Fermilab

LINAC14

PXIE RFQ BEAD PULL MEASUREMENTS*

TUPP047

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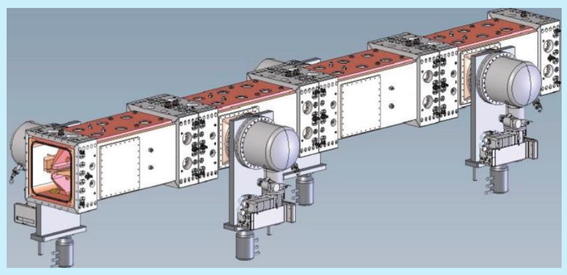
Introduction

- PXIE is a CW injector experiment of the new multi MW linac to be built at Fermilab.
- The project is composed of a H- ion source, LEBT section, RFQ, MEBT and two cryomodules of superconducting cavities for a final beam energy of 30 MeV.
- All the components will operate in CW regime having 100% duty cycle.

Input energy [keV]	30.00
Output energy[MeV]	2.10
Frequency [MHz]	162.50
Vane-vane voltage [kV]	60.00
Vane Length [cm]	444.60
RF Power [kW]	100.00
Beam Power [kW]	10.50
Duty factor	100%

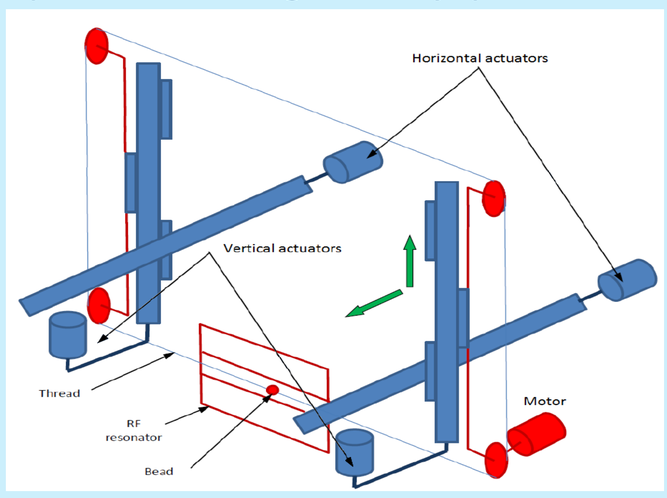
- The table reports RFQ parameters, the 3D model is shown below.



- The RFQ is being built at LBNL and is the product of collaboration between FNAL and LBNL, the bead pull measurements reported were taken on the dry fit of a single RFQ module before brazing.

Bead pull set up

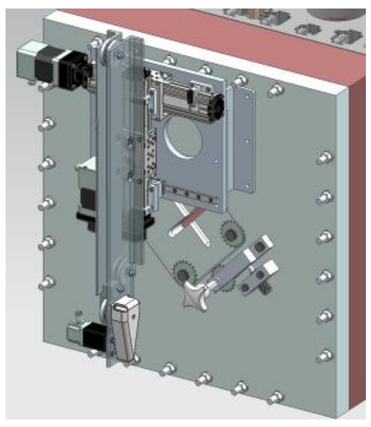
- A common measurement set up for RFQ bead pull uses 4 lines, a separate line for each quadrant
- The set up used for the measurements of PXIE RFQ module consists of one line capable of moving into any quadrant.

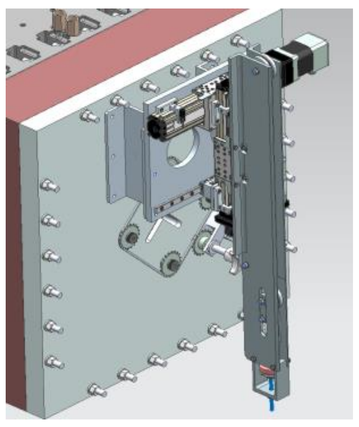


- Reduction of number of lines necessary.
- Possibility to run diagonal string scans.
- Possibility of taking measurements near and on RFQ axis, if bead diameter small enough.
- Two support plates, both with independent horizontal and vertical positioning systems moved by stepper motor with an anti-backlash screw.
- The bead line is moved by a stepper motor on the entrance plate.
- The tension on the line is monitored by a load cell to allow sag correction.
- A NWA reads the phase shift due to the bead\string motion in the RF volume.

Control and data acquisition

- All the motors and the load cell are controlled using LabVIEW®; in addition it provides real time data acquisition from the network analyzer (NWA).
- The motors and the load cell communicate with the computer via USB/RS485 serial interface, while the NWA is controlled via GPIB protocol.
- Having different buses allows parallel communication with all the instruments.
- In addition the program allows data processing, and includes a correction for sag error of the bead along the phishing line.



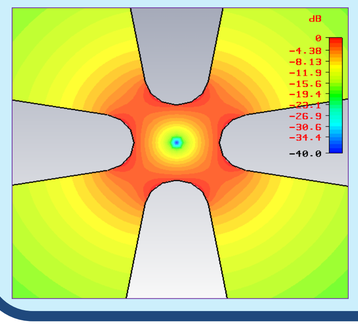


3D model of the bead pull system: motors and mechanical supports.

PXIE RFQ module 2 (out of 4 total) bead pull measurement set up at LBNL.

Electric axis measurements

- In order to measure the field amplitude of each quadrant, it is preferable to refer all the diagonal offsets with respect to the electric center.
- After a first, visual alignment, three string scans were performed, moving from -5 mm to 5 mm at ±45 degrees, while the NWA recorded the phase shift.
- The first scan with bead outside the structure
- The second and third positioning the bead just inside the two matchers plate.

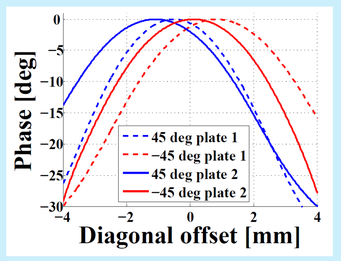


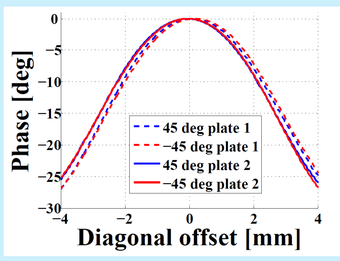
- Electric field distribution at the center of the RFQ, X–Y section.

*under Contract No. DE-AC02-07CH11359

Electric axis results

- Given the field distribution phase vs offset curve has max in the center.



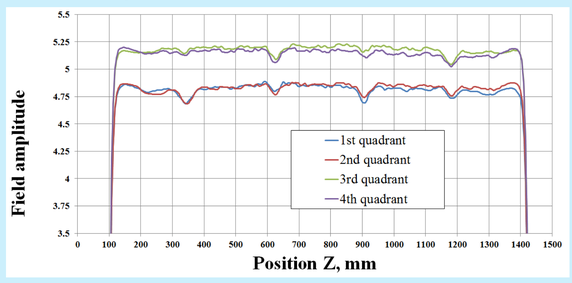


- Phase vs offset after visual and electric alignment.

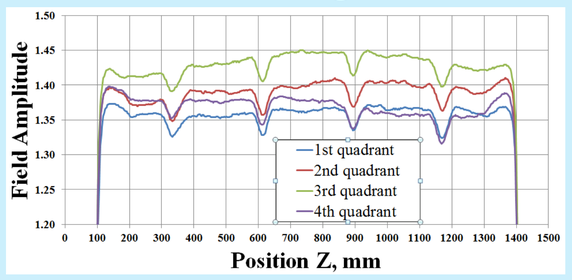
	Visual align.		Electric align.	
Diagonal offset	Plate1	Plate2	Plate1	Plate2
45 deg. [mm]	-0.52	-1.1	0.13	-0.07
-45 deg. [mm]	0.84	0.1	0.16	-0.03

Quadrants field amplitude

- Quadrant field flatness (FF) gives information about the frequency along the RFQ length and the symmetry between quadrants.



- Data taken at R= 30 mm, bead diameter= 9.5 mm after visual alignment: FF 93%.



- Data taken at R= 30 mm, bead diameter= 4 mm, after electric alignment: FF 94.6%.

Electric field on axis

- A bead having diameter 4 mm allows measurements up to 1 mm offset inside the vane tips area.