurities from the sample gas are collected in the accumulation column and measured with the gas chromatograph. The system was calibrated utilizing dynamic dilution of admixtures into the gas flow down to sub-ppb level concentrations. The total amount of impurities accumulated in the purification system during a three month long experimental run was measured and agreed well with the calculated amount based on the measured concentrations in the flow.

Keywords: gas chromatography, ultra pure hydrogen, time projection

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