Superconducting RF Modules of TARLA*

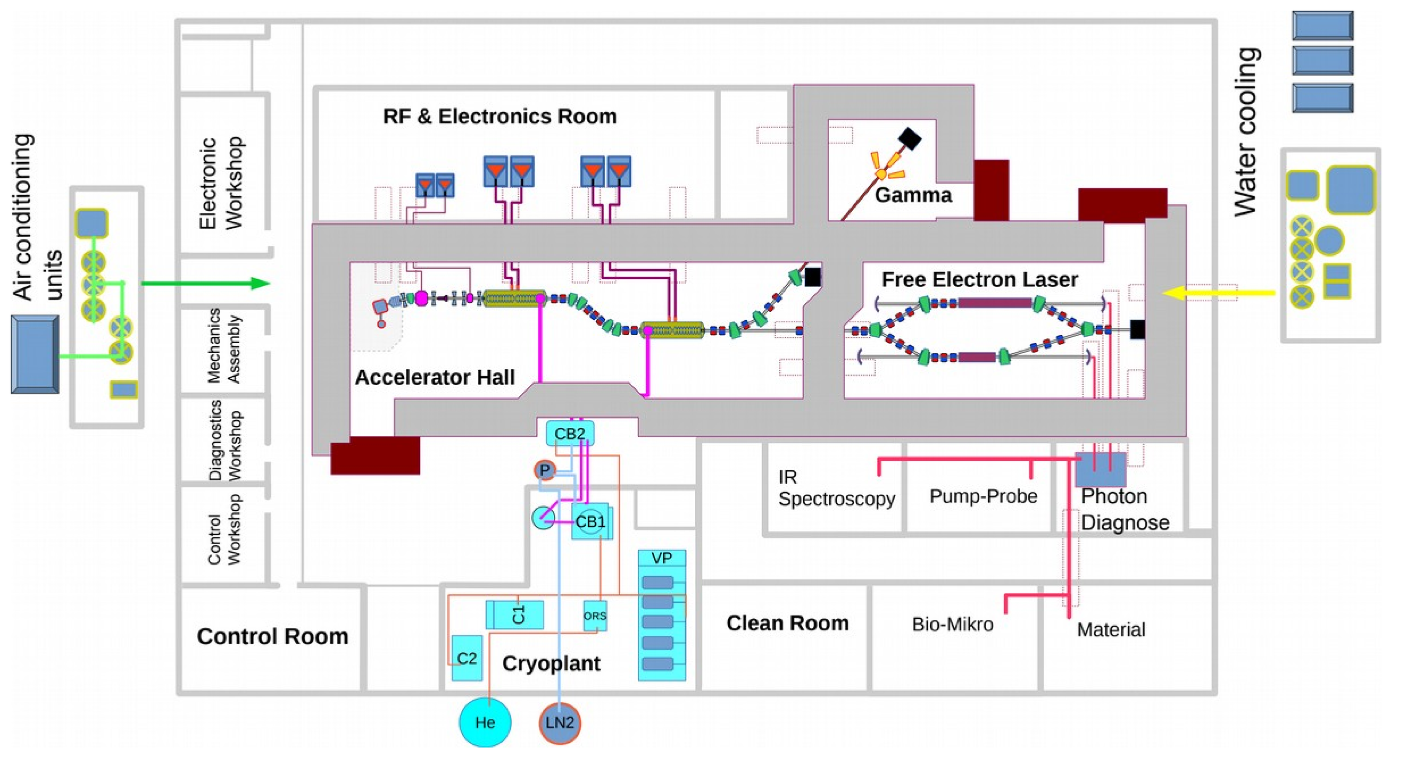
Ç. Kaya, A. Aksoy, Ö. Karslı, B. Koç, Ö. F. Elçim
Institute of Accelerator Technologies, Ankara U, Ankara, Turkey

TARLA
Turkish Accelerator & Radiation LAboratory

INTRODUCTION

- Electron bunches will be generated by a thermionic triode electron source operating at 250 kV with CW mode.
- The beam will be accelerated up to 40 MeV by two superconducting RF accelerator modules which are designed for ELBE project[6].
- TARLA-FEL is basically covering the range of IR region between 5-450 μm wavelengths.
- Additional, fixed target experiments and production of bremsstrahlung will be available at the facility [1, 2].

Parameter	Unit	Value
Beam energy	MeV	15 - 40
Max. average beam current	mA	1.5
Max. bunch charge	pC	120
Horizontal emittance	mm.mrad	<15
Vertical emittance	mm.mrad	<12
Longitudinal emittance	keV.ps	<85
Bunch length	ps	0.4 - 6
Bunch repetition rate	MHz	0.001-104
Macro pulse duration	μs	50 - CW
Macro pulse repetition rate	Hz	1 - CW

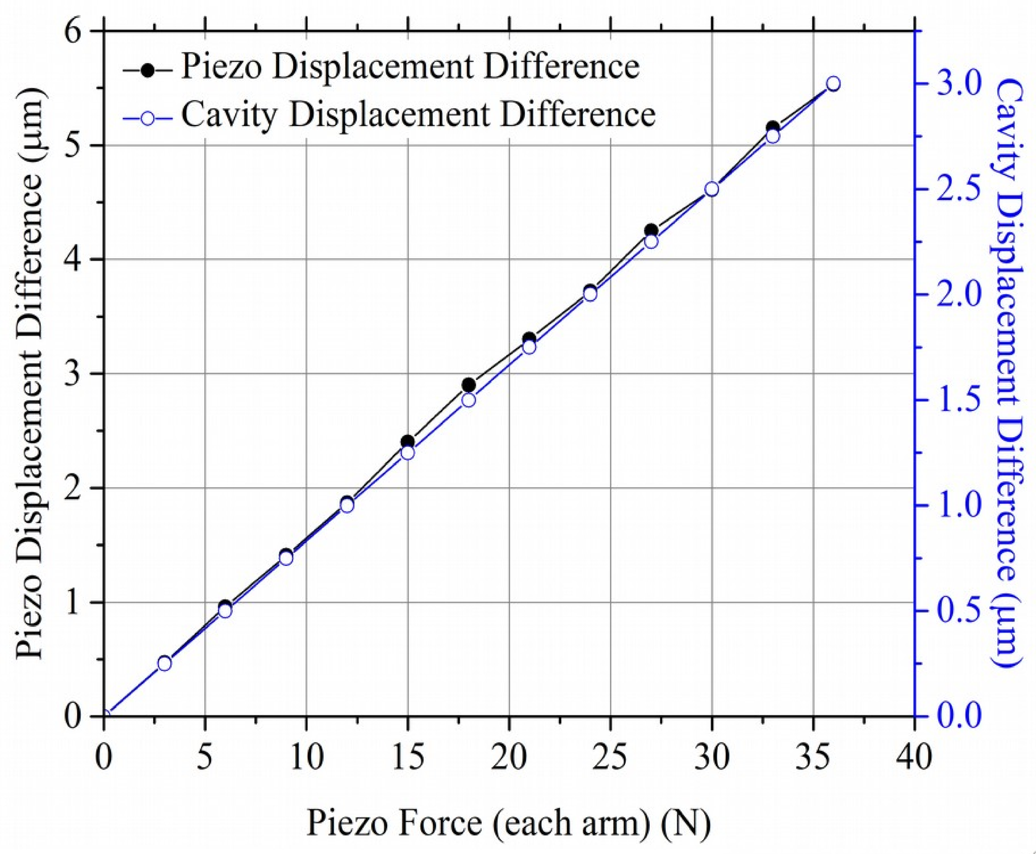


Layout of TARLA facility.

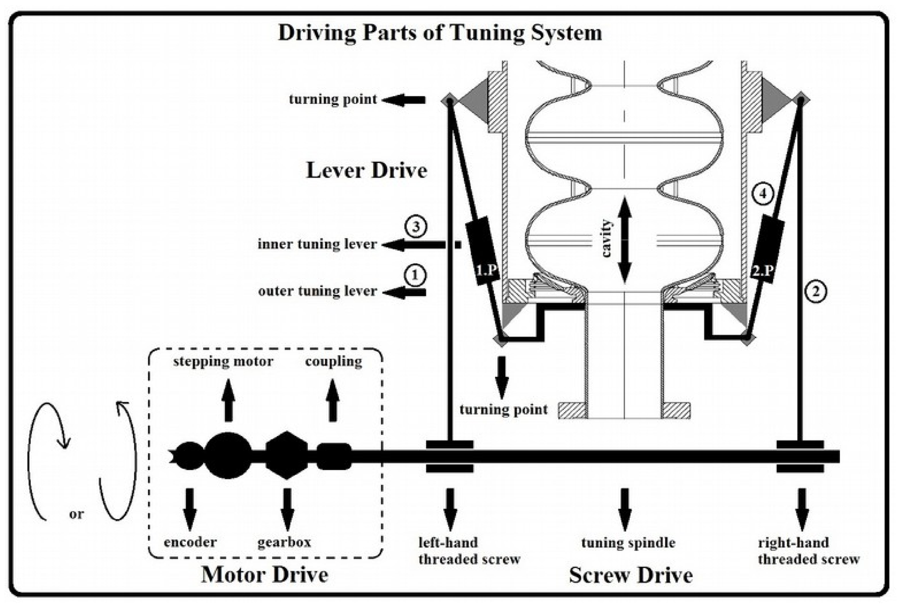
TEST RESULTS

The cryostat and mechanical tuning systems of the cryomodule have been developed and built for the ELBE project [4]. The parameters of TARLA cryomodule is given with table.

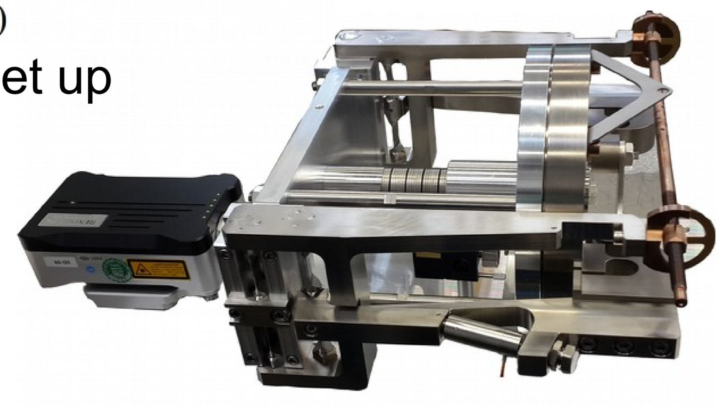
The tuning system of the cryomodules has been modified slightly to have better RF performance by adding piezo stack on the lever arms of the mechanical tuning system. The resolution and the speed of tuning has been improved from 10 Hz-5 Hz/ms to 1 Hz - 1 kHz. Each cavity has been tested in accordance with XFEL cavity manufacture procedure and assembled into helium vessel then vertically tested at DESY in 2016.



Test results of Piezo test set up



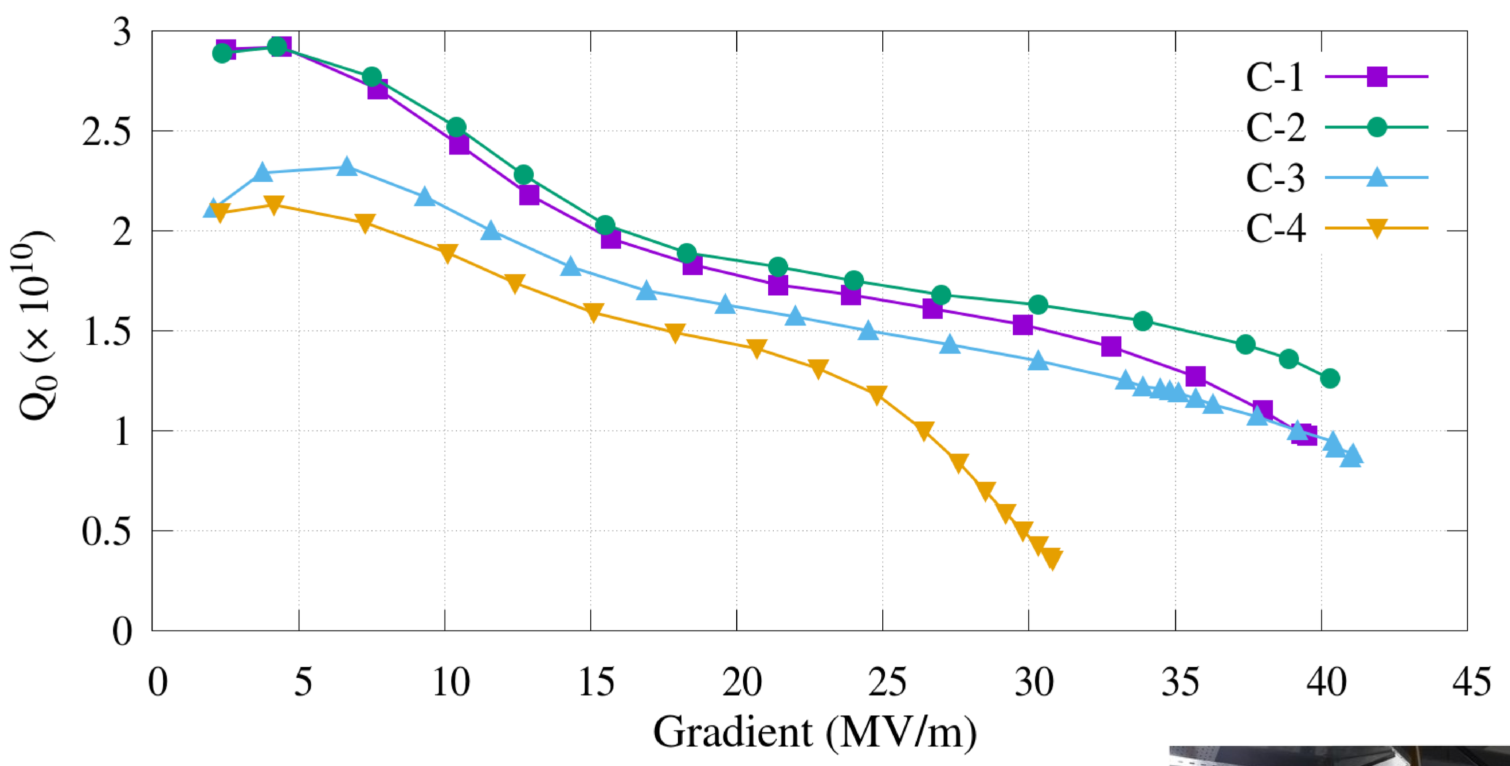
Modified piezo stack tuning system



The Piezo tuning test setup

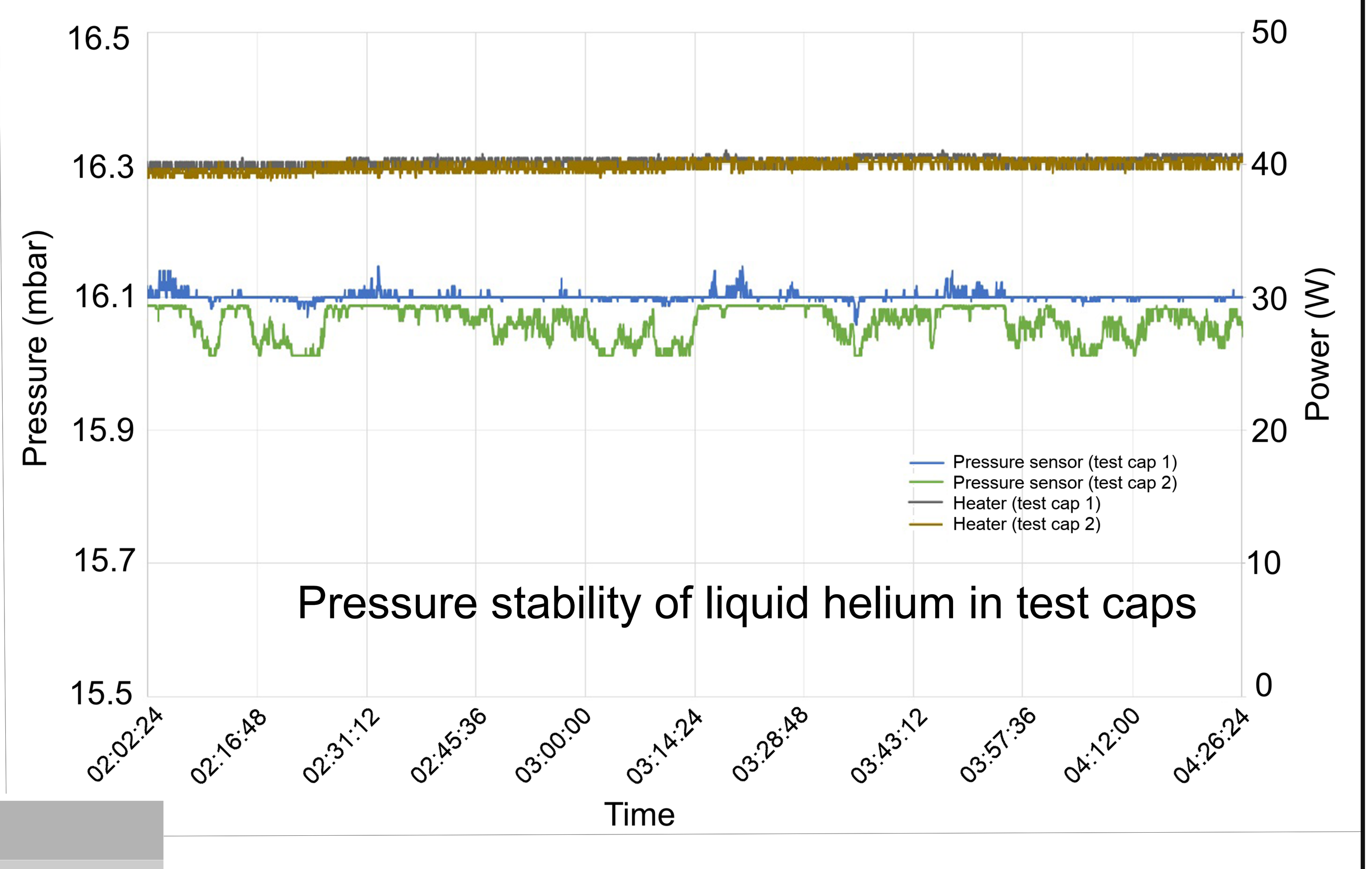
Parameter	Unit
Frequency @1.8 K (MHz)	1300 ±0.05 MHz
Tuning range (kHz)	120 kHz
Ext. Q of input couplers	(1.2±0.2)×107
Ext Q of HOM couplers	> 5×1011
Accelerating voltage/CM (MV)	> 20
Cryogenic losses at max grad. (W)	< 75
Coupler power @CW (kW)	≥15
Tunning Resolution	1 Hz
Tunning speed	1 kHz

Control cabinets of TARLA Cryomodules

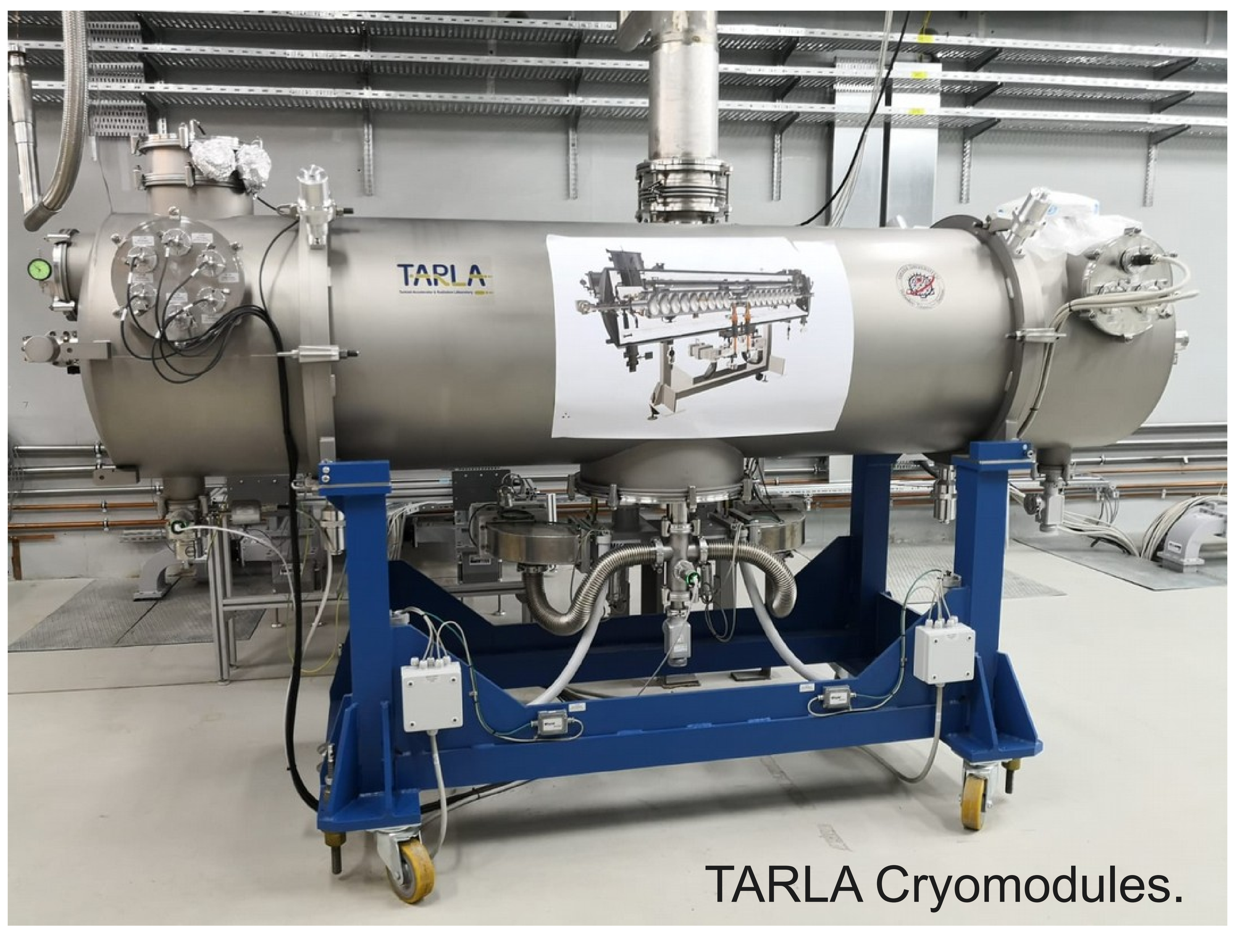


HELIUM PLANT

The helium plant of TARLA has been manufactured and delivered by Air Liquide Advanced Technologies in 2016.The cryogenic system of TARLA is designed to provide helium cooling at 1.8 K (16 mbar). with ±0.2 mbar pressure stability.



Pressure stability of liquid helium in test caps

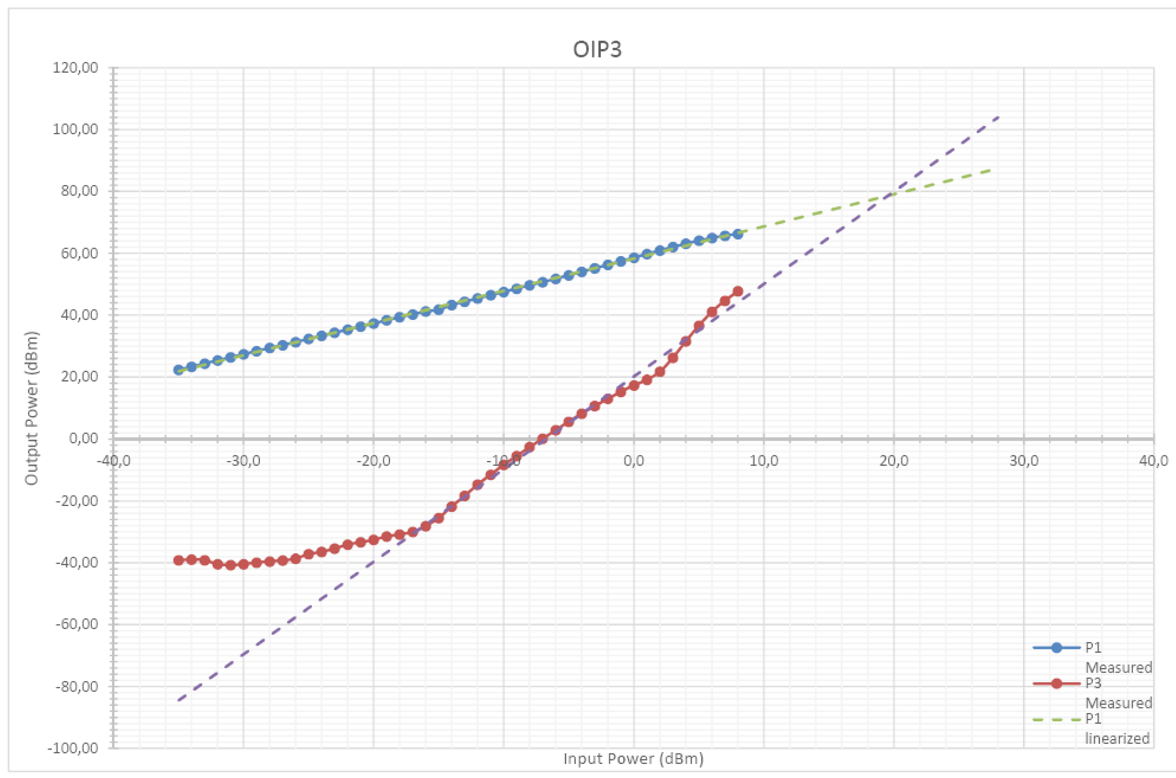


TARLA Cryomodules.

The vertical test results of TARLA cavities. As it can be seen on the figure, except one all the cavities has gradient around 40 MV/m.

- The Solis State Power Amplifier (SSPA) test consists in evaluating the stability of the amplifier output power for about 16 hours.
- The excitation power is provided by an RF generator.
- The output power is detected through an RF coupler and the RF power sensor is connected to the computer which takes a measurement point at regular intervals.
- This measurement is done at nominal power 16,4KW (72 dBm)
- Input water temperature is between 22,8°C and 25,8°C, the water flow rate is 53L/mn.

TARLA SSPA



The test results of First TARLA SSPA

CONCLUSION

The thermionic triode DC electron gun and injector part of accelerator is operating currently [5]. The cryoplant of facility is installed and commissioned. Two superconducting accelerating modules was delivered by the end of 2017. First section of the accelerator is planned to be operational in 1st quarter 2020 and the second part will be put in commission the end of 2020. First lasing is planned to be achieved in 2022 and provided to the users in the same year. A laser experimental station with conventional laser sources have already been in operation since 2018 [7].

19th International Conference on RF Superconductivity (SRF2019) Dresden, GERMANY
30 JUNE – 5 JULY 2019

c.kaya@ankara.edu.tr

REFERENCES
[1] A. Aksoy, Ö. Karslı, "The Technical Design Report of Turkish Accelerator and Radiation Laboratory in Ankara", Ankara University, (2014)
[2] A. Aksoy, et al. ,"The Turkish Accelerator Complex IR FEL Project", Infrared Physics & Technology, v:51, p:378-381, (2008)
[3] B. Aune, et al., "Superconducting TESLA cavities", Phys. Rev.ST AB, v:3, p:092001, (2000)
[4] J. Teichert, et al. "RF Status of Superconducting Module Development Suitable forCWOperation: ELBE Cryostats", Nucl. Instr. and Meth. A, v:557, p:239-242,(2006)
[5] Ç. Kaya,et al. "Beam Diagnostic and e-Gun Test Stand at TARLA", IPAC2014 (2014), Dresden, Germany
[6] J.G. Karssenberg,et al. "FEL-Oscillator Simulations with GENESIS 1.3 ", Proceedings of FEL 2006 (2006), Berlin, Germany
[7] A. Aksoy, et al. ,"Crrent Status of Turkish Accelerator and Radiation Laboratory", IPAC2019 (2019), Melbourne, Australia

* Work supported by Strategy and Budget Department of Turkey with Grand No: 2006K120470