Upgrade Plan of KOMAC 100 MeV Linac

Hyeok-Jung Kwon [a*], Han-Sung Kim [a], Young-Gi Song [a], Sang-Pil Yun [a],Seunghyun Lee [a], Dong-Hwan Kim [a], Sukho Moon [a], Sungbin Park [a] ,Gyuhaeng Jo [a]
[a]*Korea Multi-Purpose Accelerator Complex, Korea Atomic Energy Research Institute, Gyeongju 38180*
[*]*Corresponding author: hjkwon@kaeri.re.kr*

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1. Introduction

Upgrade of the existing 100 MeV proton linear accelerator is planned at Korea Multi-Purpose Accelerator Complex (KOMAC). The main purpose of the upgrade is to do the single event effect (SEU) test the semiconductor devices due to the space radiation and terrestrial radiation. The minimum proton beam energy for the SEU test is recommended as 200 MeV through JEDEC JESD89B, JEDEC JESD234, ESCC 25100 standards [1][2][3]. In addition to the needs from users, the advantages of the 200 MeV linac are such that it can be developed based on single accelerator structures and the whole facility can be installed on the existing site without further site development. The high power linac structures are summarized in Figure 1 [4].

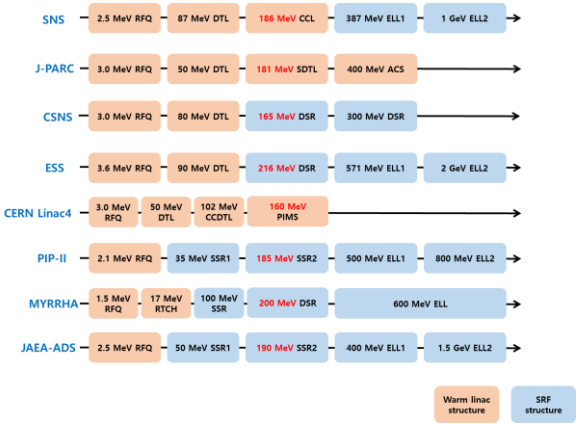

Fig. 1. High power proton linac structure

2. 200 MeV Energy Upgrade

The proposed upgrade facility consists of 200 MeV linac, beam line and target room, building extension and utility upgrade.

2.1 Beam Line and Target Room

We considers two beam lines, one is a low flux beam line which will be used for space radiation (proton) simulation, the other is a neutron beam line which will be used for terrestrial radiation (neutron) simulation. We are going to install a movable neutron target in the neutron beam line so that we can supply proton beam when we remove the neutron target in the beam path. The beam line configuration is shown in Figure 2. The proposed beam size of the low flux beam line is 100 mm X 100 mm with 10% uniformity. The dose range is 10^6~10^8 p/cm^{2}s. The proposed neutron flux of the neutron beam line is higher than 10^6 n/cm^2 s. The neutron spectrum with tungsten target and aluminum target are compared in Figure 3, which also include a neutron spectrum at the ground level of New York and neutron spectrum supplied at the TNF, TRIUMF [1].

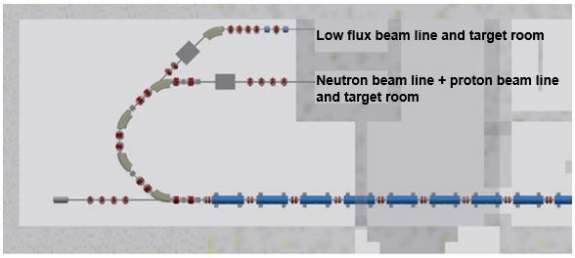

Fig. 2. Proposed beam line configuration

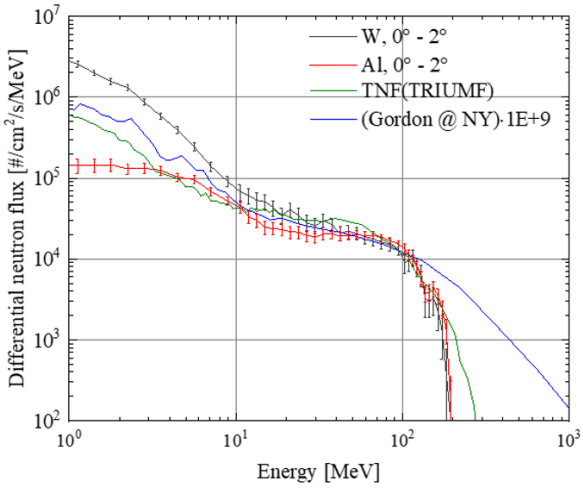

Fig. 3. Proposed neutron spectrum

2.2 200 MeV Linac

We considered several factors in order to select accelerator type. (1) Use already proven technology, (2) Single accelerating structure, (3) Frequency is the same with the existing linac, (4) Considering the accelerator for further extension, (5) Fit into the existing developed site, (6) Considering budget. The specification of the 200 MeV linac is 200 MeV, 20 mA and 3% duty factor.

The beam current can be upgradable up to 40 mA considering downstream GeV grade accelerator. We selected two accelerator types based on the above factors and the results are summarized in Table 1 [4].

Table 1: Comparison of accelerating structures

Type	HWR	SDTL
RF frequency [MHz]	350	350
Number of module	9	20
Total length [m]	46	60
RF power per module [MW]	0.12	1.6
Number of RF amplifier	36	20
Modulator power	-	5
Number of modulator	-	10

A half-wave resonator (HWR) is a superconducting accelerator with 350 MHz and separated type drift tube linac (SDTL) is a normal conducting structure. The RF power for HWR is for 20 mA case and increased up to double for 40 mA case, which is not supplied from the COTS. The building extension is necessary for both accelerator type in spite of the length of the HWR is shorter than SDTL. The budget of the SDTL is less than HWR by 20%. The layout of the 200 MeV linac and beam line is shown in Figure 4. We considered SDTL in the layout. Also the building extension is shown in Figure 5. The extension area is 27 m X 20 m, and it can be installed within existing site.

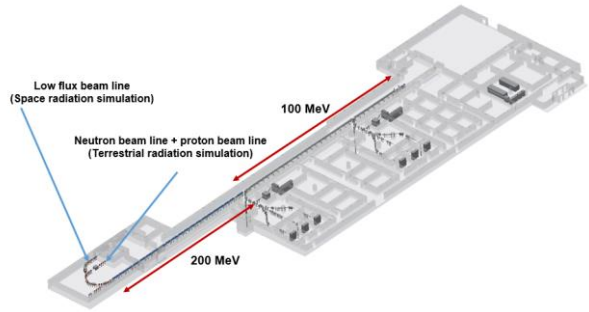

Fig. 4. Proposed layout of the 200 MeV linac and beam line

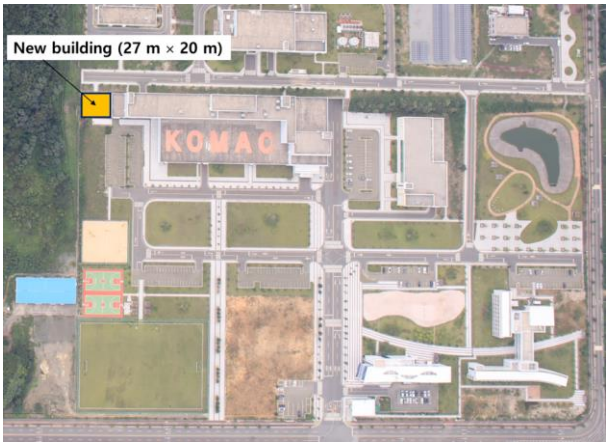

Fig. 5. Proposed 200 MeV linac building extension

3. Conclusions

Energy upgrade of the existing 100 MeV proton linac up to 200 MeV is considered at KOMAC. We proposed two beam lines capable of space radiation simulation as well as terrestrial radiation simulation. Two accelerator types are selected based on several factors and SDTL is a primary consideration. The layout of the accelerator and beam line, building extension are proposed.

REFERENCES

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[2] JEDEC Standard, Test standard for the measurement of proton irradiation single event effects in electronic devices, JESD234, October 2013.
[3] ESCC, Single event effects test method and guidelines, ESCC basic specification No.25100, ESA, October 2014.
[4] Hyeok-Jung Kwon, Han-Sung Kim, Seunghyun Lee, Dong-Hwan Kim, Comparison of the Accelerating Structures for 200 MeV Proton Linac, Transactions of the Korean Nuclear Society Autumn Meeting, Gyeongju, Korea, October 26~27, 2023.