

## News from TÜBİTAK UME

### CCEM 2021

#### NEW FACILITIES/DEVELOPMENTS:

##### **Voltage Laboratory (Contact: mehedin.arifovic@tubitak.gov.tr)**

The project of establishing of 10 V Programmable Josephson Voltage Standard in the cryocooler is completed. The new standard is begun to be used for routine calibrations of the DC voltage standards, testing of the linearity of the high precision DMMs and dynamic testing of the high resolution ADCs. Josephson Arbitrary Waveform Synthesizer (JAWS) based on 300 mV array (PTB) is completed and used for AC voltage measurement of a wideband ADC. Work in the project is currently focused on developing the system for optoelectronic pulse drive for the JAWS. EMPIR 15SIB04 project has been completed while EMPIR 17RPT03 project has been continued.

##### **Impedance Laboratory (Contact: enis.turhan@tubitak.gov.tr)**

4 TP digital impedance comparison bridge has been constructed within the scope of EMPIR 17RPT04 VersICaL project. The characterization of the digital impedance bridge has been carried out. EMPIR 17RPT04 VersICaL project will be completed in June 2021. Two new EMPIR projects will begin in June 2021, which are SRT f14 MEMQuD (Memristive devices as Quantum Standard for Nanometrology) and SRT i06 Elena (Electrical nanoscale metrology in industry). A new CCC measurement system has been ordered. Bilateral comparisons has been planned with BIPM for 2022. One of the comparisons will be performed with reference resistors the other comparison will be performed with QH resistor.

##### **High Voltage Laboratory (Contact: ahmet.merev@tubitak.gov.tr)**

The projects of establishment of measuring system on very low frequency under high voltage (VLF) supported by TÜBİTAK UME have been finalized successfully. In that scope reference resistive high voltage divider and primer measuring setup has been designed and implemented. In 2020 the national proficiency testing organization on AC and lightning impulse has been performed by TÜBİTAK UME as a pilot.

The new two EMPIR research projects have been started in 2020. One of these is 19ENG02-Future Energy that is related to build up a reference calibration system up to 2000 kV for HVDC. The other, 19NRM07, is concerning the standardization proposal about combined and composite measuring and testing systems.

##### **Power & Energy Laboratory (Contact: ozlem.yilmaz@tubitak.gov.tr)**

A project has been started to provide calibration services to the Electricity Generation Company of TURKEY (EÜAŞ) in the fields of Electricity, Temperature, Pressure, Time-Frequency, Fluid Mechanics and Acoustics Metrology. Calibrations of measurement devices, sensors and indicators used in EÜAŞ power plants, which are of great importance in energy efficiency for the power plant, will be performed by EÜAŞ staffs following this project. In addition, the EÜAŞ Quality Management System infrastructure will be established and the laboratory will be made ready for accreditation application at the end of the project.

A primary measurement system using the high voltage capacitance bridge has been successfully established to ensure the traceability of high voltage instrument transformers to the national standards. Moreover, the traceable calibration setup was developed for the high voltage capacitance bridge with the uncertainty of 10 ppm for capacitance ratios and dissipation factors. With the project, the primary voltage level is increased from 36 kV to 200 kV and the measurement uncertainties were reduced to less than 20  $\mu$ V/V for ratio error and 20  $\mu$ rad for phase displacement.

EMPIR 17NRM01 and EMPIR 17IND07 have been continued. EMPIR 19NRM05 has been started.

TURKAK laboratory accreditation assessment was held successfully.

### **RF & Microwave Laboratory (Contact: erkan.danaci@tubitak.gov.tr)**

Airline dimensional measurement for 1.35 mm connector types (up to 90 GHz) is completed. Power measurement capability is expanded to 1.1 THz. Calibration factor measurement range capability is expanded to 170 GHz. S parameter measurement range capability is expanded 170 GHz. The ability to measure material properties has been achieved up to 170 GHz. EMPIR 15RPT01 and EMPIR 16NRM07 projects are completed. EMPIR 18SIB09 project have been continued.

### **Electromagnetic Laboratory (Contact: soydan.cakir@tubitak.gov.tr)**

The establishment of a primary level Antenna Calibration Test Site (CALTS), which is internally funded by TÜBİTAK UME, was started in 2020 and is planned to be completed till the end of 2021. The CALTS whose dimensions are 30m x 60m will cover the frequency range of 30 MHz to 40 GHz and will be compatible with the standard CISPR 16-1-5. In addition, a special calibration software solution that includes antenna calibration, SIL, NSA and VSWR measurements has been designed by electromagnetic laboratory personnel.

### **Magnetism Laboratory (Contact: huseyin.sozeri@tubitak.gov.tr)**

International project JRP S01 NanoMag “Nano-scale traceable magnetic field measurements” of the EMPIR programme of the European Union’s Horizon 2020 research and innovation programme, coordinated by PTB (Germany), was completed in August 2019. In this Project TUBITAK UME was coordinating WP3 “Magneto optical indicator film microscopy”.

International project JRP g03 HEFMAG “Metrology of magnetic losses in electrical steel sheets for high-efficiency energy conversion” of the EMPIR programme of the European Union’s Horizon 2020 research and innovation programme, coordinated by INRIM (Italy) started in September 2020. In this Project TUBITAK UME participates in WP2 “Power losses under operating temperature conditions”, WP3 “Alternating power losses in thin sheets up to the MHz range” and WP4 “Two-dimensional magnetization and power losses”.

EMPIR project proposal by INRIM “JRP-h13 Radiotherapy coupled with hyperthermia - adapting the biological equivalent dose concept” was started in June 2019. TUBITAK UME synthesized several Fe<sub>3</sub>O<sub>4</sub> nanoparticles to be used in magnetic hyperthermia. Nowadays, scientific paper is being prepared.

National project about preparation of soft magnetic alloys used in high sensitive fluxgate magnetometers was started in February 2020. Several ribbon type materials have been prepared by melt spinning method. Characterization of their sensor properties is in progress.

Joint project, between TÜBİTAK UME and Slovakia Academy of Science (SAS) on the preparation and design of space qualified magnetic sensors has continued.

11 SCI-index papers were published related to the above projects.

**Quantum Metrology Laboratory (Contact: ekrem.sinir@tubitak.gov.tr)**

Establishment of the laboratory infrastructure of the Quantum Metrology Laboratory is in progress.

The devices / systems / measurement capabilities that were added to the Quantum Metrology Laboratory inventory are:

Helium-Ion Microscope /Scanning Thermal Probe Lithography, Wafer Dicing, Interferometric and Stylus Profilometry (Thin Film Thickness, Stress, Surface Roughness, Step Height, 3D Mapping), Spectroscopic Ellipsometry, Electrical Characterization of Semiconductor Materials, Impedance Measurements On Semiconductor Materials And Devices (up to 120 MHz), Precision Impedance And Phase Measurements Via Lock-In Amplifiers (up to 600 MHz), Low (up to 40 MHz ) and High (up to 50 GHz) Frequency Noise Measurements On Semiconductor Devices (On-Wafer/Fixture I-V, C-V measurements), On-Wafer S-Parameter Measurements (up to 110 GHz), Sampling and Real Time Oscilloscopes, X-Ray Diffraction Measurements, Wire And Ribbon Bonding, PCB & SMT processing, low temperature and high magnetic field cryostats, cryogenic and cryomagnetic Probe Stations, Raman and TERS microscope

The laboratory has participated to 19NET02 European Metrology Network for Quantum Technologies and also the following EMPIR Projects in 2020 call: COMET, MEMQuD, SuperQuant, FutureCom, Elena, QADeT.

No	Type of ILC/PT	Field/subfield	Pilot lab	Identification of ILC/PT	Parameters/ range of measurements	Status	Evaluation criterion	Result
1.	CIPM key comparison	EM/Radio frequencies	NMIJ	CCEM.RF-K5.c.CL	Scattering coefficients 100 MHz – 33 GHz 3.5 mm connector	Draft A report under preparation	degrees of equivalence	-
2.	CIPM key comparison	EM/Radio frequencies	NMIJ	CCEM.RF-K26	Attenuation at 18 GHz, 26.5 GHz and 40 GHz using a step attenuator	Draft A report under preparation	degrees of equivalence	-
3.	EURAMET supplementary comparison	EM/Radio frequencies	UME	EURAMET.EM-S45 (EURAMET Project 1478)	Transfer Impedance (dB $\Omega$ ): 10 kHz, 100 kHz, 1 MHz, 10 MHz, 100 MHz, 200 MHz, 300 MHz, 400 MHz, 500 MHz	Draft B report circulated	degrees of equivalence	-
4.	Multilateral ILC	EM/Radio frequencies	UME	EURAMET Project 1512	Effective Efficiency in frequency range 10 MHz to 18 GHz	Draft A report under preparation	degree of equivalence	-
5.	GULFMET supplementary comparison	EM/AC Voltage	TÜBİTAK UME	GULFMET.EM-S3	AC-DC Voltage Transfer Difference: 10 mV, 3 V, 1000 V (10 Hz, 55 Hz, 1 kHz, 20 kHz, 100 kHz, 1 MHz)	Draft B report circulated	E <sub>n</sub> criteria	-
6.	Multilateral ILC	EM/DC voltage, DC current, AC voltage, AC current, Resistance	TÜBİTAK UME	EURAMET Project 1341	DC voltage: 100 mV, 10 V, 100 V, 1000 V DC current: 100 $\mu$ A, 10 mA, 1 A AC Voltage: 100 mV, 10 V, 100 V (55 Hz, 1 kHz, 100 kHz) AC Current: 10 mA, 1 A (300 Hz, 1 kHz) Resistance: 10 $\Omega$ , 10 k $\Omega$ , 1 M $\Omega$	Draft A2 report circulated	degrees of equivalence	-
7.	Multilateral ILC	EM/DC Current	TÜBİTAK UME	EURAMET.EM-S44 (EURAMET Project 1381)	DC Current : 9.5 fA, 95 fA, 0.95 pA, 9.5 pA, 95 pA	Draft A report under preparation	degrees of equivalence	-

No	Type of ILC/PT	Field/subfield	Pilot lab	Identification of ILC/PT	Parameters/ range of measurements	Status	Evaluation criterion	Result
8.	GULFMET supplementary comparison	EM/DC Resistance	TÜBİTAK UME	GULFMET.EM-S1	DC Resistance: 100 Ω	Draft B report circulated	E <sub>n</sub> criteria	-
9.	EURAMET supplementary comparison	EM/High voltage and current	LCOE, VTT, RISE	EURAMET.EM-S42	Lightning impulse: 0.84/50 μs and 1.56/50 μs. Lightning impulse voltage (peak) -100 kV, -200 kV, -300 kV, -400 kV, -500 kV, -600 kV, -700 kV and +700 kV. Linear extension in 500 kV steps up to 2 MV.	Final Report	degrees of equivalence	Passed
10.	EURAMET supplementary comparison	EM/High voltage and current	TÜBİTAK UME	EURAMET.EM-S43	Primary voltage: 3 kV, 6 kV, 10 kV, 20 kV and 30 kV Secondary voltage: 100 V Frequency: 50 Hz	Protocol completed	degrees of equivalence	-
11.	GULFMET supplementary comparison	EM/High voltage and current	SE	GULFMET.EM-S6	Primary voltage: 6 kV, 10 kV, 22 kV, 35 kV, Secondary voltage: 100 V Frequency: 50 Hz and 60 Hz	Protocol completed	degrees of equivalence	-
12.	GULFMET supplementary comparison	EM/High voltage and current	SE	GULFMET.EM-S7	Primary current: 5 A, 50 A, 200 A, 400 A, 800 A, 1500 A, 2000 A, 4000 A Secondary current: 5 A Frequency: 50 Hz and 60 Hz	Protocol completed	degrees of equivalence	-
13.	EURAMET key comparison	EM/AC power	VSL, PTB, NPL, LNE	EURAMET.EM-K5.2018	AC power: (120 V & 240 V, 5 A, 53 Hz, PF: 0 - 1)	Draft A report under preparation	degrees of equivalence	-