

Jay Hendricks –IUVSTA Scientific Director
Katsuyuki Fukutani– IUVSTA Scientific Secretary

Clarion Hotel & Congress Malmo Live
July 3rd 2019



The Scientific and Technical Directorate (STD) coordinates the Scientific and Technical activities of the Nine IUVSTA Divisions

- **Communication:** “Serve as an international communication ‘hub’ that connects vacuum science and technology scientists around the world”.
- **Education:** Work with Division Chairs to develop *Workshops, Schools, Short Courses, and Technical Training*
- **IVC Scientific:** Work with IUVSTA Division Chairs to Develop IVC-22 Program and abstract calls through the international program committee.
- **Society Impact:** Find Applications where our science has positive impact for society.
 - Support for science in less developed countries .
- **Develop Focus Topics:**
 - Quantum Science (AVS launches Quantum Science journal, Quantum Based Units, Quantum Computing/deep learning).
 - Photonics and Nano photonics (multiple technologies, including bio applications)
 - Role of Sensors and Sensor Science (AI, Self-driving cars)
 - Technologies for Sustainability (clean water, air,)
 - Next Gen. Energy (Fusion, Solar, new materials and process enabling technologies, batteries)

2019-2022 IUVSTA Scientific and Technical Division Officers

ECM-131-10A-01

IUVSTA Division

Chair

Vice Chair

Secretary

ASSD - Applied Surface Science

Leszek Markowski

John T. Grant

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BI - Biointerfaces Division

Dmitri Petrovykh*

M. Manso

Carlos R. Grandini

EMPD - Electronics Materials & Proc.

Ivana Capan

Reinhard Schwarz

Monika Kwoka

NSD - Nanometer Structures

Ana Gomes Silva

Shuji Hasegawa

Carla Bittencourt

PSTD - Plasma Science & Tech.

Satoshi Hamaguchi*

Deborah O'Connell

Miran Mozetič

SED - Surface Engineering

Ivan G. Petrov

Peter Schaaf

Monika Jenko

SSD - Surface Science

María Carmen ASENSIO

Mario Rocca

Fumio Komori

TFD - Thin Film

Mile Ivanda*

Papken Hovsepian

Diederik Depla

VSTD - Vac. Science & Tech.

Marcelo J. Ferreira*

Martin Wüest

Joe Herbert

Vacuum Science & Technology Division (VSTD)

"Serving as an international communication 'hub' that connects vacuum science and technology scientists around the world"


1. International Vacuum Congress-Program Development for VST for IVC-21 (2019)
2. Organize call for European Vacuum Conferences (EVC) proposals and selection EVC14 (2016), EVC15 (2018)
3. Education: Organize/Sponsor Workshops, Technical Training, and Schools in Vacuum Technology

Jay Hendricks, USA, Chair; M. Leisch, Austria, Vice-Chair; Joe Herbert, UK, Secretary


IUVSTA WORKSHOPS, SCHOOLS, TECHNICAL TRAINING, CONFERENCES

IUVSTA WORKSHOPS/SCHOOLS/Technical Training/EVC

- 11th IUVSTA School "Measurements and Applications in Vacuum: Theory, Experiments and Applications" May 17-21, 2015, Thessaloniki, Greece
- Technical Training Course #17 "Principles of Technology" October 8-11, 2015, Bratislava, Slovakia
- EVC-14/ IVC-16 / Joint Vacuum Congress, June 5-10, 2016, Portoroz, Slovenia
- 77th IUVSTA Workshop, "Surface processes, gas dynamic and vacuum technology of organic vacuum systems", August 17-21, 2016, Fuzhou, Japan
- 82th IUVSTA Workshop "Ultra Low Emission Light Source Vacuum Systems", October 24-28, 2016, Hsinchu, Taiwan



THE BEGINNING, MILESTONES, FUTURE AND BENEFITS TO SOCIETY

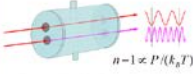


1643 Manometer → 1874 McLeod Gauge → 1950 Bayard Alpert Gauge → 1960 Integrated Circuit Kirby, Lehovec, Noyce → 2007 "modern" Smart Phone

NEXT GENERATION RESEARCH ADVANCES IN VACUUM SCIENCE AND TECHNOLOGY

Near atmospheric

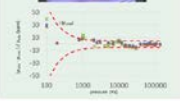
FLOC (Fixed length optical cavity): Replaces Mercury Manometer



$n - 1 \propto P / (k_B T)$

Pressure determined from beat frequency $f_{\text{pressure}} = f_{\text{vacuum cavity}}$


- Based on refractive, absolute and intrinsic first comparison primary pressure and vacuum standard
- New route for better traceability after SI redefinition
- Pico-meter scale length metrology in air



Determination of refractivity:

Any gas can be used in a FLOC but it's refractivity must be known. Possible routes to knowing the refractivity of a gas are:

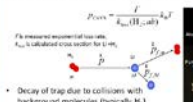
- First-principle calculations
- Absolute measurements, such as in the NIST
- Relative measurements (e.g. using silicon gauges)



Monthly metrology (NIST)

The lowest pressures


CAVS (Cold atom vacuum standard): dual standard/sensor for lowest pressures



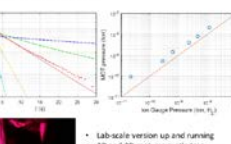
$P_{\text{CAVS}} = \frac{f}{k_B T} \frac{h_{\text{eff}}}{(2\pi)^2 m \lambda^3}$

f_{eff} measured resonance of ion wire
 h_{eff} is calibrated cross section for $U \ll v_{\text{th}}$

- Decay of trap due to collisions with background molecules (typically H_2)
- Nearly 1-1 correspondence between collisions and ejections
- Two-body and three-body losses produce non-exponential decay, can be eliminated by fitting
- Evaporative losses will be well modeled
- Arbitrary gains handled through measured sensitivity coefficients



CAVS does not depend on any calibrated gauge, it's quantum-based and absolute



- Lab-scale version (a) and running
- 2D and 3D mot. magnetic trap
- Fluorescence indicates trap population
- Flow meter designed for relative sensitivity measurements

Scherschligt et al., "Quantum-based vacuum metrology at NIST" accepted JVST-A May 2018, arXiv:1805.06928

IUVSTA 60th

IUVSTA 60th Anniversary 2018

