NEAR TERM PERSPECTIVE _ RMAPFBW

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ABSTRACT

There is a chance to design the cheapest proton linac based on the Modified Alternating Phase Focusing approach [1].

We have just finished computer modelling and investigation of about 1 m-length AS for 5.5 cm-wavelength of RF.

Results are perspective but positive. Energy of protons was increased from 20 MeV up to 44 MeV in Ramped APF section used BW-structure.

The same result is observed for 60-200 MeV RMAPFBW with 10-40 MV/m E -distribution along 6-m-long BW-structure.

These results are after early computer modelling.

INTRODUTION

The present state of the "Linac Field Technology" and the main trends, as it seems to me, are demonstrated by Fig.1.

A main ridge (1) is represented by the Mont Blancs: RFQ, DTL, and CCL.

Fig.2. compares Z_{sh} of these giants.

There are several steady lines of the development:

- Increasing frequencies which are being used for proton linacs at the highest energy end of the ridge in particular (in CCL up to 1.3-3 GHz);
- Decreasing frequencies which are being used for the heaviest ion linacs (down to 6 MHz);
- Replacing the bulky and unreliable HV DC preinjectors by RFQs;
- Moving the CCL into DTL-dominant energy region (to 30-40 MeV);
- Designing novel of RFQ variants (Split Coaxial, Interdigital - IH -, and Spiral options for low q/M-heavy ions at the low energy end of the ridge, and using RF-Focussing Iris Structure with Rectangular Holes at relativistic energy of particles end);
- Designing novel of DTL options (BDTL, CCDTL), combining the best features of both the DTL and the CCL shemes.
- Progress in creating analytical and computer models and codes for simulation of all nonlinearities of the accelerating process that are more adequate to real 6-Dimensional motion of accelerated particles;
- Reviewing the necessity for a constant E (z)-distribution along the DTL and converting to a ramped E (z)-distribution (RDTL).
- A standard of unsurpassed value of the Z_{sh} - shunt-impedance of the DTL at 5-50 MeV/nucleon zone.

Two schemes - APF [2] and BWLAP [3] - are on the foothills (2) of these Alps.

No quadrupole focusing is used in either system. The former focuses the particles by an axial E -component of the RF e.m.f.; the latter uses the longitudinal magnetic field of a super-conducting solenoid.

The last item in Fig.1 is a newcomer - Ramped Modified Alternative Phase Focusing accelerator based on Backward Wave structures or RMARFBW. (3)

RMAPFBW

The RMAPFBW approach is one close to Kushin ideology (see Invited Papers of LINAC94 - "Ion Acceleration in APF Systems and [2], modified by Chizhnyack [1]), developed and advanced owing to this investigation by use the increasing (ramped) E (z)- distribution along an accelerating structure and application AS of Backward Wave type.

The acceleration and focusing of protons is carried out only by RF electromagnetic field forces into BW AS as it is done in [1], [2].

RESULTS

Fig.2 shows both the (dW/W - $d\Phi$) and (α - r), and beam envelope (r - z) distributions along the accelerating structure.

The beam is more or less constant in diameter and is about 1 mm. in RMAPFBW. (if E(z) is constant, the diameter of the accelerated beam always increases along the AS).

To confirm the validity of this scheme I can say that we have already reached E = 32 MV/m at the AS-axis in the experimental model that in turn will correspond to approximately 22 MeV/m - gradient of proton acceleration.

CONCLUSION

Offered results can only guide us through the prospective R&D.

If we are precise in our computer evaluations and conclusions thereof, production of RMAPFBW will be finished within 1.5-2 years provided the adequate finance will be granted.

The accelerator itself shall include a number of segments, containing only 4 major elements, comprising an accelerating structure with external dimensions of 3-5 cm in diameter, RF-supply and vacuum pump, AS aligning chassis, measuring gauges and beam heading elements.

The above accelerator will probably be the best booster for medical application to use with cyclotrons. It will help to increase the beam energy up to 200-250 MeV,- the calculated values which are now only planned to achieve using proton synchrotrons or classical DTL + CCL (on the new approach in creation of an LA - BWLAP - refer to the materials of the present conference "BWLAP - Backward Wave Linear

Accelerator of Protons" and "The Proposed Hospital- Based Proton Therapy Linear Accelerator").

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[3] A.Bogomolov Russian patent ("Copyright Certificate") N269369, 1969.

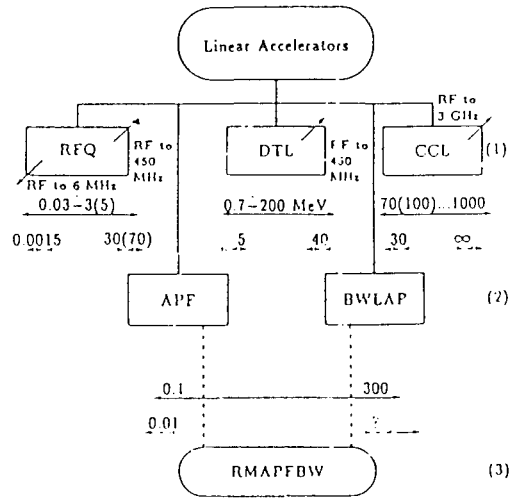

Fig1. Ramped Modified Alternative Phase Focusing accelerator based on Backward Wave Structures.

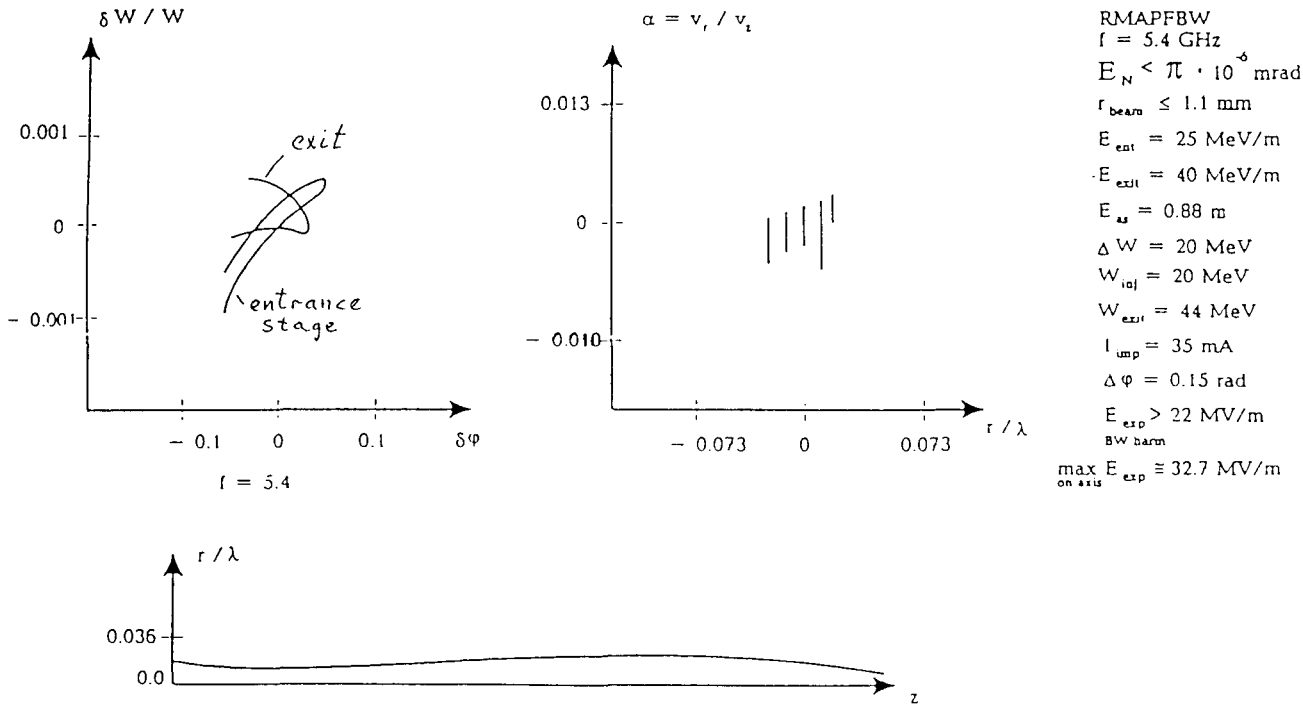

Fig. 2.