Effect of Energy Spread on the BBU Instability Threshold in Case of Off-Crest Acceleration

CERL 8.2 lattice with a single HOM in each of the six cavities in the final cryostat of the north linac

BMAD BBU instability threshold calculation bug introduced 3 months ago when code for HOMs with frequency at fundamental introduced – FIXED.

No energy spread induced by bunch length in upstream cavities because hybridized cavity elements have only linear tracking – FIXED, by tracking all cavities (slow).

Today: effect of off-crest acceleration on threshold with no energy spread.

(18Nov11: Corrected slide 3)

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ERL@CESR Meeting
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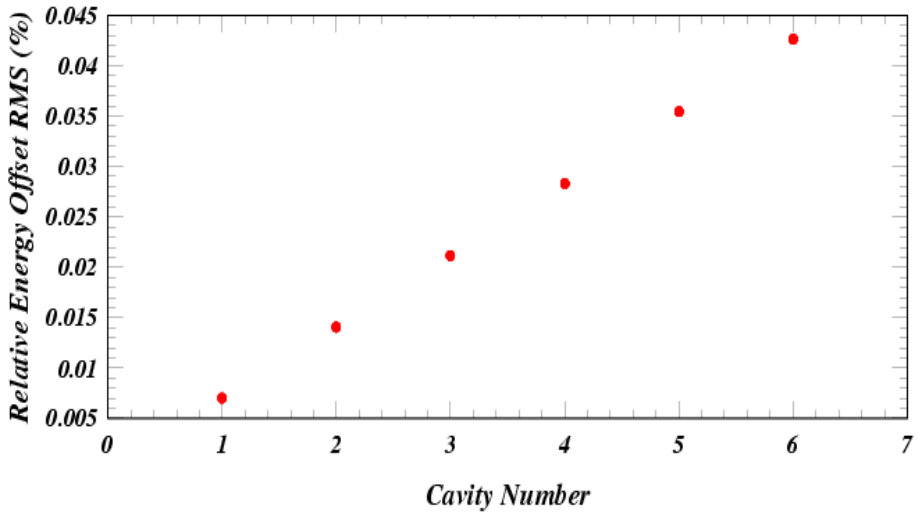
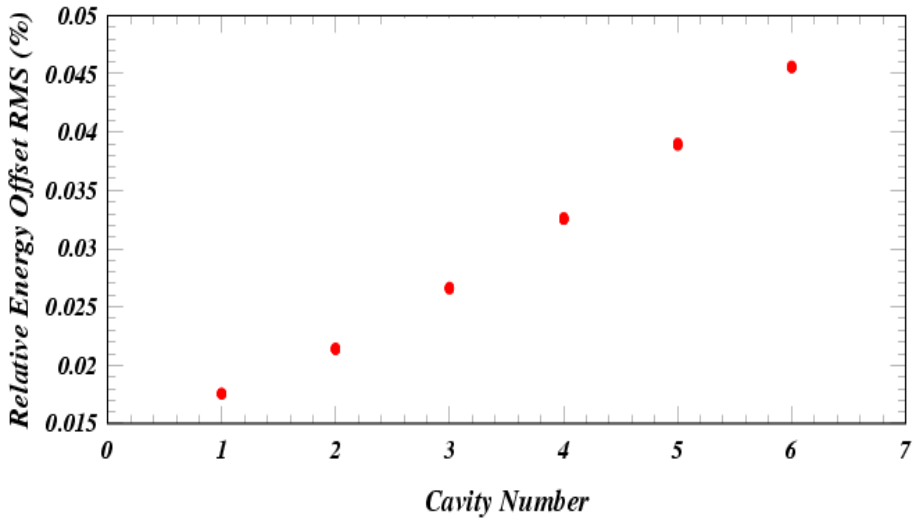
Initialize beam with 2-ps bunch length and ten particles/bunch. On-crest acceleration.

Upstream cavities hybridized

Track all cavities



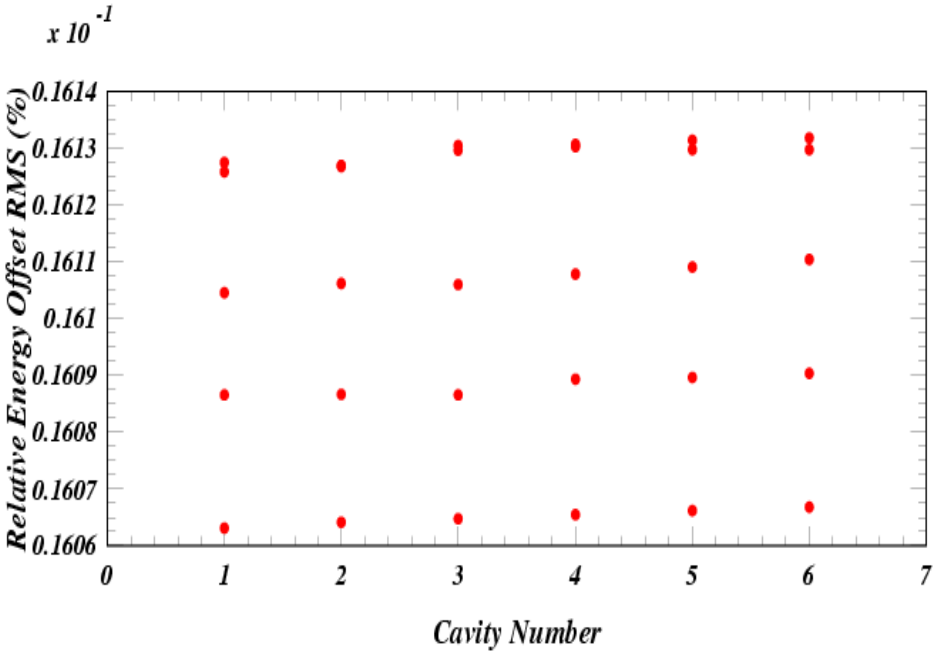


Second-order tracking through cavities induced 1.5e-4 relative energy offset in the 204 cavities upstream of the cryomodule with the 6 HOMs.

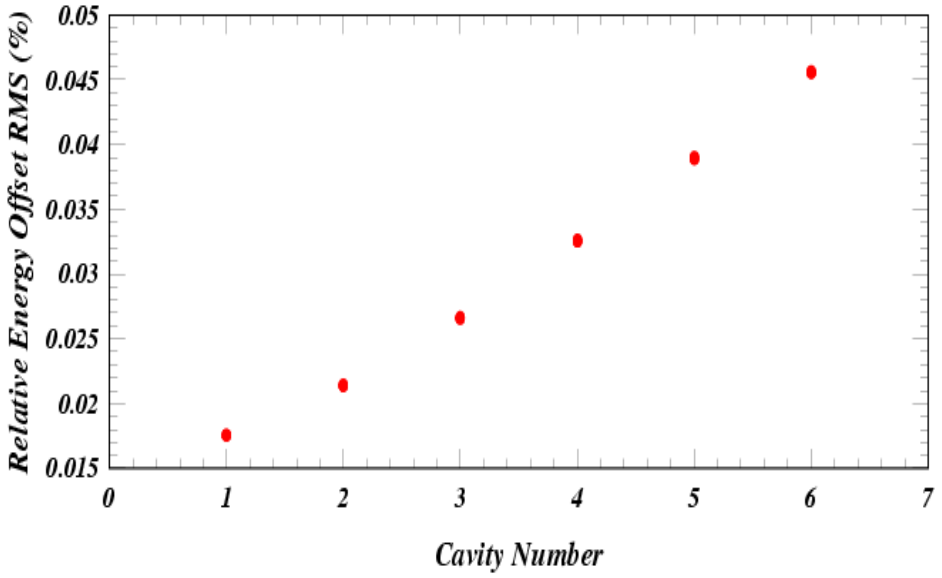
The last six cavities increase the energy spread to 4.5e-4.

Effect of 330 mrad phase shift in each of the six cavities

On-crest



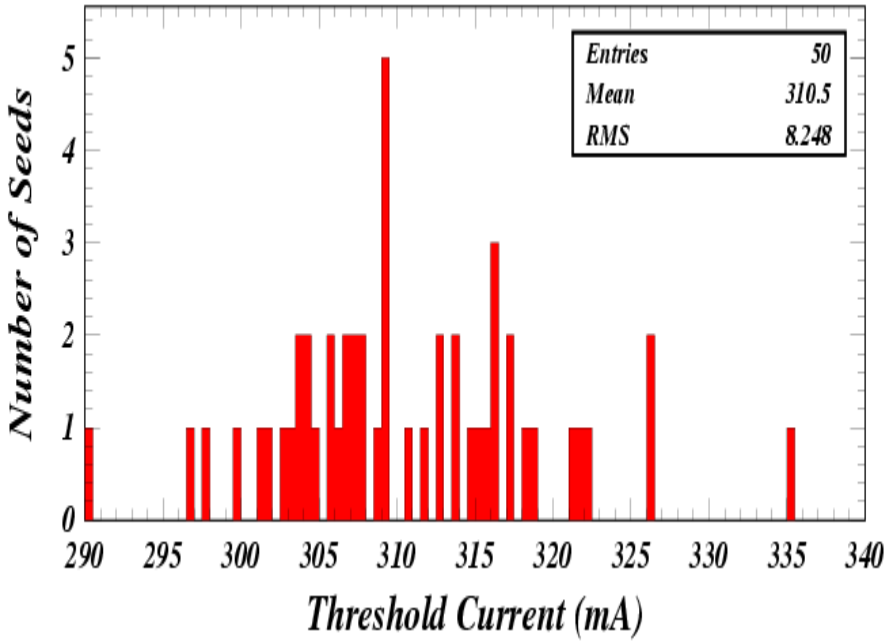
Off-crest



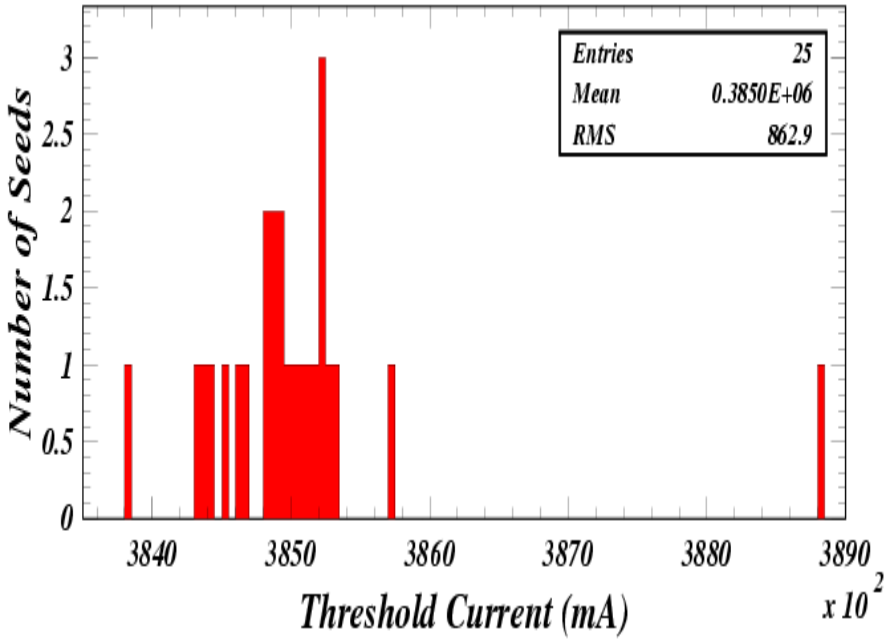
Energy spread increases by a factor of 3 from 0.016% to 0.045%.

Effect of 330 mrad phase shift in the six cavities
No energy spread

On-crest



Off-crest



The instability threshold increases by 3 orders of magnitude from 310 mA to 385 A.