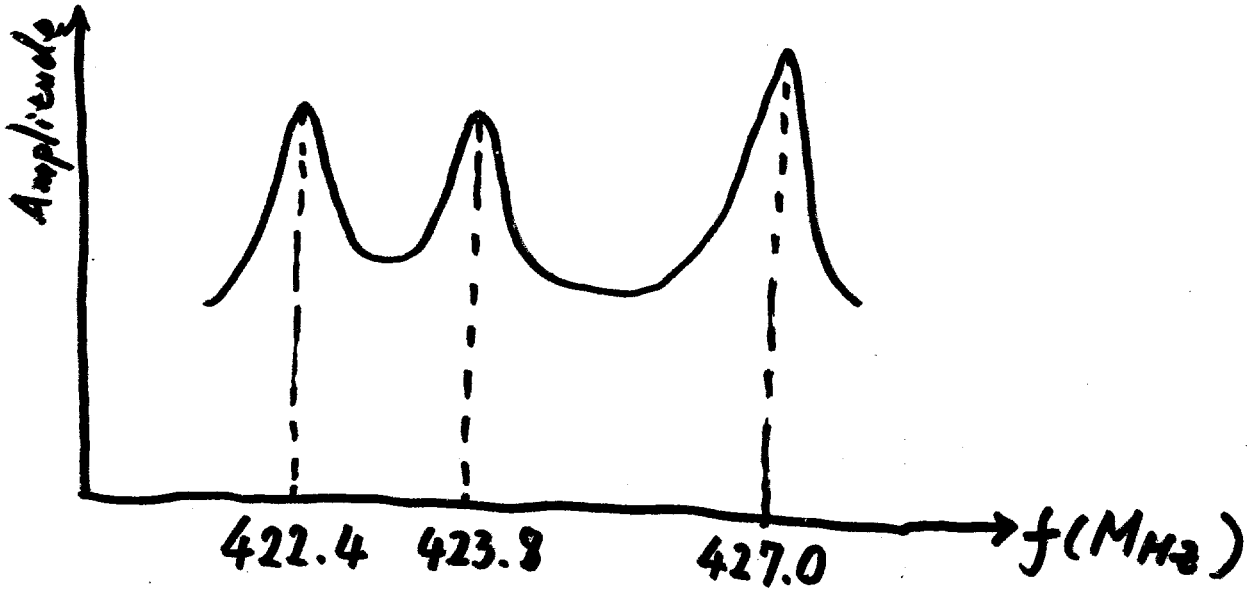
Discusion about First Measurement of 425 MHz RFQ Linac at Fermilab (Bosi Wang 10/23/87)

1. Main Parameters of the RFQ Linac
2. Measurement of Mode Spectra and Field Flatness
3. Problems and Further Works

---

2. Measurement of Mode Spectra and Field Flatness



measured mode spectra

RFQ-Based Thermal Neutron Source Parameters

1. Main Parameters

Particle	D+
Energy	1 MeV
Pulse Repetition Rate	360 Hz
Pulse Length	28 us
Duty Factor	1 %
Current (peak)	5 mA
Current (average)	50 uA
Injection Energy	20 keV
Injection Current	6 mA
RF Power (peak)	75 kW
RF Power (average)	750 W
Beam Power (peak)	5 kW
Beam Power (average)	50 W
Thermal Neutron Yield	5 x 10 9 n/s
Length	63.0 cm
Radius of cavity	7.874 cm

③

$$\frac{E}{E_0} = 10^{4/20} = 1.5848$$

Longitudinal Flatness:

$$\frac{\bar{E}}{E_0} = \frac{1.995 + 1.5848}{2} = 1.7899$$

$$\frac{\Delta E}{\bar{E}} = \frac{1.995 - 1.5848}{1.7899} = 23\%$$

$$20 \log \frac{E}{E_0} = (xx)db$$

$$10 \log \frac{P}{P_0} = (xx)db$$

$$E = E_0 \times 10^{\frac{(xx)db}{20}}$$

$$\frac{E}{E_0} = 10^{(xx)db/20}$$

$$6db: \frac{E}{E_0} = 10^{\frac{6}{20}} = 1.995$$

$$3db: \frac{E}{E_0} = 10^{3/20} = 1.412$$

$$\frac{\bar{E}}{E_0} = (1.995 + 1.412)/2 = 1.7036$$

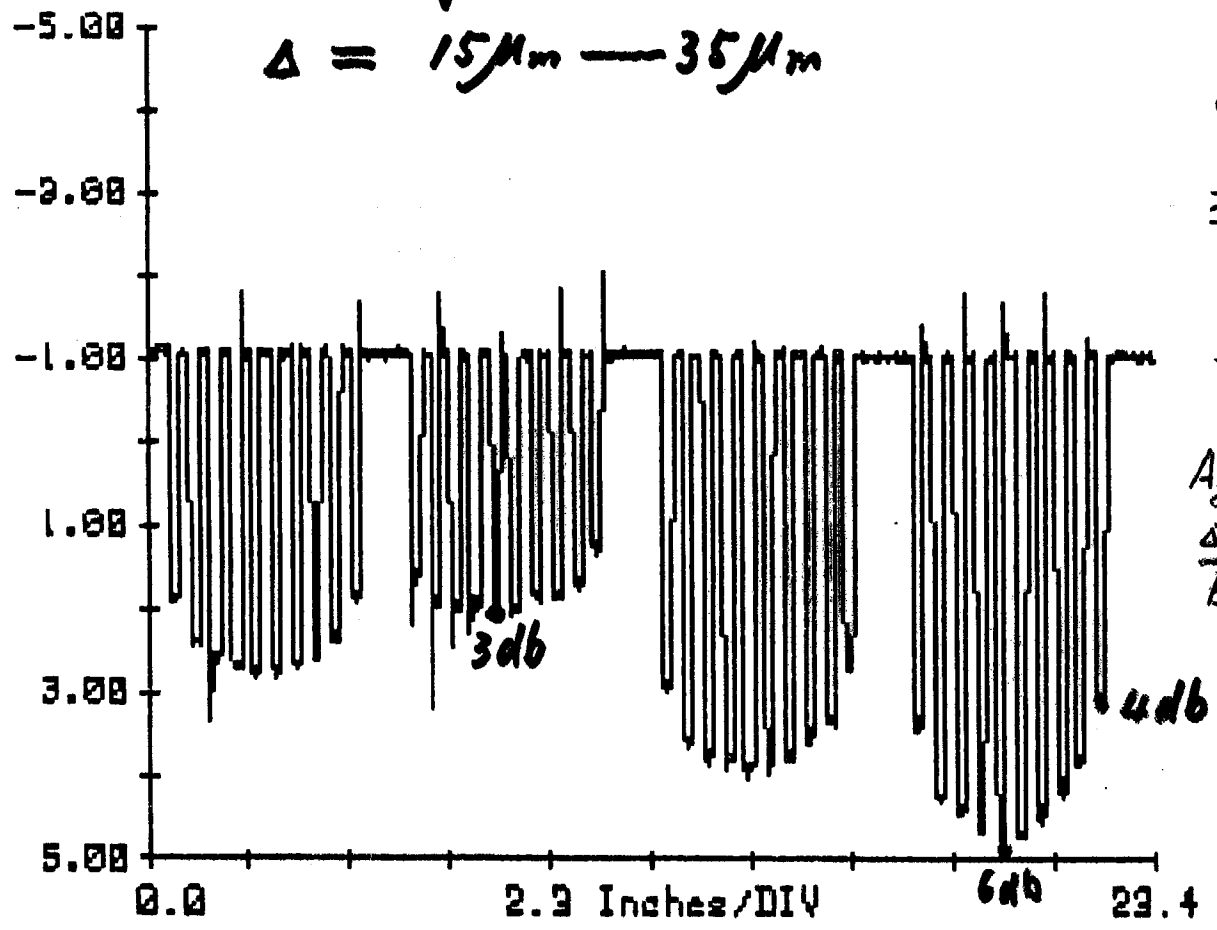
Azimuthal Flatness:

$$\frac{\Delta E}{\bar{E}} = \frac{1.995 - 1.412}{1.7036} = 34\%$$

FAA RFQ Cold Test Measurements at FERMILAB.

Vane Alignment Errors:

$\Delta = 15\mu m$ — $35\mu m$



FREQUENCY= 427.587000
20 Oct 1987
FAA RFQ Cold Test Measurements at FERMILAB.

NUMBER OF SAMPLES=1000
18:08:47

S21-dB LOSS

4

Longitudinal Flatness:

$$\bar{E} = \frac{(60+50)}{2} = 55$$

$$\frac{\Delta E}{\bar{E}} = \frac{10}{55} = 18\%$$

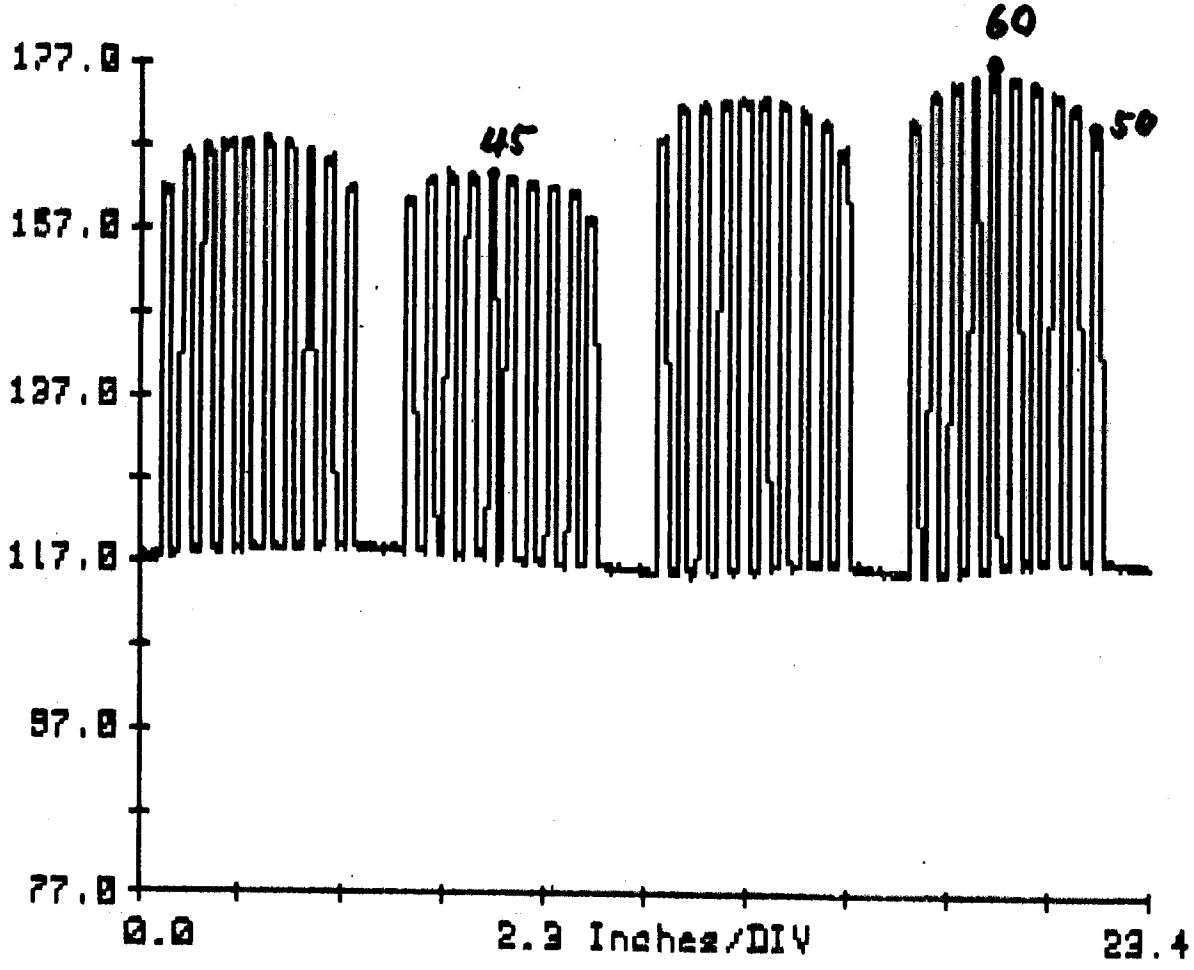
Azimuthal Flatness:

$$\Delta E = (60+45)/2 = \cancel{50}\ 52.5$$

$$\frac{\Delta E}{\bar{E}} = \frac{60-45}{52.5} = \cancel{\frac{10}{55} = 40\%}$$

$$= \frac{15}{52.5} = 29\%$$

FAA RFQ Cold Test Measurements at FERMILAB.



3. Problems and Further Works

Mode discrimination

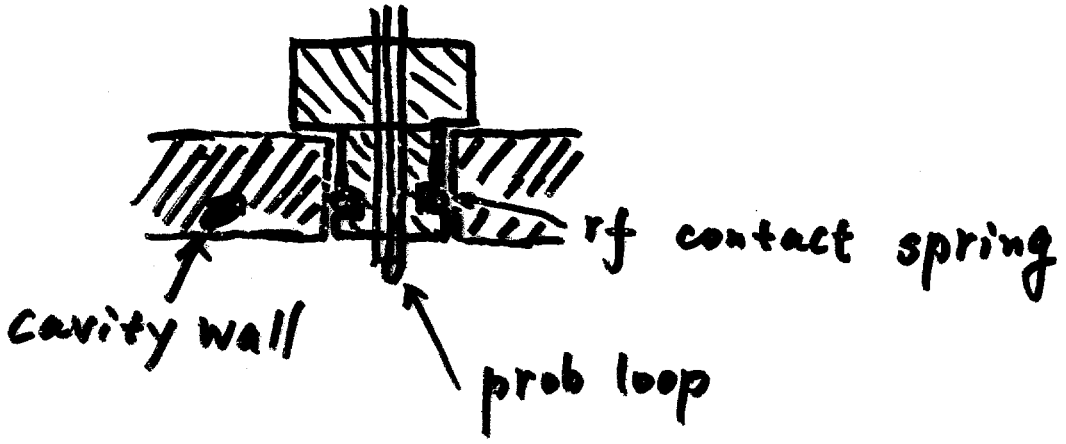
Results calculated by SUPERFISH show that frequency of dipole mode lower than that of quadrupole mode.

Results measured in several cases (Japan and my own experiment study) show that the frequency of dipole mode higher than that of quadrupole mode.

According to the theory of circular periodic system if the coupling between adjacent quadrants is magnetic the dispersion curve will be backward wave type, then the frequency of dipole mode will be higher than that of quadrupole mode; if the coupling between adjacen quadrants is electrical the dispersion curve will be forward wave type then the frequency of dipole mode will be lower than that of quadrupole.

So the further work is :

- to discriminat the three modes
- in order to do this the new driven and signal pick-up probs should be designed. to make the prob be tightly contacted with metalic surface of the RFQ cavity.



- using vector voltmeter to precisely determine the field pattern of dipole and quadrupole modes
- in the measurements the noise in the signal should be eliminated.