THE TUNING RF PARAMETERS OF 40 MHZ RFQ

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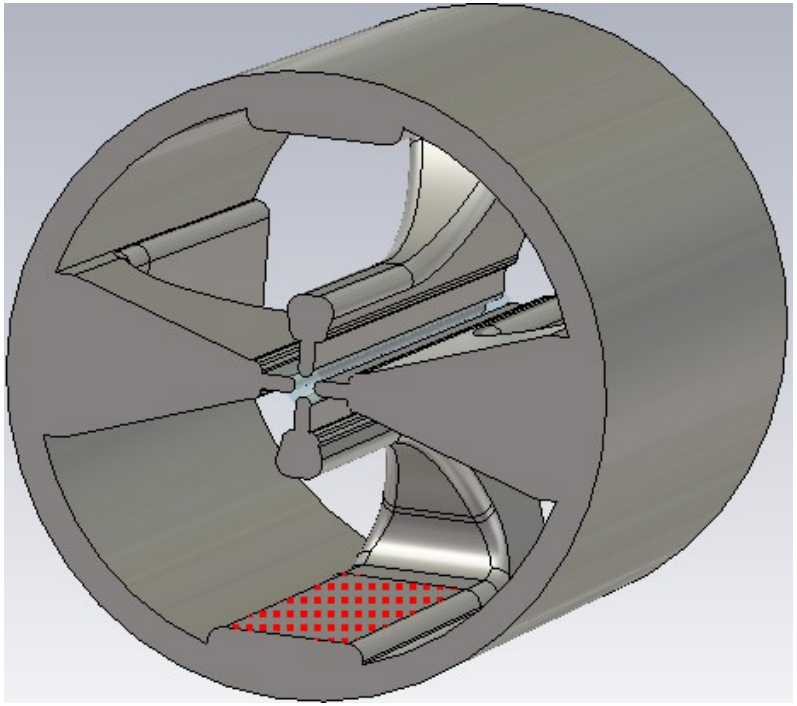
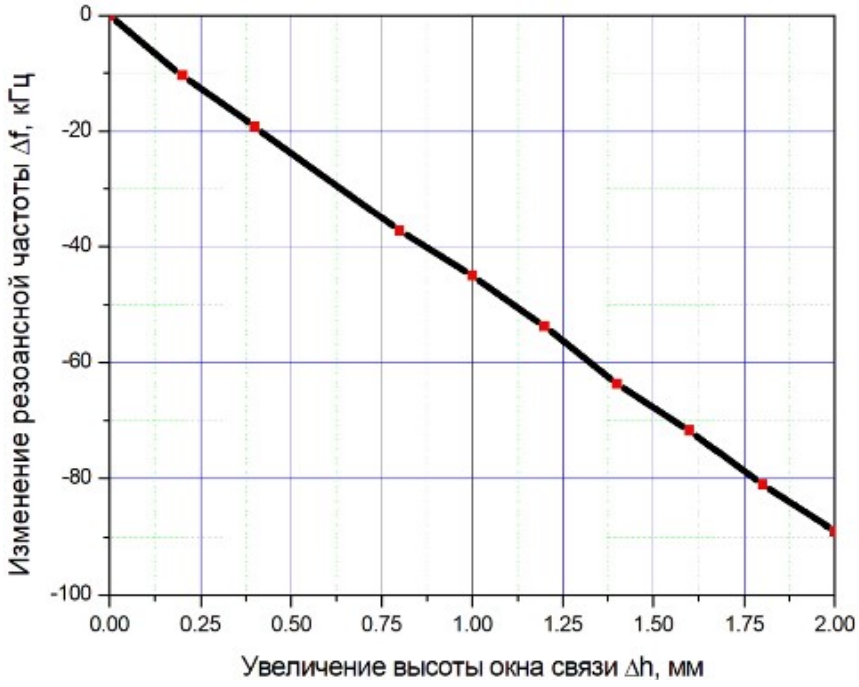
Abstract.

The new linac for A/Z = 8, output energy 4 MeV/u and 10 mA current is under development at NRC “Kurchatov Institute”-ITEP. The linac consists of Radio-Frequency Quadrupole (RFQ) and two sections of Drift Tube Linac (DTL).

The 40 MHz 11 meters long RFQ is based on a 4-vane structure with magnetic coupling windows. The paper presents results of tuning radio-frequency (RF) RFQ parameters.

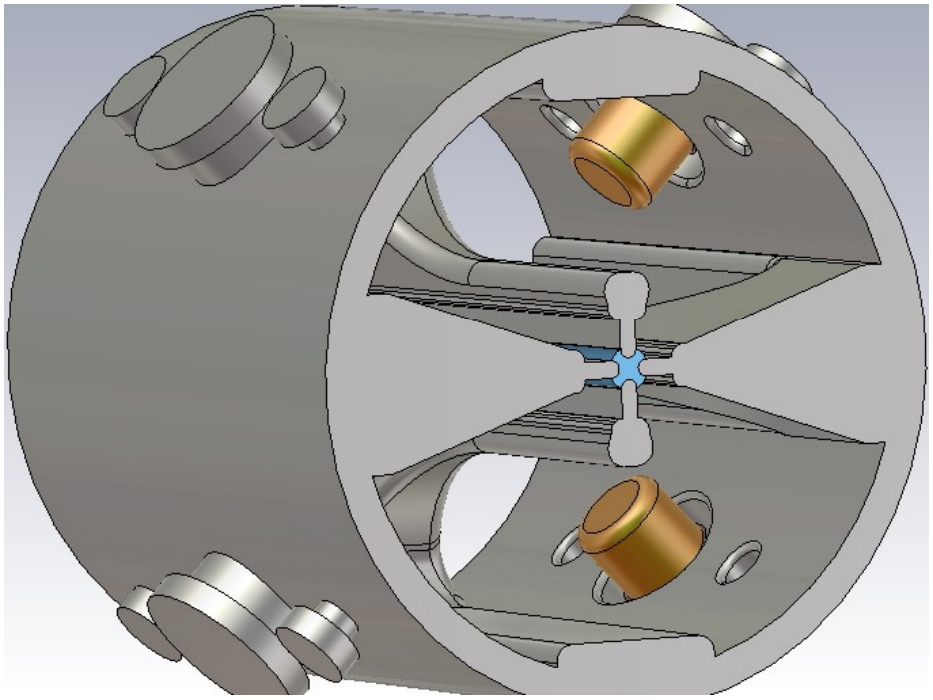
The RFQ linac RF parameters tuning under manufacturing stage

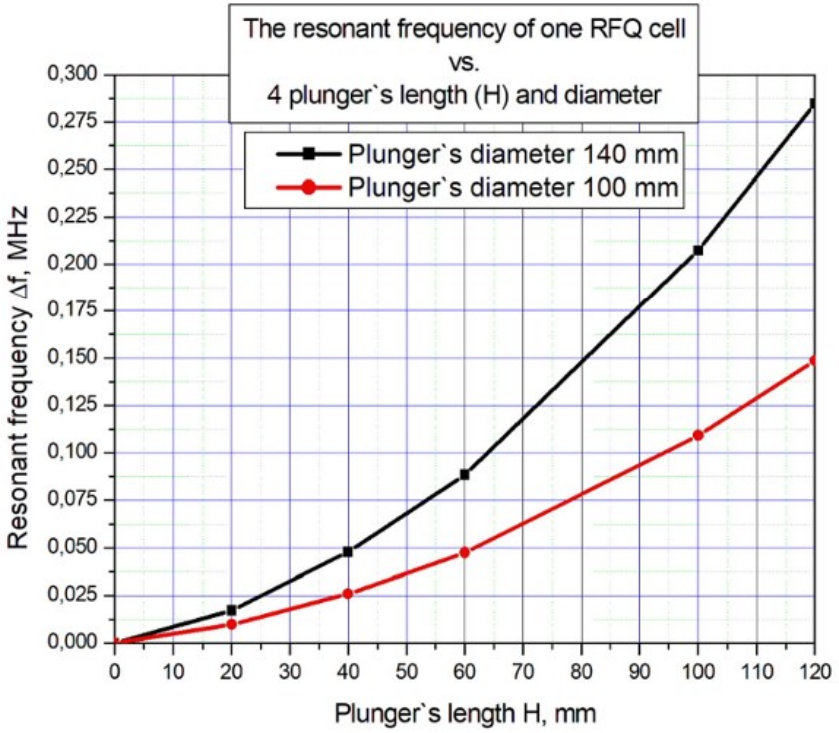




The gradient is equal to -45 kHz/mm. The same simulation was done for coupling window`s length. In this case the gradient is equal to -90 kHz/mm.

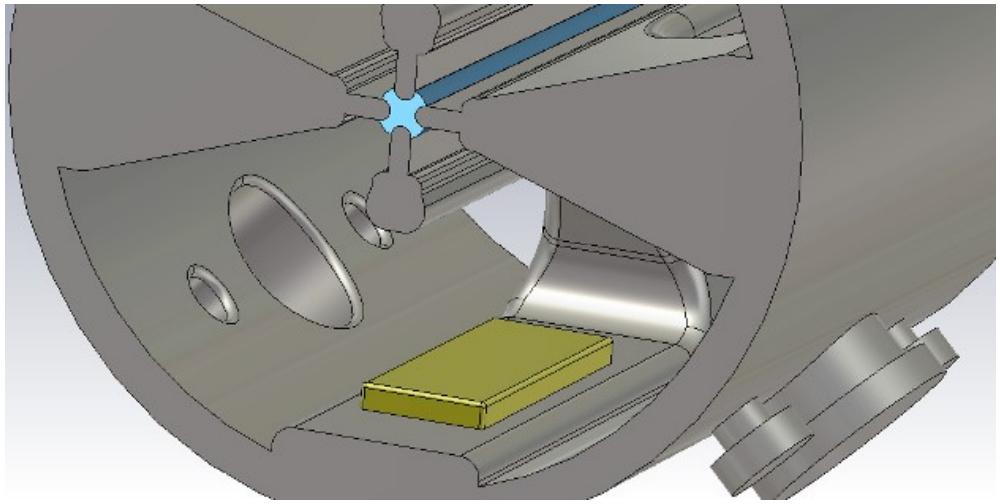
The RFQ linac RF parameters tuning by movable plungers

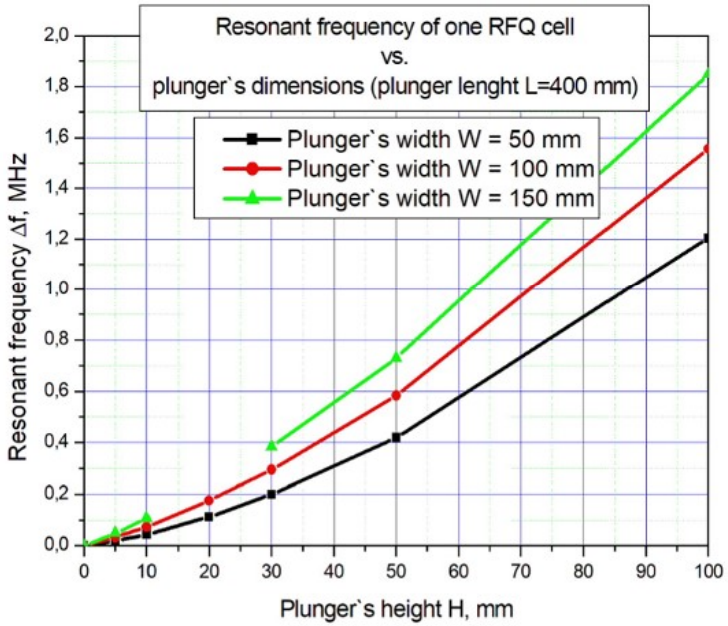




As an example, four cylindrical plungers with diameter 140 mm and length 100 mm injected into first cell would lead to non-uniformity RF field up to = 5% and resonant frequency change = 22 kHz. In order to compensate RF field non-uniformity the additional plungers should be injected into central (four plungers) and last sections (four plungers). In this case, the non-uniformity of the RF field would be decreased to = 2.4% while resonant frequency would be changed up to = 65 kHz

The RFQ linac RF parameters tuning by stationary plungers





If four stationary plungers with L*W*H = 400*150*100 mm mounted in the first section the RF field non-uniformity would be rise up to = 12% while frequency changing doesn`t exceed = 66 kHz. In order to compensate such non-uniformity the additional four stationary plungers (in each section) should be mounted in the last section and in two sections nearby central. In this case the non-uniformity of the RF field would be worse than ≤ 5% while frequency changing = 272 kHz.

THE RFQ LINAC RF PARAMETERS

The main dimensions of RFQ sections

Parameter	Value (mm)
Cavity inner diameter	860
Cavity length	1000
Vane base width	250
Vane base height	37.5
Vane top width	60
Vane window length	770
Vane window height	290
Vane tip height	30

The main RF RFQ parameters

Parameter	Value
Resonant frequency, MHz	40.625
Resonant frequency of the dipole mode, MHz	53
Inter-vane voltage, kV	170
Self quality factor	14000
RF power losses, kW/m	44
Full RF power losses, kW	484

Conclusion

Based on simulation the next conclusion could be done:

- The RFQ linac design should have elements which could be modified after primary cavity assembling and RF parameters measurement. Particularly, increasing coupling windows lead to decreasing resonant frequency. Thus, RFQ linac design should have a smaller coupling windows compared to simulated one;
- It is appropriate to tune RF field distribution by stationary plunger taking into account its influence to resonant frequency changing;
- The motorized plungers should be used for Automatic Frequency Tuning system (AFT).