

# RESISTIVE-WALL INSTABILITY FOR THE

TCDQ = Target Collimator Dump Quadrupole

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- ◆ **“Effective” impedance**
- ◆ **Coherent tune shift**
- ◆ **Heat load**

## TCDQ (1/2)

- ◆ TCDQ is an all graphite structure, similar design as TCDS, beam passing at 8 sigmas from blocks at 7 TeV and 450 GeV
- ◆ 2-layer formula
  - 1 = C
  - 2 = Vacuum
- ◆ Betatron function  $\beta_y \approx 550 \text{ m}$
- ◆ Resistivity  $\rho_1 = 6 \times 10^{-5} \text{ } \Omega\text{m}$
- ◆ Skin depth  $\delta_1 (8 \text{ kHz}) = 4.4 \text{ cm}$

For the collimators  
 $1.4 \times 10^{-5} \text{ } \Omega\text{m}$  was used !

## TCDQ (2/2)

### ◆ Injection

- “Effective” impedance

$$Z_y^{eff} = -2.7 + 13.6 j \text{ M}\Omega / \text{m}$$

- Coherent tune shift

$$\Delta Q_{m=0} = -(1.1 + 0.2 j) \times 10^{-4}$$

- Heat load

$$P_{loss} \approx 105 \text{ W}$$



$$\times \frac{S_b}{2\sqrt{\pi} \sigma_z} \approx 16$$

### ◆ Collision

- “Effective” impedance

$$Z_y^{eff} = -33 + 435 j \text{ M}\Omega / \text{m}$$

- Coherent tune shift

$$\Delta Q_{m=0} = -(2.3 + 0.2 j) \times 10^{-4}$$

- Heat load

$$P_{loss} \approx 935 \text{ W}$$

It's a lot !

# Stability diagram (maximum octupoles) and collective tune shift for the most unstable coupled-bunch mode and head-tail mode 0 (1.15e11 p/b at 7 TeV)

Vertical plane

$\text{Re}(\Delta Q)$

$-\text{Im}(\Delta Q)$

-0.001      -0.0008      -0.0006      -0.0004      -0.0002

0.00015  
0.000125  
0.0001  
0.000075  
0.00005  
0.000025



# TCDQ with Cu coating (1/2)

## ◆ 3-layer formula

- 1 = Cu  $s_1 = 5 \mu\text{m}$
- 2 = C
- 3 = Vacuum

## ◆ Resistivity $\rho_1 = 1.5 \times 10^{-8} \Omega\text{m}$

## TCDQ with Cu coating (2/2)

### ◆ Collision



$$\times \frac{S_b}{2\sqrt{\pi}\sigma_z} \approx 28$$

- “Effective” impedance

$$Z_y^{eff} = -68 + 170 j \text{ M}\Omega / \text{m}$$

- Coherent tune shift

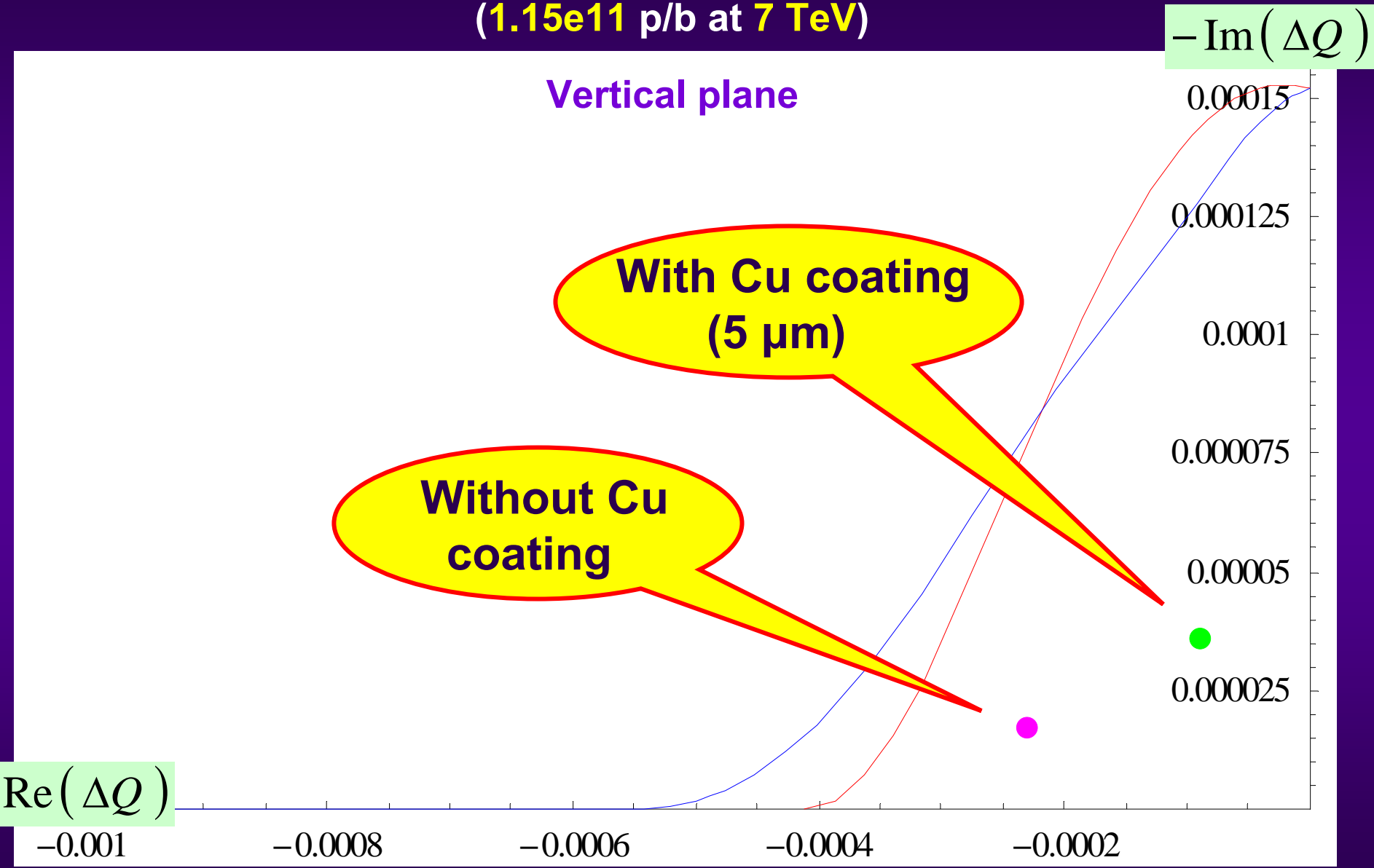
$$\Delta Q_{m=0} = -(0.9 + 0.4 j) \times 10^{-4}$$

- Heat load

$$P_{loss} \approx 15 \text{ W}$$

It's still a lot!

# Stability diagram (maximum octupoles) and collective tune shift for the most unstable coupled-bunch mode and head-tail mode 0 (1.15e11 p/b at 7 TeV)



## Future work for TCDQ

- ◆ **What about the trapped modes between the blocks ?**