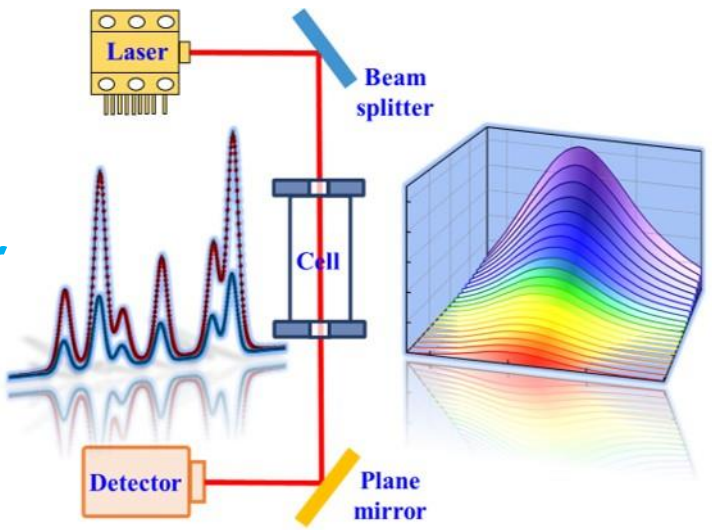


Optical Gas Standard:

Laser Absorption Spectroscopy for traceable hydrogen purity analysis



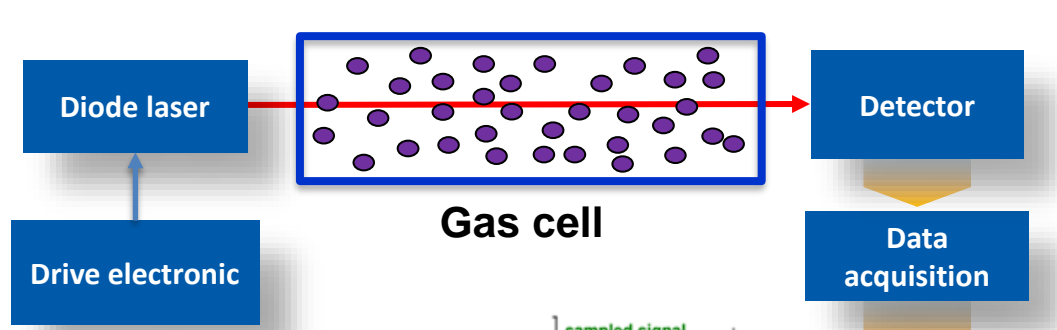
Sumit Agarwal, Denghao Zhu, Bo Shu, Ravi Fernandes

Zhechao Qu

Department of Physical Chemistry, PTB, Germany

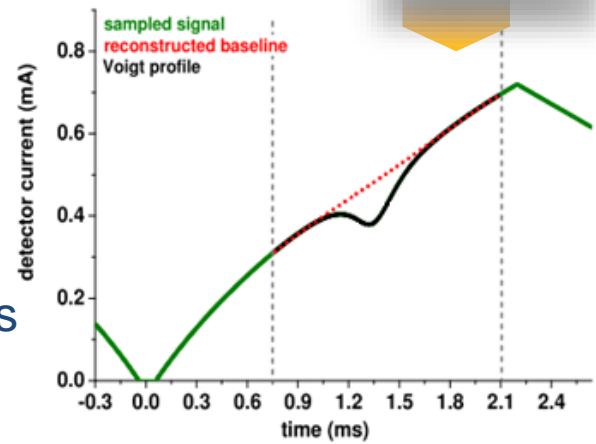


Laser Absorption Spectroscopy



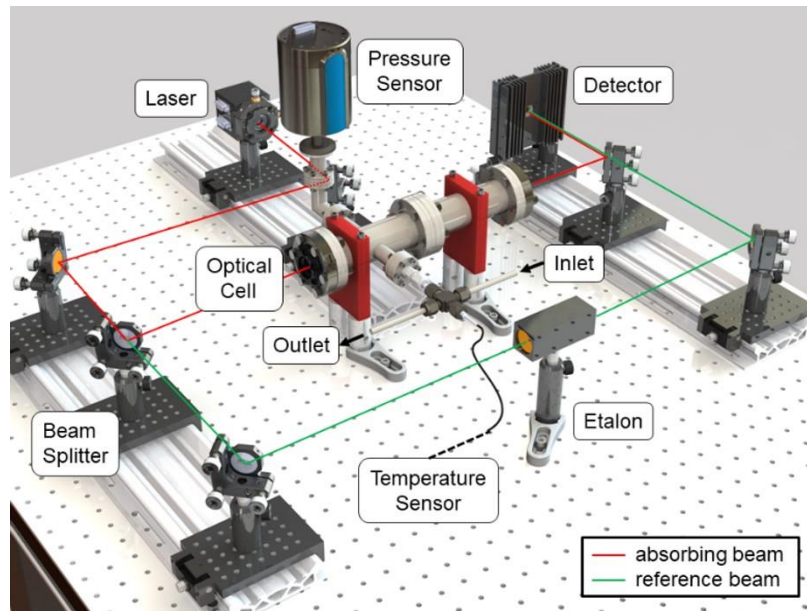
$$x_{H2} = \frac{k_B \cdot A \cdot T}{S \cdot p \cdot L}$$

measured parameters
 constants
 molecular line data



```

    graph TD
      A[Measure spectral absorbance (via laser intensity)] --> B[Line area, A]
      C[Laser tuning] --> B
      D[Traceable inputs: p, T, L, S, kB] --> E[Calculate traceable amount fraction, x]
      B --> E
    
```



Light source:

- ICL laser at 2.2 μm - Swept at 140 l

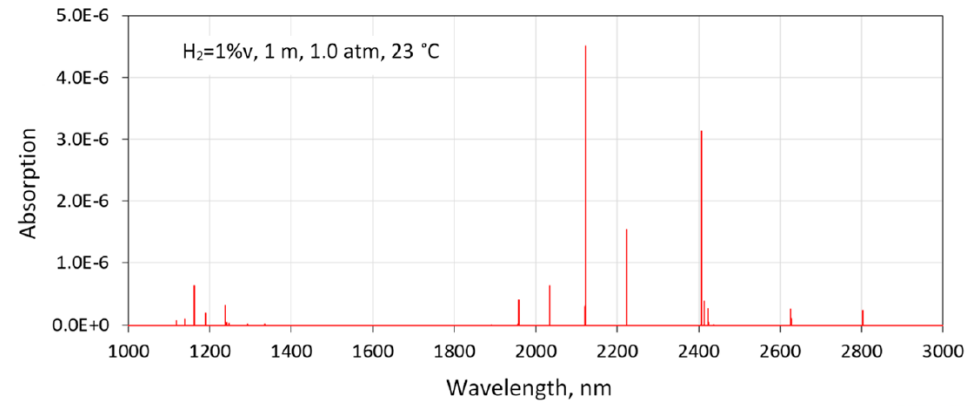
Gas cell:

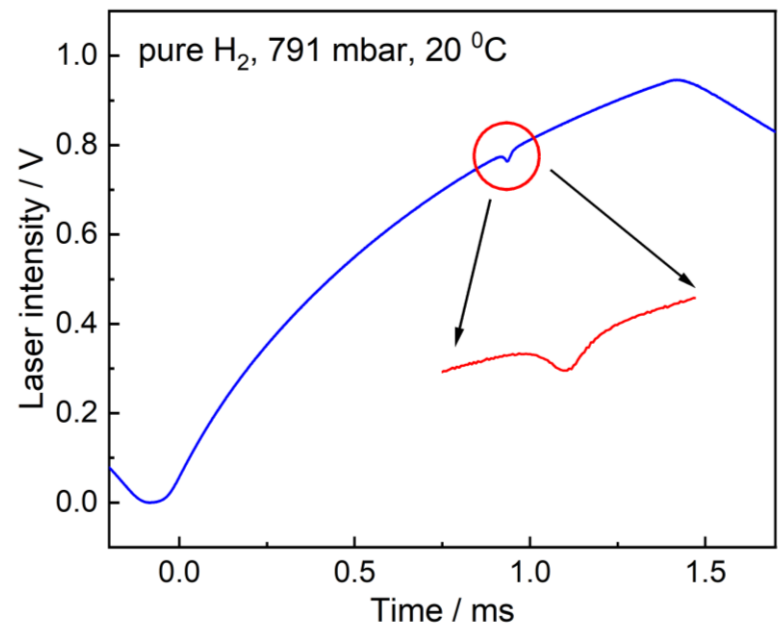
- multi pass, cavity enhanced cell



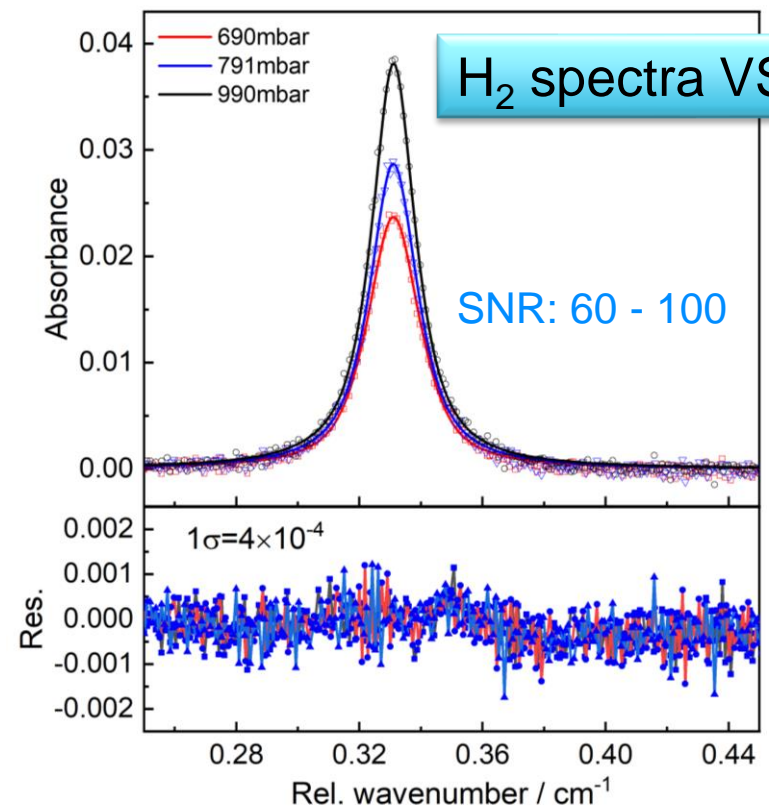
Detector/Sensors:

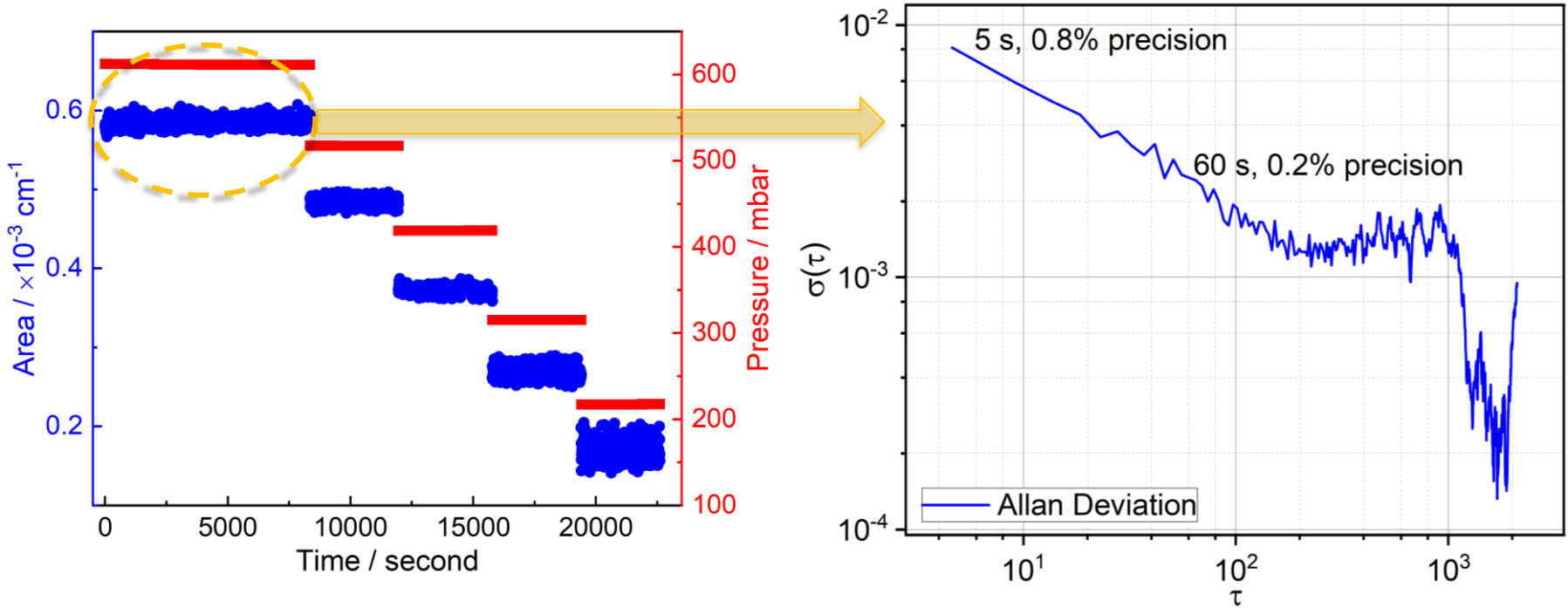
- T sensor: PT100b -P sensor: MKS baratron
- IR detector





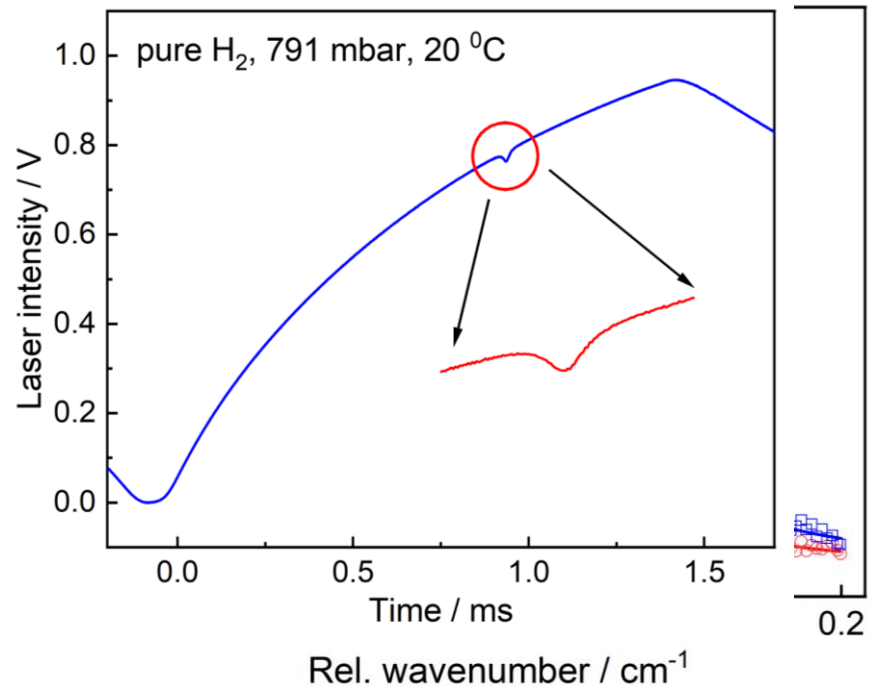
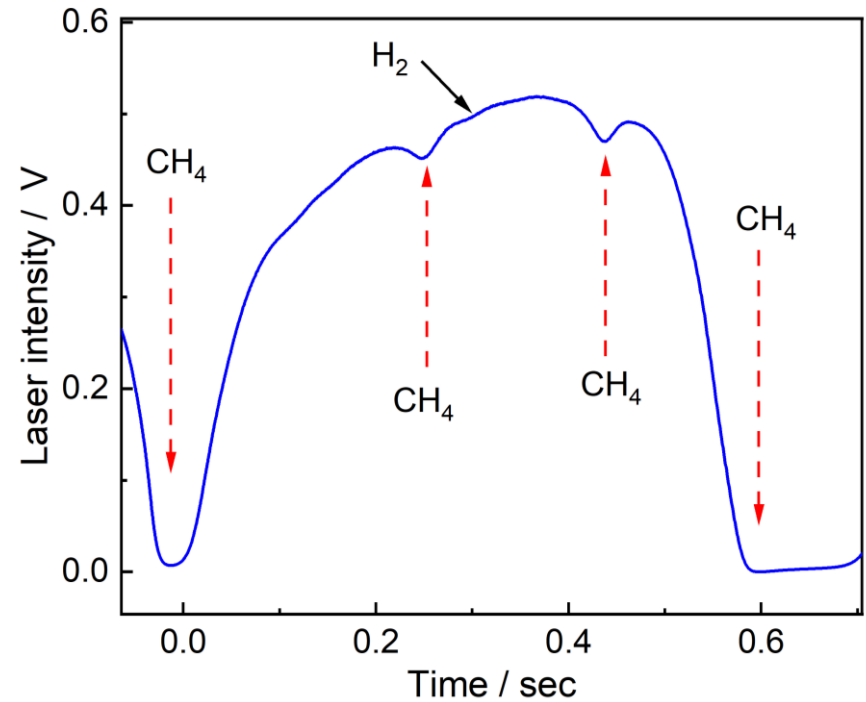
Raw laser signal





The instrument has 0.2% precision @ 1 min

Hydrogen and CH₄ blends: ongoing



Multi spectral line fitting

- **bring OGS concept to H₂ purity analysis << traceable**
- **Laser absorption spectroscopy << OGS**
 - ✓ serve as **SI-traceable** instruments;
 - ✓ can be used for **field measurements**;
 - ✓ H₂ line strength
 - ✓ Multi pass gas cell (1 - 100% H₂)
- **Ongoing**
 - Cavity enhanced gas cell (< 1% H₂)
 - H₂ broadening parameters
 - H₂/CH₄ blends

Thanks for your attention!



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EMPIR



EURAMET

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