Bilateral Comparison of Josephson Voltage Standards between the BIPM and the NMC (part of the ongoing BIPM key comparison BIPM.EM-K10)

The BIPM and the National Metrology Centre (NMC) of A*STAR, Singapore, performed a week-long bilateral comparison of Josephson voltage standards from 22 to 30 September 2010. The comparison was carried out with three NMC staff members: Chua Sze Wey, Jinni Lee and Zhou Yinzhu, and two BIPM staff members: Stéphane Solve and Régis Chayramy at the NMC laboratory following the technical protocol for BIPM.EM-K10. The final results show good agreement and validated the NMC’s Calibration and Measurement Capabilities (CMCs) submitted to the CIPM MRA KCDB.

The NMC has routinely carried out in-house direct Josephson voltage systems (JVS) comparisons based on a common biasing setup since 2008. This is part of our quality assurance measures to ensure the consistency and accurate reproduction of the unit of volt for calibration of secondary standards. Our previous experience and results provided us with confidence that the comparison between the BIPM and the NMC would be a straightforward routine exercise.

However, during the initial measurements, there was a discrepancy of a few tens of nanovolts between the BIPM and the NMC setup. We came to realize that it was a completely different situation when two JVS systems were biased by their own biasing sources. Effects and issues such as interferences between the two systems, grounding and filtered power supply configurations in the shielding room, and the inherent constraints and drawbacks of the biasing source and control software were brought to light as a result of this comparison.

This bilateral comparison has provided us with a better understanding of the problems of our setup, and we can now begin to improve the system setup and update our operational procedures to attain a more robust primary dc voltage standard. Apart from meeting an obligation to the CIPM MRA, the bilateral comparison has also been an exceptional opportunity for our staff to work directly with BIPM staff members to acquire valuable experience and knowledge in verifying our Josephson voltage system’s performance. Discussions with BIPM staff members during the comparisons on future collaborations and comparisons in the upcoming areas of voltage measurement standards, such as the programmable Josephson voltage systems, which will have a big impact on voltage metrology in the next few years, will help us in planning our next phase of development in our reproduction of the unit of volt.

The BIPM should be commended for its key role in supporting the national metrology institutes world-wide to maintain the consistency and uniformity of measurements and their traceability to the International System of Units (SI) through the on-going comparisons. The BIPM-NMC bilateral Josephson Voltage Standards comparison is a success. It has not only validated our dc voltage Calibration and Measurement Capabilities and our role as a linking laboratory for the region, but has also assisted us immensely in strengthening our competency and confidence in our reproduction of the unit of volt.

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