

Beam Dynamics Simulations and Code Comparison for a new CW RFQ Design

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Abstract

Research and development of CW applications is an important step in RFQ design. The RF potential should be limited by 1.3-1.5 of Kilpatrick criterion for the CW mode. A 2 MeV RFQ is under development for the compact CW research proton accelerator, as well as for planned driver linac in Russia. The maximum beam current is fixed to 10 mA; the operating frequency has been set to 162 MHz. The new RFQ linac design will be presented and beam dynamics simulation results will be discussed. Calculations of the beam dynamics are provided using the codes BEAMDULAC (developed at MEPhI for linac design) and DYNAMION. A comparison of the software performance is presented.

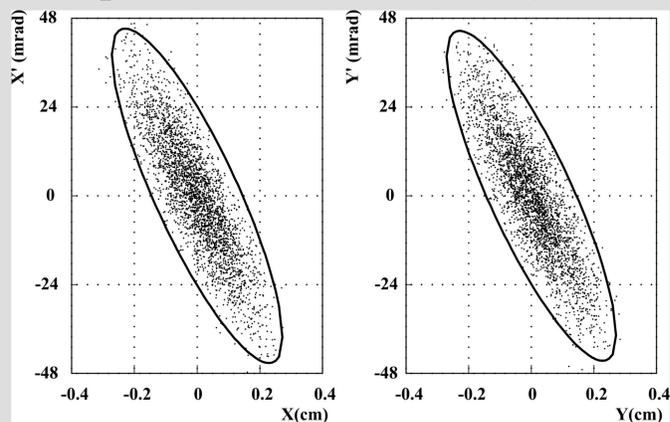
The presented RFQ accelerating-focusing channel has been designed at MEPhI by means of the BEAMDULAC code
S.M. Polozov, Prob. of Atomic Sci. and Tech., 3 (79) (2012)

A cross-check, including calculations of RFQ characteristics and beam dynamics simulation, was performed by use of the DYNAMION software
S. Yaramyshev et al., NIM A, 558/1 (2006)

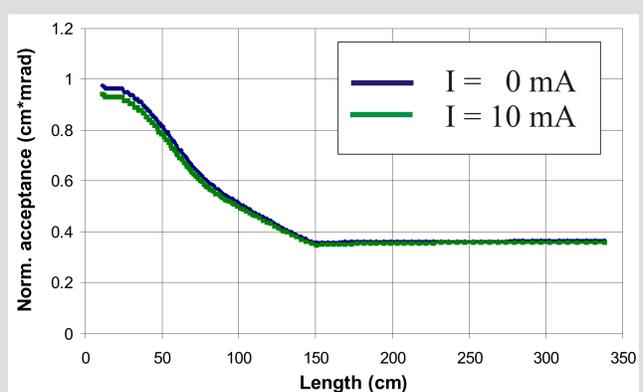
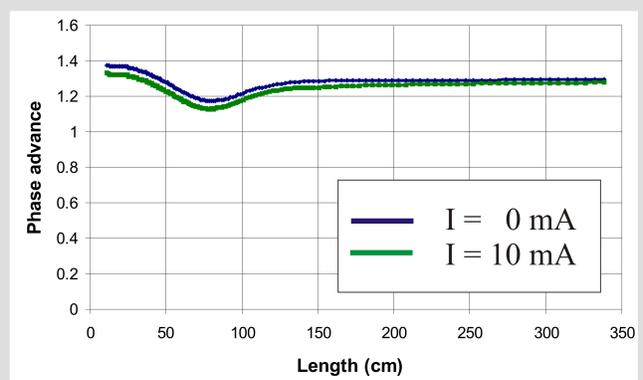
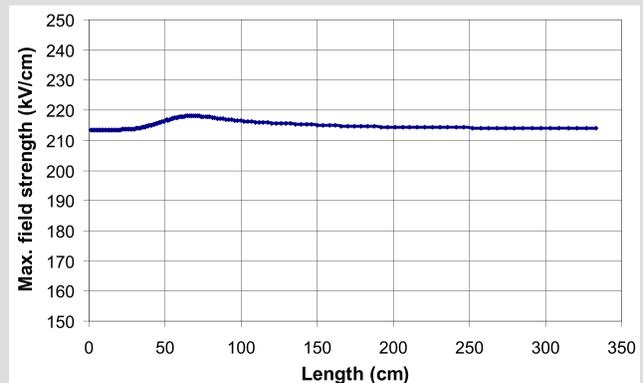
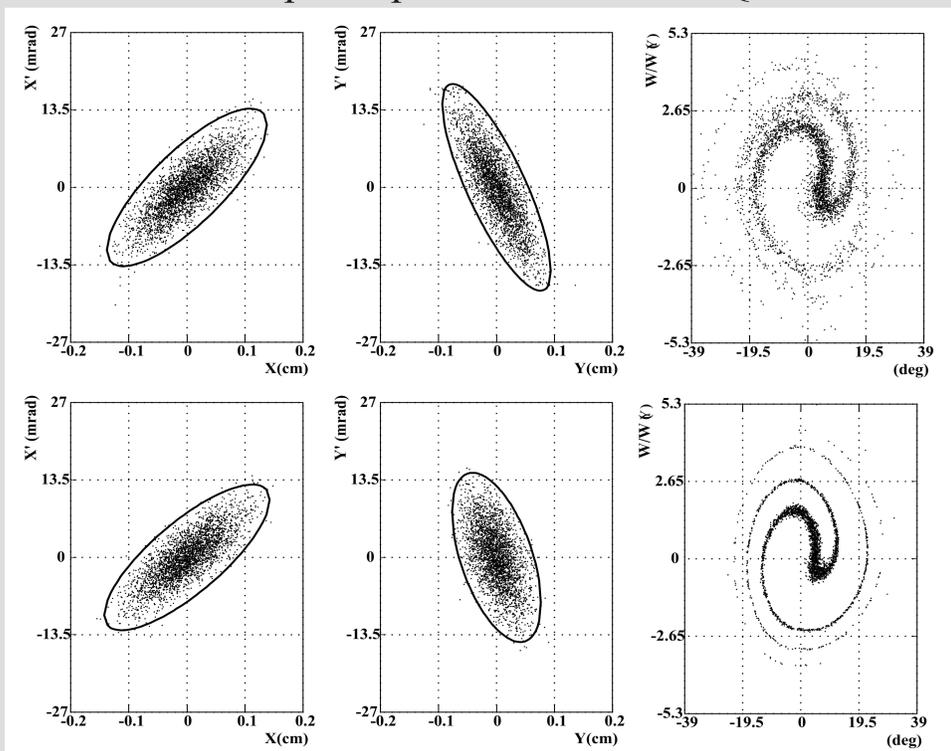
Main parameters of the CW RFQ

Ions	protons
Input energy	46 keV
Output energy	2.0 MeV
RF frequency	162 MHz
Intervane voltage	90 kV
Kilpatrick criterion	1.5
RFQ length	3.45 m
Average radius	5.30 mm
Vanes half-width	4.12 mm
Modulation	1.000 - 2.250
Synchr. phase	-90° - -33°
Beam current	10 mA
Beam emittance	60 mm·mrad
Particle transmission	> 99%

Macroparticle ensemble at RFQ entrance



Beam phase portraits behind RFQ



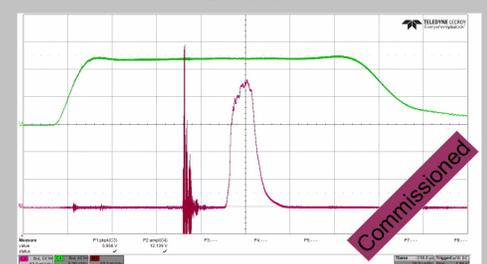
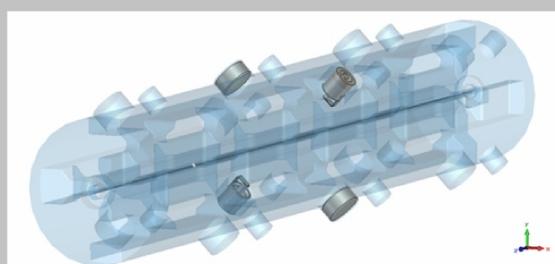
Conclusion

A new CW 2 MeV RFQ linac design is proposed. The maximum field strength is limited by the 1.5 Kilpatrick criterion. The machine can accelerate 10 mA proton beam with a particle transmission close to 100%. Beam dynamics simulations were performed by means of the codes BEAMDULAC and DYNAMION. The results of the codes are in good agreement. The electrodynamic simulations, as well as mechanical layout for a new CW RFQ cavity are in progress. Final optimization of the RFQ channel has been already started.

Recent MEPhI and ITEP RFQ Project

4-vane RFQ cavity with magnetic coupling windows successfully realized for new Nuclotron-NICA injector
S.M. Polozov et al., Proc. of IPAC-2016, pp. 941-943

Pulse length up to 200 μ s
Repetition rate up to 6 Hz
Max. electrical field 1.8 E_{kp}



2014

2015

2016

Commissioned

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