



Cavity WG Meeting

# HOM POWER AND FPC DAMPING SIMULATIONS

**Marcel Schuh**

**CERN-BE-RF-LR  
CH-1211 Genève 23, Switzerland  
[marcel.schuh@cern.ch](mailto:marcel.schuh@cern.ch)**





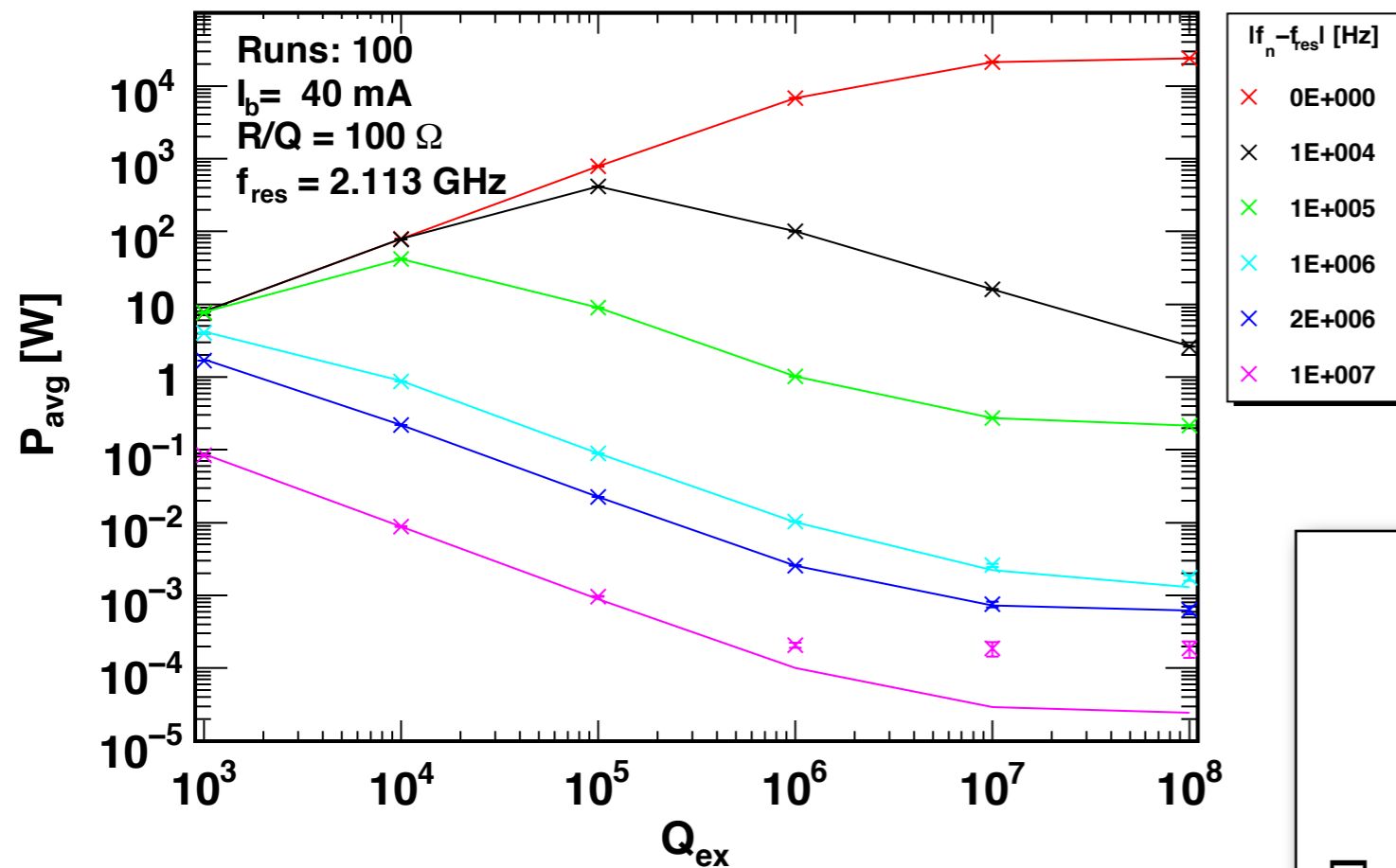
# HOM POWER - SIMULATION SETUP

- Run beam dynamic simulations with injection noise and HOMs (no RF-errors included up to now) to generate a beam pattern
- Trace Voltage development in one cavity at the end of the linac with different HOM settings close to a machine line.
- Compare results with simulations without noise in first cavity.



# HOM POWER SIMULATION WITH BEAM NOISE

Average HOM power dissipation in HOM coupler

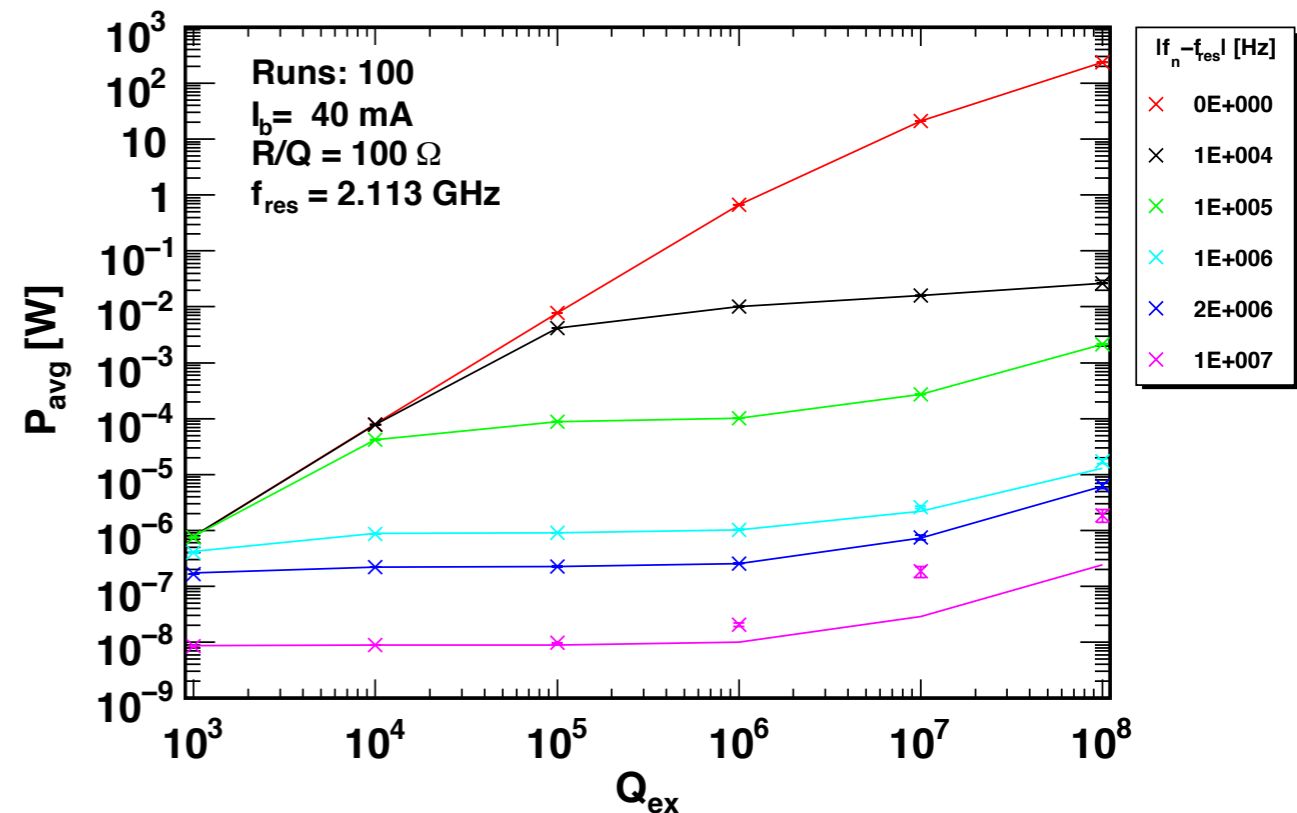


Beam noise:

-  $\sigma_q = 1\%$

-  $\sigma_\phi \approx 0.4$  ps (not const. during pulse)

Average HOM power dissipation in cavity



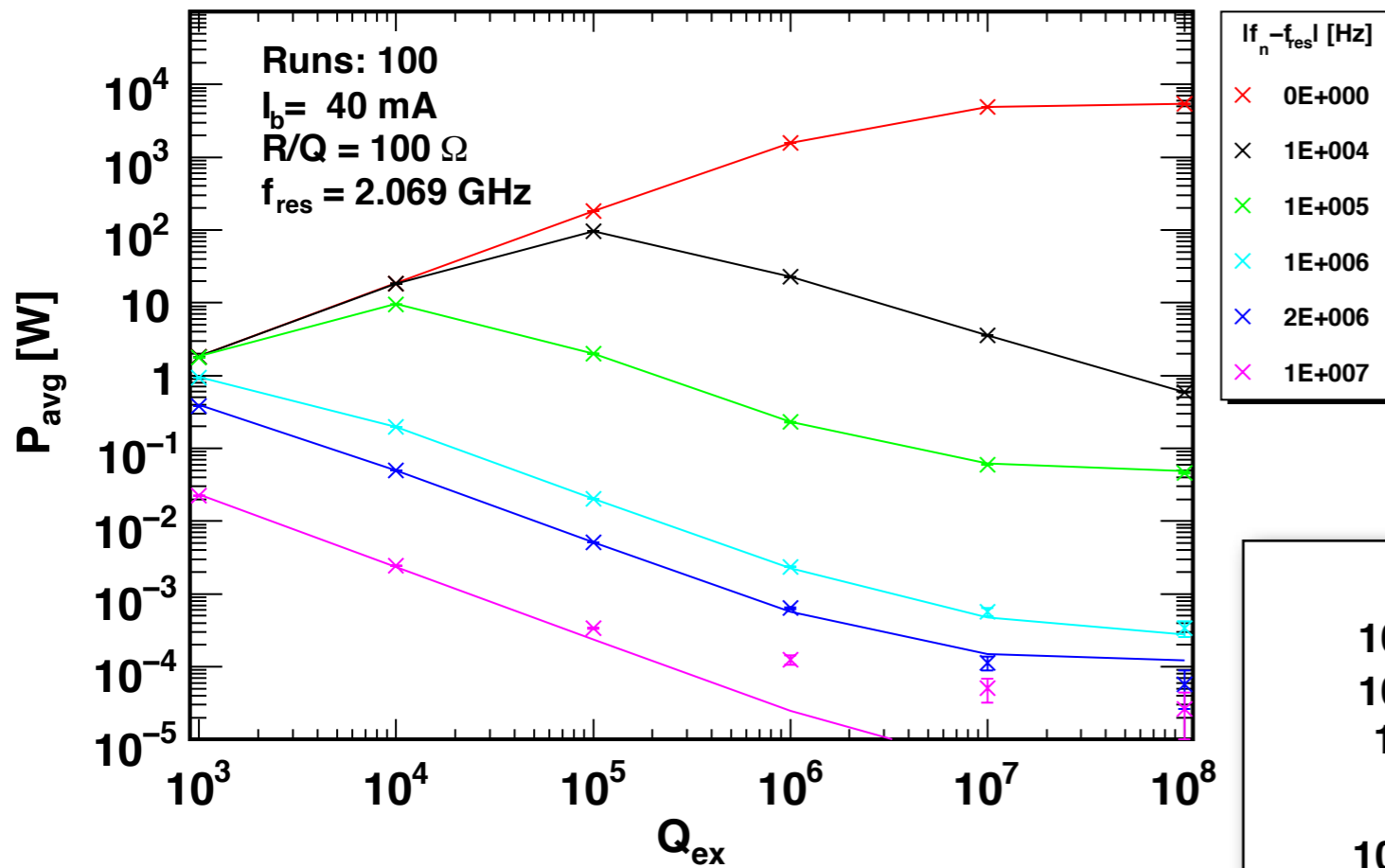
Solid lines are analytic values without noise.

**Deviation only off resonance!**



# POWER DISSIPATION SIMULATION CHOPPING 5/8

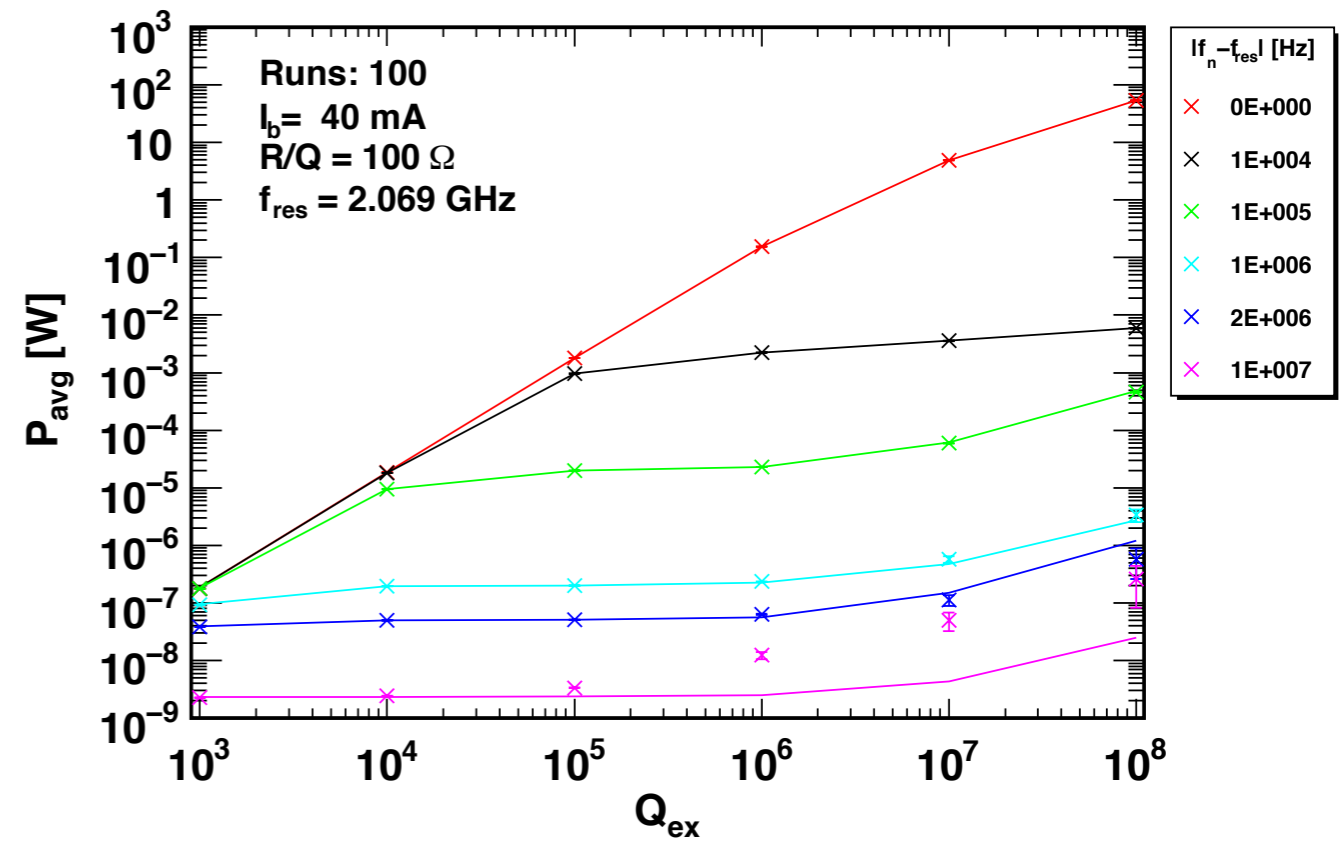
Average HOM power dissipation in coupler – 5/8 chopping



Beam noise:

- $\sigma_q = 1\%$
- $\sigma_\phi \approx 0.4 \text{ ps}$  (not const. during pulse)
- increased charge per bunch to keep integrated charge per pulse const.

Average HOM power dissipation in cavity – 5/8 chopping



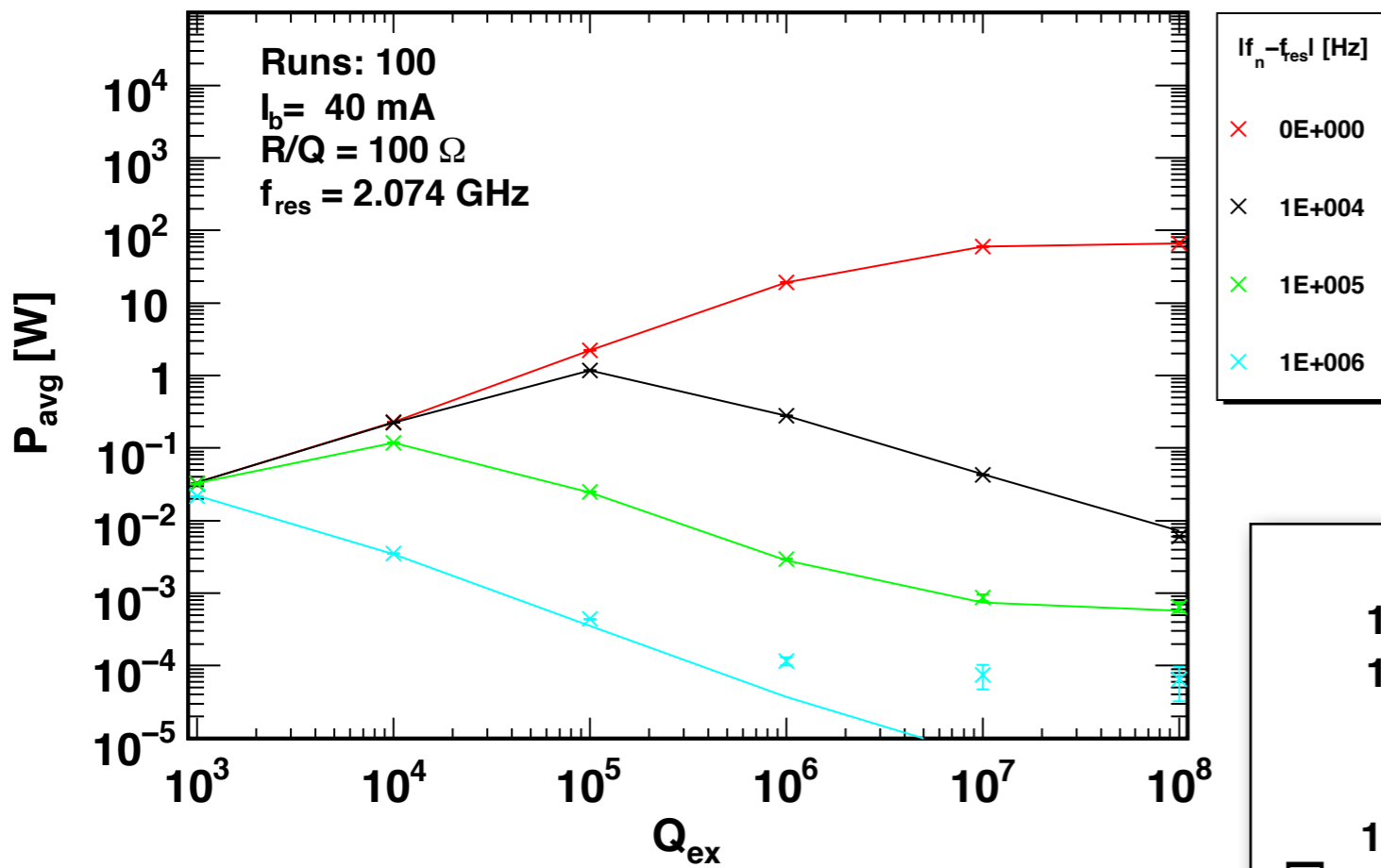
Solid lines are analytic values without noise.

**Deviation only off resonance!**



# POWER DISSIPATION SIMULATION CHOPPING 50/80

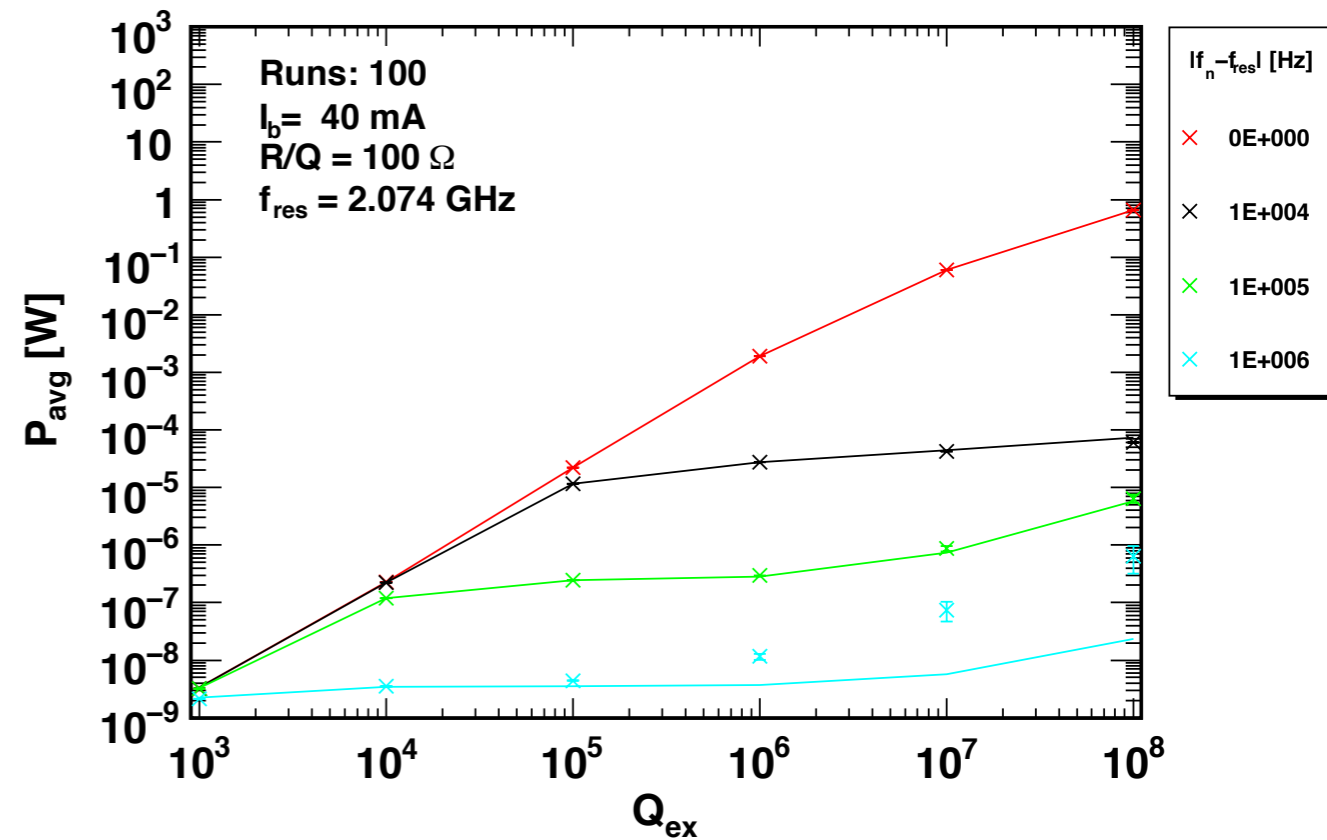
Average HOM power dissipation in coupler – 50/80 chopping



## Beam noise:

- $\sigma_q = 1\%$
- $\sigma_\phi \approx 0.4 \text{ ps}$  (not const. during pulse)
- increased charge per bunch to keep integrated charge per pulse const.

Average HOM power dissipation in cavity – 50/80 chopping



Solid lines are analytic values without noise.

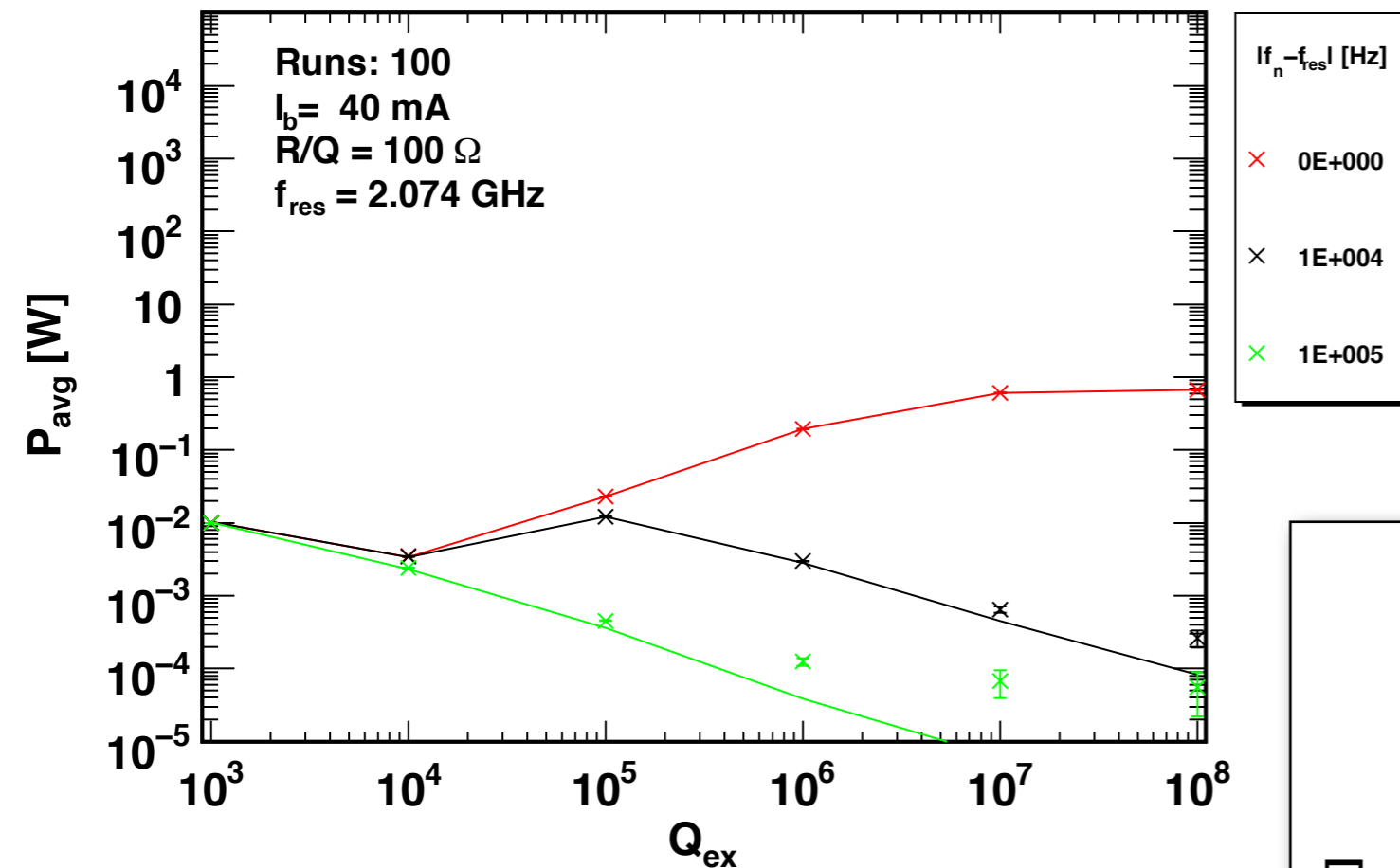
**Deviation only off resonance!**





# POWER DISSIPATION SIMULATION CHOPPING 500/800

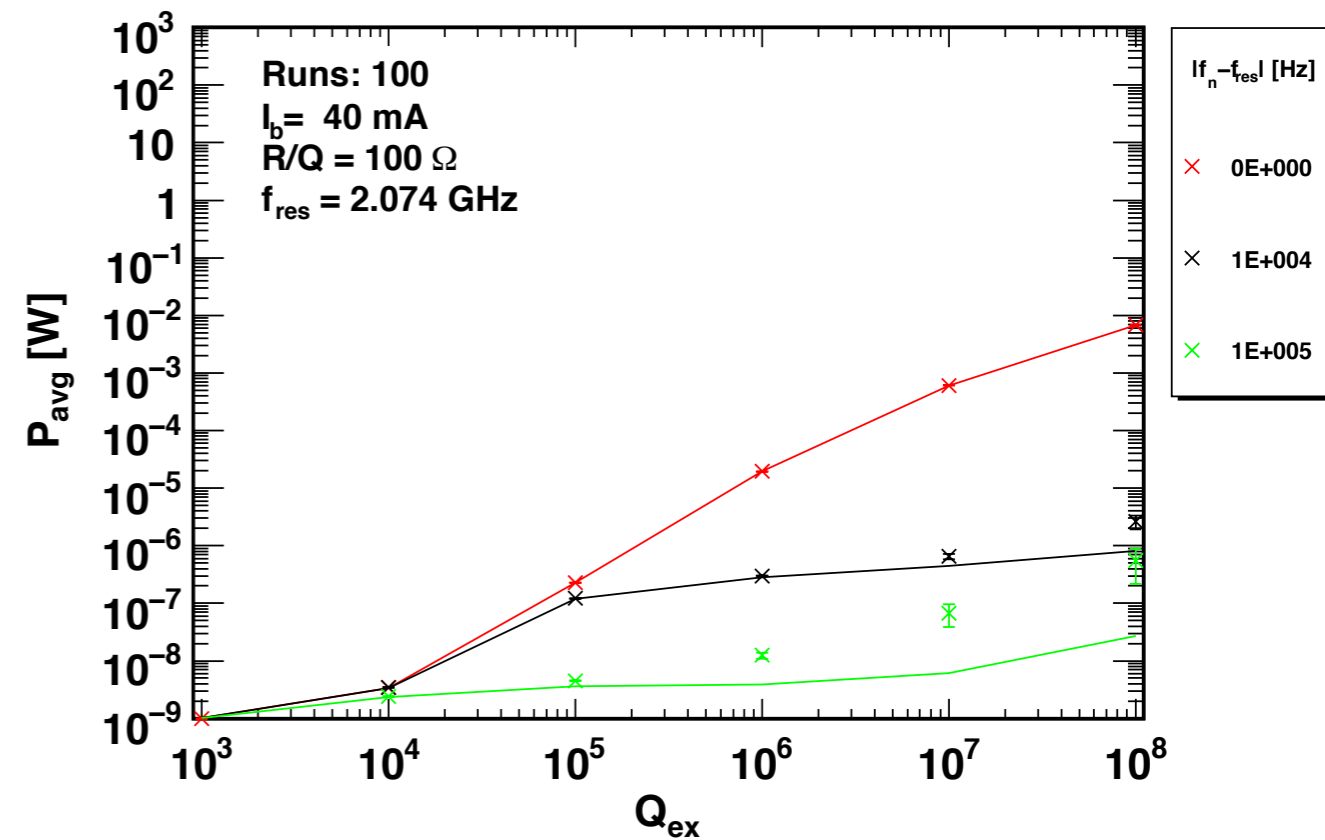
Average HOM power dissipation in coupler – 500/800 chopping



## Beam noise:

- $\sigma_q = 1\%$
- $\sigma_\phi \approx 0.4 \text{ ps}$  (not const. during pulse)
- increased charge per bunch to keep integrated charge per pulse const.

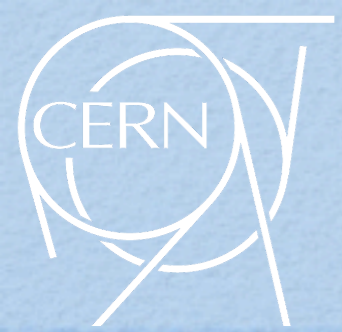
Average HOM power dissipation in cavity – 500/800 chopping



Solid lines are analytic values without noise.

**Deviation only off resonance!**



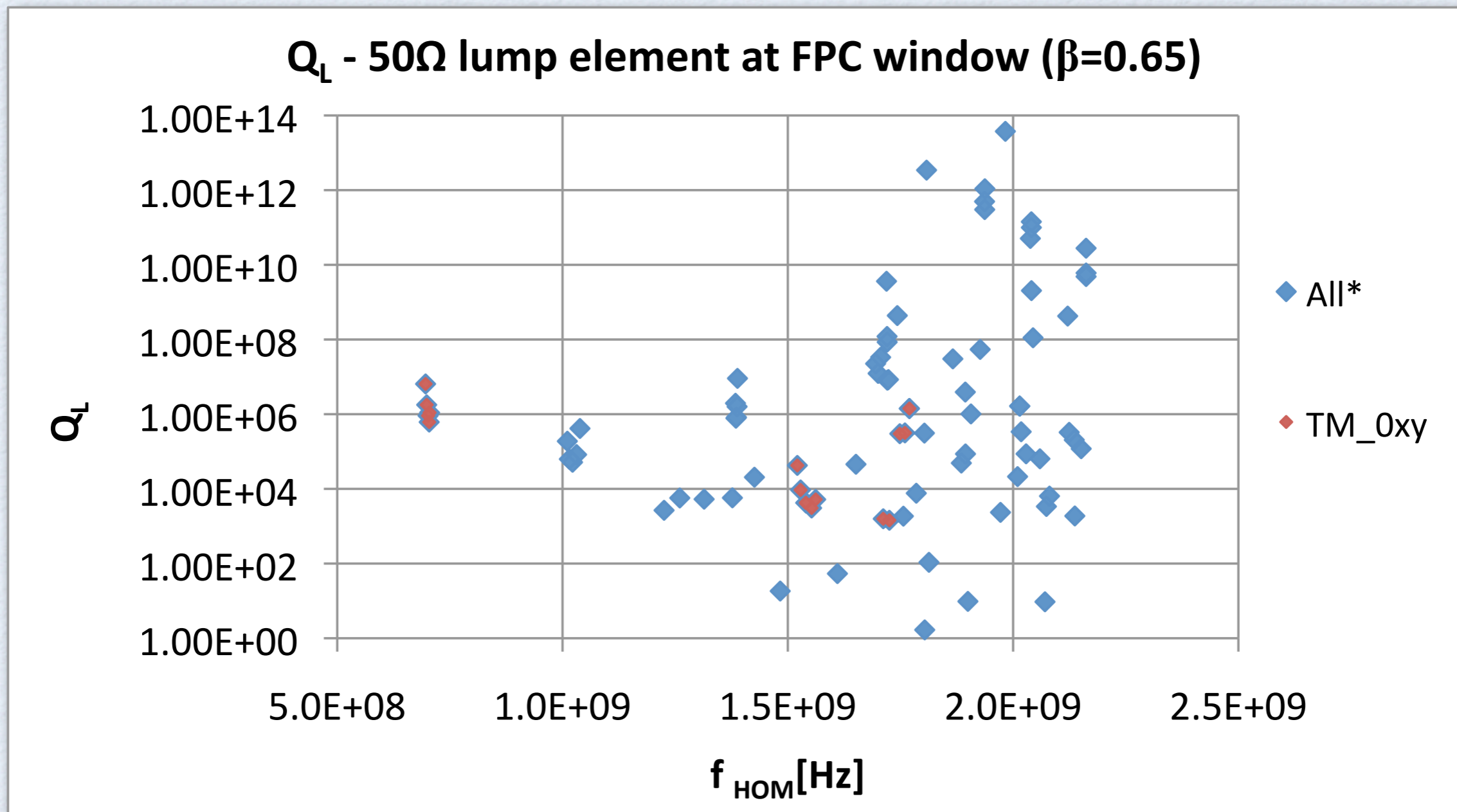


# ESTIMATION OF DAMPING WITH FPC

- 3d HFSS and MWS simulations:
  - HFSS: 180° model with lump circuit element at FPC window
  - MWS: full cavity (360°) with port at FPC window
- ➔ Calculate loaded Q value of system (damping)



# MEDIUM BETA CAVITY

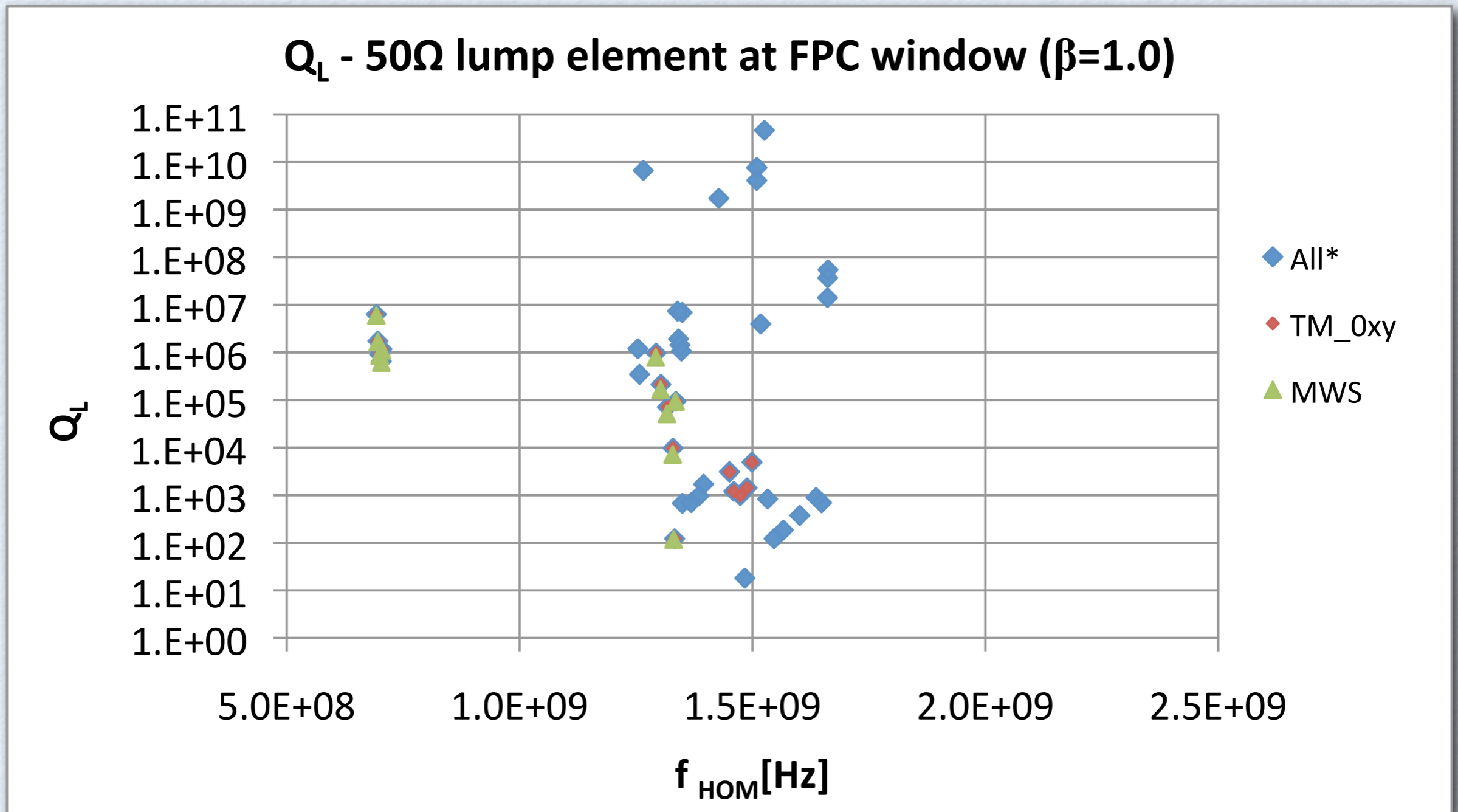


\* All modes found in 180° model up to 2.1GHz





# HIGH BETA CAVITY



\* All modes found in 180° model in simulated range! (simulation gap around 1GHz)



# SUMMARY

- HOM power values differ from analytic values only off resonance at high  $Q_{ex}$  - saturation is observed.
- FPC can provide damping, but further more detailed studies are needed!