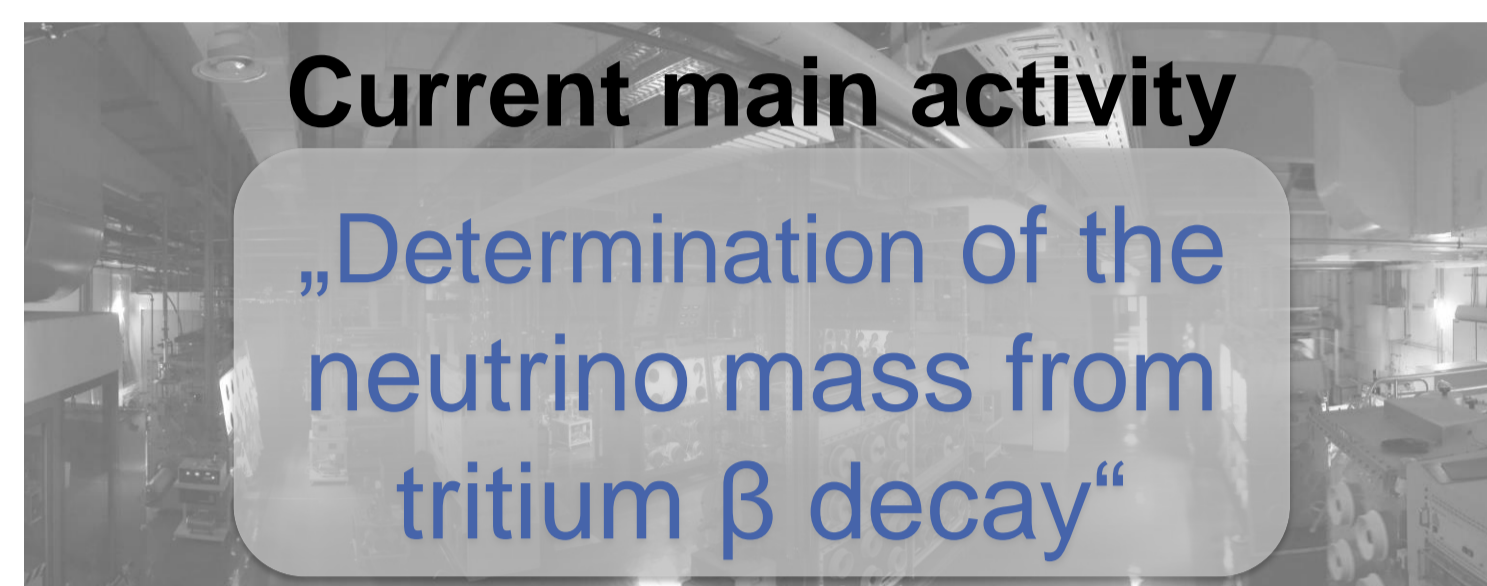


TLK - Providing tritium expertise and technology for the neutrino community

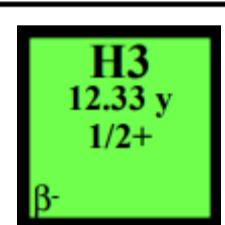
Florian Priester, Robin Größle, Simon Niemes, Magnus Schlösser, Stefan Welte

Tritium Laboratory Karlsruhe (TLK) overview



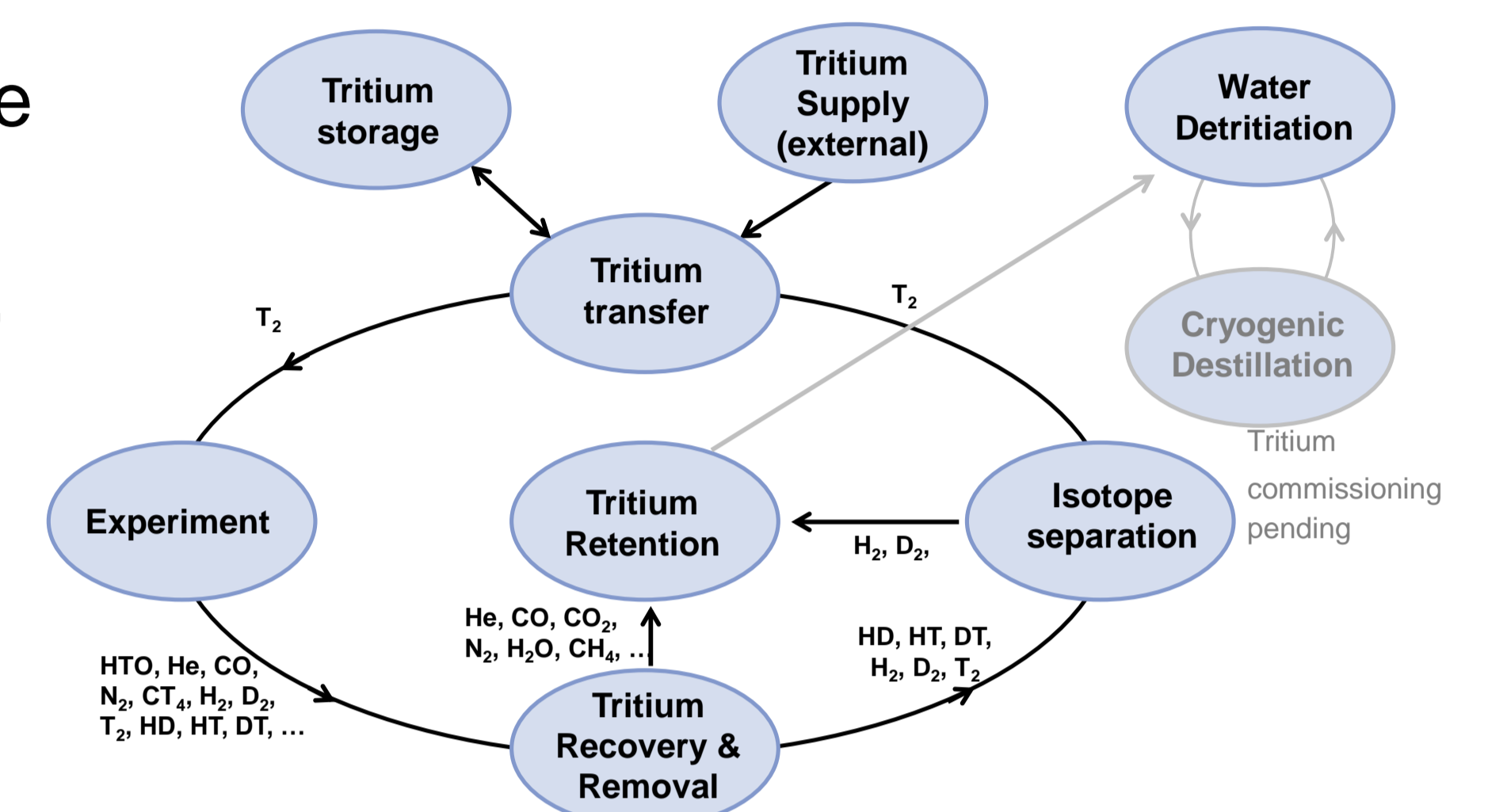
Tritium (^3H or T) key data

- rare isotope of hydrogen
- half life $t_{1/2} = 12.33$ years
- β^- -emitter, $E_{\text{max}} = 18.59$ keV, $E_{\text{mean}} = 5.7$ keV
- specific activity $a = 3.57 \cdot 10^{14}$ Bq/g
- induces "radio-chemistry" on materials



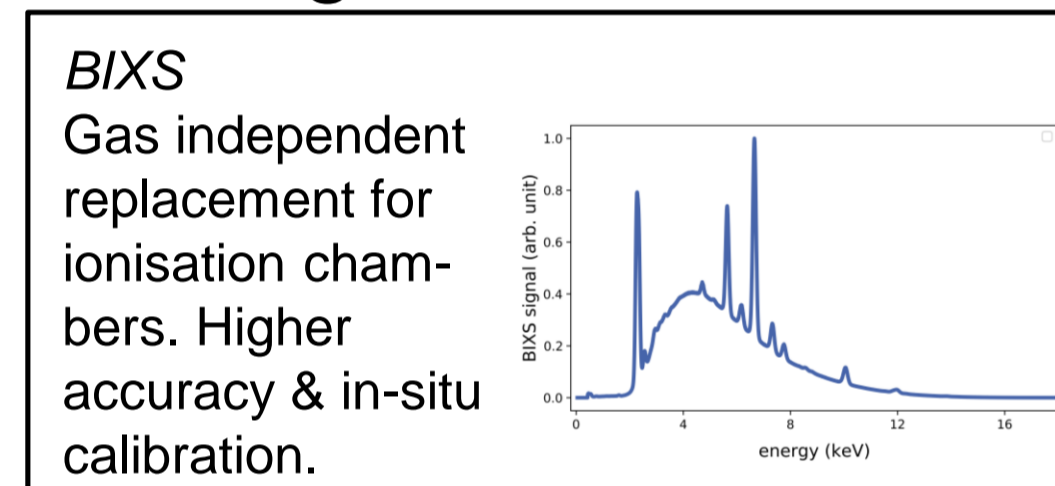
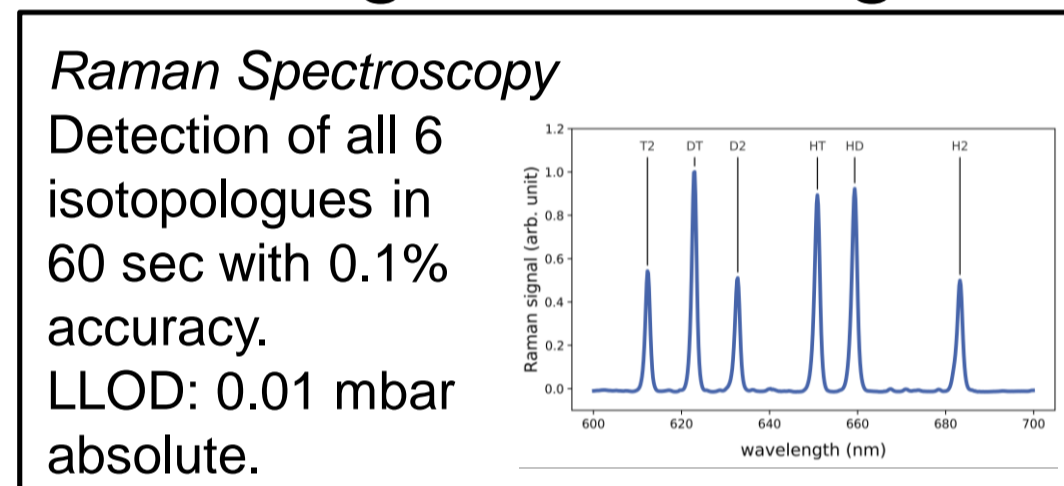
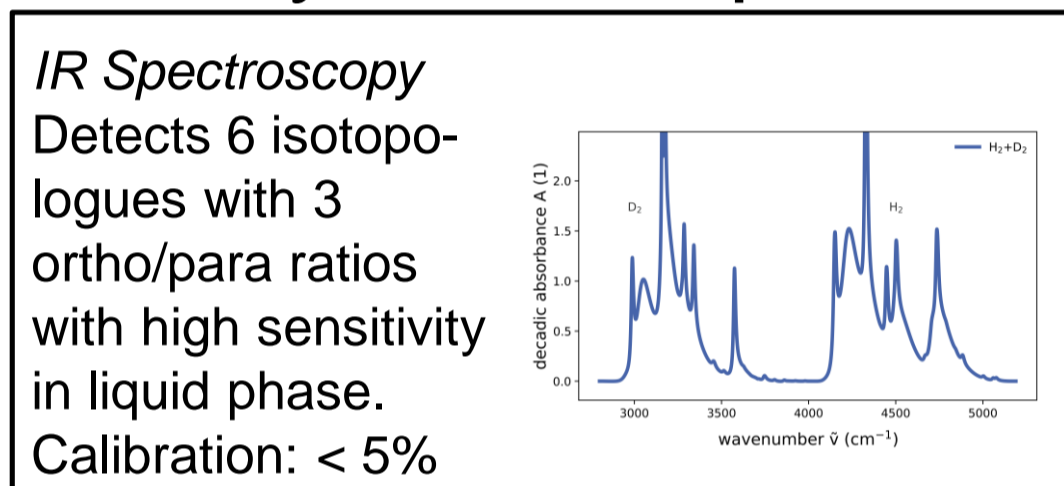
- TLK was commissioned with tritium in 1993
- ≈ 50 people staff
- Experimental area of 1200 m² and a total glove box volume of 160 m³
- Reliable infrastructure for storage, purification, isotope separation and accountancy
- TLK currently holds a licence for 40 g of ^3H ($1.4 \cdot 10^{16}$ Bq, highest-licensed civil tritium laboratory), 10^{10} Bq ^{83}Rb for calibration and 100 kg uranium for ^3H storage

TLK's unique closed tritium loop

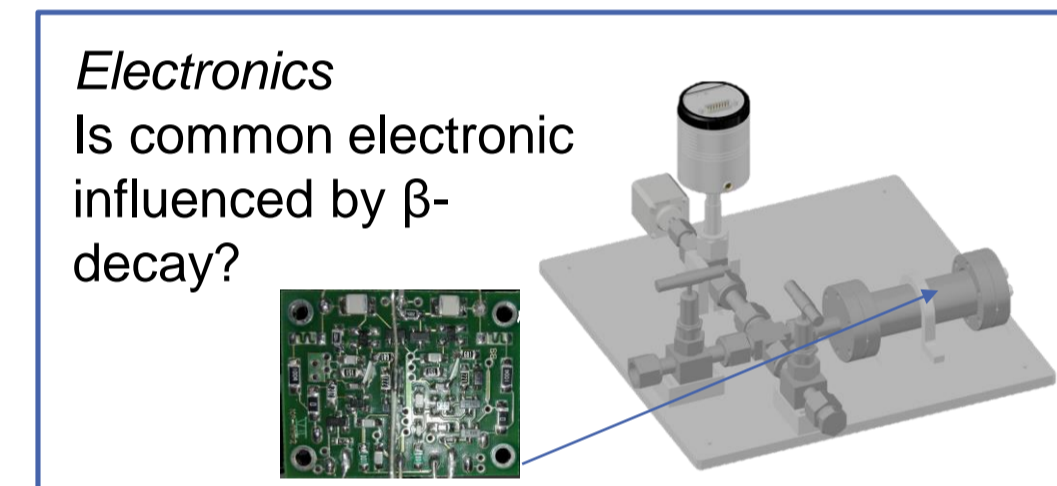


Development and testing of new technology, materials and measurement techniques

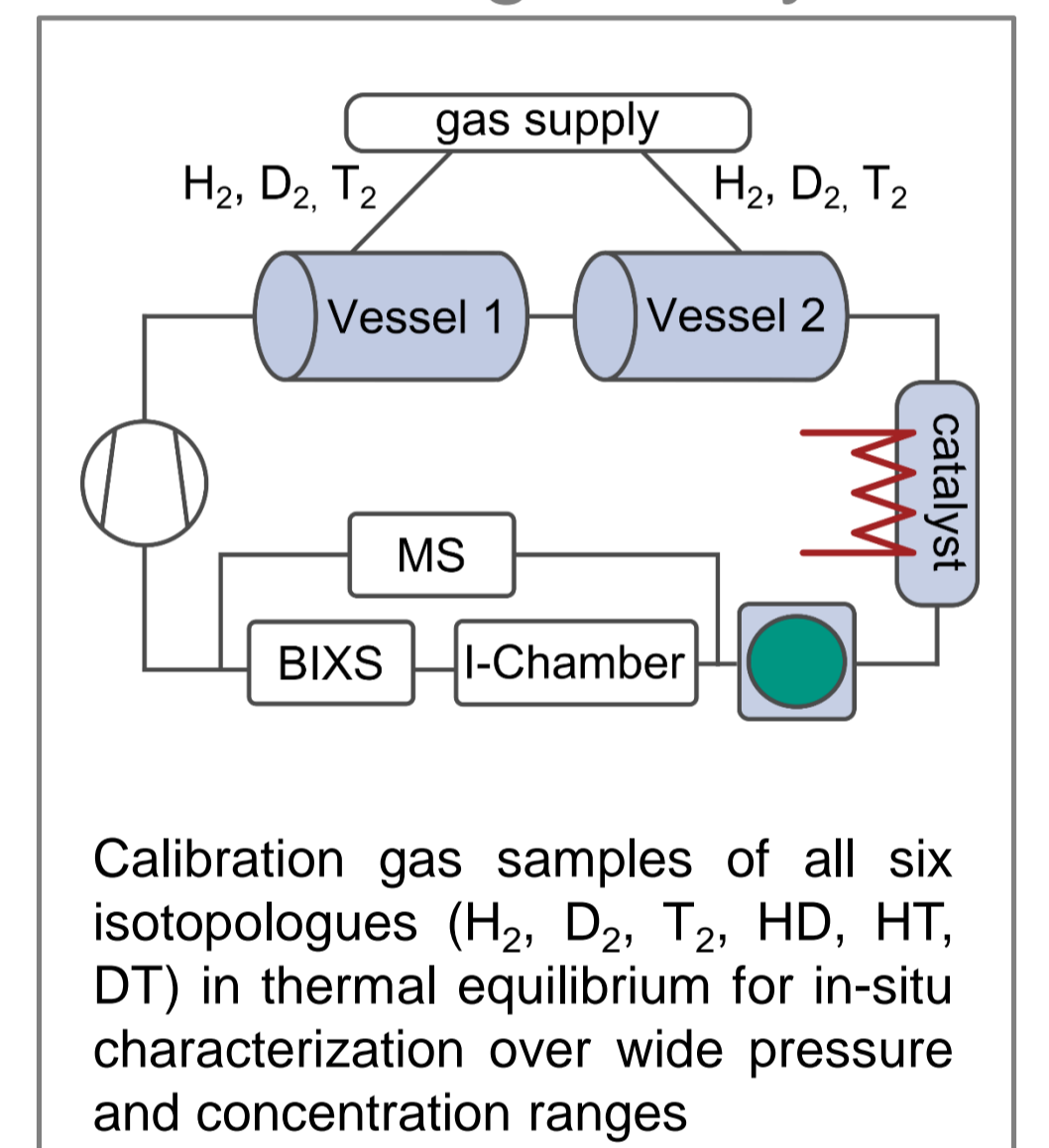
Activity and composition monitoring: Wide range from IR to gamma



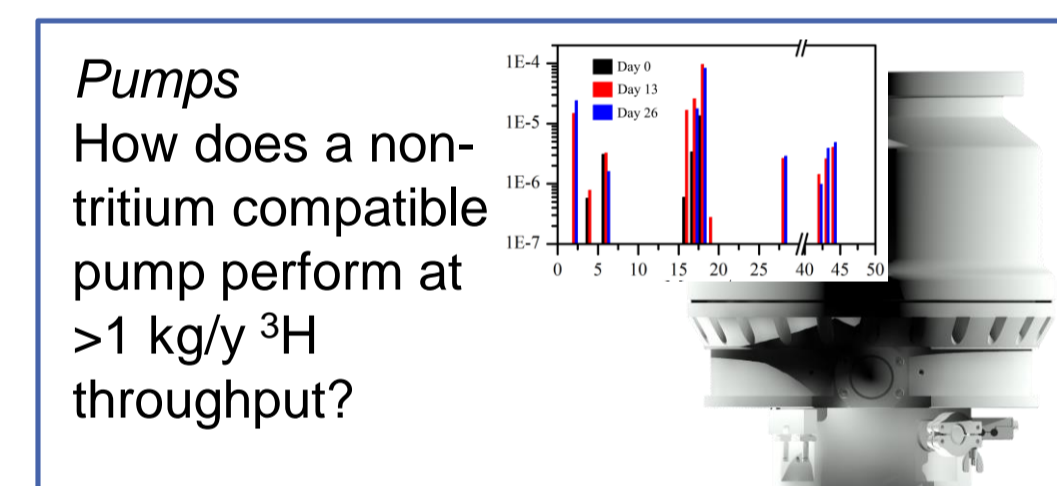
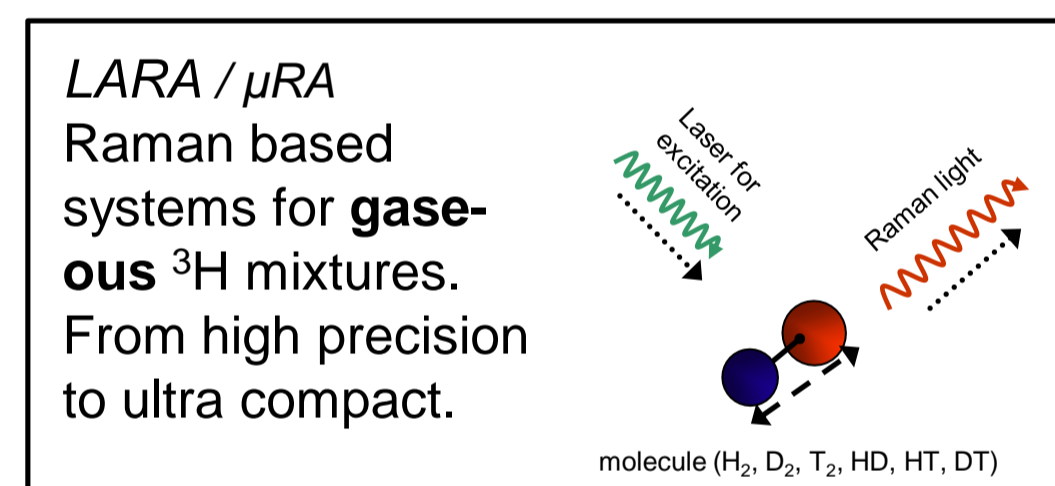
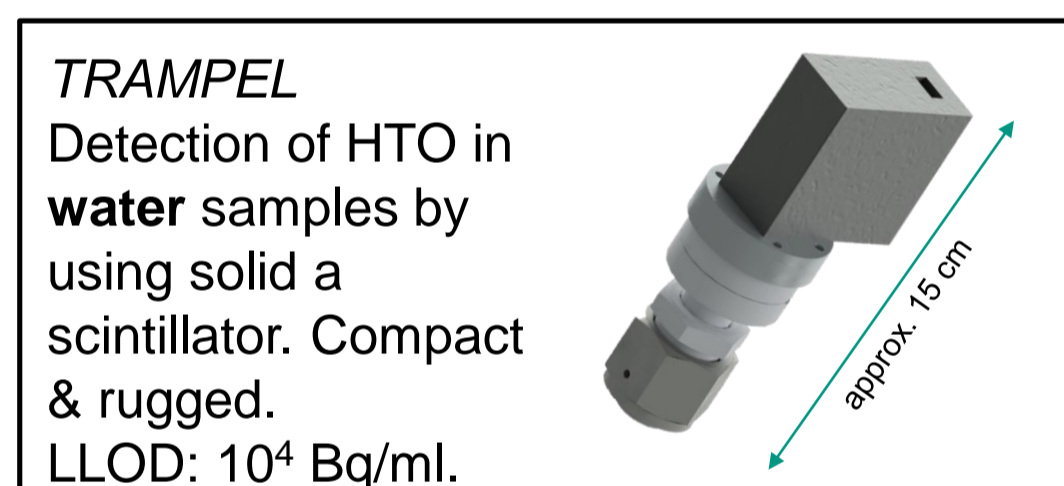
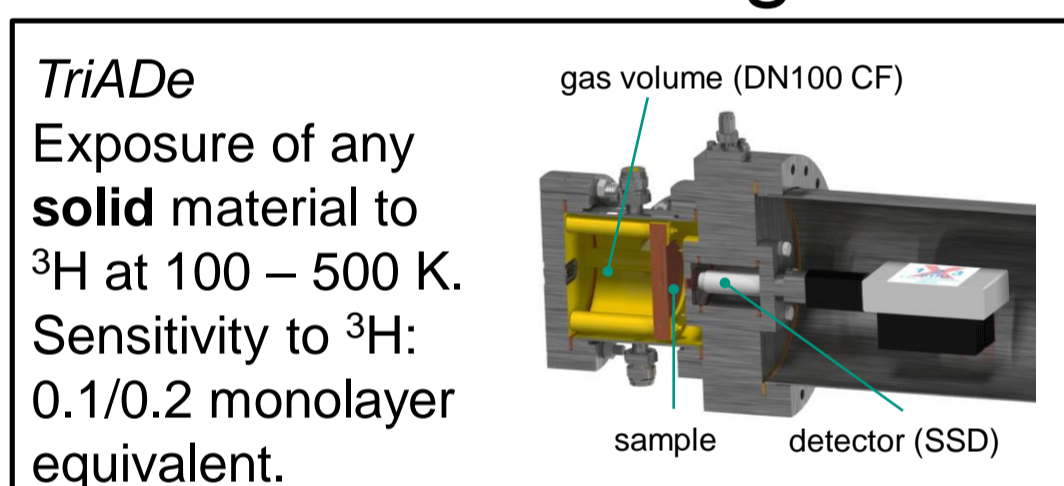
Compatibility tests



Gas mixing facility




Tritium monitoring in all states of matter

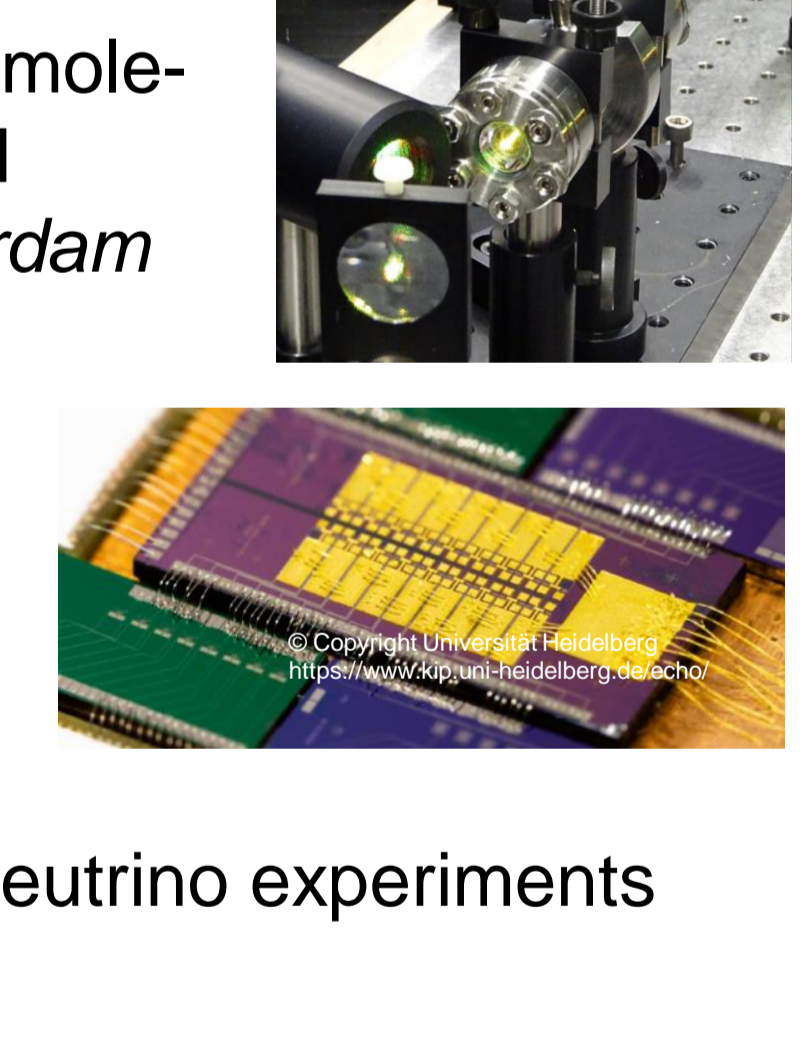


Providing expertise to the community

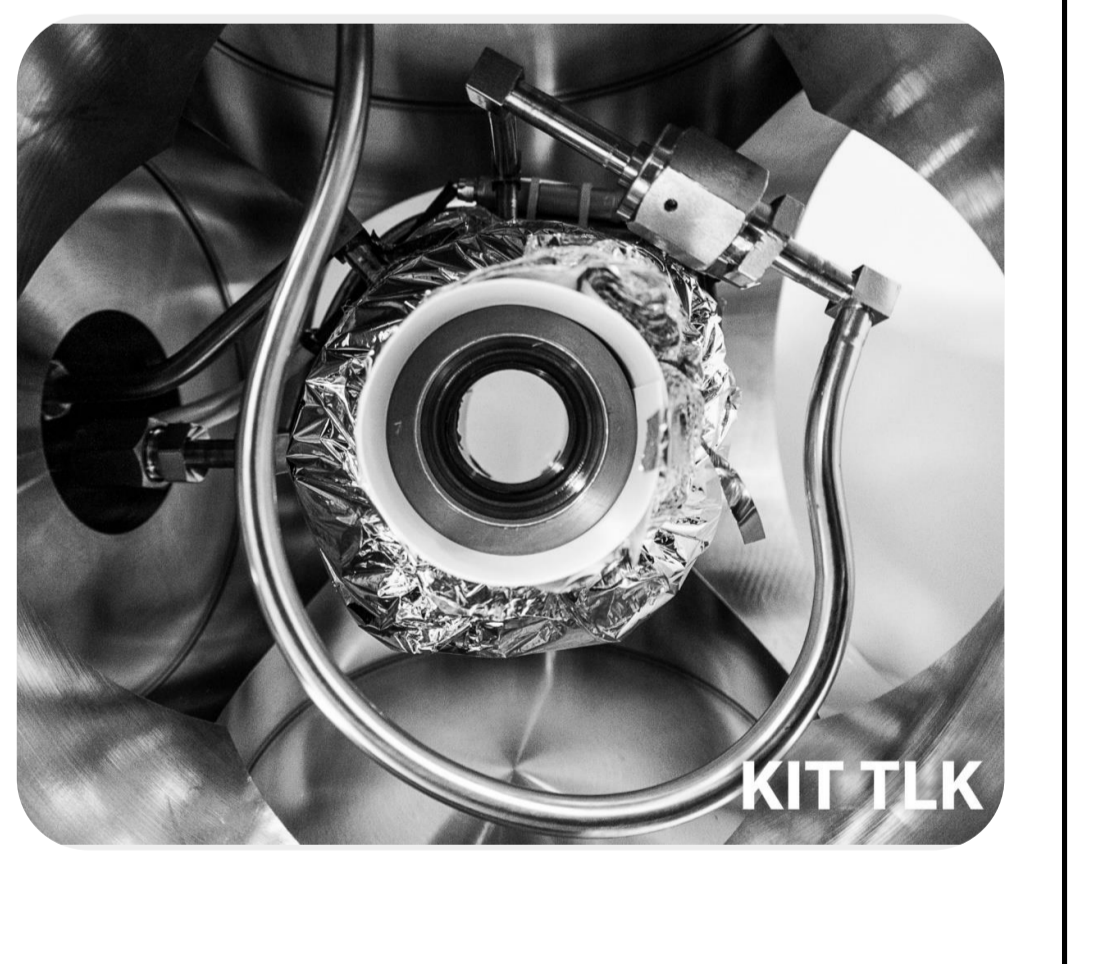
Industrial collaborations

- Long term testing of a hermetic all-metal scroll pump. Suitable for ^3H and high purity gas applications.
 - Testing and assisting in development of a tritium compatible Raman head with fibre coupling.
- 

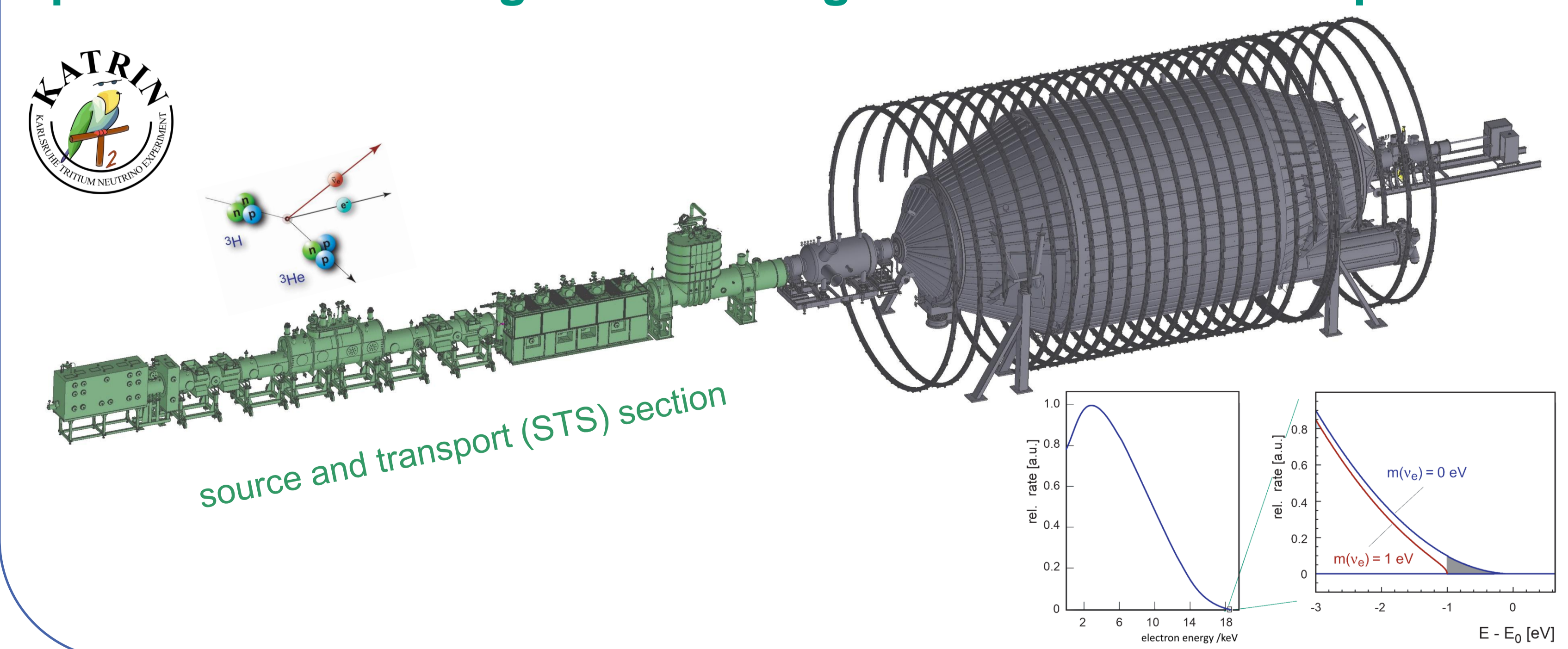
Scientific collaborations

- Ultra-high resolution spectroscopy of molecular tritium for testing QED and BSM physics, with *Vrije Universiteit Amsterdam*
 - Tritium loading into $\mu\text{Calorimeters}$ for metrology of the beta spectrum with *University of Heidelberg*
 - Tritium depth profiling with *University of Toyama*
 - Sharing expertise with future tritium neutrino experiments such as *PROJECT 8* or *PTOLEMY*
- 

Cold hydrogen isotopologues ($\sim 10\text{K}$ to $>300\text{K}$)

- Isotope and ortho para separation (e.g. cryogenic distillation, GC)
 - Dynamic processes like chemical and ortho para equilibration with and without catalysis
 - Study of solid, liquid and gaseous hydrogen and molecular interactions
- 

Operation site for large scale next generation neutrino experiment



The **KARlsruhe TRITium Neutrino** experiment

- TLK was chosen because of closed tritium cycle
- High throughput of 40 g/day pure ($>97\%$) ^3H
- Unmatched gaseous source stability of $< 0.1\%$
- Complex "Tritium Loop" system, equipped with ≈ 220 sensors and ≈ 50 pumps, connects the tritium related components along the 35m long STS section
- Full integration into TLK's infrastructure