Report of the CCM Working Group on Pressure and Vacuum

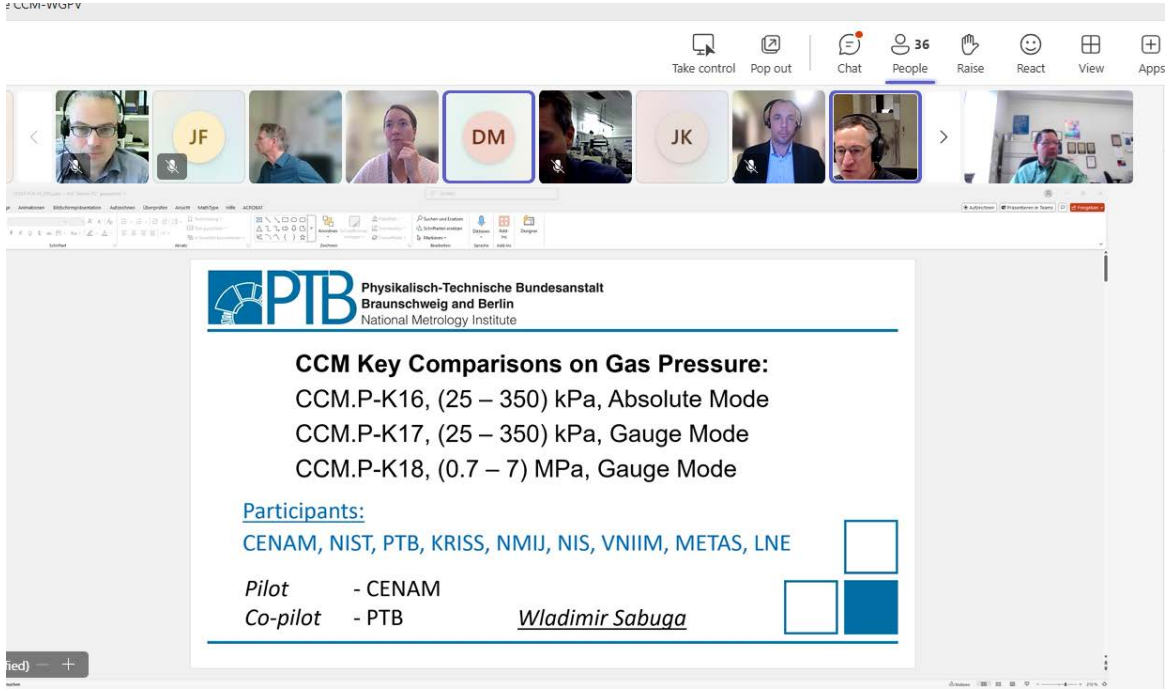
Julia Scherschligt

20th CCM meeting, 26-27 June 2025

WG Meetings

Spring 2025 meeting of the WGPV (virtual) 5 June 2025.

Attended by 35 individuals from 20 unique NMIs representing most regions (SIM, AFRIMETS, EURAMET, COOMET, and APMP)



CMI has agreed to host the CCM PV-8 conference in Prague in 2029

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Main actions and achievements

- ***Completion of guidance documents:***
  - *Guideline for reviewers of CMC entries in P&V, a risk-based approach*
  - *Statement 2 on the content of CMC entries for pressure, vacuum, and molar flow rate*
  - *Statement 3 Agreement on the uncertainties of the best units under test for CMC entries*

- ***New chair Julia Scherschligt and vice chair Hiroaki Kajikawa (AIST/NMIJ)***

- ***Dynamic pressure – fundamentally a different pursuit than static pressure***
  - *Dynamical quantities arise in areas beyond pressure. We propose promoting this topic to the CCM level.*

- ***Success in many diverse research efforts***

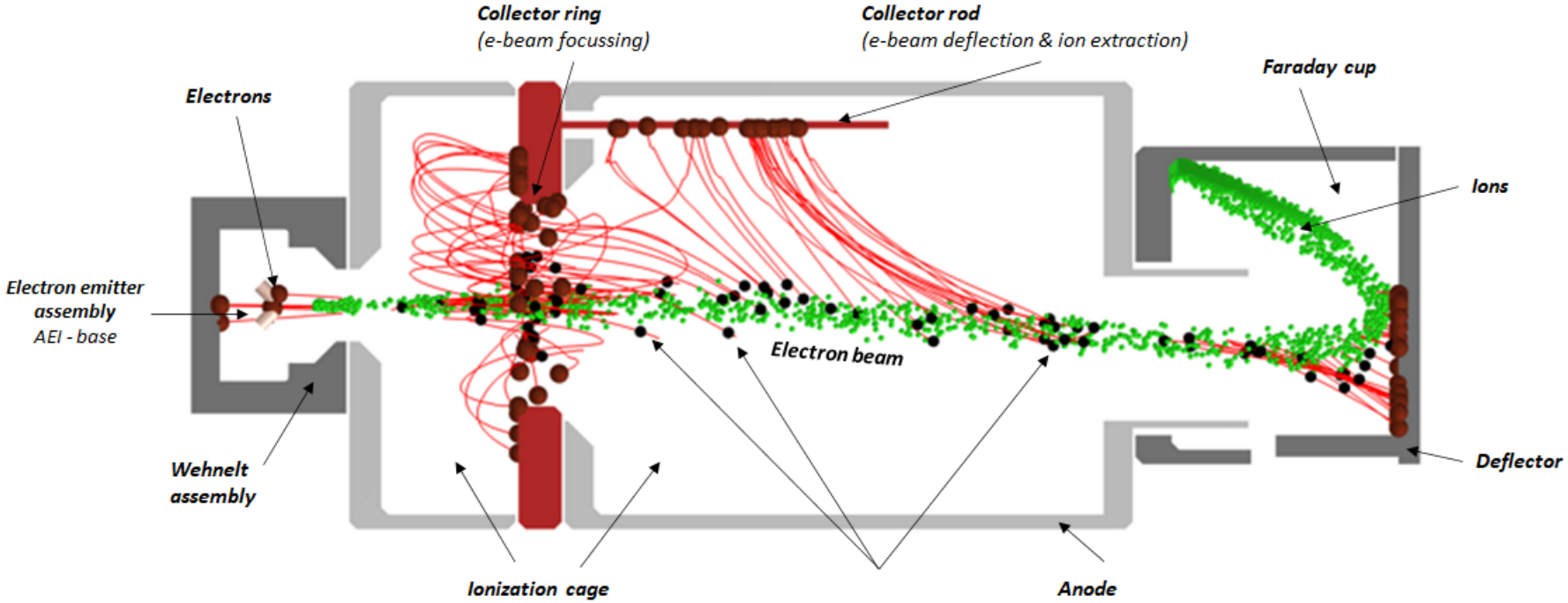
Progressing the state of the art

The WGPV supports research efforts in applications of traditional metrology to needs including food safety, energy, and health (e.g. eye tonometry).

As well as expanding realization techniques into *quantum* by leveraging the redefinition of the SI. These include optical pressure, measuring vacuum with cold atoms, and…?

Progressing the state of the art

WGPV members in conjunction with ISO TC112 developed a vacuum sensor suitable for use as a reference standard in the range of 10^{-6} Pa to 10^{-2} Pa with accuracy down to 1% for any gas species.

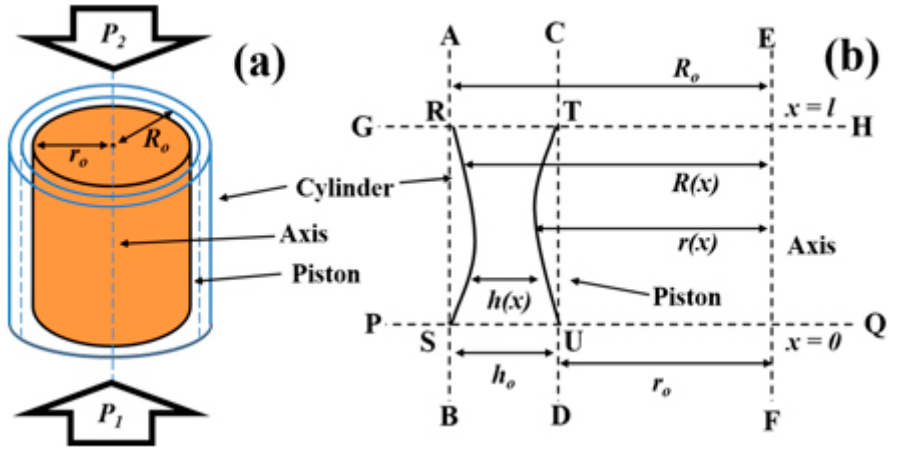


Evaluation and metrological performance of a novel ionisation vacuum gauge suitable as reference standard, **Jousten et al, Measurement 210, 31 (2023)**

Progressing the state of the art

Selected recent publications by WGPV members and observers in the field of pressure:

- *Metrological characterization of force-balanced piston gauge up to 15,000 Pa pressure range,* **Durgut, Y. *MAPAN* 38, 147–159 (2023)**
- *The measurement method of a piston fall rate,* **Brzozowski A. et al *Pomiary Automatyka Robotyka* 27:65-69 (2023)**
- *A Method for Characterization and Performance Evaluation of Differential Pressure Transducer by Using Twin-Piston Pressure Balance,* **Chanchal, Z. et al *MAPAN* 37, 379–386 (2022)**
- *Evaluation of effective area of air piston gauge with limitations in piston-cylinder dimension measurements,* **Vikas N. Thakur et al *Metrologia* 58 035004 (2021)**



Liaison & stakeholders

WGPV maintains relationships with:

IMEKO TC16 (pressure and vacuum measurement)

ISO TC112 (vacuum technology)

Stakeholders include:

- **Accelerators and “big science” facilities like gravity wave detectors,**
- **Instrument manufacturers and the semiconductor industry,**
- **Automotive, Aerospace, and the Energy sector,**
- **Research institutes and universities.**

CIPM MRA: KCs & CMCs

Key Comparisons

- CCM.P-K4 Atmospheric range, bilateral using new type of standard. A successful result will enable the use of a “quantum-SI” optical pressure standard as a laboratory standard.
- CCM.P-K3 high/ultra-high vacuum, desired by many NMIs, delayed start due to loss of staff member at pilot institute (PTB). Transfer standards are currently being characterized and will include a new type of ultra-stable ionization gauge developed by WGPV members in conjunction with ISO TC112.
- CCM-KC-ATL Leaks to atmosphere, change in approach due to unavailability of refrigerant gas. Several NMIs interested, including LNE (pilot), CMI, NMIJ, and PTB.
- CCM.P-S1 Pneumatic pressure, measurements in progress, all should be completed by early 2026.
- Hydraulic pressure, many interested participants, no confirmed plan to date.

Programme of work for the next 2 years

Replacement of mercury manometers as primary realization by alternative standards. In some cases, it is possible to use improved versions of well-established techniques like static expansion, pressure balances, and oil manometers. Some institutes are working to establish optical standards based on refractive index.

Address the issue of dark uncertainty in Key Comparisons and consider possible adoption of the “NIST decision tree” (or another mechanism to account for dark uncertainty).

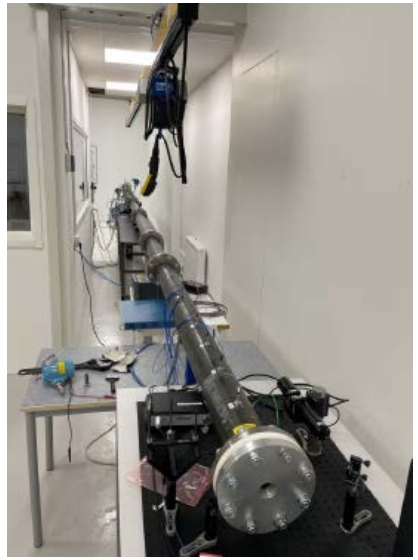
Digitalization: “play” with schema developed by PTB, possibly testing it out during a comparison.

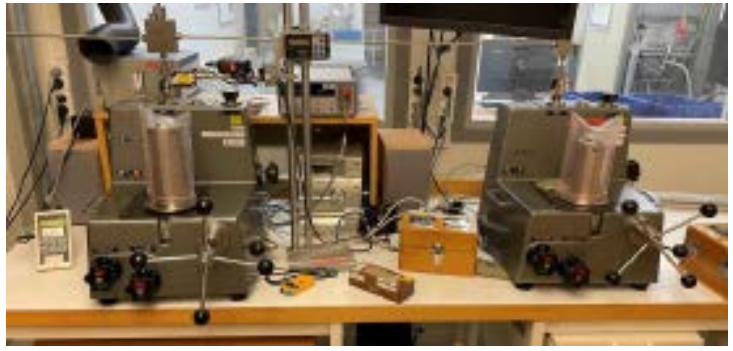
Continue development of standards and technologies in application areas related to food preservation, health, energy, and other emerging stakeholder needs.

Proposals

The WGPV recently voted to recommend full working group membership for RISE (Sweden).

- Active programs in pressure and vacuum calibration
- Long history of participation in comparisons with published CMCs
- Strong research program in dynamic pressure
- Research activity in optical pressure with Fabry-Perot interferometry (i.e. “quantum pascal”) and Rayleigh scattering
- Adequate equipment, facilities, and staffing





Thank you.

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