Report of NRC activities 2019-2021

AC voltage

We continue to develop our capabilities for the accurate measurement of AC voltages based on Josephson standards and synchronous sampling. Some key developments include:

- A digital synchronizer that generates clock signals for the synchronization and phase adjustment of several instruments.
- Modification of 3458 voltmeters to extract their internal clock signal.
- Home-made AC sources with high amplitude and phase stability and low noise.
- Demonstrated capability to calibrate an AC source in terms of the pulse-driven Josephson standard, using either direct sampling or differential sampling, with a type A uncertainty of less than 1 part in 10^8. These results were reported at CPEM 2020.

Impedance

A new four port capacitance bridge is now in operation. The bridge is intended to be used with the Calculable Capacitor and to scale up to 1 nF. A boothstrap transformer for the accurate calibration of this bridge, using the Thompson method, is almost complete. A preliminary calibration of the IVD was made by connecting capacitors in parallel to build up capacitance values between 10 pF and 100 pF.

A digital bridge using our home-made AC sources and a 3458 is in the late stage of development. This bridge is intended to be used mainly to support inductance calibrations and to determine the phase angle of AC resistors.

Kibble balance

We participated in the CCM.M-K8.2019 comparison of kg realizations. Our results were consistent with previous runs in 2013 and 2016 and we reported an uncertainty of 12 parts in 10^9.

A comparison of 100 g masses between NIST and NRC had been planned. The measurements had to be interrupted due to the pandemic but the exercise demonstrated Kibble balance measurements at 100 g with a type A uncertainty of 14 parts in 10^9 over a one week period. The total uncertainty for this kind of measurement is expected to be around 25 parts in 10^9.

Lastly, we presented a paper at CPEM 2020 that discusses some details of our procedure to measure the Abbe offset.