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AN ALTERNATIVE BEAM TRAJECTORY THROUGH THE 2.2 GEV LINAC BEAM CHOPPER REDUCES THE POWER REQUIREMENTS BY A FACTOR 4

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1. Introduction

Driving the beam chopper for the proposed 2.2 GeV linac (SPL) requires high instantaneous power switching, in very short time. This makes the pulse amplifier a critical and expensive device. An alternative beam trajectory configuration, which reduces the required power by a factor 4, is presented in the following sections.

2. Principle

In the present proposal[1] the beam deflector is aligned on the accelerator longitudinal axis (Fig.1A). The beam entering the device can either continue straight ahead, if no electric field is provided, or is deviated by an angle ϑ if a field E exists between the deflector plates*. For small values of ϑ, the relation is nearly linear and can be written as

$$E \approx \vartheta \cdot \frac{p \cdot \beta}{\ell}$$

where β is the relativistic velocity, p is the particle momentum, ℓ is the deflector length and E the required deflection field[2]. If one can drive each of the deflector plates in both polarities, the same overall deflection angle ϑ can be split into two halves around a symmetry axis (Fig.1B), requiring thus only half of the deflecting field. The same reduction applies to the driving voltage and since the deflector plates are transmission lines terminated on their characteristic impedance, the driving power goes down by a factor 4.

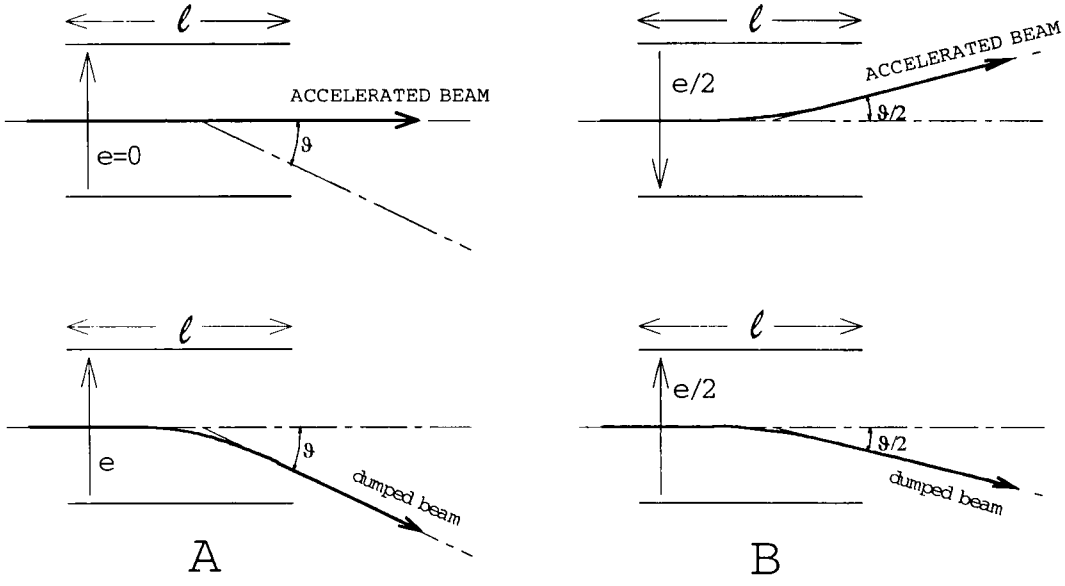

Figure 1

* The deflector is actually a travelling wave chopper but for simplicity we consider the electrodes as simple plates.

3. Amplifiers

With the figures foreseen for the 2.2GeV SPL, the peak power required to drive each of the deflector plates, is ~20kW. This figure goes down to ~5kW for the case depicted in figure 1B. At this power level the market offers some devices which nearly meet the specifications (i.e. Kalmus type 140C : 2kW 220MHz or type LA4000L : 4kW 100MHz) and Prana R&D apparently has already produced a device compatible with the required rise/fall times and power.
Nevertheless one should notice that if this scheme relaxes the power specification, as the accelerated beam is also deflected, it makes the flat-top requirements more stringent.

4. Conclusion

The configuration presented above, reduces the power required for driving the SPL beam chopper to a level at which commercial devices seem to exist. The need of a lower power will relax the thermal dissipation of the meander lines and, with a linear amplifier, it will be possible to pre-distort the input signal so as to compensate, to some degree, the pulse deformation introduced by dispersion in the meander structure.

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[1] B. Autin et al., Conceptual Design of the SPL, A High-Power Superconducting H^- Linac at Cern, to be published

[2] C. Bovet et al., A Selection of Formulae and Data useful for the Design of A.G. Synchrotrons, CERN/MPS-SI/Int. DL/70/4, 1970