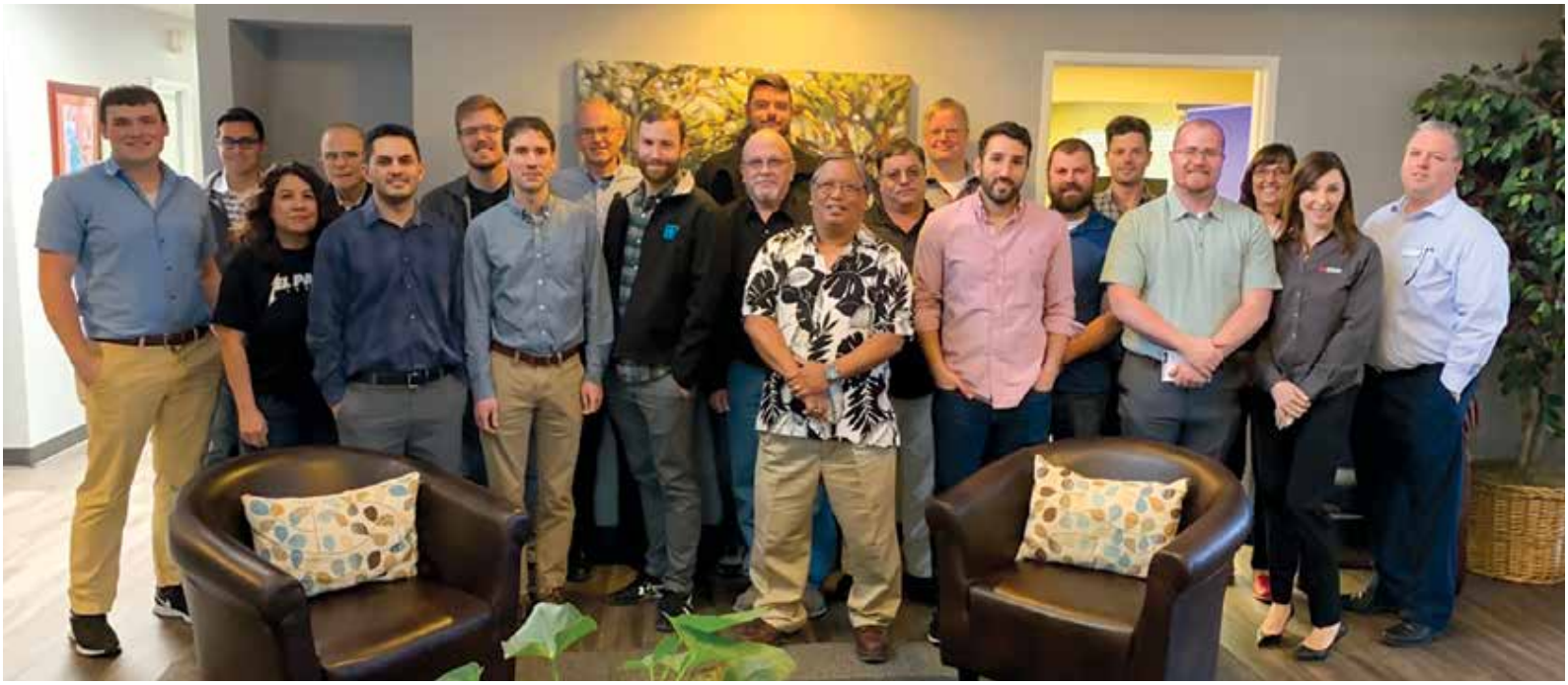

Albuquerque Meeting, Hosted by Keysight Technologies.

REGIONAL NEWS

Albuquerque

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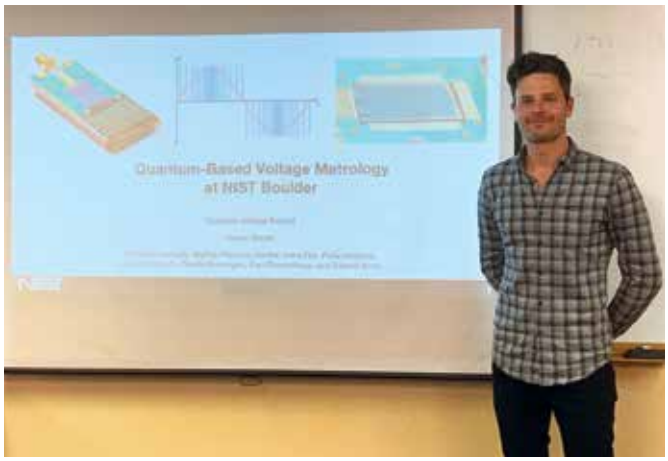
The NCSL International Albuquerque Section held its winter meeting on March 4, 2019 at the Compa Industries/ TEVET Albuquerque Corporate Office. The meeting lasted for approximately three hours and had 23 attendees. The meeting was split between two individuals, Justus Brevik of the National Institute of Standards and Technology (NIST) and Elbara Ziade of the Primary Standards Laboratory at Sandia National Laboratories. The meeting host was Keysight Technologies, which provided both the meeting location and lunch for all attendees. Snacks and refreshments were provided throughout the meeting, provided by the NCSL International Albuquerque Section Leads.

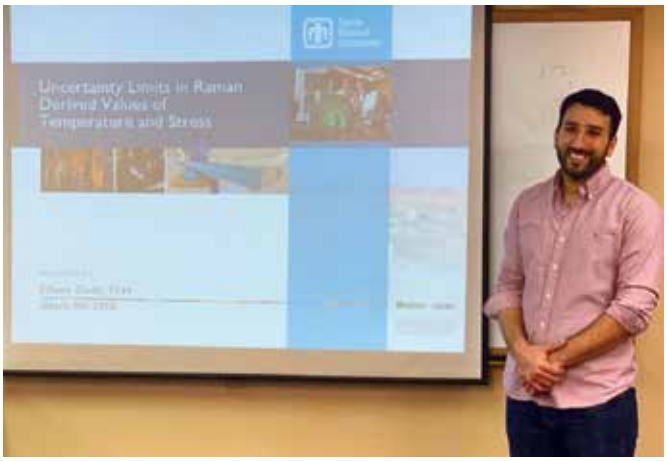
The meeting began with an announcement of the upcoming NCSL International Workshop & Symposium being held August 24-29, 2019 in Cleveland, Ohio. Attendees were urged to become an NCSLI member and register for the conference if they were not already.

After the introduction, the first presenter, Justus Brevik PhD, NIST Boulder, was introduced. His topic addressed the development of quantum-based voltage metrology at NIST Boulder. One of the goals within voltage metrology is to replace artifact standards with quantum standards, whose outputs are derived from fundamental physical constants. Justus began with the history of the representation of the derived unit of the volt from the International System of Units (SI). He discussed an electrochemical battery called the Weston cell, which was the international representation for the volt until it was replaced by the Josephson voltage standard.

The discussion then led into the Programmable Josephson Voltage Standard (PJVS). The PJVS system uses Josephson junction (JJ) arrays operating at 4 Kelvin to generate quantized DC voltages, as well as low-frequency stepwise voltages. From the PJVS, Justus went on to discuss the Josephson Arbitrary Waveform Synthesizer



Justus Brevik PhD, NIST Boulder.



Elbara Ziade, Primary Standards Laboratory, Sandia National Laboratories.

(JAWS), which uses pulse-biased JJ arrays to generate quantum-accurate, arbitrary waveforms from DC to audio frequencies (around 20 kHz).

Justus then went on to discuss the effort being made to extend the synthesis frequency range of JAWS to several hundred GHz, to create the first quantum-based RF signal source. The audio-frequency JAWS system is unable to deliver quantum-accurate signals at room temperature at synthesis frequencies above around 20 kHz. Two development paths have been pursued to improve the accuracy of the signals at room temperature. The first approach included an impedance matching network that was placed in the circuitry to extend the usable frequency range of the JAWS. The second approach, which will be necessary for delivering quantum-accurate signals in the RF regime, includes cryogenic on-wafer calibration.

A two-tier calibration technique is being developed to correct errors between the JJ arrays and room temperature. A Short Open Load Through (SOLT) calibration is performed up to the coaxial reference plane and a cryogenic Multi-Line Through Reflect Line (TRL) calibration is performed at the wafer plane using a cryogenic probe station. Measurements are currently being made to correct the JAWS signal from DC up to 1 GHz, and demonstrate a calibrated, quantum-accurate signal at room temperature.

The second presenter, Elbara Ziade, PhD, Sandia National Laboratories, was then introduced. His presentation was entitled "Uncertainty Limits in Raman Derived Values of Temperature and Stress." The basis of the presentation was an uncertainty analysis for temperature and stress values derived from shifts in wavenumbers observed during Raman spectroscopy. Elbara indicated that the motivation for the use of Raman spectroscopy is pertinent to measurement science in a couple of ways. As the world of metrology migrates to instruments and standards that are based on fundamental constants and invariant quantum phenomena, as is the goal of the program, "NIST-on-a-Chip," Raman spectroscopy becomes a factor for photonic thermometry. With the increase of additive manufacturing across multiple industries, material properties should be analyzed before these parts are utilized in applications where they may present a risk to the operation of the system.

One of the material properties that can be analyzed with Raman spectroscopy is residual stress. After providing the motivation for the work, Elbara went on to describe the physics of the Raman measurement. An analogy to an audio frequency doppler effect was provided to give the audience an idea of the inelastic scattering that is occurring during the Raman effect. For total energy conservation, the scattered photon might gain energy from the lattice which will result in a lower frequency photon, a Stokes shift.

Alternatively, for an anti-Stokes shift the scattered photon will gain energy from the lattice and will result in a higher frequency photon. Elbara then went into the traceability to the SI and the contributions to the expanded measurement uncertainty for the measured spectra including the relative and absolute peak positions. The expanded measurement uncertainty for the spectrometer comes from three sources including: process uncertainty, the uncertainty due to implementation of ASTM E1840 (Standard Guide for Raman Shift Standards for Spectrometer Calibration), and environmental controls.

The process uncertainty is further broken down into three components including Signal to Noise Ratio, resolution, and variability of the sample. After providing uncertainty analysis results for relative and absolute temperature and stress measurements, Elbara concluded that higher accuracy standards are needed for Raman spectrometer calibrations.

The next Albuquerque section meeting will be scheduled for September 2019. We are hoping to have multiple technical presentations that relate to metrology. The meeting announcement is to follow on the NCSL International website.