# INSTALLATION AND OPERATION OF THE BEAMLINES FOR THE 100-MeV PROTON LINAC *

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*Abstract*

Beamlines and 100-MeV proton linac have been developed for 1st phase of KOMAC(Korea Multi-purpose Accelerator Complex) at the Gyeong-ju site. The linac supplies either 20-MeV or 100-MeV proton beams for beam applications. Each proton beam can be transported to 2 beamlines for industrial purpose and 3 beamlines for various researches. At the first phase, 2 beamlines were installed and under test.

## INTRODUCTION

KOMAC was developed a 100MeV proton linac which can supply 20MeV proton beam and 100MeV proton beam to 10 beam lines [1-4]. Figure 1 shows the layout of the accelerator building including the accelerator, beam lines, RF systems and modulators. The linac consists with a 50keV microwave proton source, a LEBT(low energy beam transport), a 3MeV RFQ, 20MeV DTLs, 100MeV DTLs and a 1kW beam dump which are located in the accelerator tunnel. The proton beam is transported to one of 5 beam lines for 20MeV proton beam and one of 5 beam lines for 100MeV beam lines. The RF systems and power supply was installed in the klystron gallery. The modulators were installed in the 3rd floor.

## ALIGNMENT

### *Coordinate System*

The global coordinate system was setup. The Y axis was setup by the gravity direction measured with the NIVEL(Leica co.). The Z axis and the origin were determined by using two permanent references as shown in Figure 2. These references are linked to the construction coordinate system. For each floor, the coordinate system is linked by the 5 see-through holes which are penetrated from the 1st floor to the 3rd floor.

The alignment targets were installed for the tunnel, the length is 135m, with the interval of 10 m on one side where the waveguides were installed and 5m on the other side. We measured the tunnel align network 3 times. The first measurement was conducted for the blue line survey. At that time, the temperature of the tunnel was 7°C in the winter because the utility was not operated. The difference in temperature is 20°C compared to the operation condition. The thermal expansion rate, 1.2 X $10^{-5}$/°C-m for the concrete, was considered to install the supports and magnets in the Z axis direction during the blue line survey. But the tunnel length is deformed as a bow. So, we moved the high energy part of the linac as -11mm in the Z-axis direction.

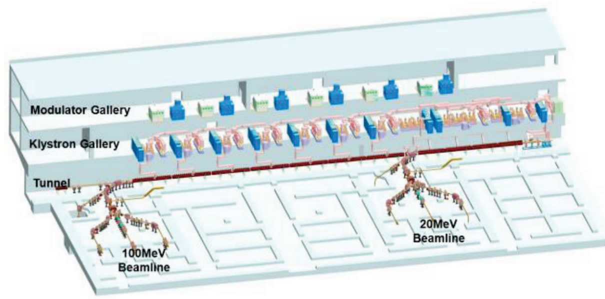


Figure 1: The layout of the linac, beam lines and the accelerator building.

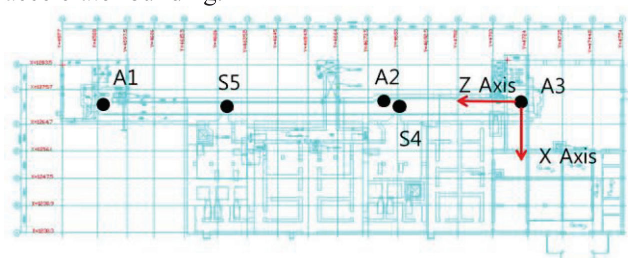


Figure 2: Coordinate system for the accelerator. The coordinates of A1 and A3 are linked with the coordinate system used for the construction.

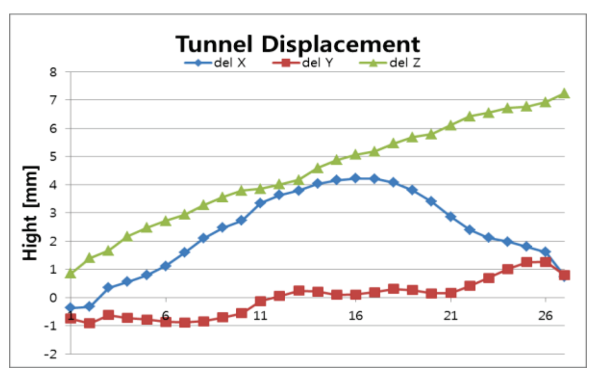


Figure 3: Tunnel displacement according to the increasing of the temperature as 20℃.

## INSTALLATION OF THE 100MEV LINAC

The DTL was manufactured and the drift tubes(DTs) were aligned in the KAERI site. It was delivered from Daejeon to Gyeongju site by using the vibration-free vehicle. Before the installation of DTLs, we checked the

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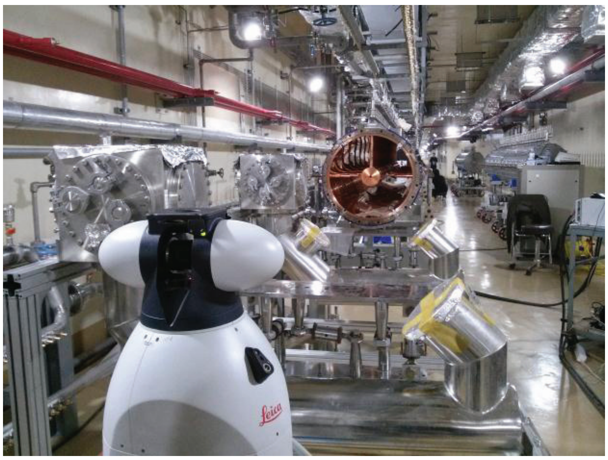
DT alignment condition. According to the results, DT position was not satisfied the alignment criteria. So, all of DTs were realigned as shown in Figure 4. After the alignment of the DTs, the 100MeV linac was aligned in the tunnel. Figure 5 shows the DTL tank alignment by using two laser tracker systems under the real time position monitoring condition. By using this method, we aligned the 100MeV linac, from the injector to the beam dump, in the tunnel.



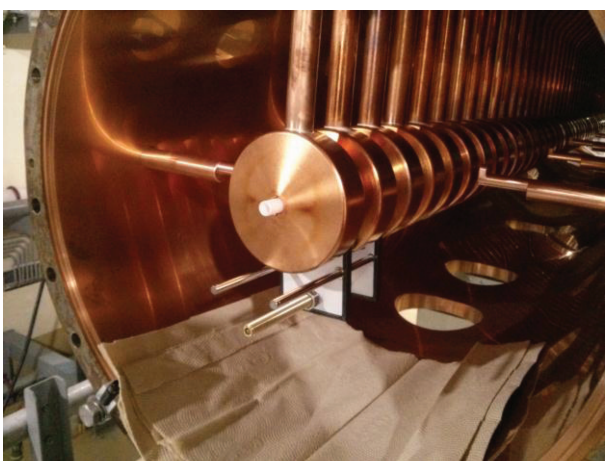


Figure 4: The position of drift tubes were checked and realigned.

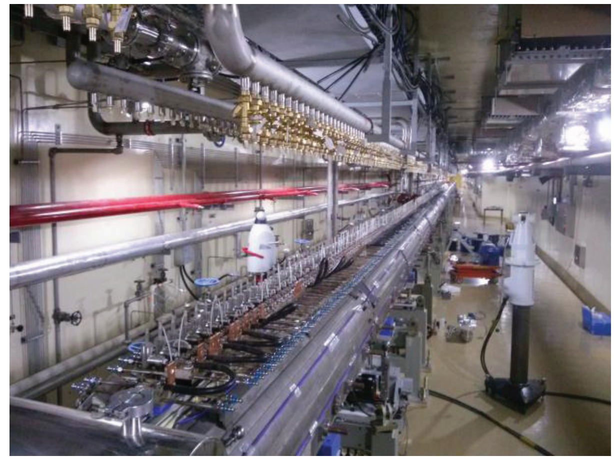


Figure 5: DTL tanks were aligned in the tunnel by using two laser tracker systems. The position was monitored in real time.

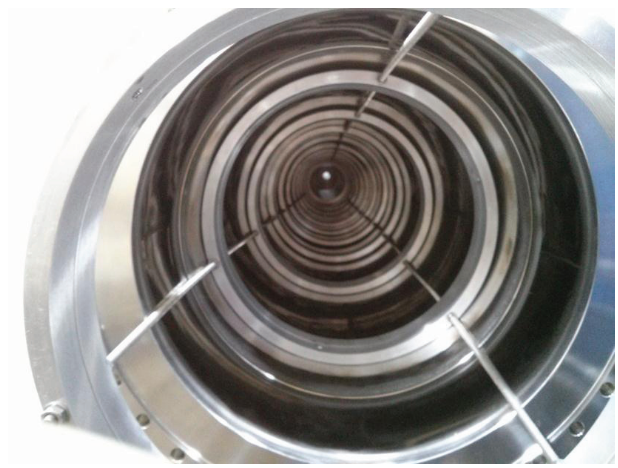


Figure 6: Collimators inserted in the beam pipe.




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Figure 7: KOMAC beam lines.

## CONCLUSIONS

The installation of the 100MeV linac is completed. And the beam commissioning is underway for the 100MeV proton beam. As a preliminary test, we extracted 20MeV proton beam. The installation of beamlines was also finished and will serve to the users from July 2013.

## REFERENCES

[1] K. Y. Kim, Y. S. Cho, J. Y. Kim, K. R. Kim, and B. H. Choi, “The Proton Engineering Frontier Project: Accelerator Development”, J. of Korea Phys. Soc., 56 (2010) 1936.

[2] Y. S. Cho, et al., “100-MeV High – Duty - Factor Proton Linac Development at KAERI”, Proceedings of LINAC 2006, Knoxville, p. 501 (2006).

[3] Y. S. Cho, H. J. Kwon, J. H. Jang, H. S. Kim, K. T. Seol, D. I. Kim, Y. G. Song, and I. S. Hong, “The PEFP 20-MeV Proton Linear Accelerator”, J. of Korea Phys. Soc., 52 (2008) 721.

[4] B. S. Park, Y. S. Cho, H. J. Kwon, J. H. Jang, I. S. Hong, H. S. Kim, S. P. Yun, H. R. Lee, K. R. Kim, and B. H. Choi., “Conceptual Design of Beam Transport Lines for PEFP User Facilities”, the proceedings of PAC 2009, 1626 (2009).