TUNABLE Q-FACTOR
RF CAVITY

Mario D. Balcazar

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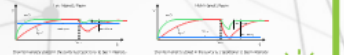

$$Q = \frac{E}{P}$$

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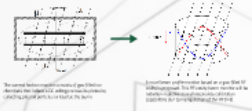

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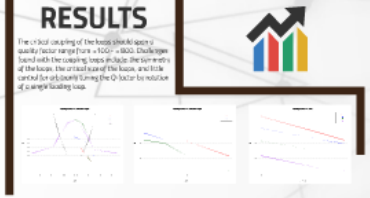

NEUTRINO BEAM RECIPE

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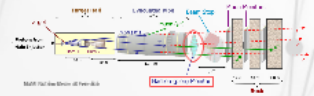

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IMPROVED DESIGN

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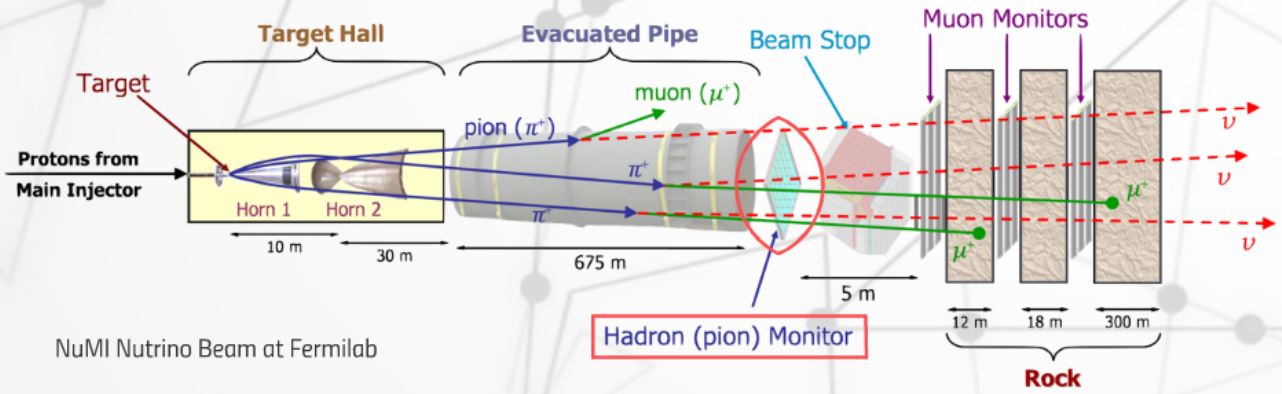
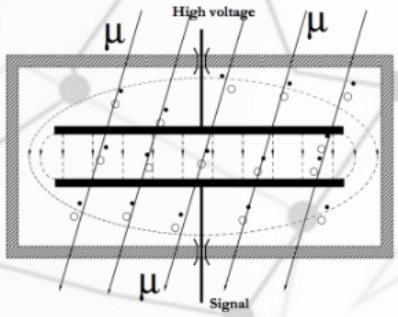
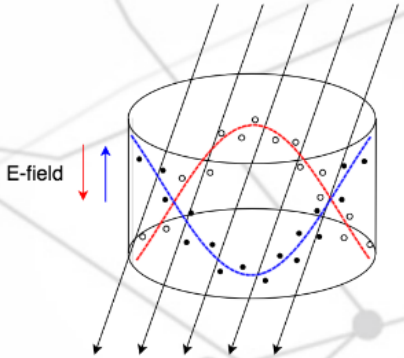


NuMI Nutrino Beam at Fermilab

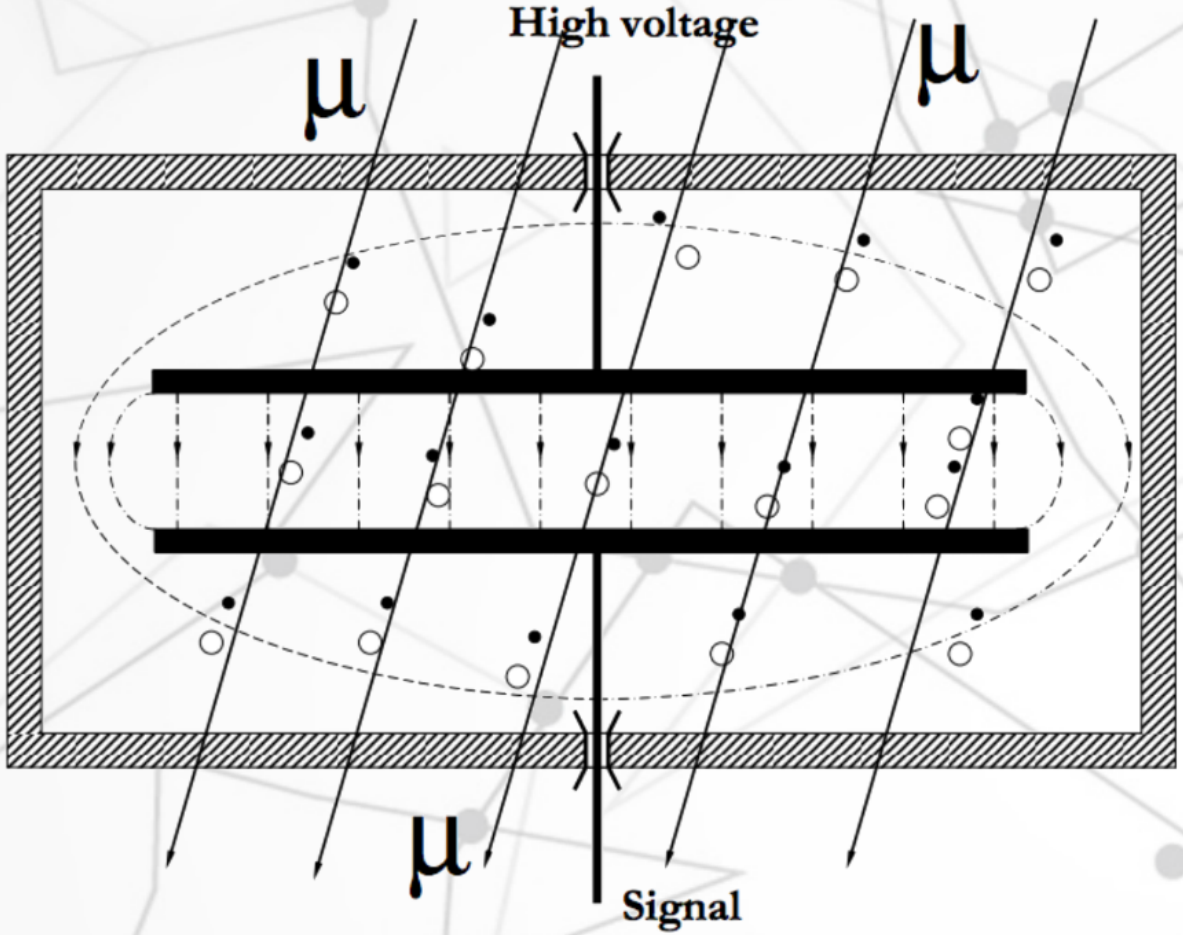
HADRON MONITOR



The current hadron monitor consists of gas-filled ion chambers that induce a DC voltage across its plates by collecting plasma particles ionized by the beam.



A novel beam profile monitor based on a gas-filled RF cavity is proposed. This RF cavity beam monitor will be radiation-resistive as well as provide calibration capabilities due to manipulation of the RF field.



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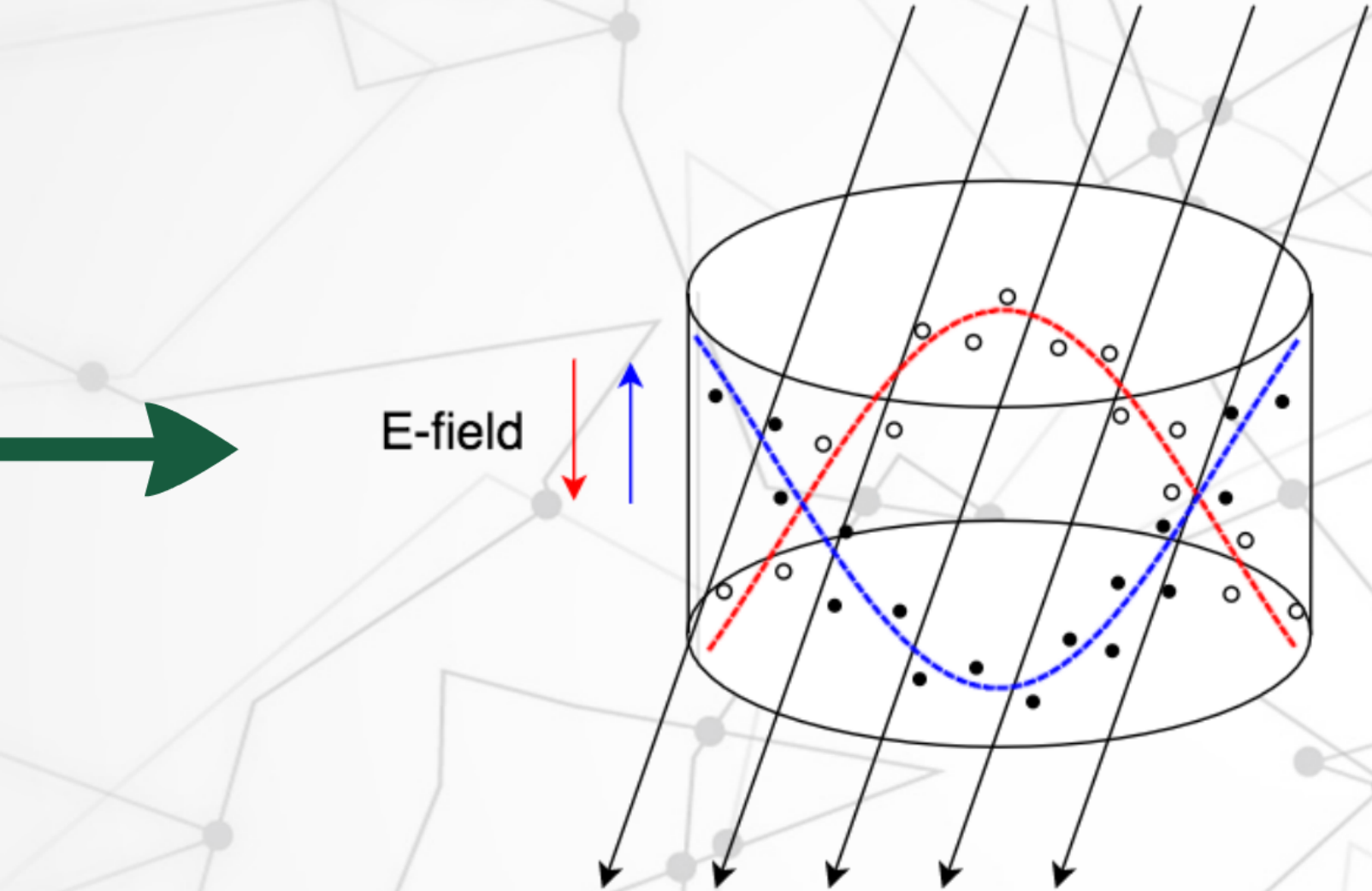

A novel beam profile monitor based on a gas-filled RF cavity is proposed. This RF cavity beam monitor will be radiation-resistive as well as provide calibration capabilities due to manipulation of the RF field.

- Study RF Cavity
- Accuracy of signal vs Q-factor
- Improve Design

TUNABLE Q-FACTOR RF CAVITY

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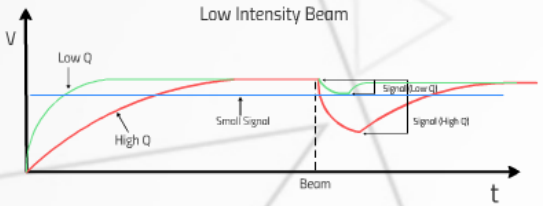
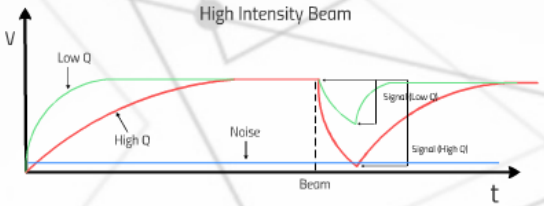


Change in energy stored in the cavity is proportional to beam intensity.



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$$Q = \frac{E}{P}$$

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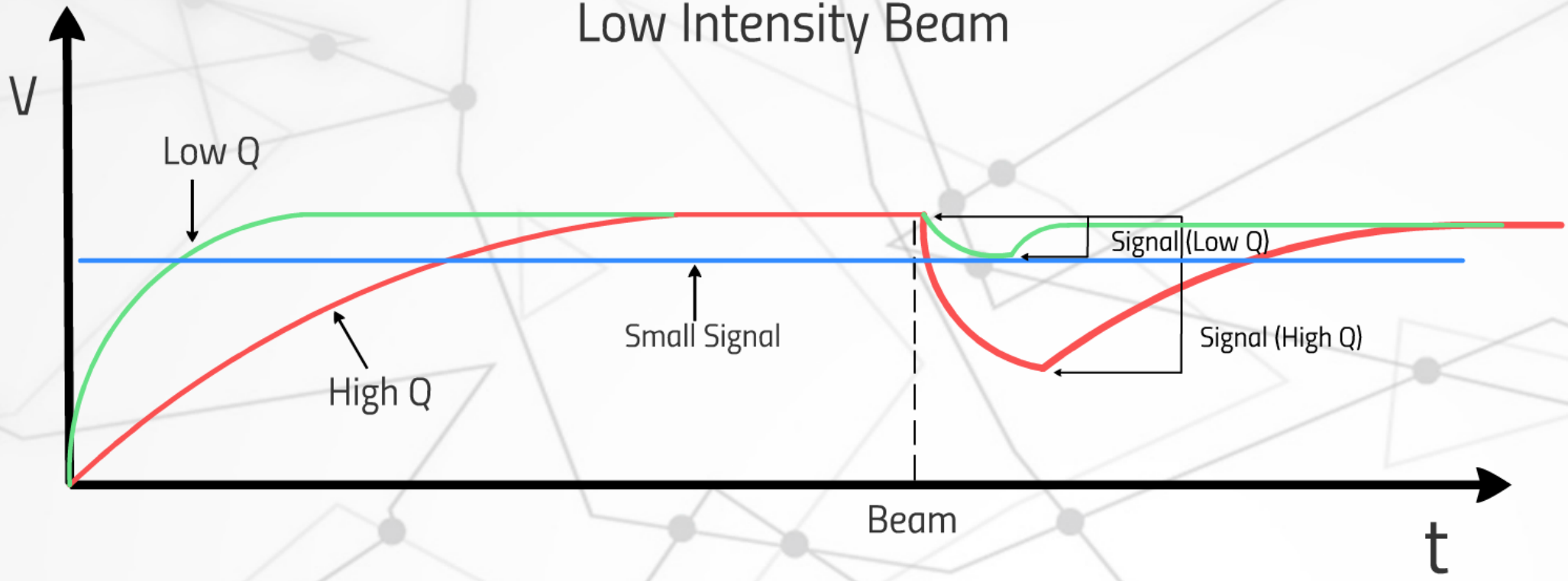

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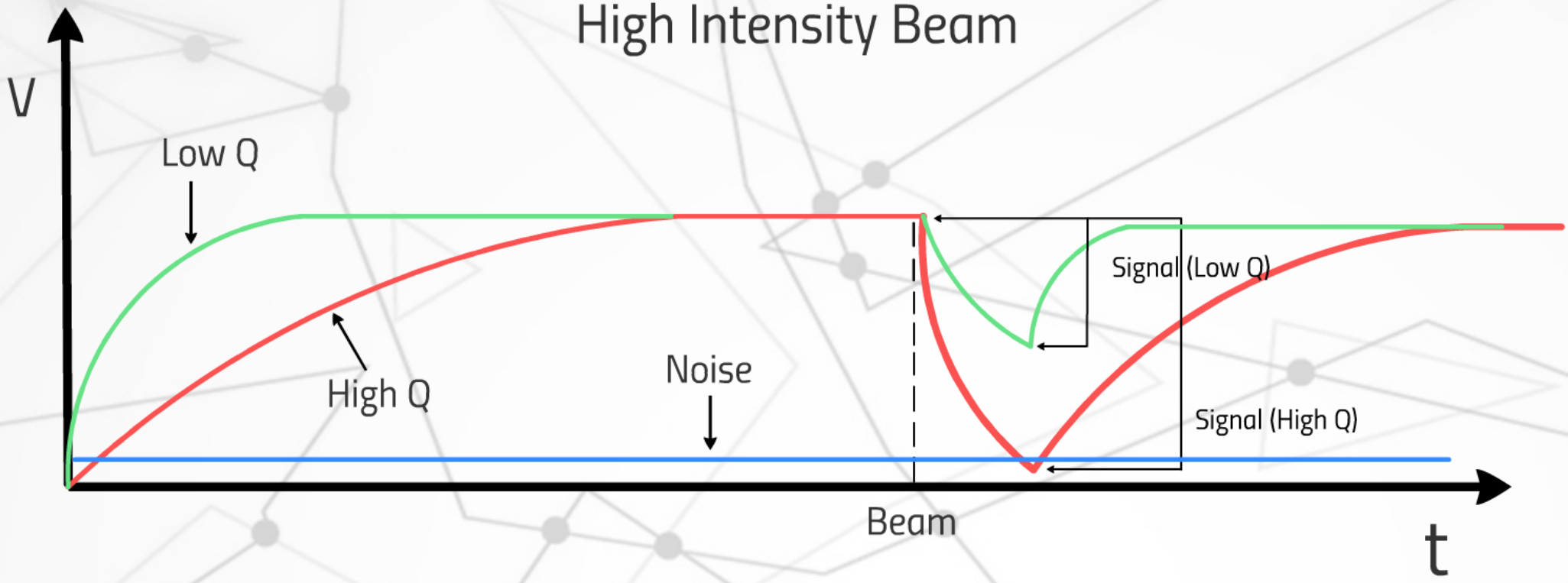
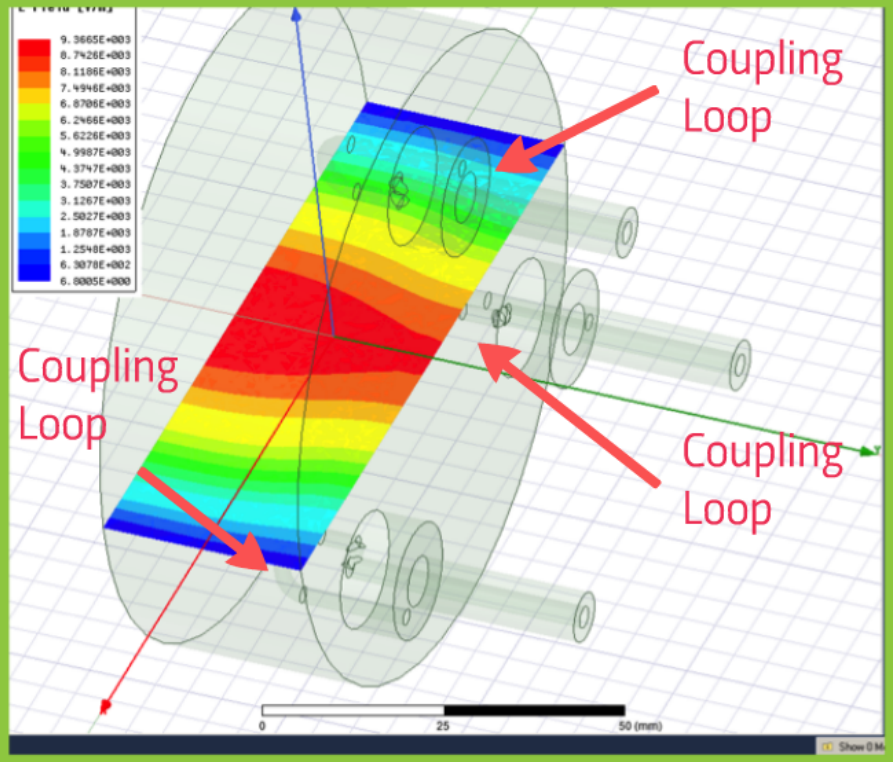
High Intensity Beam

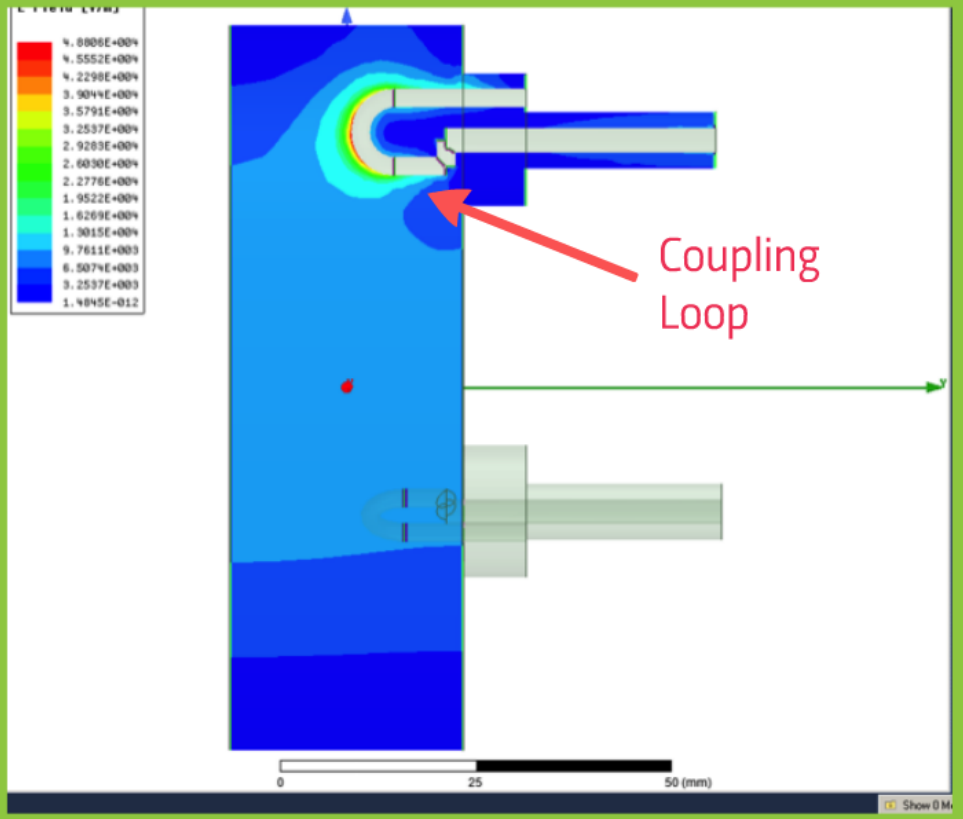


Change in energy stored in the cavity is proportional to beam intensity.

Conceptual Design of tunable Q-factor RF cavity.

The pillbox cavity excites the fundamental TM010 electromagnetic mode with a resonant frequency of 2.45 GHz.





CALIBRATION TEST

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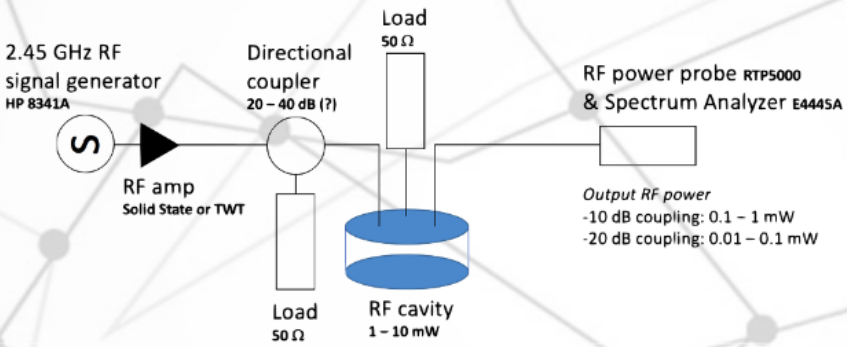
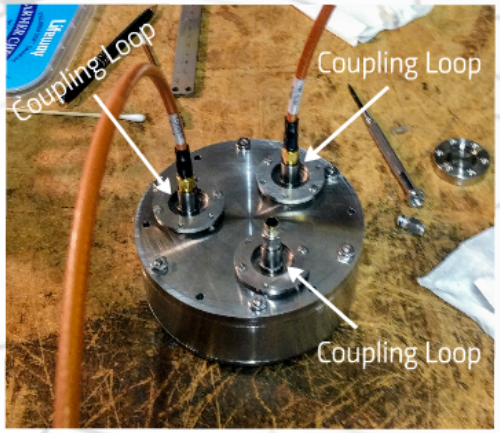
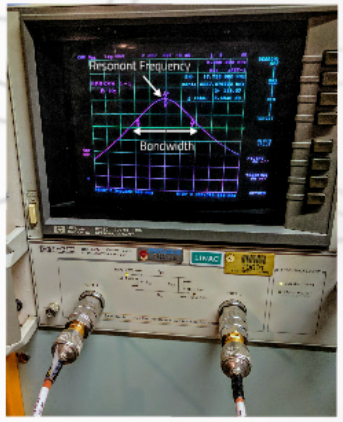
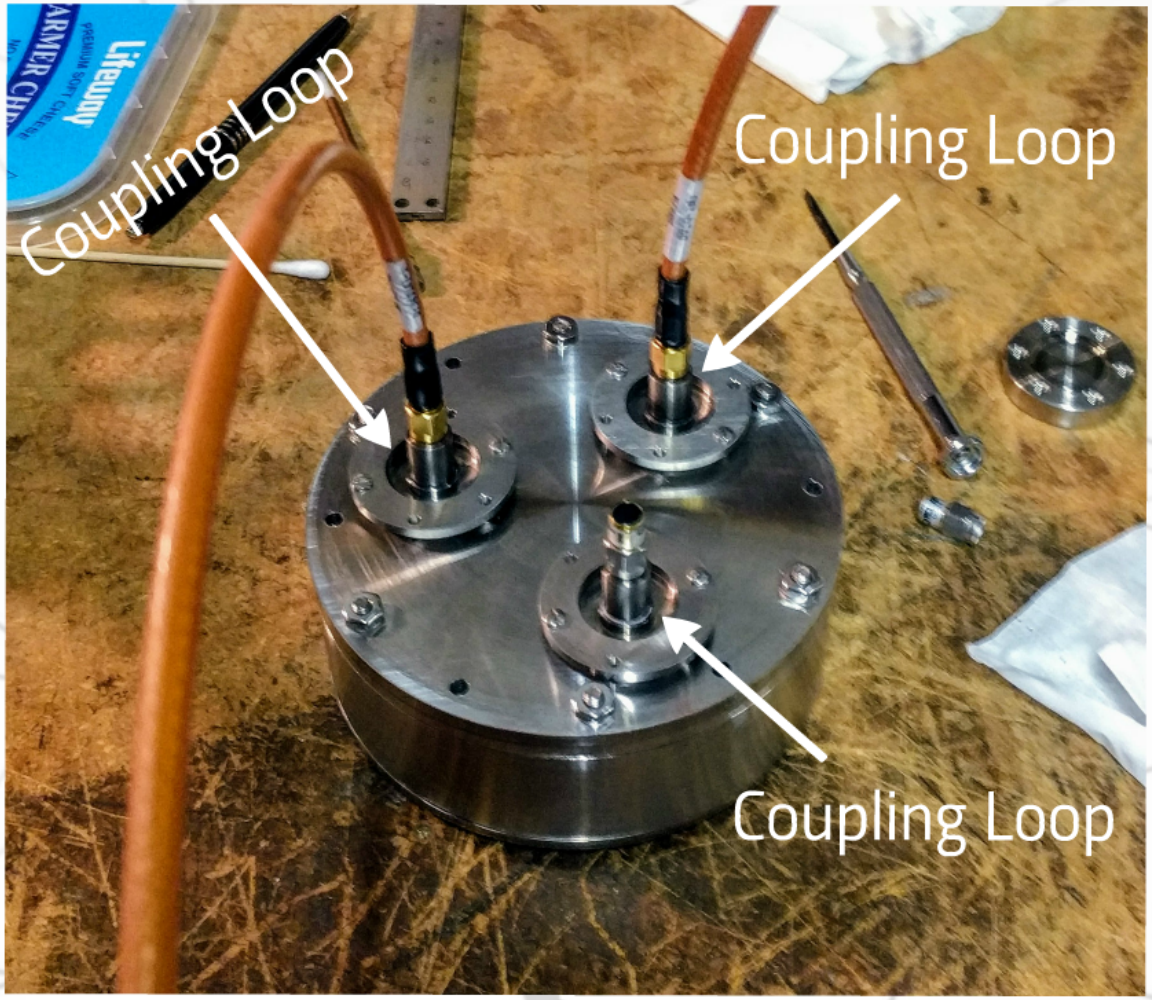
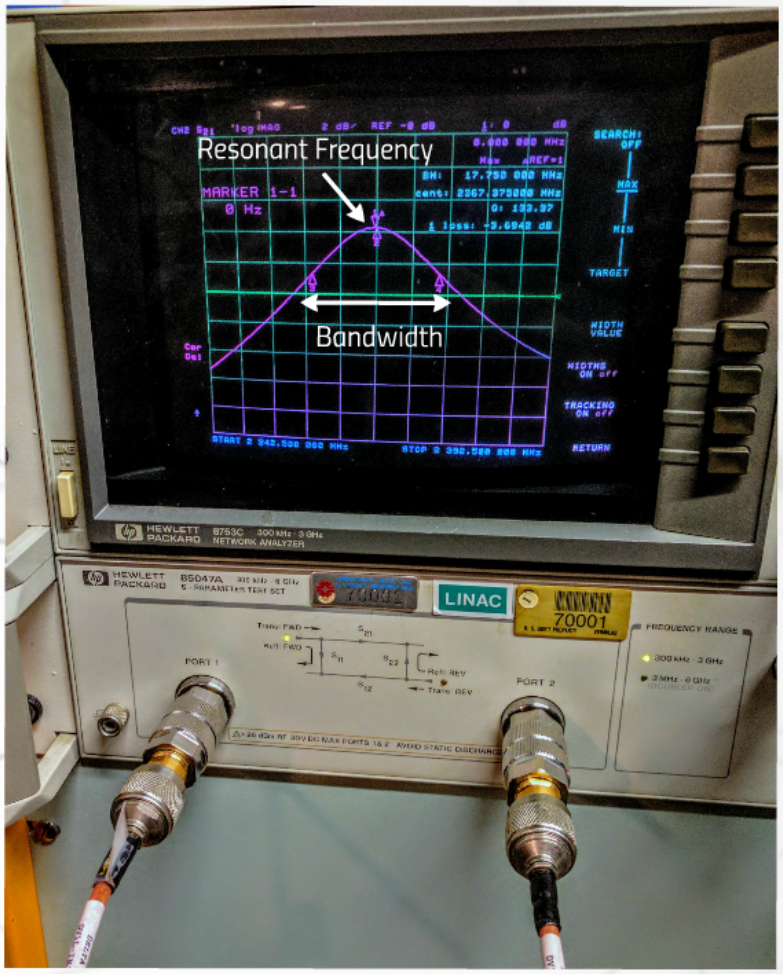






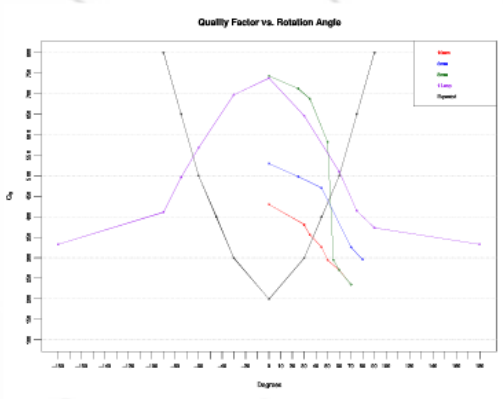
ed in order to apply more coupling strength and tune

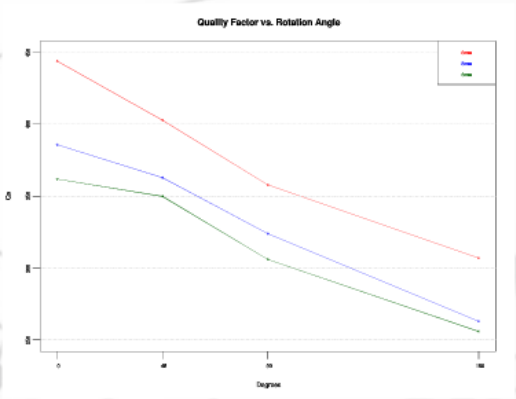


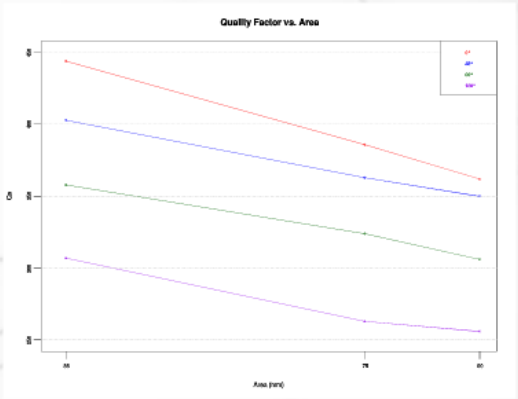


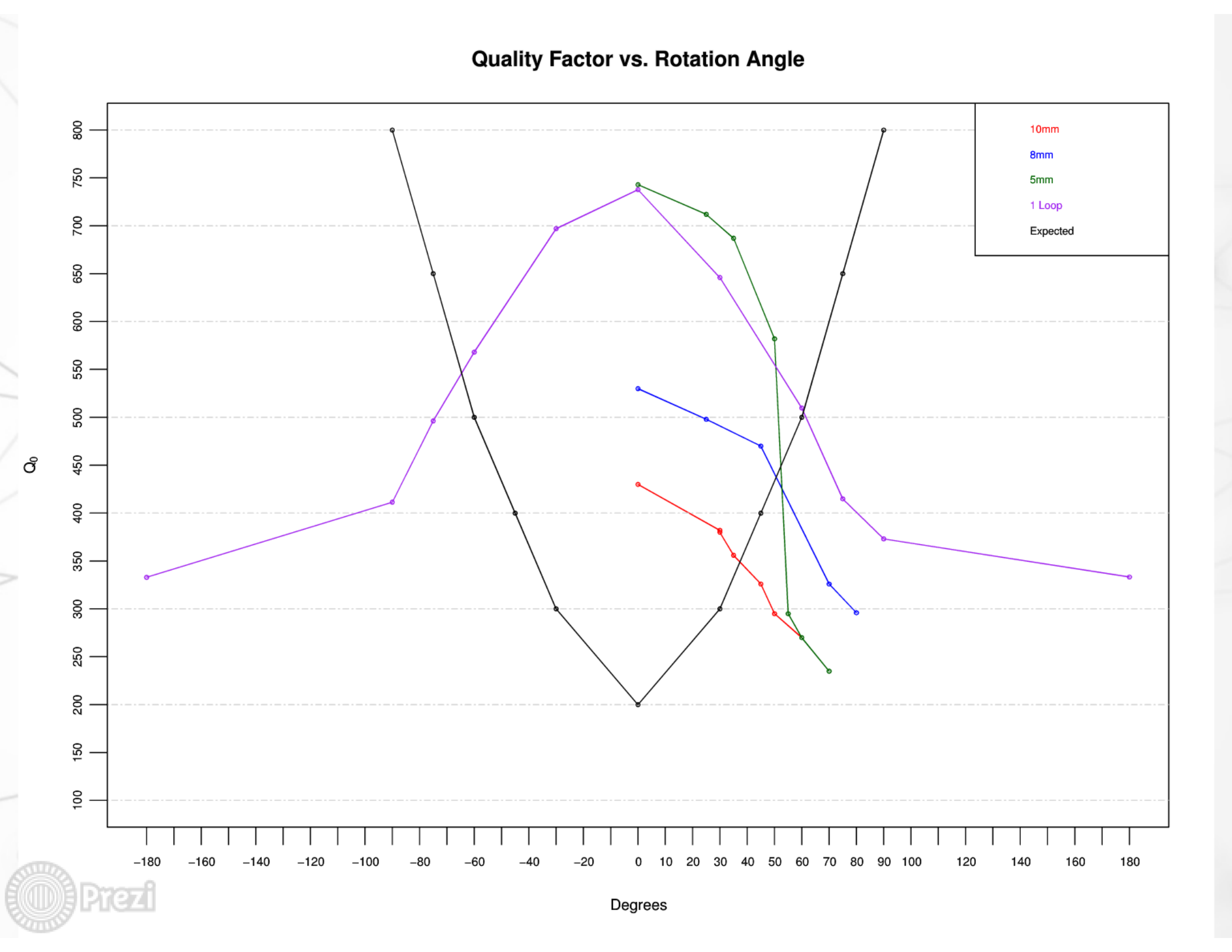
RESULTS

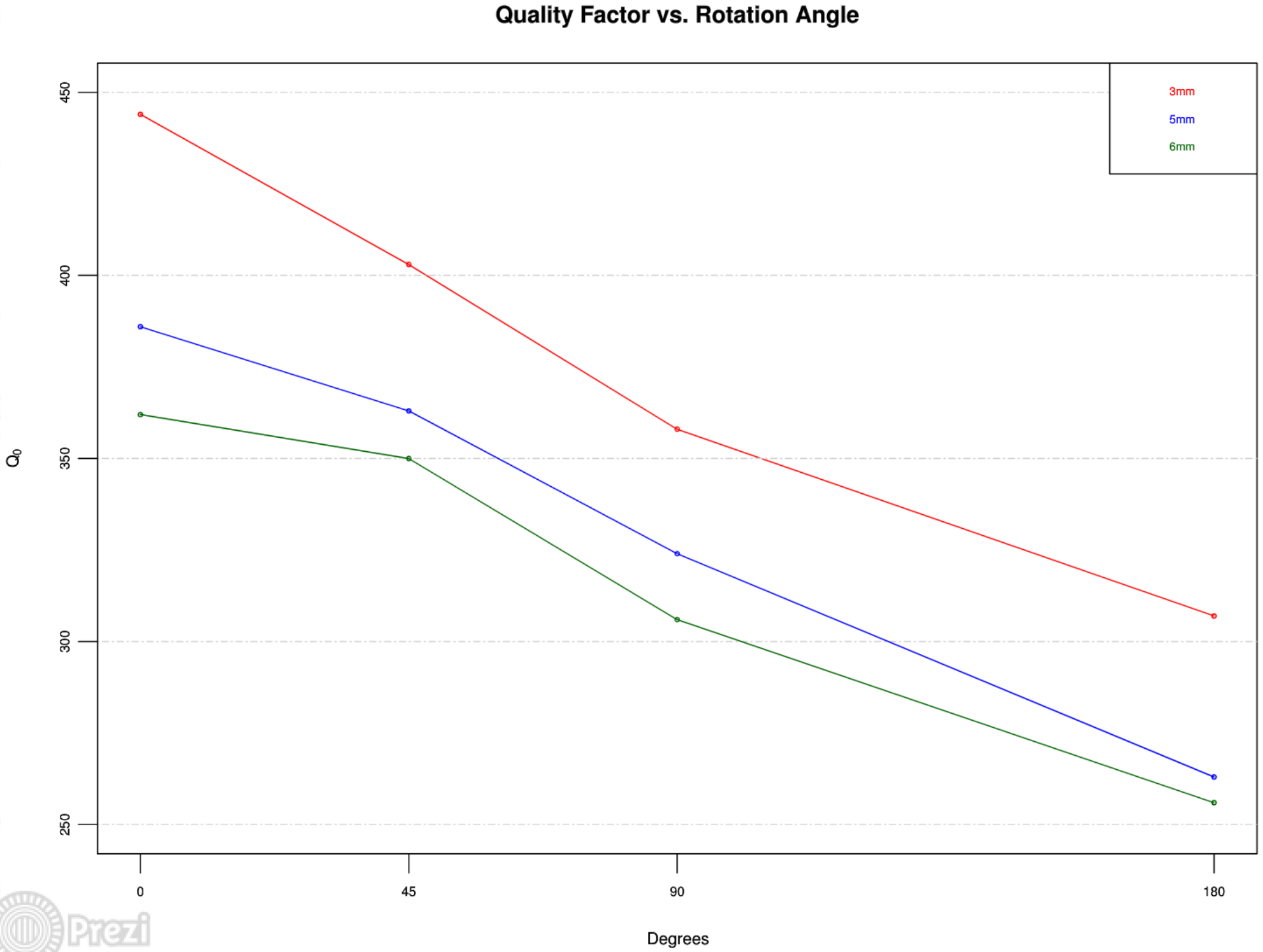
The critical coupling of the loops should span a quality factor range from ≈100 - ≈ 800. Challenges found with the coupling loops include: the symmetry of the loops, the critical size of the loops, and little control for arbitrarily tuning the Q-factor by rotation of a single loading loop.

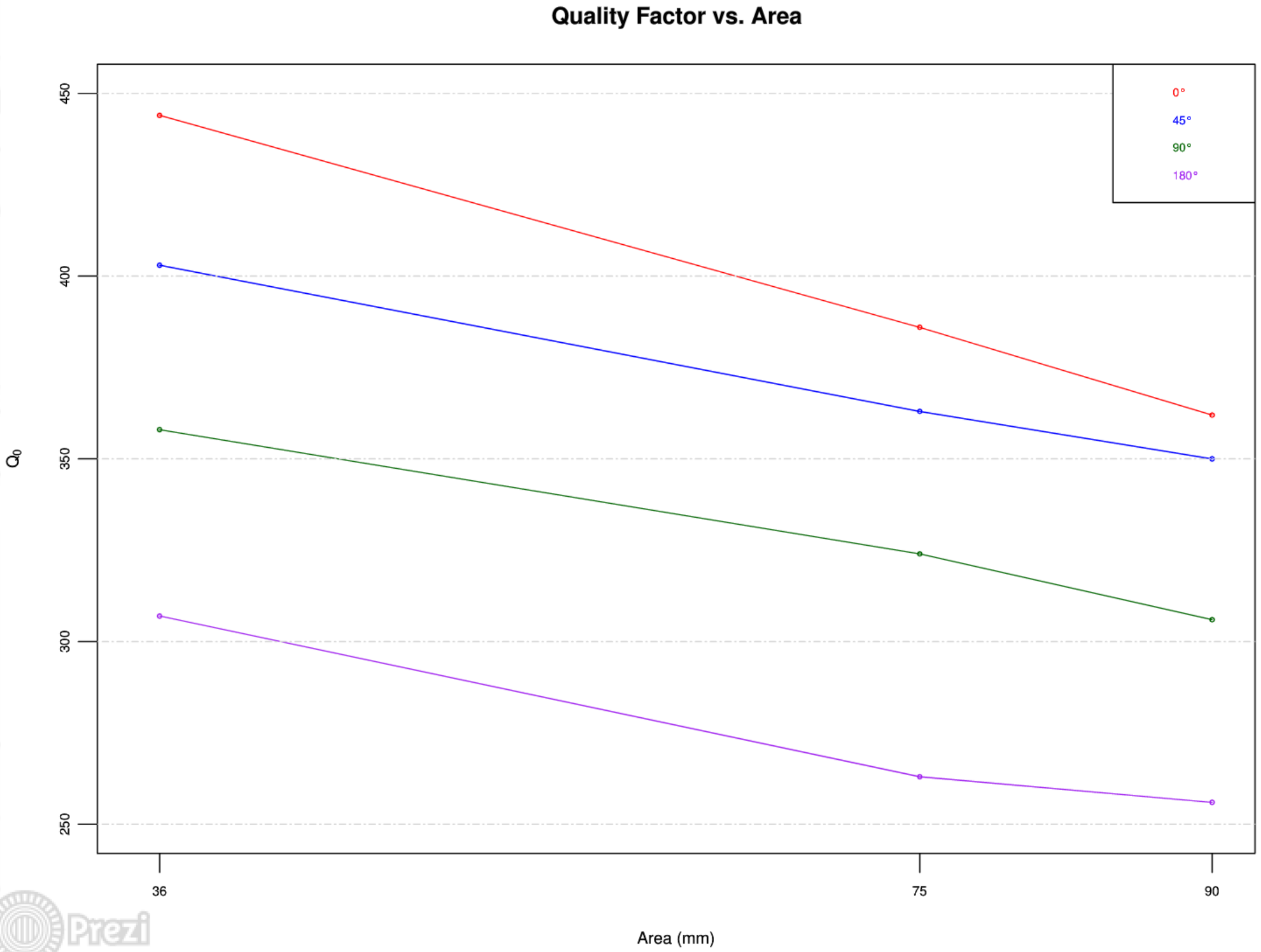







Quality Factor vs. Rotation Angle
10mm
8mm
5mm
1 Loop
Expected
Q_0
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
−180
−160
−140
−120
−100
−80
−60
−40
−20
0
10
20
30
40
50
60
70
80
90
100
120
140
160
180
Degrees


Quality Factor vs. Rotation Angle
3mm
5mm
6mm
450
400
350
300
250
Q_0
0
45
90
180
Degrees


Quality Factor vs. Area
0°
45°
90°
180°
450
400
350
300
250
Q_0
36
75
90
Area (mm)

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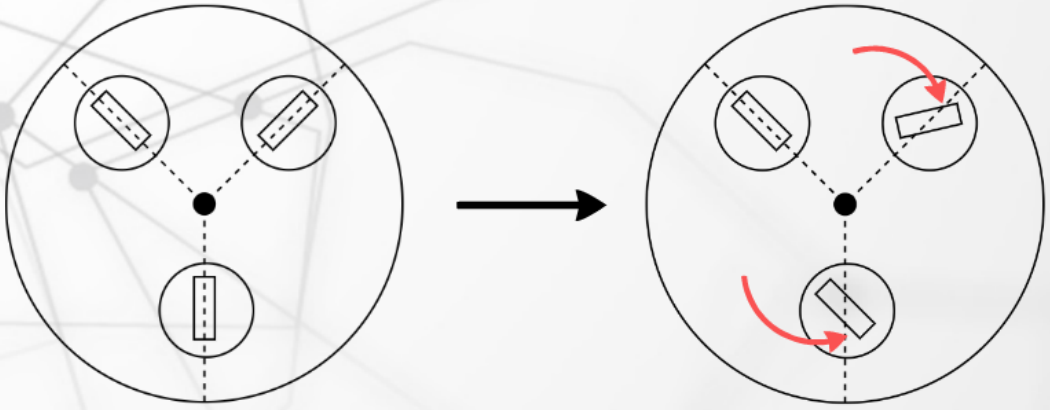

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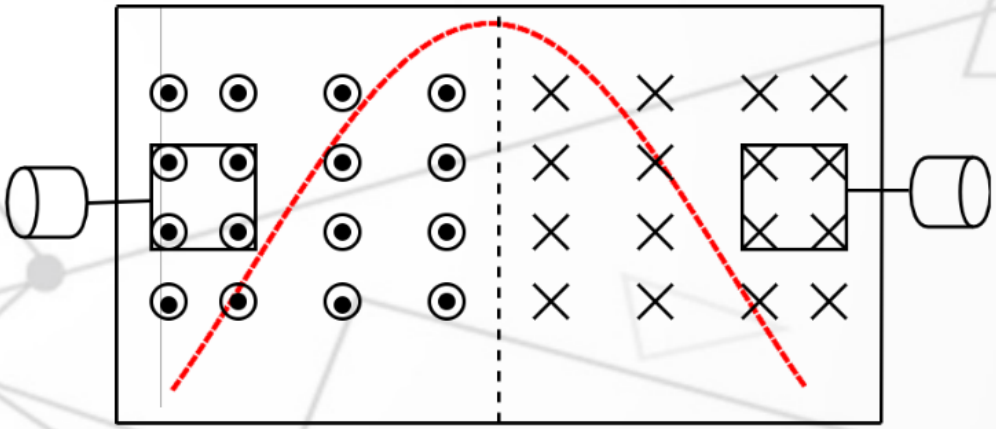

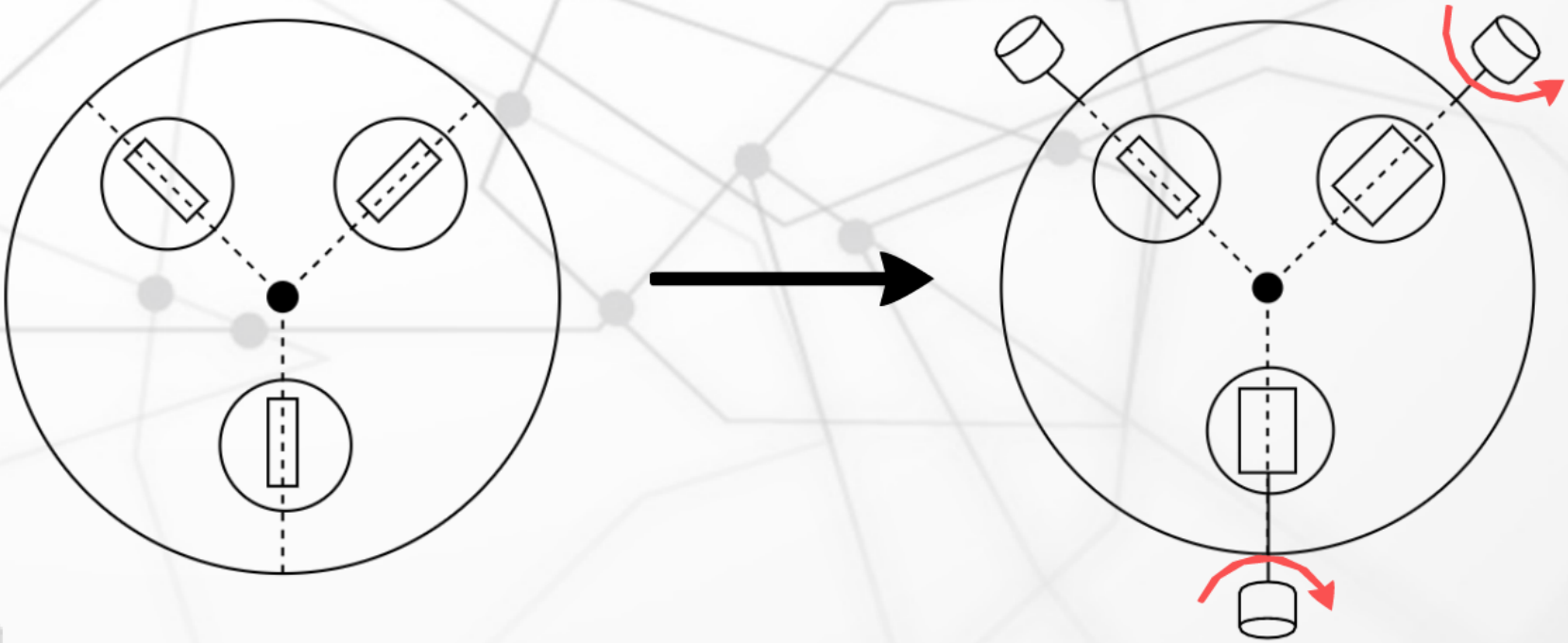

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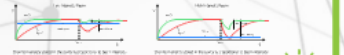

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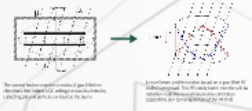

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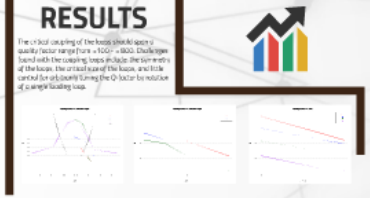

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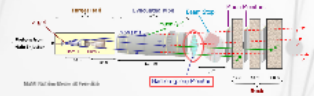

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