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Proton Linac Energy Upgrade Plan at KOMAC

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1. Introduction

The Korea Multipurpose Accelerator Complex (KOMAC) has been operating a 100 MeV Proton Linear Accelerator (linac) since 2013, supporting various research and industrial applications by providing proton beams to users through four regularly used beam lines. An energy upgrade of the proton linear accelerator is also planned. The proposed upgrade of the 100 MeV proton lianc consists of the 200 MeV linac section, two beam lines and target rooms, building expansion, and utility upgrade. The design for this extended linac is based on a normal-conducting separated-drift tube linac (SDTL) structure. Two beamlines are planned in the downstream section of the SDTL for space radiation and terrestrial radiation environment testing. This paper discusses the upgrade plans for the KOMAC linac.

2. Energy Upgrade Plan

With increasing demand, especially from the semiconductor industry for testing and evaluation, there has been a continuous push for an energy upgrade. The upgrade aims to 200 MeV proton accelerator using a normal-conducting separated-DTL (SDTL) structure [1,2] with two new beamlines for space and terrestrial radiation environment tests [3].

2.1. SDTL

KOMAC proposes an energy upgrade of the 100 MeV proton linac to 200 MeV. The design of the extended linac is based on a normal-conducting SDTL structure which offers several advantages over other accelerating structures. The SDTL structure is similar to a conventional DTL, however unlike the general DTL, the quadrupole magnet is not placed inside the DT, but outside. This provides greater flexibility in optimizing the DT structure for improved accelerating efficiency [4]. In addition, since only 5 DTs are installed in each SDTL tank, a separate field gradient stabilization device is not required. Consequently, the SDTL is considered easier to manufacture and align compared to a conventional DTL. Our upgrade design consists of a beam matching section between the existing DTL and the new SDTL, and 16 SDTL tanks, each containing 5 DTs with a doublet focusing lattice structure. Beam dynamics simulations were performed using an optimized DT geometry to accelerate proton beams from 100 to 200 MeV. A schematic diagram of the lattice is shown in Fig. 1. The distance between adjacent SDTL tanks is $2\beta\lambda$, and one lattice period is defined as distance from the center of a doublet to the center of the next doublet. The calculated beam envelope and radial density for the acceleration of a 3 MeV proton beam to 200 MeV using the designed SDTL structure are shown in Figs. 2 and 3 respectively.

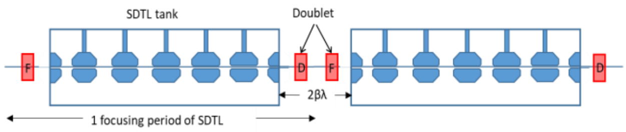

Fig. 1. SDTL lattice period.

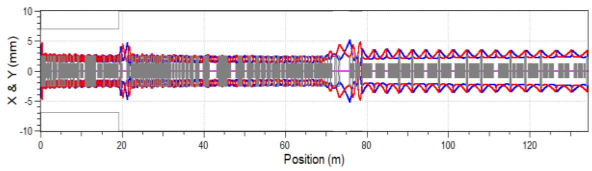

Fig. 2. Envelope simulation from 3 MeV to 200 MeV.

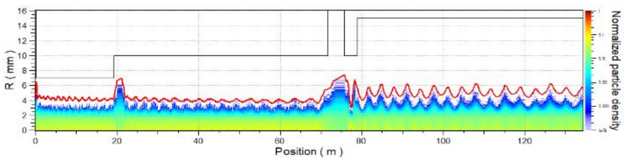

Fig. 3. Radial density simulation from 3 MeV to 200 MeV.

2.2. New Beamlines

Two beamlines are planned in the downstream section of the SDTL. Beamline 1 is dedicated to space radiation environment testing, delivering a low-current, uniform, large-area proton beam. To achieve the required beam specifications, a collimator and downstream octupole magnets are employed to generate a uniform transverse beam profile, achieving approximately 10% uniformity over a 150 mm × 150 mm area. In contrast, beamline 2 is designed to provide a high-current proton beam and can also produce neutrons when a target is inserted in the beamline, depending on experimental requirements. An overview of the two beamlines is shown in Fig. 4.

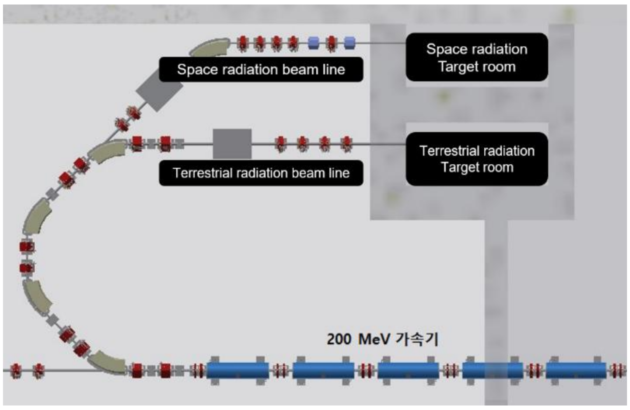

Fig. 4. 200 MeV beamlines: space radiation and terrestrial radiation beamlines.

3. Conclusion

The 100-MeV proton linac at the Korea Multi-purpose Accelerator Complex (KOMAC) has been in stable operation for over a decade, supporting a wide range of research and industrial applications. A phased energy upgrade of the proton linac is planned, with an initial step to 200 MeV. A summary of the beam dynamics studies and new beamline design for the 200 MeV energy upgrade is presented.

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