Albuquerque Meeting, Hosted by Keysight Technologies.

Albuquerque

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The NCSL International Albuquerque Section held its summer meeting on August 13, 2019 at the Compa Industries/ TEVET Albuquerque Corporate Office. The meeting had 24 attendees representing Sandia National Laboratories, National Institute of Standards and Technology (NIST) and Keysight Technologies. The presentations were split between three individuals, Kevin Douglass of NIST, Raegan Johnson of the Primary Standards Laboratory at Sandia National Laboratories and Spencer Slack of Keysight Technologies. 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 by the NCSL International Albuquerque Section leads.

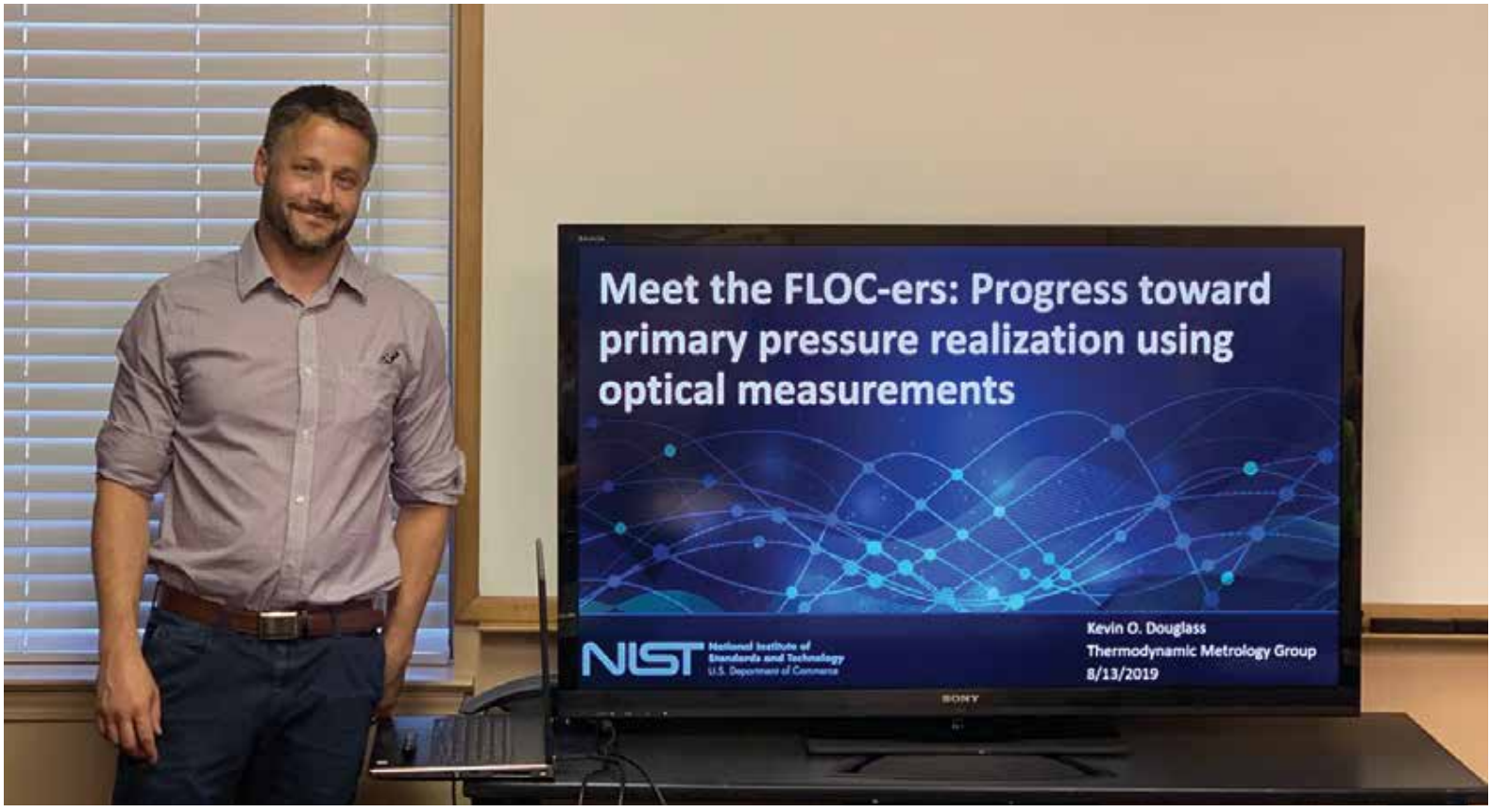
The meeting commenced with an announcement of upcoming NCSL International events such as the upcoming Workshop & Symposium held in late August. During the announcement portion, attendees were urged to become an NCSL International member, if they were not already.

Kevin Douglass was the first speaker of the day. Kevin's presentation was entitled, "Meet the FLOC-ers: Progress toward primary pressure realization using optical measurements." His topic addressed quantum-based traceability to the International System of Units (SI), specifically, the development of the Fixed-Length Optical Cavity (FLOC) at NIST-Gaithersburg. FLOC achieves traceability to the SI through quantum mechanical calculations of the refractivity virial coefficients of helium. FLOC, an optical pressure standard, relies on the phenomenon that the refractive index of a gas varies with its density. If the temperature of the gas is known and held constant, then the pressure of the gas can be determined through the refractive index. To determine the refractive index, two Fabry-Perot optical cavity channels are utilized. The first channel is a reference channel in vacuum and the other channel is filled with the gas whose pressure is being measured. Laser light is passed through the two cavities and the beat frequency of the two channels is measured. This measurement is used in determining the index of refraction of the gas, and ultimately, the pressure of the gas by relating the refractive index to the density through the Lorentz-Lorenz relation. The primary issue for the FLOC system is the determination of the pressure

dependent distortion terms. These distortion terms need to be determined from measurements that do not rely on other pressure measurements. The most viable means of determining the pressure and pressure dependent distortion terms is by using the two-gas and two-color methods. These two measurements provide the values of the two unknowns.

NIST created a laboratory-grade version of the FLOC in 2014, however, due to customer demand, a smaller, more robust version was desired. NIST and MKS Instruments, Inc. signed a Cooperative Research and Development Agreement in 2017 to meet this goal. Since then, the two groups developed a prototype FLOC system that is small enough to fit into two suitcases. The portable FLOC has provided great signal-to-noise ratio, resolution, and insensitivity to surrounding vibrations. The team hopes that further development and testing of the prototype will lead to higher dynamic range, further miniaturization, and quantification of the repeatability and reproducibility of the prototype.

Raegan Johnson was the second presenter for the day. Her presentation was entitled "Multi-Junction Thermal Converters for AC Calibrations." The presentation covered Multi-Junction Thermal Converters (MJTCs) that are being designed and built at Sandia. MJTCs are used as transfer standards to realize the AC Volt and current using AC-DC Difference calculations. Traditionally, a Single-Junction Thermal Converter has been used for AC voltage and current calibrations. In a Single-Junction Thermal Converter, current passes through a single wire, and, as a result, the wire heats up. A tiny thermocouple that sits near the wire detects the change in temperature and results in a DC voltage output. . In short, an input AC current is converted to DC voltage through the thermoelectric effect. MJTCs utilize a similar concept to Single-Junction Thermal Converters, with the exception that the device is designed to include many hundreds of thermocouples that are fabricated using silicon micro-fabrication methods. The larger number of thermocouples increases the overall output voltage and sensitivity of the device. The goal of the project is to collaborate with NIST and build upon the MJTC design developed circa 2000 by Tom Wunsch at Sandia National Laboratories. The proposed new device design will have a wider frequency range, larger voltage range and a more practical impedance. Raegan presented the initial results from these devices which show an AC-DC difference <2 μV/V in the 100 Hz to 10 kHz range. Raegan also discussed quantum electrical standards such as the Quantum Hall Resistance (QHR) systems for realizing the ohm and the Josephson Voltage



Kevin Douglass PhD, National Institute of Standards and Technology (NIST).

Raegan Johnson PhD, Primary Standards Laboratory, Sandia National Laboratories.

Standards (JVS) for realizing the volt. She also briefly touched on the relatively new quantum standard for AC voltage, the Josephson Arbitrary Waveform Synthesize (JAWS). Raegan concluded that moving forward, MJTCs will be utilized in parallel with quantum standards to cover the full spectrum of AC voltages and frequencies.

The third presenter of the day was Spencer Slack. His presentation was entitled, "3458 Sustainability." Spencer discussed the history of the 3458A which was first released in 1989 by Hewlett Packard. These instruments are still used today since the reliability and accuracy of these instruments has not been exceeded. Unfortunately, the materials used to produce the 3458A are no longer commonly available and, in some cases, have become obsolete. Keysight has updated the 3458A using current SMT and RoHS compliant technology and is offering a 3458A update service which enables legacy units to be upgraded to a fully sustainable revision.

The next Albuquerque section meeting will be scheduled for March 2020. Guest speakers from NIST will discuss topics related to electrical metrology. The meeting announcement will be posted on the NCSL International website.

Spencer Slack, Keysight Technologies.