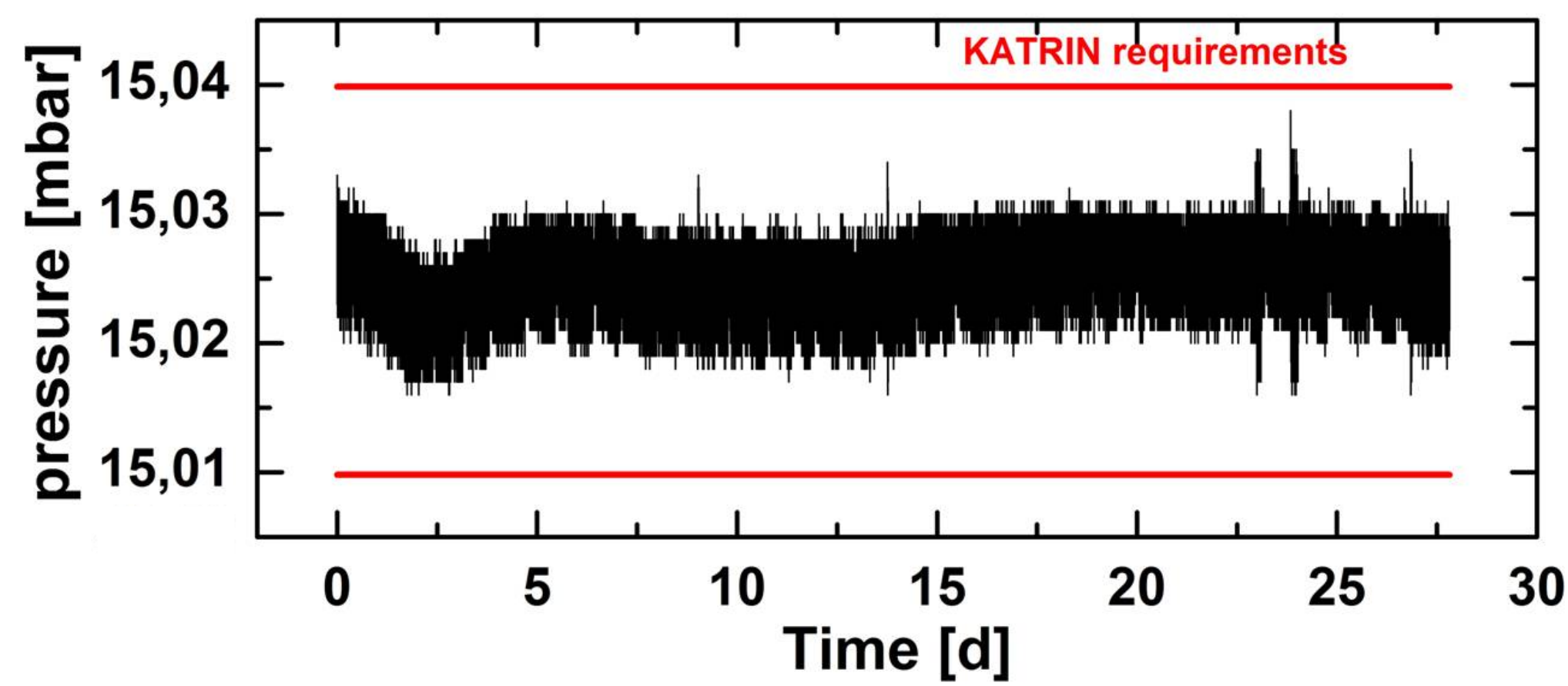


## Inner Loop system

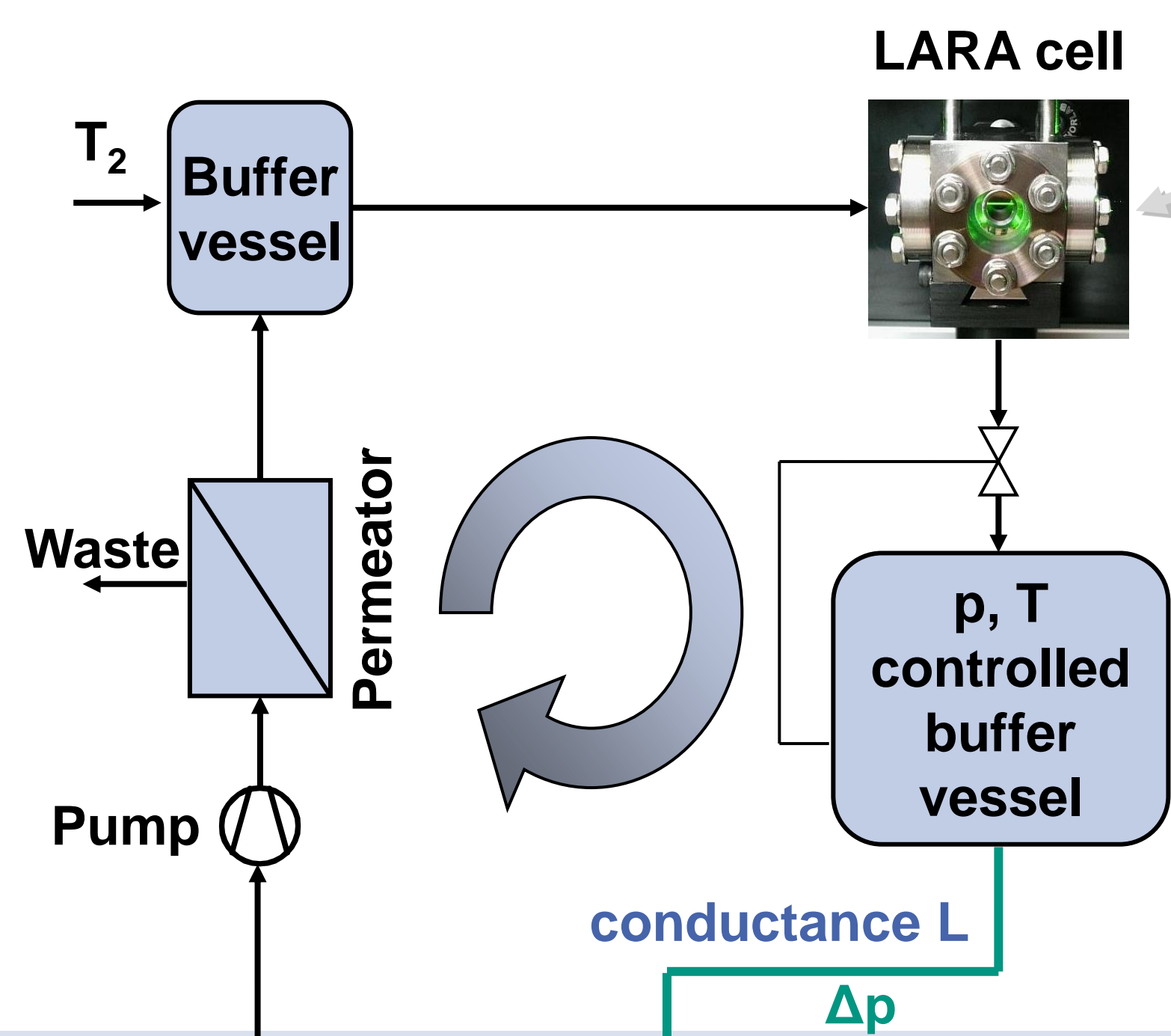


### Results

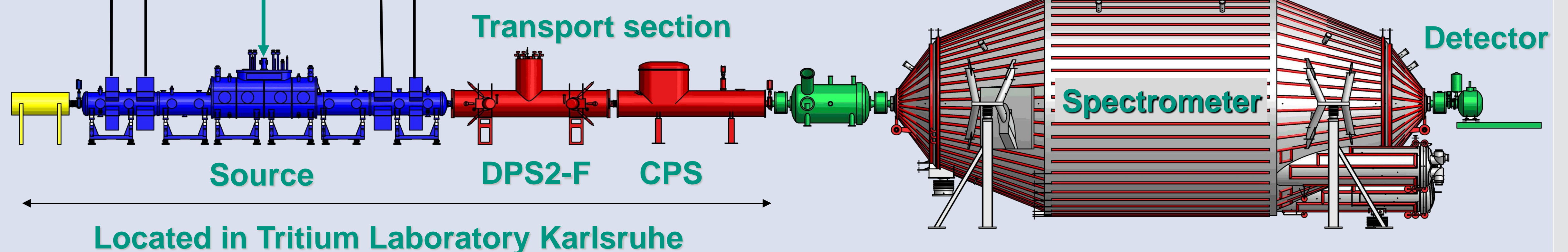
28 days of gas circulation: improved pressure stabilization  $\Delta p/p \approx 2 \cdot 10^{-4}$  is more stringent than requirement of 0.1%

### Objectives

- Stable injection  
 $q_{in} = 1.8 \text{ mbar l s}^{-1}$   
 $q_{in} = L \cdot \Delta p$   
→ pressure stability
- Tritium throughput  
40 g/day
- Stable tritium purity  
 $\epsilon_T > 95\%$



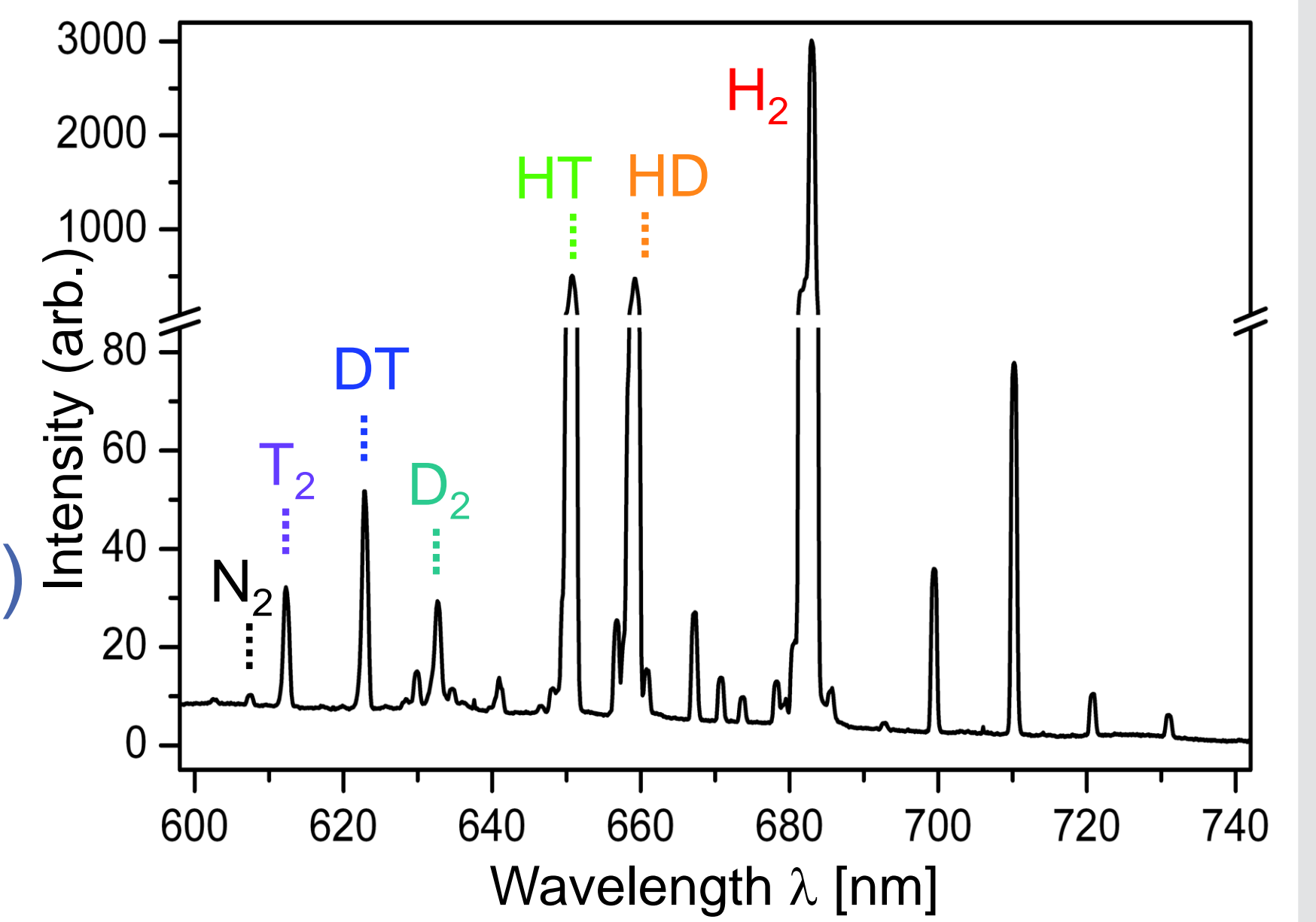
Determine  $m_{\nu_e}$  from Tritium beta decay:  
Sensitivity on  $m_{\nu_e}$ :  
**0.2 eV/c<sup>2</sup> (90% C. L.)**  
Statistic and systematic error of equal size!



## Laser Raman spectroscopy

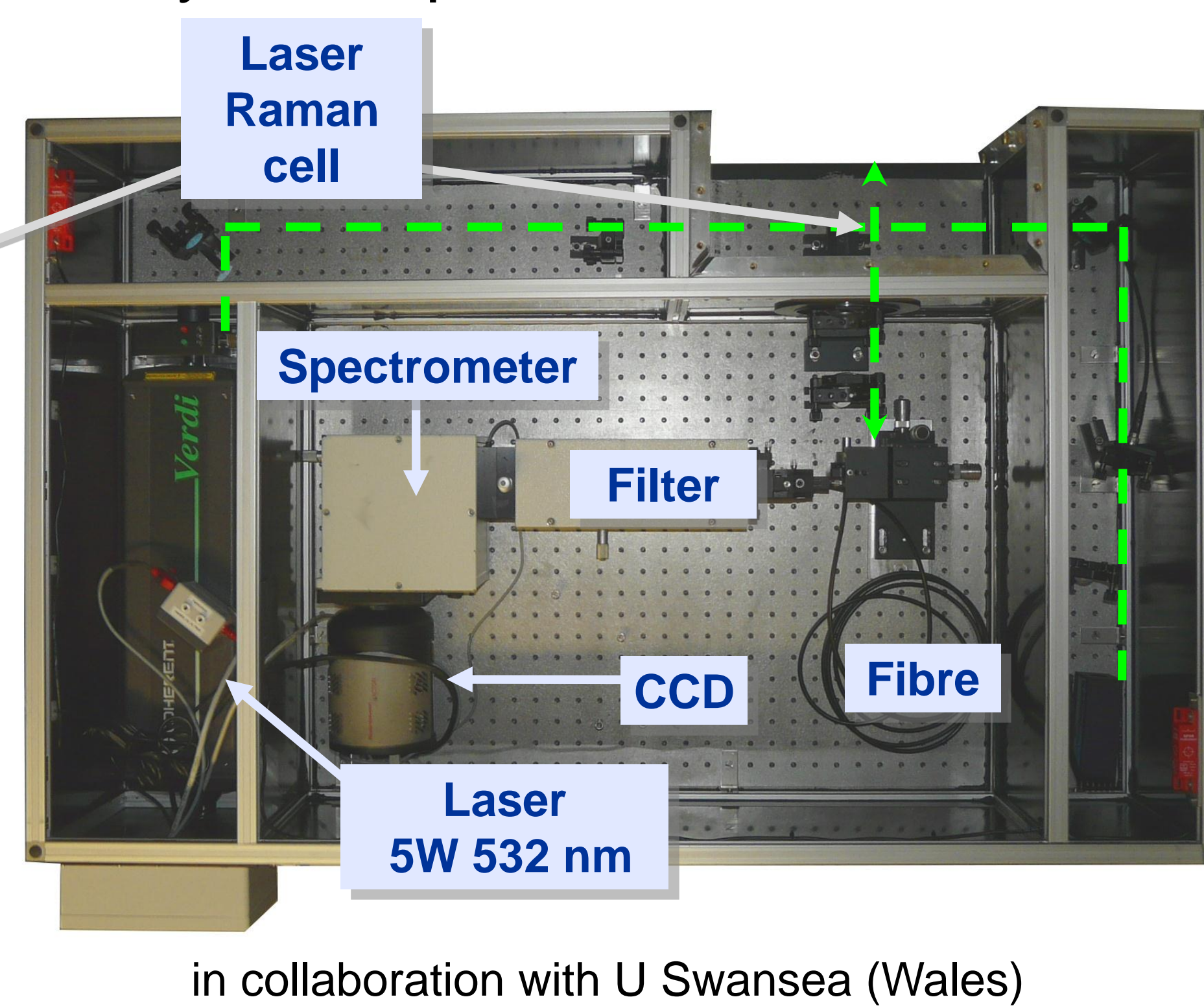
### Objectives

- Long-term monitoring of isotopic content of tritium source and  $\epsilon_T$
- Required precision  
**0.2 % @ 150 mbar ( $2\sigma$ )**
- Sampling interval  
**< 250 s** and automated analysis of spectra



### Results:

- All hydrogen isotopologues can be detected simultaneously
- 0.1% precision ( $1\sigma$ ) reached**  
→ KATRIN requirements fulfilled

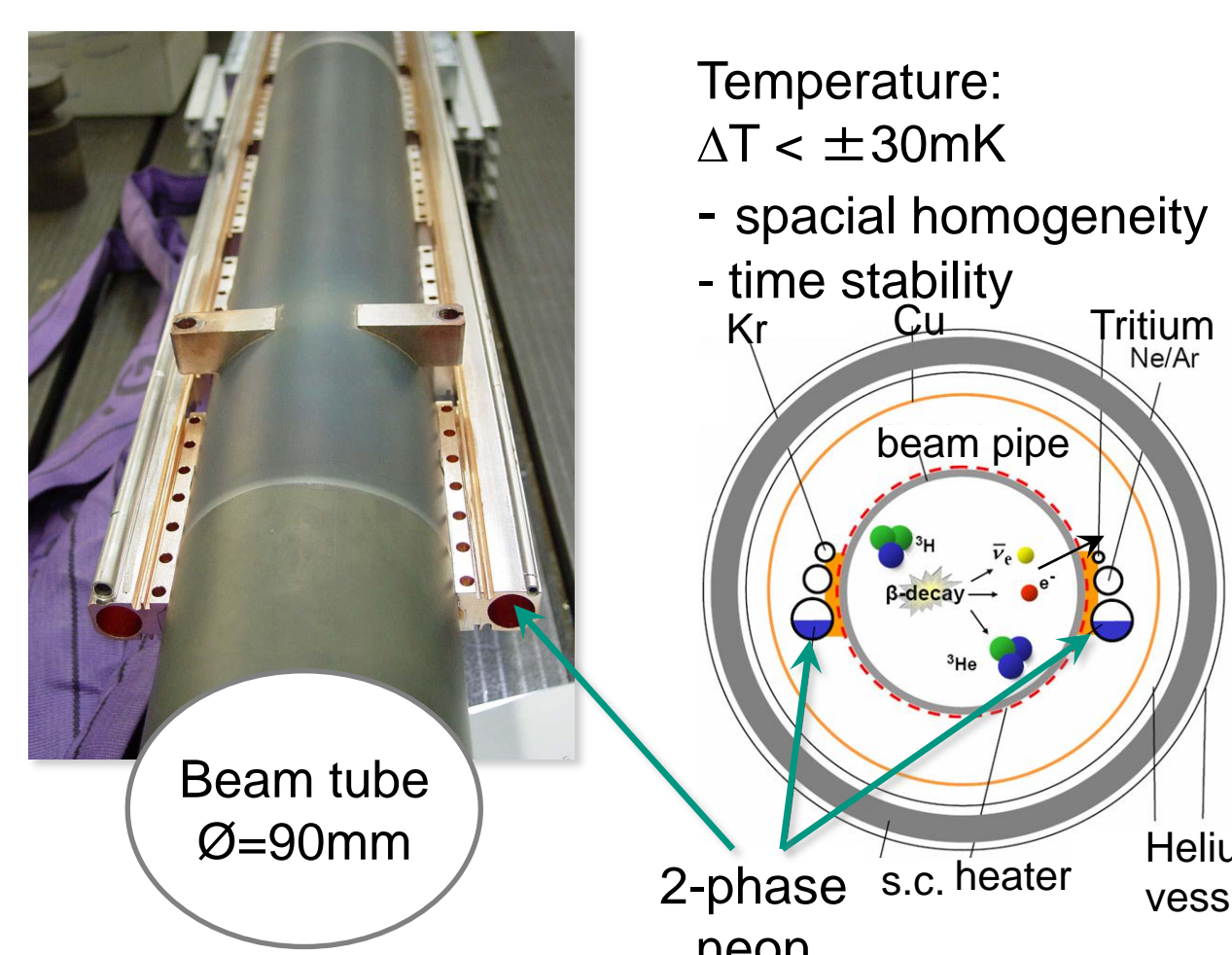


## WGTS

Principle of a Windowless Gaseous Tritium Source (WGTS)

- column density:  $5 \cdot 10^{17} \text{ molecules/cm}^2$
- activity:  $1.1 \cdot 10^{11} \text{ Bq}$
- stability: 0.1% (temp., pressure)

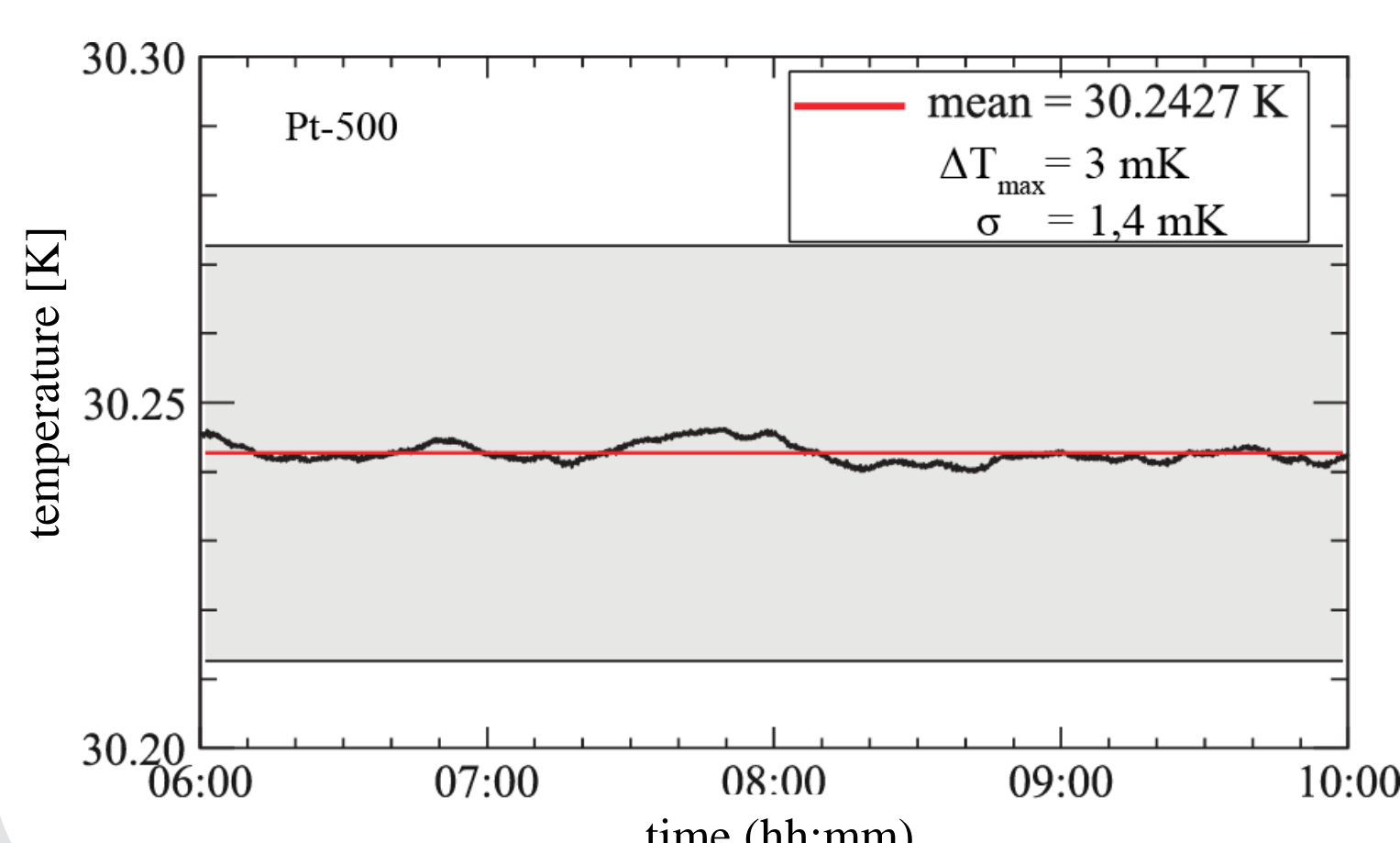
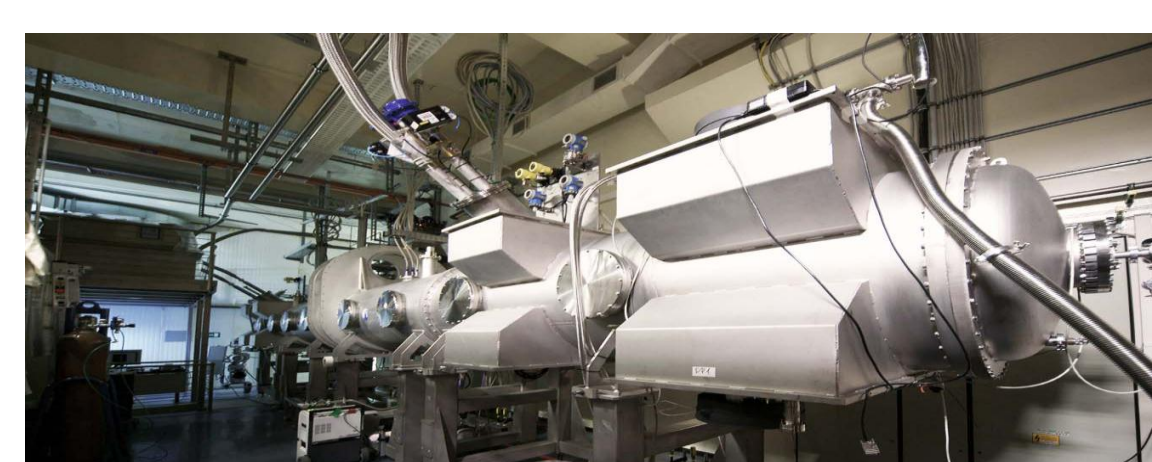
Technological challenge: precise beam tube cooling



### Demonstrator test at TLK:

- Test and optimization of the novel 2-phase GNe/LNe cooling system
- Test of the mechanic integrity of beam tube & pumping chambers

Principle: 2 separate cooling tubes ( $\varnothing=16 \text{ mm}$ ) with boiling LNe at  $p = 1 \text{ bar}$  (thermosiphon)

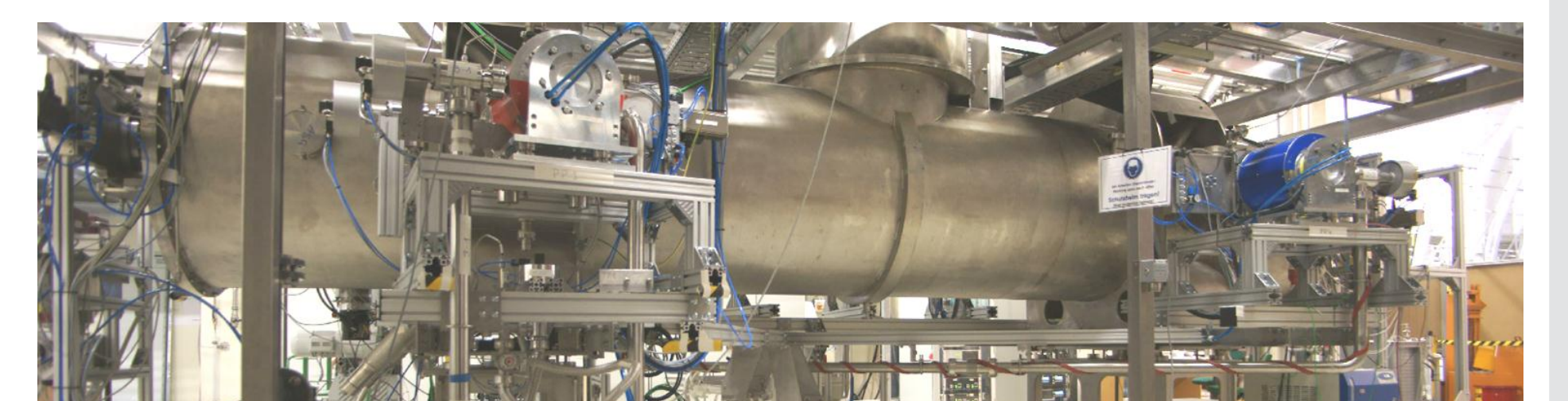


### Status

- Demonstrator on site
- Temperature stability in mK range** → Improvement by 10-20 w.r.t. specification

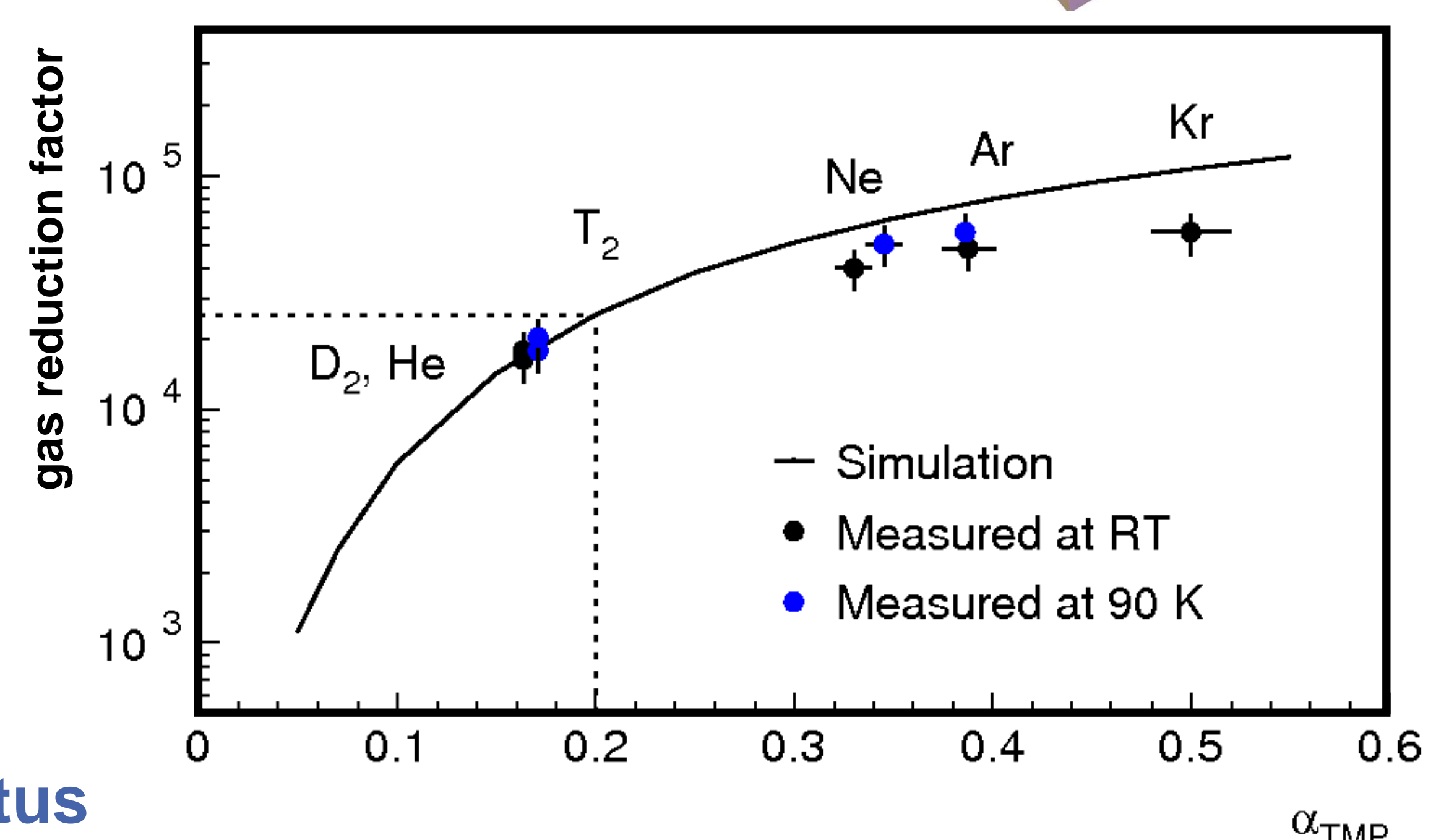
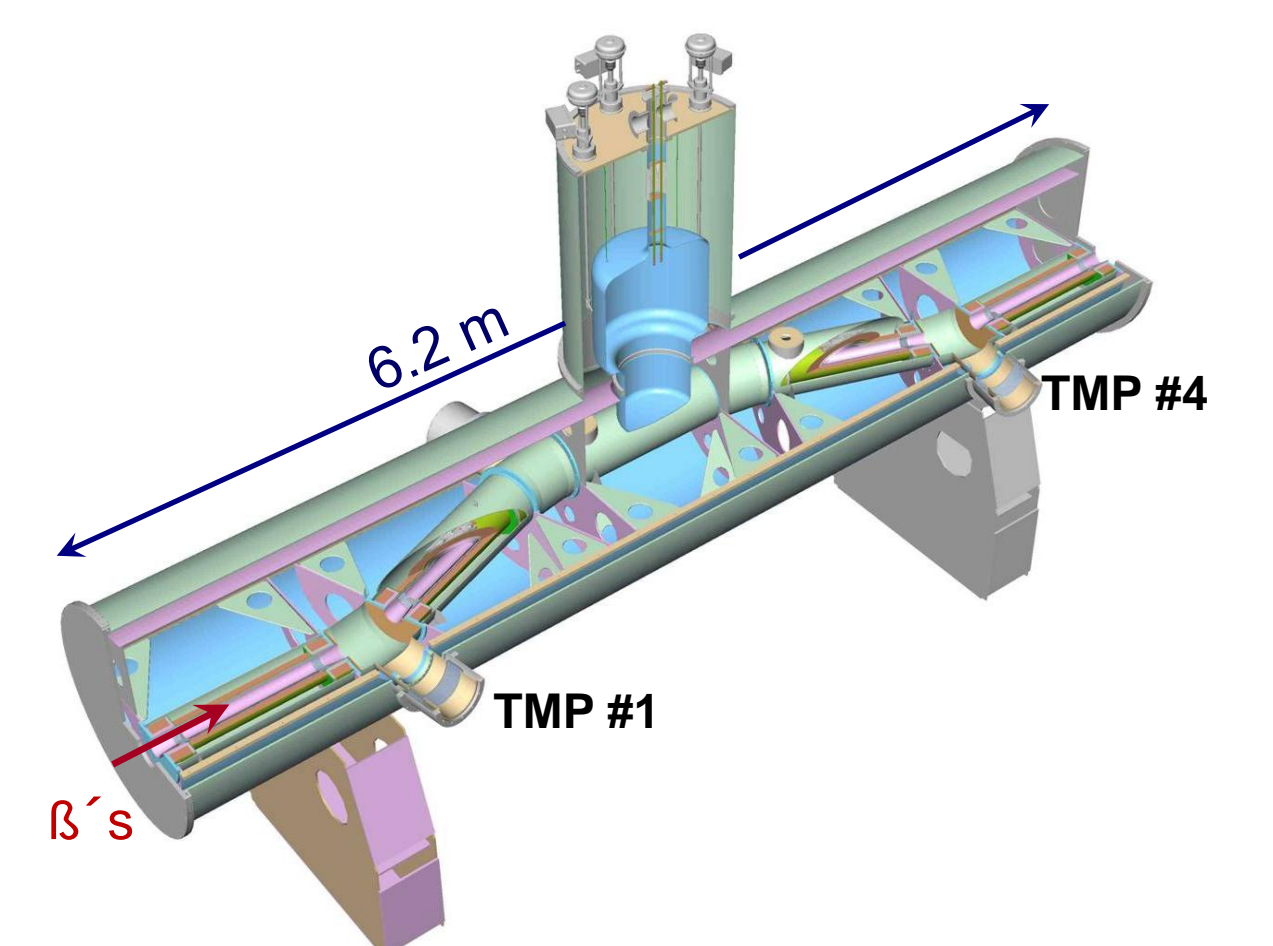
## DPS2-F

Differential Pumping Section



### Objectives

- Reduction of gas flow rate by factor  $10^5$
- Transport of electrons in magnetic field
- Suppression of ions



### Status

- Gas-flow reduction** measurement (without beam tube instrumentation) in agreement with simulation
- Instrumentation for ion detection (FT-ICR) & elimination (el. dipoles) will increase the gas reduction factor