Justervesenet

Report on Electromagnetic Metrology Activities at JV, Norway Prepared for the 31st Meeting of the CCEM, 27-29 March 2019

Staff

Dr. Helge Malmbekk – **ACI/ACV** – Group leader – hma@justervesenet.no
Mr. Frank Sengebusch – **DCV**, DC-Josephson – fse@justervesenet.no
- Will retire 31.05.2019 - vacant position, now hiring

Mr. Tore Sørsdal – **Resistance**, QHR, CCC – tsr@justervesenet.no
Mr. Bjørnar Karlsen – **Power and Energy** – bka@justervesenet.no , soon to finish PhD
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ACI/ACV

- In January 2019 we performed measurements for the CCEM-K6a/K9 comparison. The transfer standards were shipped to RISE in February 2019.
- During the EMPIR project QuADC, we have demonstrated LHe operation of InGaAs photo diodes, generating up to 7.5 gigabit-per-second current pulses used for operation Josephson arrays. This has been the topic of the PhD-thesis of Mr. Bjørnar Karlsen. He will hand in the thesis during the spring of 2019. We have together with the University of South-Eastern Norway, demonstrated flip chip bonding of photo diodes to a carrier developed in collaboration with NPL and PTB. Measurements have been performed in collaboration with PTB, in Braunschweig. The work of running JAWS arrays with photodiodes will continue in collaboration with PTB, NPL and USN after the project ends in May 2019.
- In May-Aug 2019 Dr. Helge Malmbekk will visit NPL for a 3 month research visit as part of the EMPIR project DIG-AC. He will work on characterization of digitizers with Josephson Voltage standards.

DCI/DCV and resistance

- Our old DC Josephson system has been replaced by a new 10 V PJVS system and will be implemented into the traceability chain for both DC and AC voltage. Research efforts are being pursued in order to extend the traceability to other areas, such as electrical power.
- The previous run of our QHR setup was in 2012/2013, and after some years of problems with the setup and replacing parts of the electronics of the CCC, a successful run was achieved in 2018, providing fresh traceability to our reference standards.

Power & Energy

- During the EMPIR-project TracePQM, we have contributed to the development of an open software for power measurements using Keysight 3458A and NI5922. Before the project ends, several algorithms for calculating parameters from samples waveforms will be tested and verified.
- As part of the EMPIR project ADVENT, we are developing an active current shunt for measuring on low power devices without disrupting the current flow in the system.
- In the EMPIR project MeterEMI, we are collaborating with grid operators to measure real life electromagnetic interference on static electricity meters, in a bid to determine if current standards for type approval need updates.

Publications

- Karlsen, B et al. "Pulsation of InGaAs photodiodes in liquid helium for driving Josephson arrays in ac voltage realization" accepted for pulication in IEEE Trans. Appl. Supercond (2019)
- Kieler, O., Karlsen, B., Ohlckers, P. A., Bardalen, E., Akram, M. N., Behr, R., ... & Wendisch, R. (2019). Optical pulse-drive for the pulse-driven AC Josephson voltage standard. IEEE Transactions on Applied Superconductivity.
- Malmbekk, H., Shelly, C. D., & Williams, J. M. (2018, July). Calibrating a Voltmeter with a PJVS Using a DAC as a Real-Time Calibrated Transfer Standard. In 2018 Conference on Precision Electromagnetic Measurements (CPEM 2018) (pp. 1-2). IEEE.
- Bardalen, E., Karlsen, B., Malmbekk, H., Akram, M. N., & Ohlckers, P. (2018). Reliability study of fiber-coupled photodiode module for operation at 4 K. Microelectronics Reliability, 81, 362-367.
- Bardalen, E., Karlsen, B., Malmbekk, H., Akram, M. N., & Ohlckers, P. (2018). Evaluation of InGaAs/InP photodiode for high-speed operation at 4 K. International Journal of Metrology and Quality Engineering, 9, 13.
- Wright, P. S., Ellingsberg, K., ..., and Svoboda, M. (2018, July). Evaluation of EMI Effects on Static Electricity Meters. In 2018 Conference on Precision Electromagnetic Measurements (CPEM 2018) (pp. 1-2). IEEE.
- V Nováková Zachovalová, K Ellingsberg, ..., and M Garcocz (2018, August). Introduction and progress in the EMPIR project TracePQM: Traceability Routes for Electric Power Quality Measurements. In Journal of Physics: Conference Series (Vol. 1065, No. 5, p. 052016). IOP Publishing.