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4.1 Summary Report - Accelerator (Linac)

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Abstract

The papers presented in the accelerator session are summarized for linacs.

1. Introduction

In the accelerator session, there are presented the following six papers for linacs.

1. Linac Design for the KEK/JAERI Joint Project, by Kazuo Hasegawa, JAERI,
2. Ion Source and RFQ, by Akira Ueno, KEK,
3. 60 MeV Linac, by Fujio Naito, KEK,
4. Progress in Design of the SNS Linac, by Bob Hardekopf, LANL,
5. The SNS Superconducting Linac Architecture, John Galambos, JLab, and
6. Superconducting Linac, by Ron Sundelin, JLab.

Kazuo Hasegawa, representing the Joint Accelerator Team, presented the summary of the linac design for the KEK/JAERI Joint Project. The main parameters of the linacs for the SNS and Joint are compared in Table 1.

Table 1. Comparison of the main parameters of the linacs for the SNS and KEK/JAERI Joint Project.

	SNS	Joint Project
Energy	1 GeV	600 MeV
Peak current	52 mA	50 mA
Repetition	60 Hz	50 Hz
Beam pulse width	1 ms	0.5 ms
Duty	6 %	2.5 %
RFQ		
Type	Both Four-vane type with PISL's	
Energy	2.5 MeV	3 MeV
Frequency	402.5 MHz	324 MHz
DTL		
Quadrupole Magnets	Partly Permanent	Electromagnets
Energy	87 MeV	50 MeV
Frequency	402.5 MHz	324 MHz
CCDTL or SDTL		
Type	None	SDTL
Energy		200 MeV
Frequency		324 MHz
CCL (Coupled-Cavity Linac)		
Type	SCS	ACS
Energy	186 MeV	400 MeV
Frequency	805 MHz	972 MHz
SCC (Superconducting Cavity)		
Energy	1 GeV	600 MeV
Frequency	805 MHz	972 MHz
Chopper	Traveling	RF

2. Ion Source and RFQ

Akira Ueno presented the paper on the present status of the ion source and RFQ linac for the Joint Project. They have obtianes the peak current of 11.5 mA without Cs (a pulse length of 600 μs, a repetition of 20 Hz, and an emittance of 0.43 π mm mrad (4 rms normalized emittance)), whiile they have obtained the peak current of 37.5 mA with Cs (a pulse length of 1 ms, a repetition of 50 Hz, and an emittance of 0.6 π mm mrad (4 rms normalized emittance)).

The RFQ linac for a peak current of 30 mA with PISL's is just installed. This was designed for the Japan Hadron Facility. Its Q value was 83.5 % of MAFIA calculation. Design of the RFQ for 60 mA is in progress for the final goal of the Joint Project.

3. 60 MeV Linac

Fujio Naito presented the paper on the 50-MeV DTL and the 60-MeV SDTL for the Joint Project. Both the DTL and the SDTL are made of copper-electroplating on the steel. The PR (Periodically Reversed) method was newly developed for the cavity application. The electric conductivity and the outgas rate are excellent, being the same as those of OFC. The first breakdown voltage is about four times as high as the other conventionally electroplated ones.

The electroformed hollow coil was also newly developed for the high frequency DTL.
The magnetic field centers of the quadrupole electromagnets thus fabricated deviated by less than 10 μm, which is nearly the accuracy of the measurement, from their mechanical center.

The high-power test result of the prototype with six drift tubes (three for the lowest β and three for the highest β) is excellent. The conditioning was very fast due to the excellent quality of the PR electroplating method.

4. Progress in Design of the SNS Linac

Bob Hardekopf presented the paper on the progress in design of the SNS linac.

The CCDTL has been given up, since the funneling will not be done even in future.

One 550-kW klystron is necesssary per one superconducting cavity. As a result, 92 klystrons should be prepared in total for SCC.

The chopper with rise and falling times less than 10 ns becomes possible by a series of FET's.

5. The SNS Superconducting Linac Architecture

John Galambos presented the paper on the SNS Superconducting Linac Architecture.

The SCCs are classified into two sets of cavities, each of which has the same β value. These two values are refered to as medium beta and high beta, respectively.

The optimization study has been done, regarding which β values should be chosen. Three 6-cell cavities per one klyomodule is assumed for the medium beta, while four 6-cell cavities per one klyomodule for the high beta.

The optimization is dependent upon the peak surface field. If a peak surface field of 25 MV/m is chosen, a choice of $\beta = 0.61$ and $\beta = 0.81$ for the medium β and the high β, respectively, is most efficient.

A large phase slip exists, since only two sets of β values are used. Although no beam loss is predicted from the simulation, it is interesting to compare the halo formation for this case with that for more sets of β.

6. Superconducting Linac

Ron Sundelin presented the paper on the study of the superconducting linac.

For the case of 6 % duty like the SNS, the capital cost of the SCC option is about the same as that of the NCC (normal-conducting cavity, or room-temperature cavity) option (, which the author does not agree to).

The peak surface field of 27.5 ± 2.5 MV/m, the number of cells of 6, and so on have been determined from optimization and/or of many factors.

Microphonic amplitude of 6σ is approximately 100 , which is significantly smaller than a band width of 1,103 Hz. The Lorentz detuning is approximately 390 Hz, which is also much smaller than a band width of 1,103 Hz. Even so, the phase and amplitude control of each cavity is necessary by having one klystron per one cavity.

No longitudinal cumulative instability is expected.

7. Conclusion

Both the SNS linac and JKJ linac are in progress on schedule.

Already some collaboration is under way between SNS linac group and Joint Project linac group. For example, the SCC couplers of KEKB will be the base of those for the SNS, the RF antennas for the ion Source of the SNS will be used for the Joint Project, and so on. More close collaboration will be beneficial for both, since both of the linacs are very modern and challenging theoretically and technically in many features.

Participants of the session are sure that the linac technology will make big progress by constructing and operating both the facilities.