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First Attempt to Calculate the Effect of Cavity Offsets on BBU Thresholds and Orbit Stability in the CERN 8.1 Lattice

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Frequency [Hz]	R/Q [Ohm/m ^ (2n)]	Q	n	Polarization_Angle [Radians/2pi]
&long_range_modes				
lr(1) = 2.512896E+009	21180	8867	1	0.00
lr(2) = 2.513556E+009	76777	1472	1	0.00
lr(3) = 2.514671E+009	81083	8557	1	0.00
lr(4) = 3.068192E+009	632	186198	1	0.00
lr(5) = 3.073245E+009	3971	64567	1	0.00

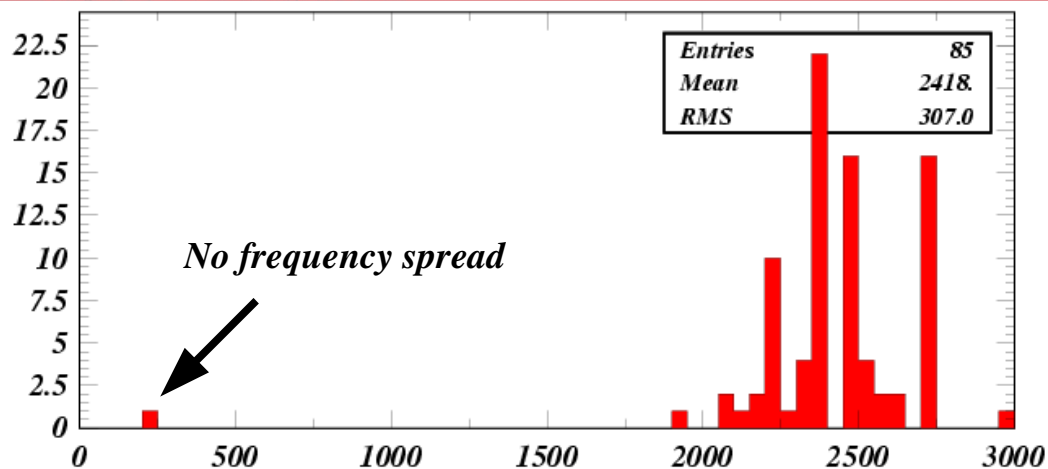
The frequency spread σ_f is 10-12 Mhz.

Three of the HOM frequencies are within $1\sigma_f$ of twice the fundamental (1.3 Ghz).

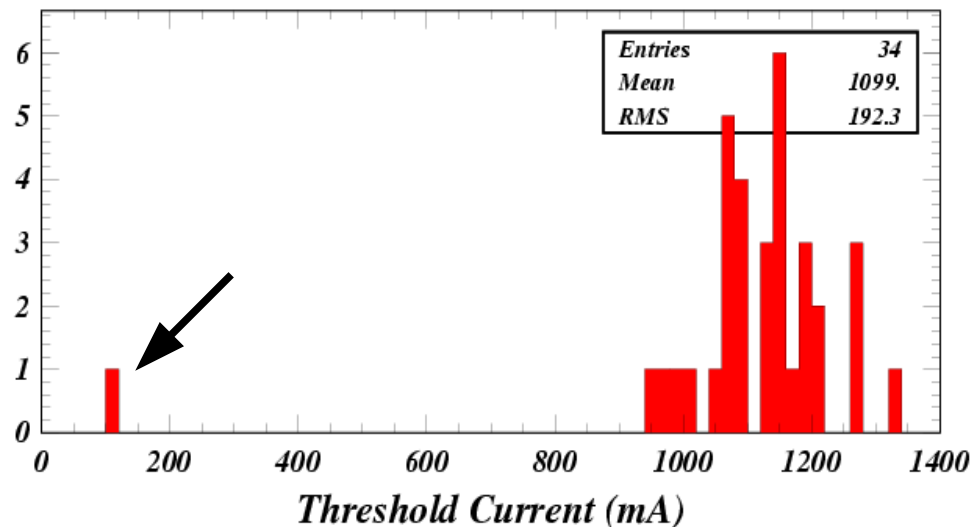
The randomization of the HOM frequencies is limited to $\pm 3\sigma_f$



No Offsets



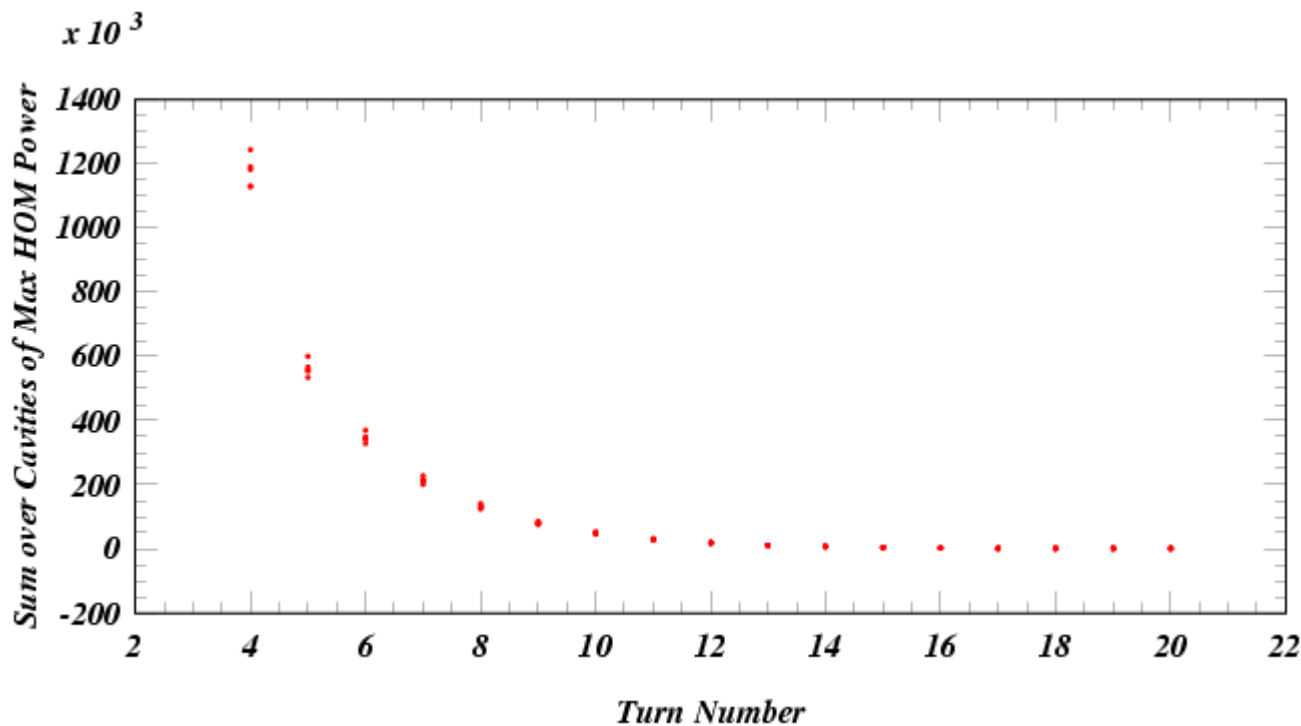
$\sigma_x = 0.1 \text{ mm}$
Limited to $\pm 3\sigma_x$.



Offsetting the cavities horizontally with an rms value of 0.1 mm lowers the BBU instability threshold current from about 2400 mA to 1100 mA.



How many turns suffice to stabilize the HOM power for 100 mA beam?



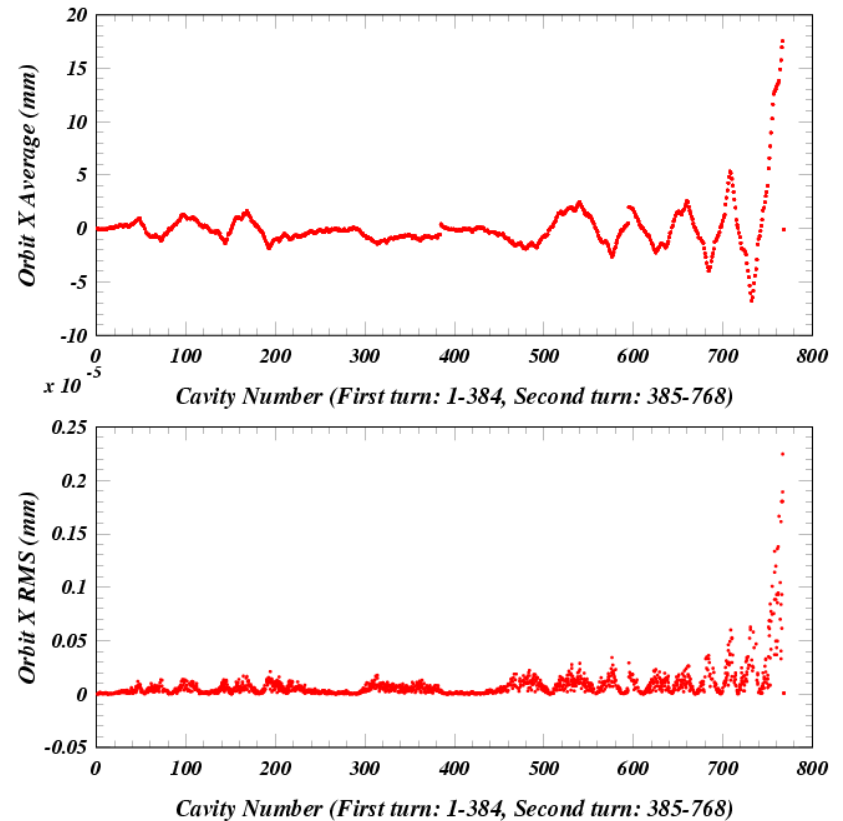
“Twenty”

The sum over cavities of the maximum-power HOM decreases by a factor of about two each turn, continuing to decrease even after 100 turns.



*Average horizontal orbit distortion (mm)
for 12k orbits*

*RMS fluctuation of the orbit (mm)
for 12k orbits*



*Each of the 384 cavities shows up twice in these plots, once for the accelerating pass and once for the decelerating pass.
The average and rms values are calculated for each of the 2x384 tracking elements for 12k orbits
(injected single-particle bunches).*

*The calculation is repeated five times with re-randomized HOM frequencies,
so five points are plotted for each tracking element.*