

High Field Q-Slope in Superconducting RF Cavities

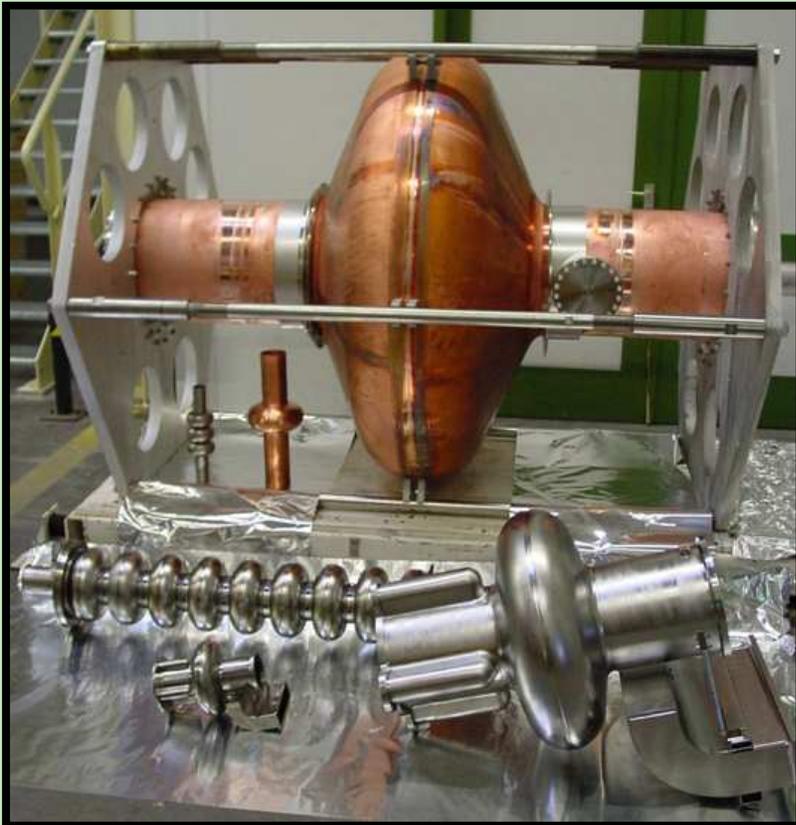
Jordan Webster

Advisor: Matthias Liepe

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Background

SRF Cavities



Collection of SRF cavities, taken at Cornell

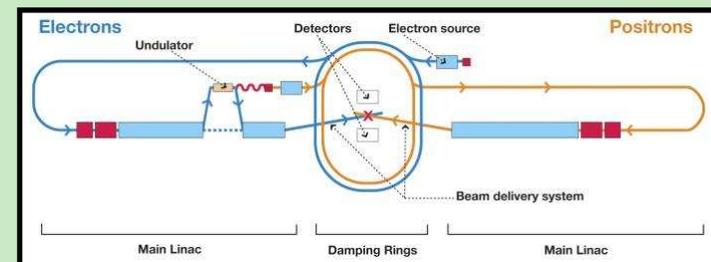
Used to accelerate bunches through EM waves

normal conducting



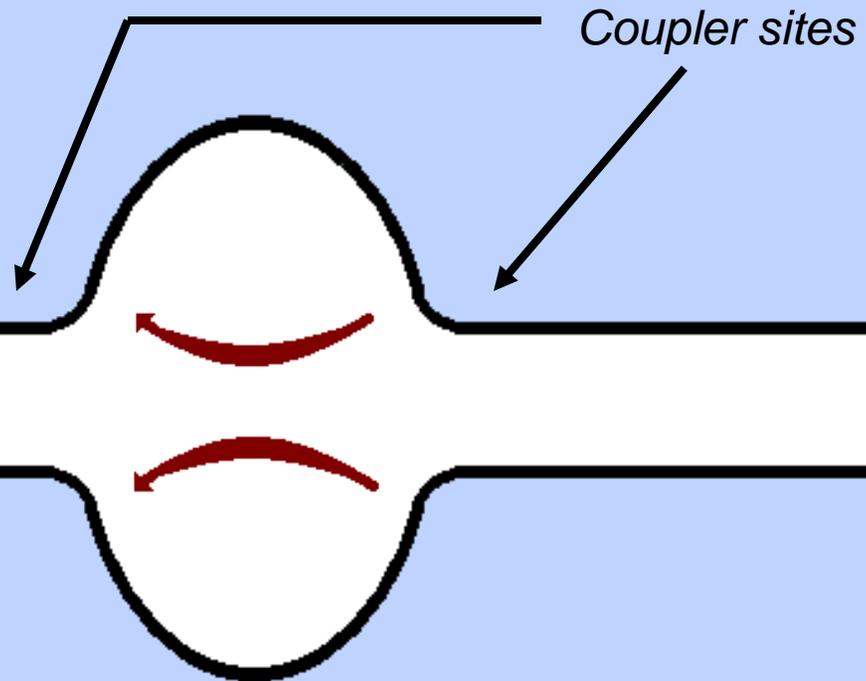
superconducting (1965)

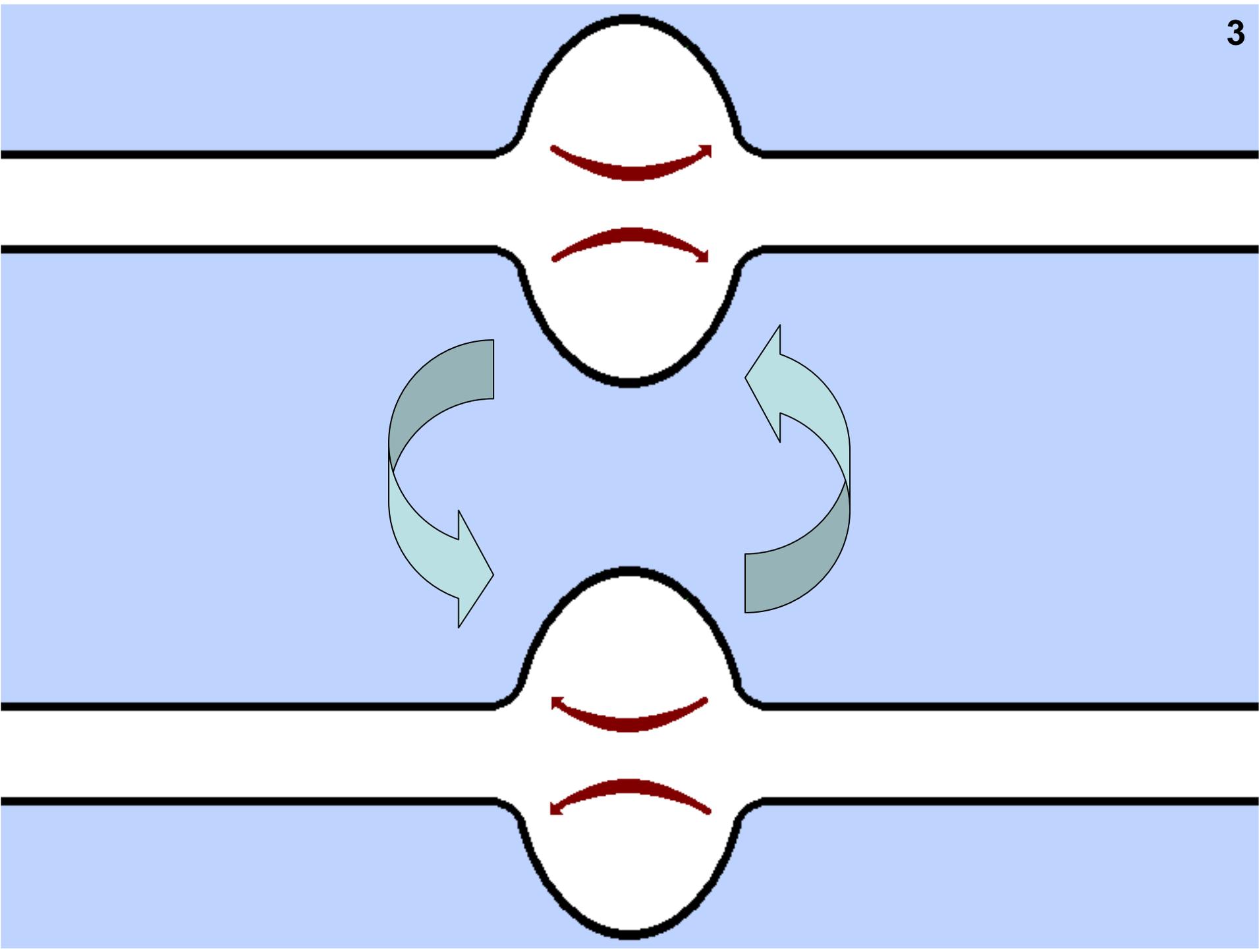
constructed from niobium

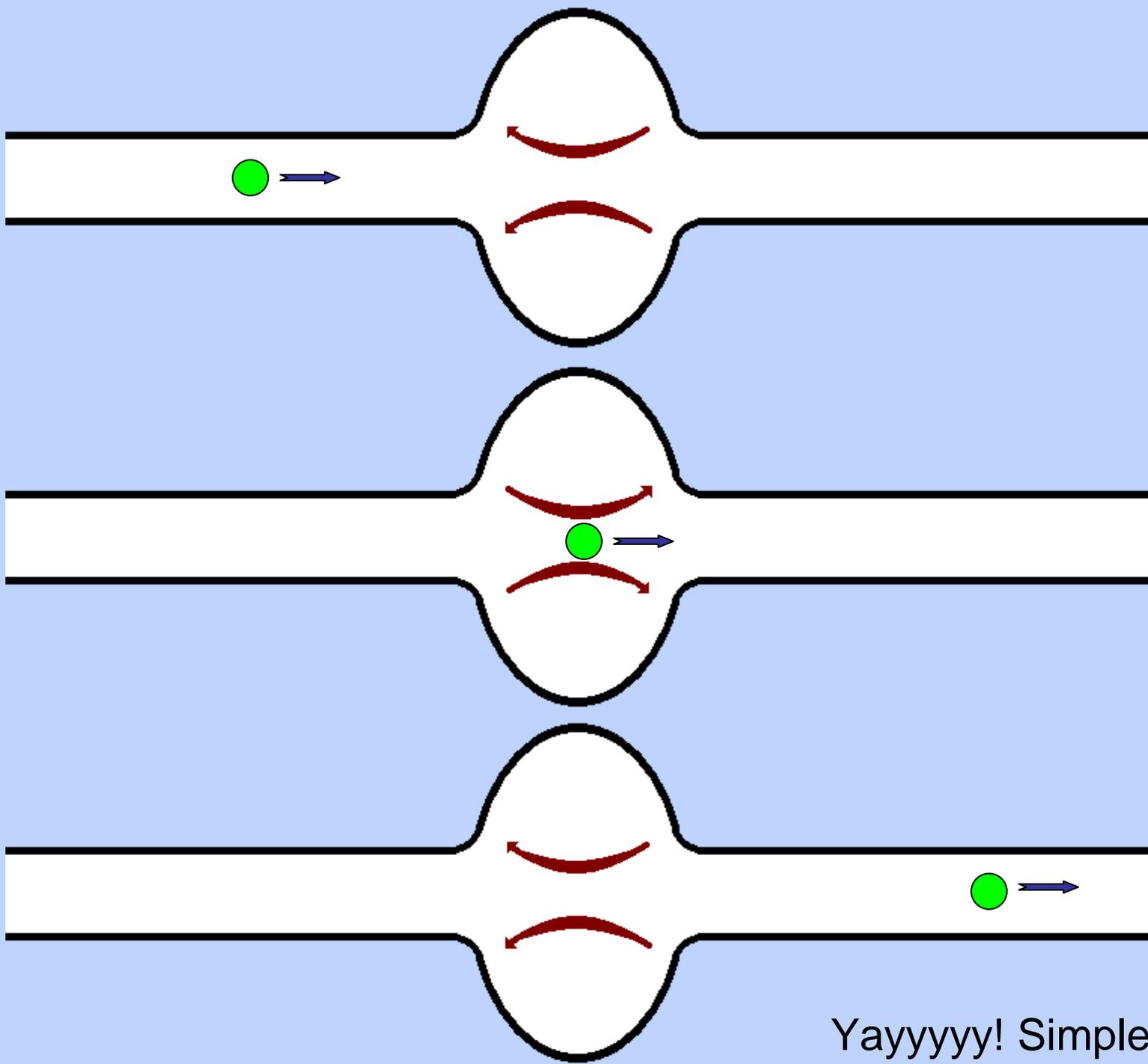


ILC

Single-Cell Cavity



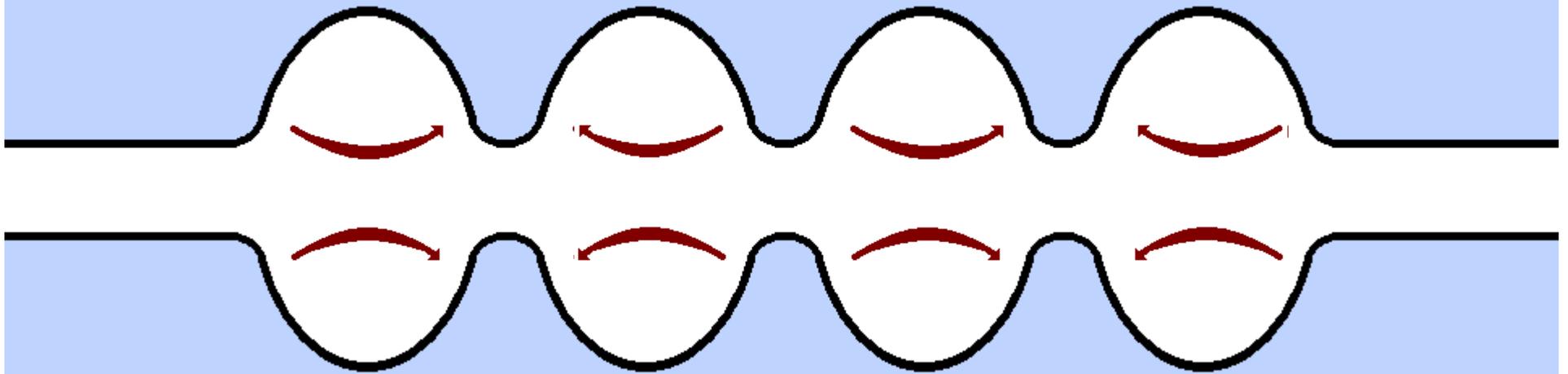


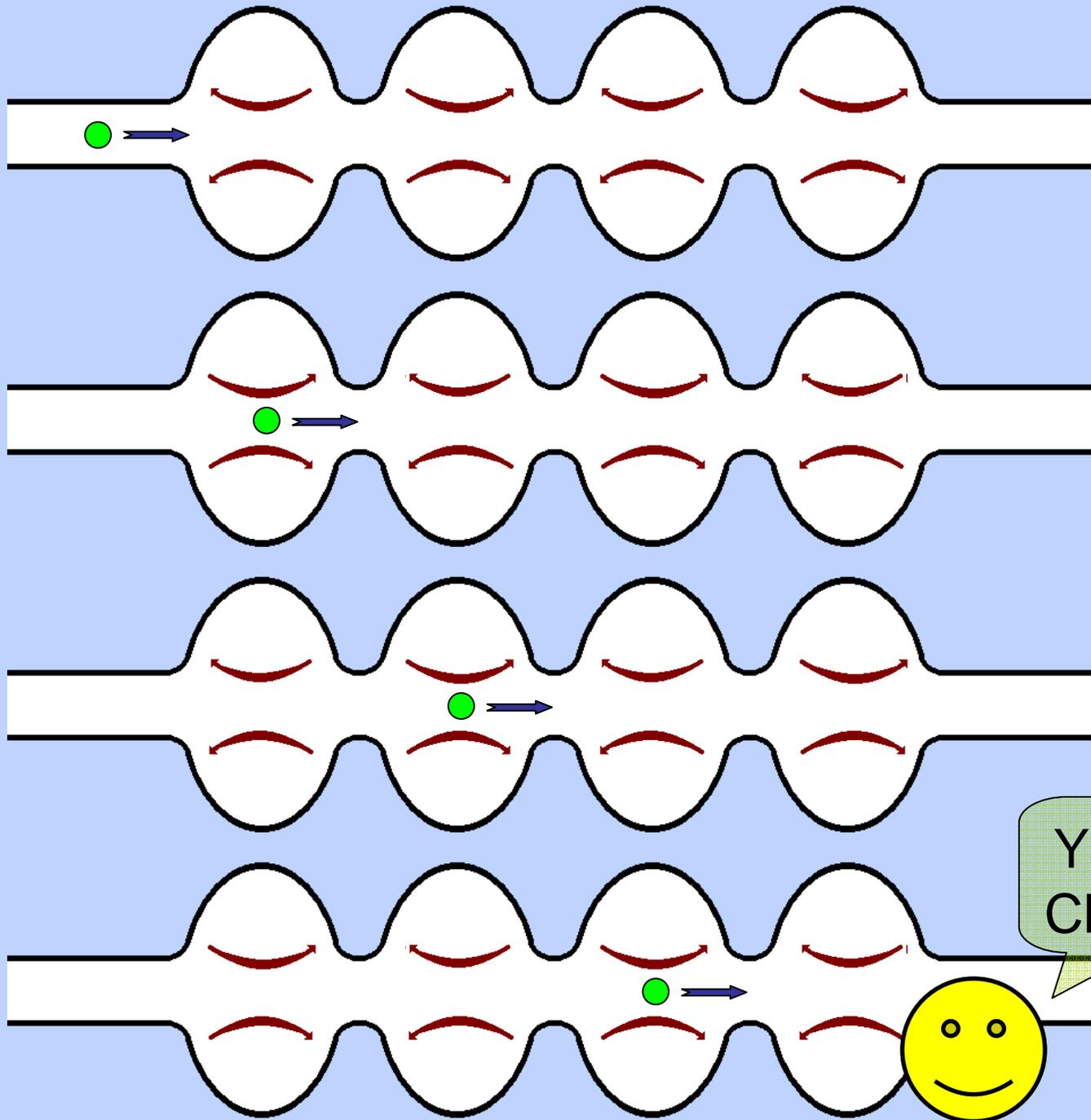


Yayyyyyy! Simple!!

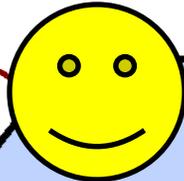


Multi-Cell Cavity





Yayyyyy!
Cheap!!\$!

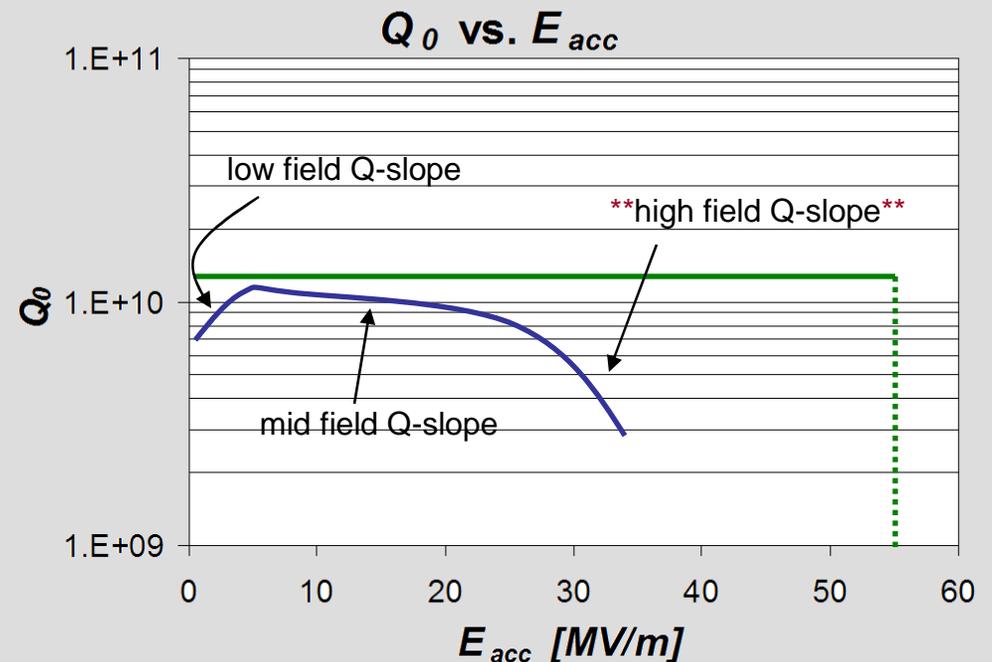


Boring Math Stuff...

$$V_c = \int_0^d E_{el} dz \quad \Rightarrow \text{(voltage seen by a passing electron bunch)}$$

$$E_{acc} = \frac{V_c}{d} \quad \Rightarrow \text{(average accelerating field seen by a passing electron bunch)}$$

$$Q_0 = \frac{\omega_0 U}{P_c}$$



Cavity Development 101

cavity is prepared...

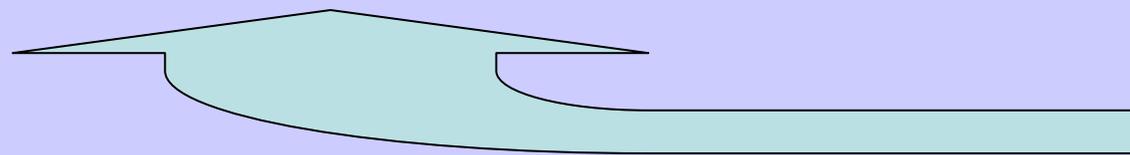
- Chemical etching (BCP, EP)
- High Pressure Rinsing
- Anodizing
- Baking
- Air Exposure

testing



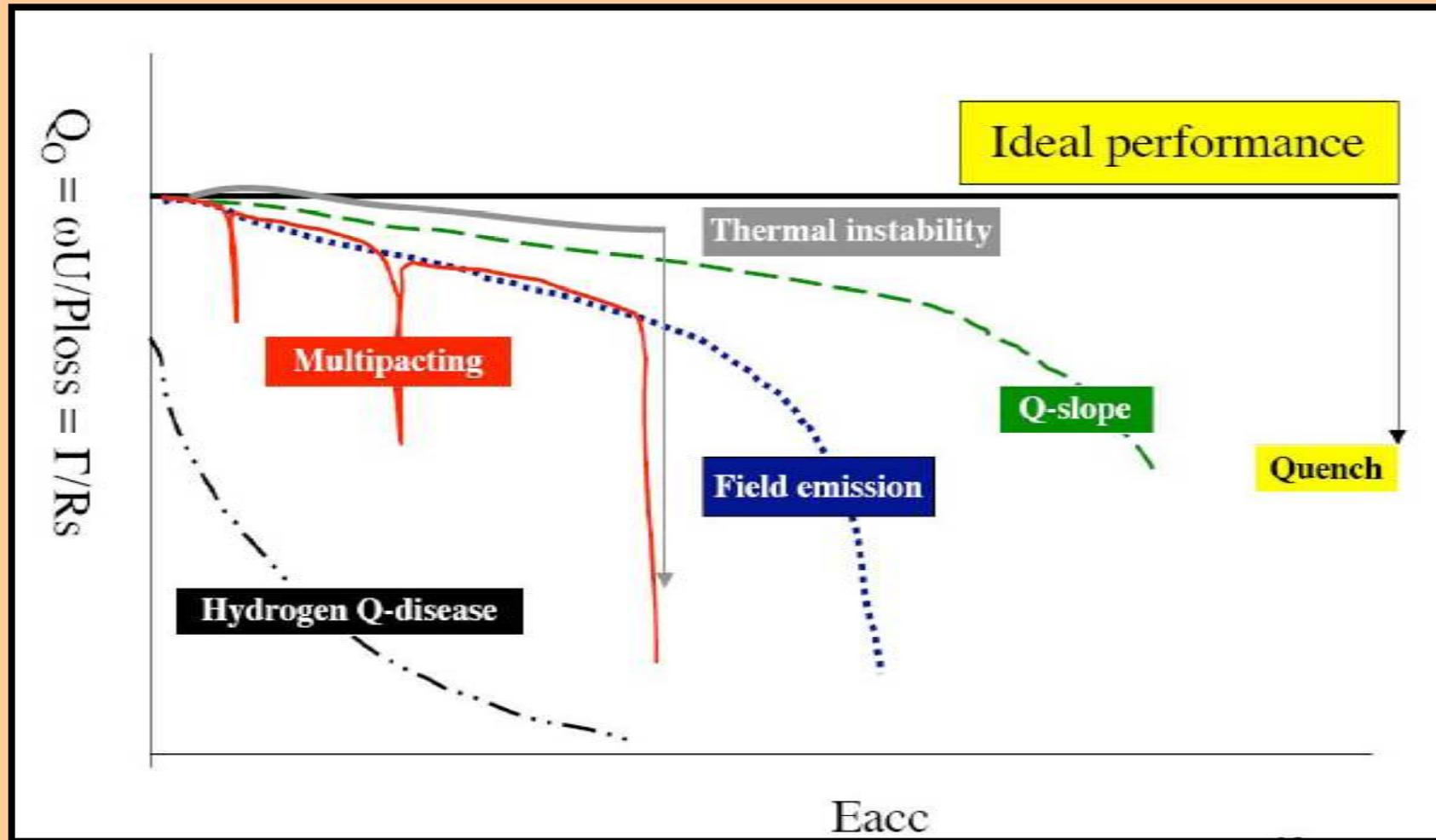
problems!!

- Multipacting
- Field Emission
- Hydrogen Q-Disease
- Pits



Problems that we understand can be fixed, but *high field Q-slope* remains even after fixing

Quality vs. Accelerating Field (Example)



Detlef Reschke (of DESY), tutorial on *Limits in Cavity Performance*, 2007 (2)

My Project:

Improve our understanding of high field Q-drop

1. What role does the oxide layer play in causing defects?
2. How does N₂ effect high field Q-slope?

Here's the plan...

- high pressure rinse

- mount and test cavity, look for Q-drop
- **HF rinse (removes oxide on surface)**
- high pressure rinse
- test, look for Q-drop

- 400°C bake

- test, look for Q-drop

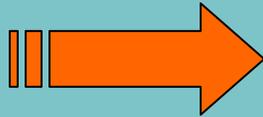
- **vent cavity with N₂ gas**

- test...

effects of oxide layer

effects of N₂ impurities

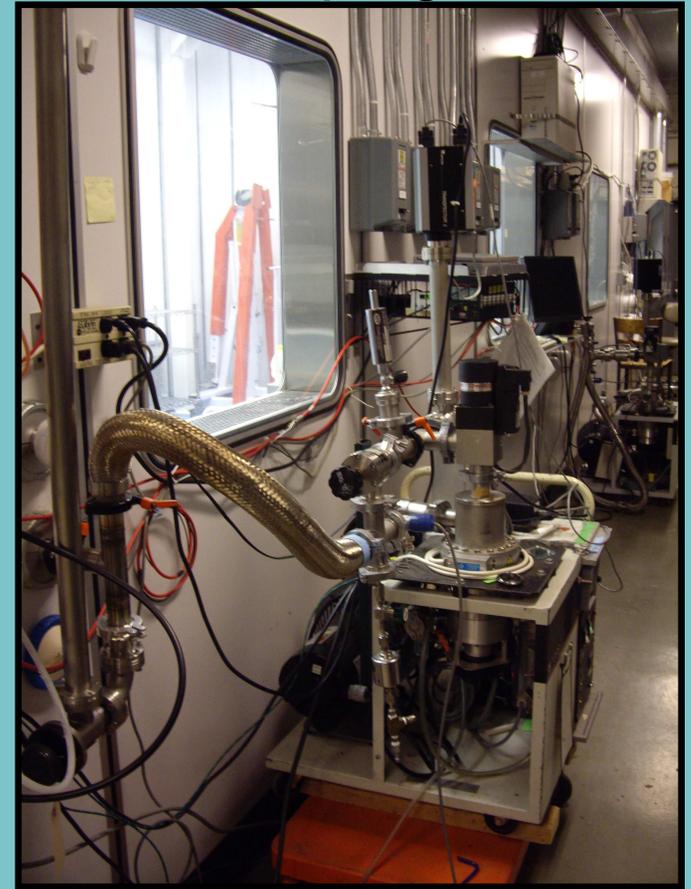
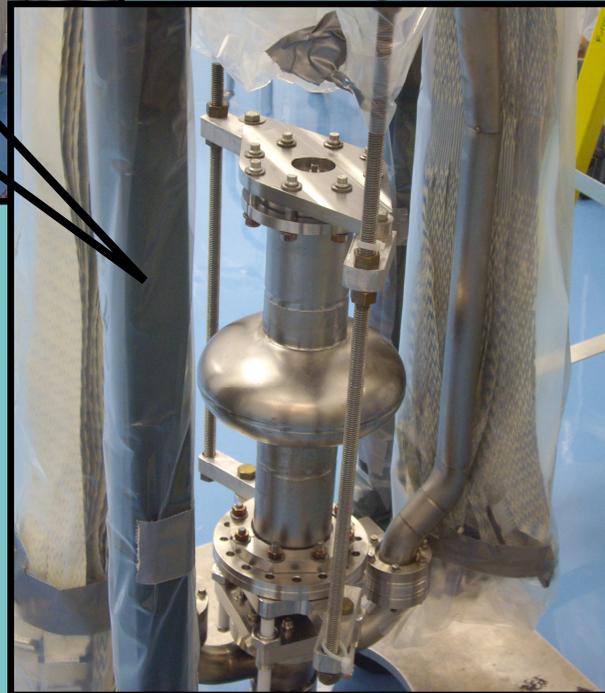
High Pressure Rinse



Pumping



Mounting



& Leak Check?...