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1 GeV リニアック検討資料

1 GeV LINAC DESIGN NOTE

題目 (TITLE) Space between RFQ and DTL

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概要 (ABSTRACT)

RFQとDTL の間にドリフトスペースを置く場合のパラメーターをバンチャーを含めて求めた。ドリフトスペースは 2mと1.4m、バンチャー電圧は 70 kV でよい。

KEY WORDS:
Ion source, RFQ, DTL, CCL, Magnet, Monitor, Beam Dynamics,
Transport, Vacuum, Cooling
Klystron, Low level rf, High power rf, Modulator
Control, Operation, Radiation, Others

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Space between RFQ and DTL

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There are two ways for beam transportation from RFQ to DTL. If the transverse emittances match with the DTL acceptances satisfactory, the DTL entrance is located just after the RFQ exit without any matching devices. If the transverse acceptances do not match with the DTL acceptances satisfactory or a beam handling device such as a beam chopper is necessary, the DTL is located after some distance from the RFQ exit. In that case, it is necessary to satisfy the matching condition in the both phase space, transverse and longitudinal. This paper describes the results of calculation about the longitudinal motion in the drift space including the effects of buncher, which is necessary to shorten the bunch length to meet with the DTL longitudinal acceptance.

1. RFQ beam

energy	3.02 MeV
energy width	36 keV (90% full width)
phase width	20 deg (90% full width)
εx	1.17 πmm.mrad
εy	1.29 πmm.mrad

2. The effects of drift space

The phase width becomes wide as the beam passes through drift space. Figure 1 shows the phase width (almost 100% full width) versus drift length. If the phase acceptance of the DTL is 90 degrees, the maximum allowable drift length is about 75 cm. If the drift space is longer than 75 cm, a bunching system (one gap accelerating cavity and drift space) is necessary.

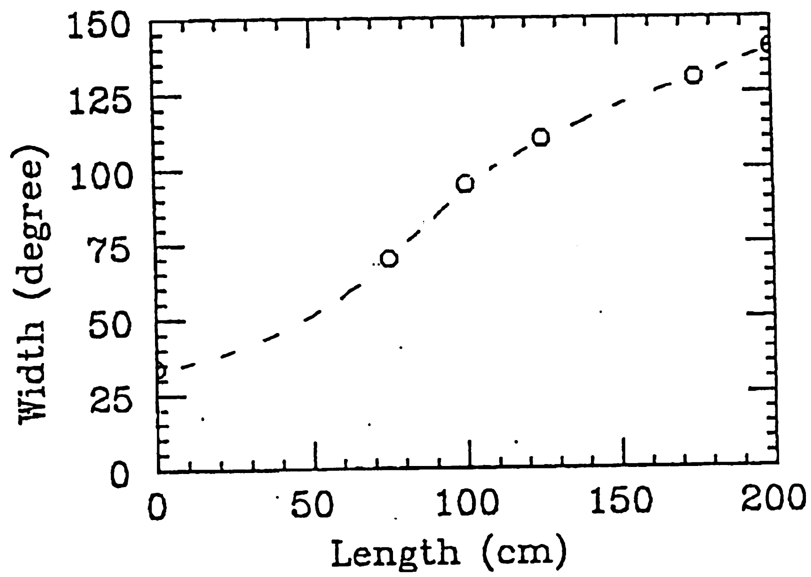

Fig.1 Phase width (nearly 100% full width) vs. drift length (L1).

3. Buncher

A bunching cavity can accept the beam phase width of 180. Then we choose the drift length (L1) before the buncher to be 200 cm, which gives the phase width of 140 degrees (full width).

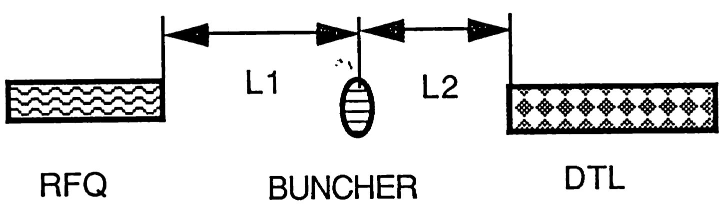

Fig.2 Configuration between RFQ and DTL.

Figure 3 shows the phase width (90% full) as a function of the drift length (L2) for three kinds of the buncher voltage, 50, 70 and 90 kV. The phase and energy width are shown in Fig.4

as a function of buncher voltage when the drift space between the buncher and the DTL is 140 cm. If we impose the condition that the energy width of the beam does not exceed that of the RFQ exit, we can not increase the buncher voltage so much.

The buncher system (200 cm drift space + 70 kV buncher + 140 cm drift space) can produce the phase width of 20 degrees and the energy width of 40 keV (both 90 % full width), that is enough for the capture of the DTL. The longitudinal emittances can be varied by the amplitude and phase of the buncher field, which gives the effective tools for the precise matching and emittance growth problems of the low energy part of the DTL.

In this study, we ignore the condition of transverse maching and expected size of the beam chopper.

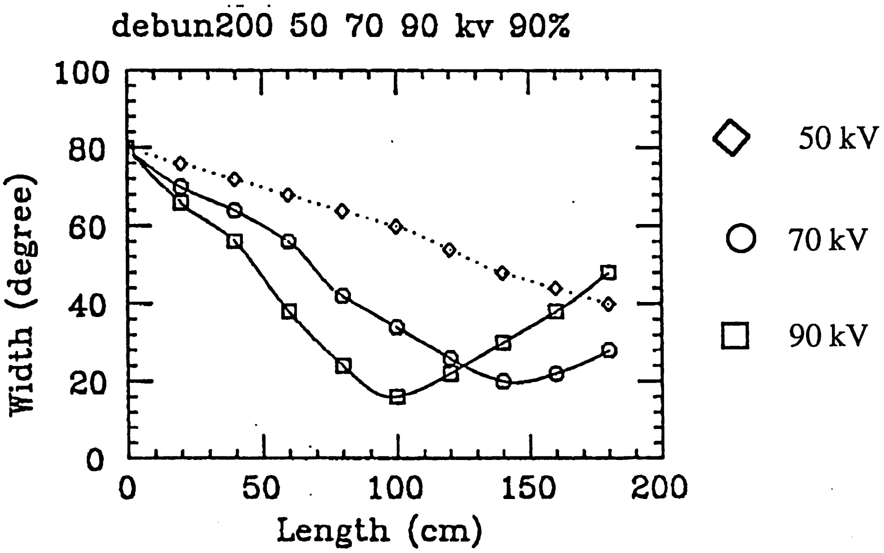

Fig.3 Phase width (90% full) as a function of the drift length (L2) for three kinds of the buncher voltage, 50, 70 and 90 kV.

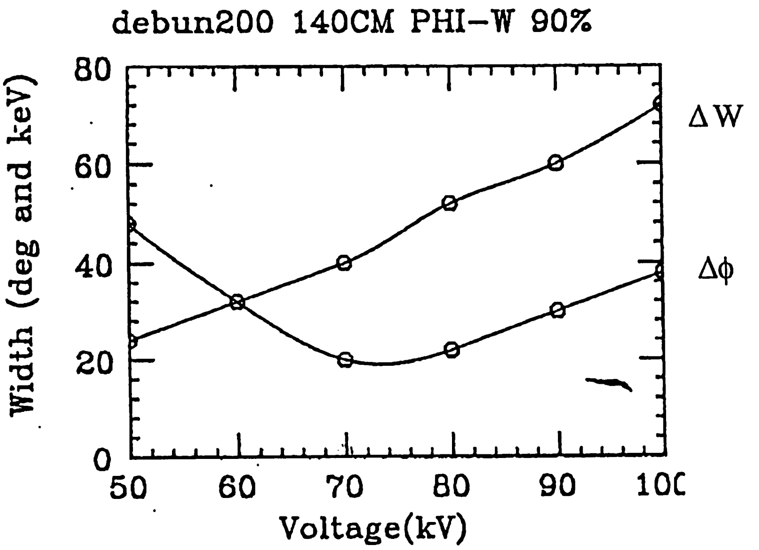

Fig. 4 Phase and energy width as a function of buncher voltage when the drift space between the buncher and the DTL is 140 cm.