LINACS WITH SELF-ACCELERATION OF BUNCHED BEAM

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Summary

Application possibilities of charged particle accelerators are notably determined by the magnitude of output beam energy and its variation range, Conventional methods of beam energy increase require additional RF generators, their cost coming to 40-50% of total accelerator cost. Thus, new methods of energy increase without raise of RF power supply are of great interest works in this field are being carried out in the USA (SLAC) and the USSR (HPTI, MEPI).

This paper is devoted to theoretical and experimental study of variable energy accelerators based on out autoacceleration of bunched relativistic beam. Besides main design princips illustrated by two new accelerator structures are discussed. The investigation has been carried out on special experimental equipment. Experimental and theoretical results obtained in this work as well as their analysis allow us to emphasise that proposed accelerator studies can be widely used for different purposes.

Introduction

The output energy of accelerated beam its variability for a linac determines the area of its application in technology and research. The simplest way to increase the beam energy is to add more accelerating sections with r.f. power generators. Such method is an expensive one due to the cost of r.f. generators. Therefore the development of methods to increase the energywithout additional power supply is essential. It can be done by an interpulse power redistribution.

Experiments and results

A research on the self-acceleration of relativistic bunches is the subject of the report. Fundamentals of the self-acceleration will be considered in two different schemes. The first one consists of an injection linac, a power free system (i.e. without a power supply) and some auxiliary arrangements. The injection linac involves an acceleration section, an electron gum, a master generator, a klistron amplifier and a fast-latching π -phase shifter inserted between the generator and the amplifier. The power free system is a travelling wave resonator which consists of a disc loaded guide and a waveguide freedback with a phase-shifter. (The latter is used for resonance tuning).

In the first part of an operating cycle the r.f. power build up takes place, when electron bunches passing through the disc loaded guide exite the E_{01} mode electromagnetic field. The r.f. power build up last the major part of a pulse during which the microwave field phase in the injection linac is π -shifted with respect to the field phase in the disc loaded section.

Then the field plase within the r.f. power pulse in the injection linac is changed by means of a sast-latching π -phase shifter making it equal to the field phase inside the disc loaded section. At that moment the second part of an operating sycle starts. Electron bunches enter the disc loaded guide in a proper phase and are additionalle accelerated.

Experiments were made using the injection linac with 30 MeV electron beam energy and 100mA pulse current. The additional energy obtained by electron bunches was 1.2 MeV.

The second scheme consists of an injection linac with an r.f. power supply, a travelling wave resonator including deceleration and acceleration sections with a waveguide feedback and a phase-shifter and a deflector between the two sections. The main difference

sections. The main difference as compared with the first scheme is separation of a disc loaded guide into two parts. The investigation og the self-acceleration process in this case included the exitation of the deceleration section and measurement of energy loss in it and energy gain in the acceleration section as well. The energy gain was measured to be 1.7 MeV.

To obtain a greater energy gain the peak current of the injection linac must be increased.

The model assumption for the self-acceleration evalution was proved to be correct and in a good agreement with experimental results.

References

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