Slow extraction w/ transverse noise

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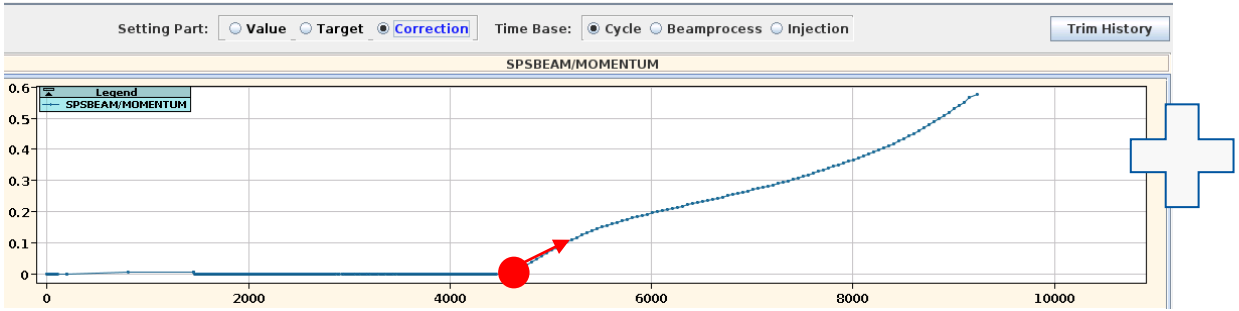
Intro

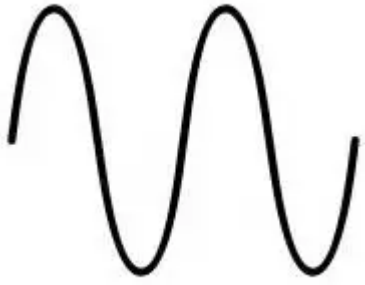
- In PS, a small Transverse FeedBack (TFB) excitation is added to EAST during slow extraction to improve spill quality:
  - M. Delrieux: “intuitively it makes sense”

- Motivations of SPS dedicated MD:
  - Implement similar approach to SPS SFTPRO.
  - Better understand why/how this works.

Concept: OP

- We use: nominal SFTPRO cycle w/ momentum ramp to push beam into resonance
- We add: horizontal sinusoidal excitation w/ TFB at freq. approx betatron tune, ⅓*frev) ~ “AC Dipole”, but on debunched beam.

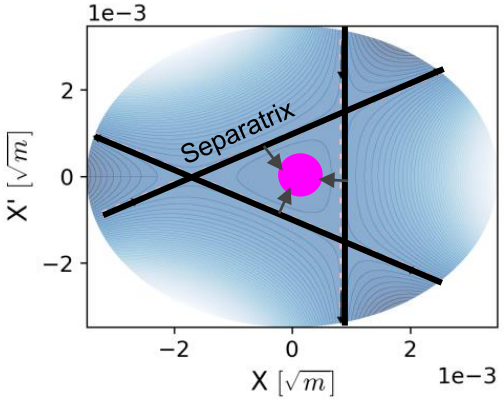




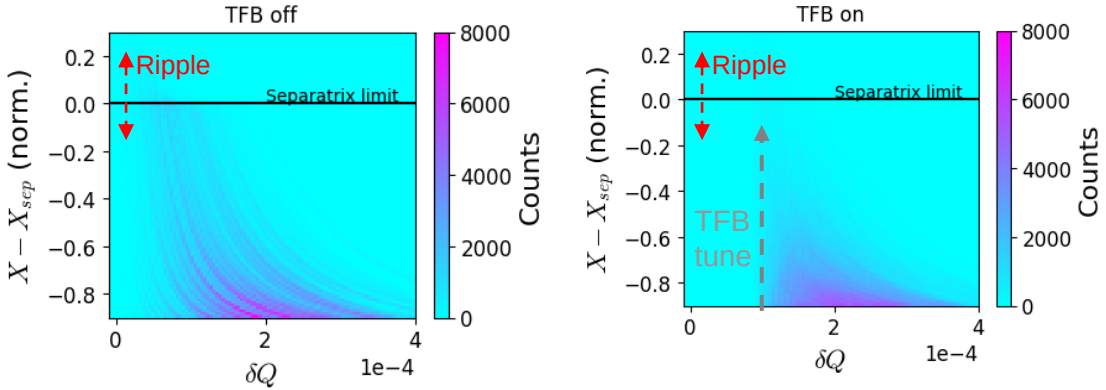
(frequency, amplitude)

Concept: beam dynamics

The TFB kicks help particles cross into the resonance -> tune ripple has less impact on extraction rate.



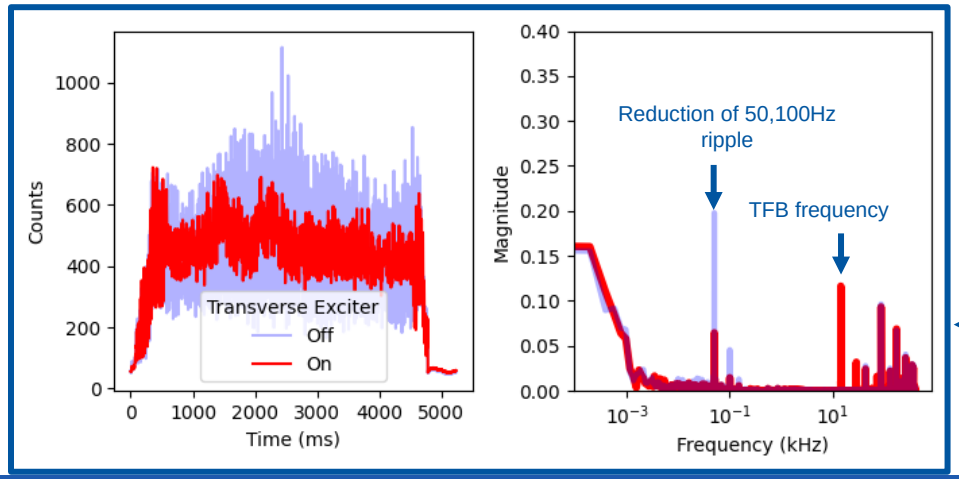
Beam tracking sim.

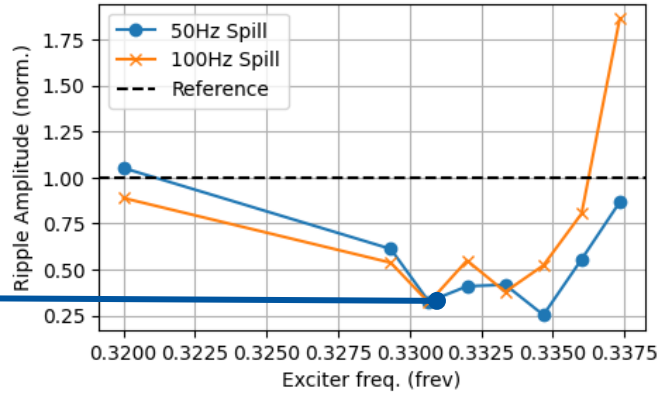


Results (i)

Clear spill quality improvement observed, in particular at low frequencies: 50Hz, 100Hz, …

Setting (a): Spill quality improvement

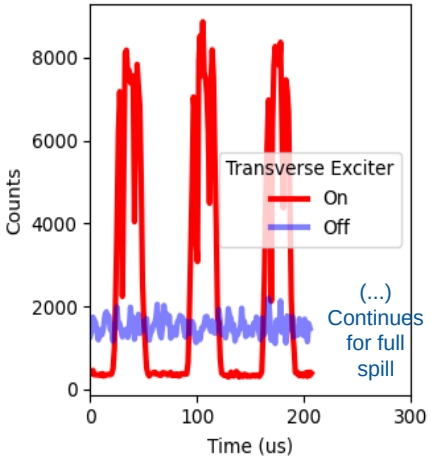


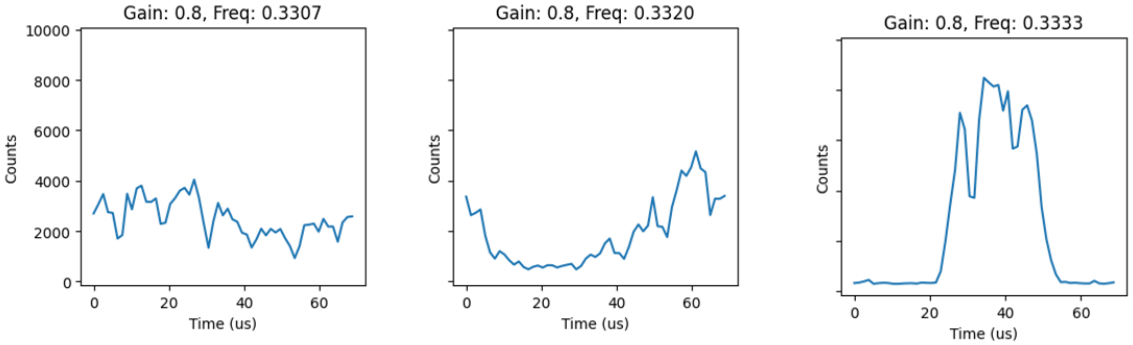


Results (ii)

- Technique can also be used to give bunched structure to the spill (starting from a debunched beam).
- Provides flexible way to create an “extinction region” for time of flight discrimination (could interest SHiP, alternative mode of operation).

Setting (b): bunched beams





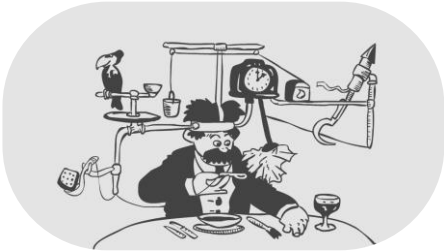
TFB freq

Q=1/3

Wishes

- **SY-BI:** the new spill monitor (OTR-PMT) with 200MHz sampling acquisition. During 2024 MD, up to 800kHz, but not enough to probe 40MHz TFB limit.

- **SY-RF:** Controls Interface to program sinusoidal excitations on the TFB. During 2024 MD, excitation injected via BBQ channel using signal generator -> not viable long term.



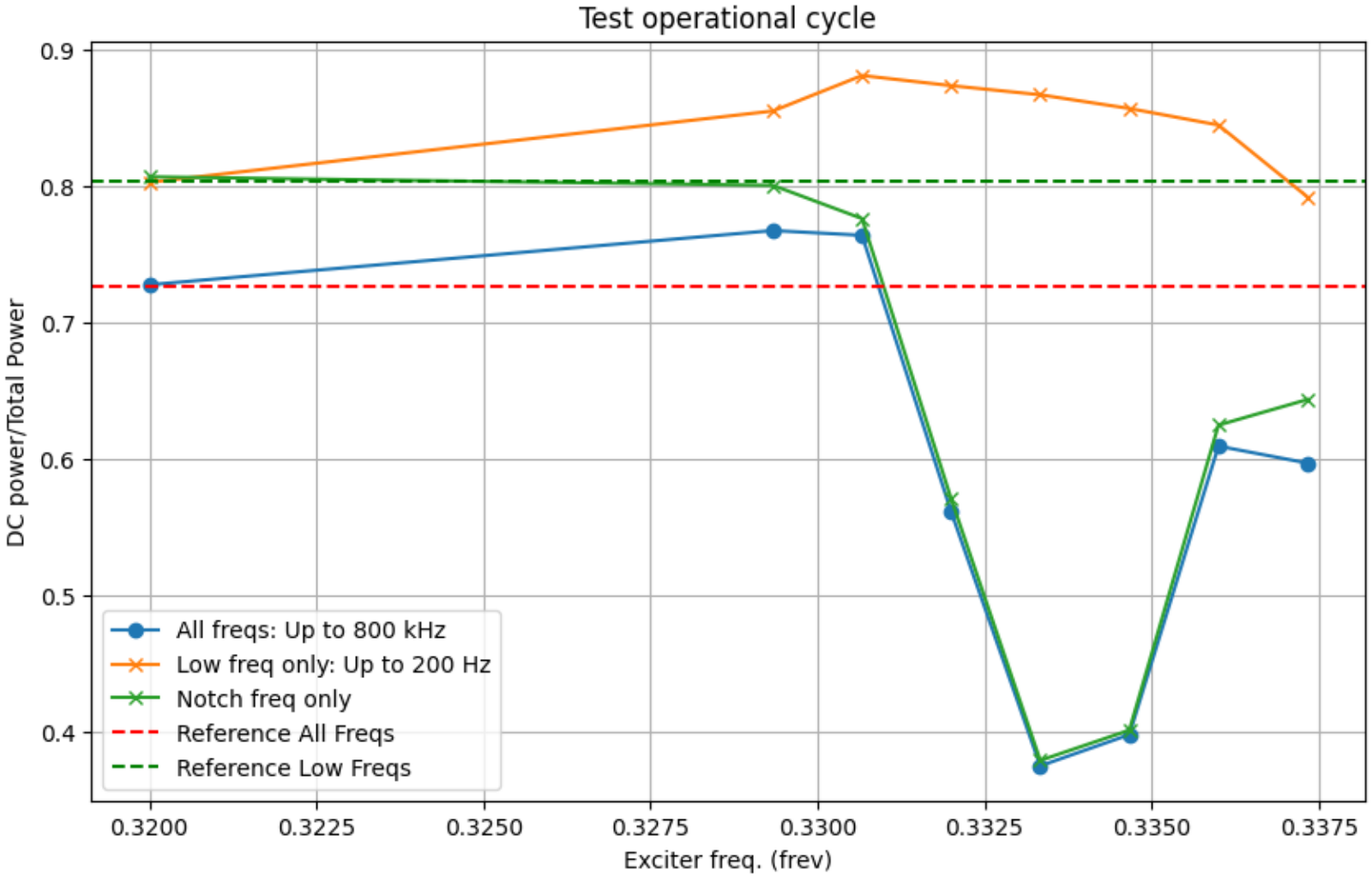
Plans

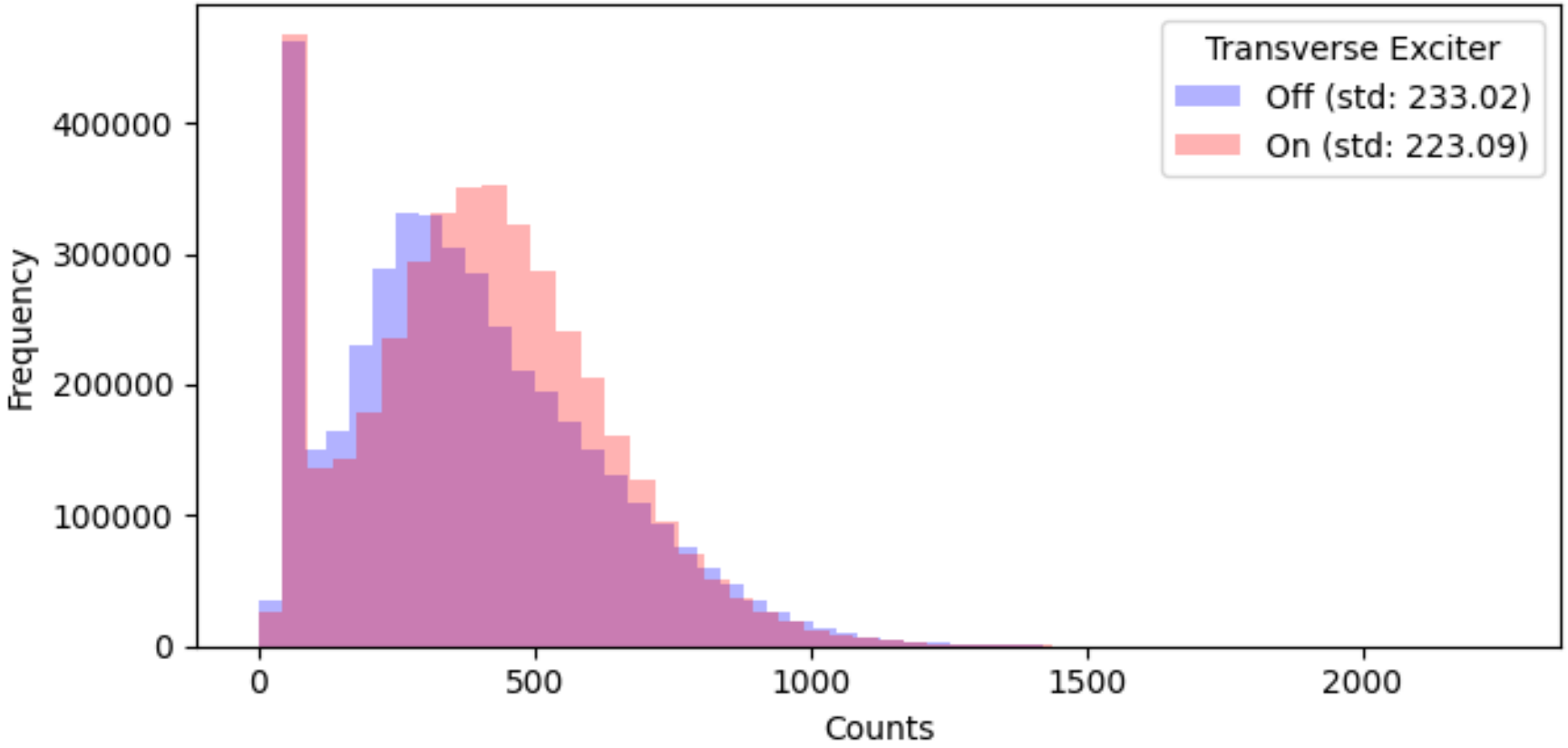
- Push bandwidth limit of the TFB -> for spill quality, interesting to test higher harmonics of betatron tune.

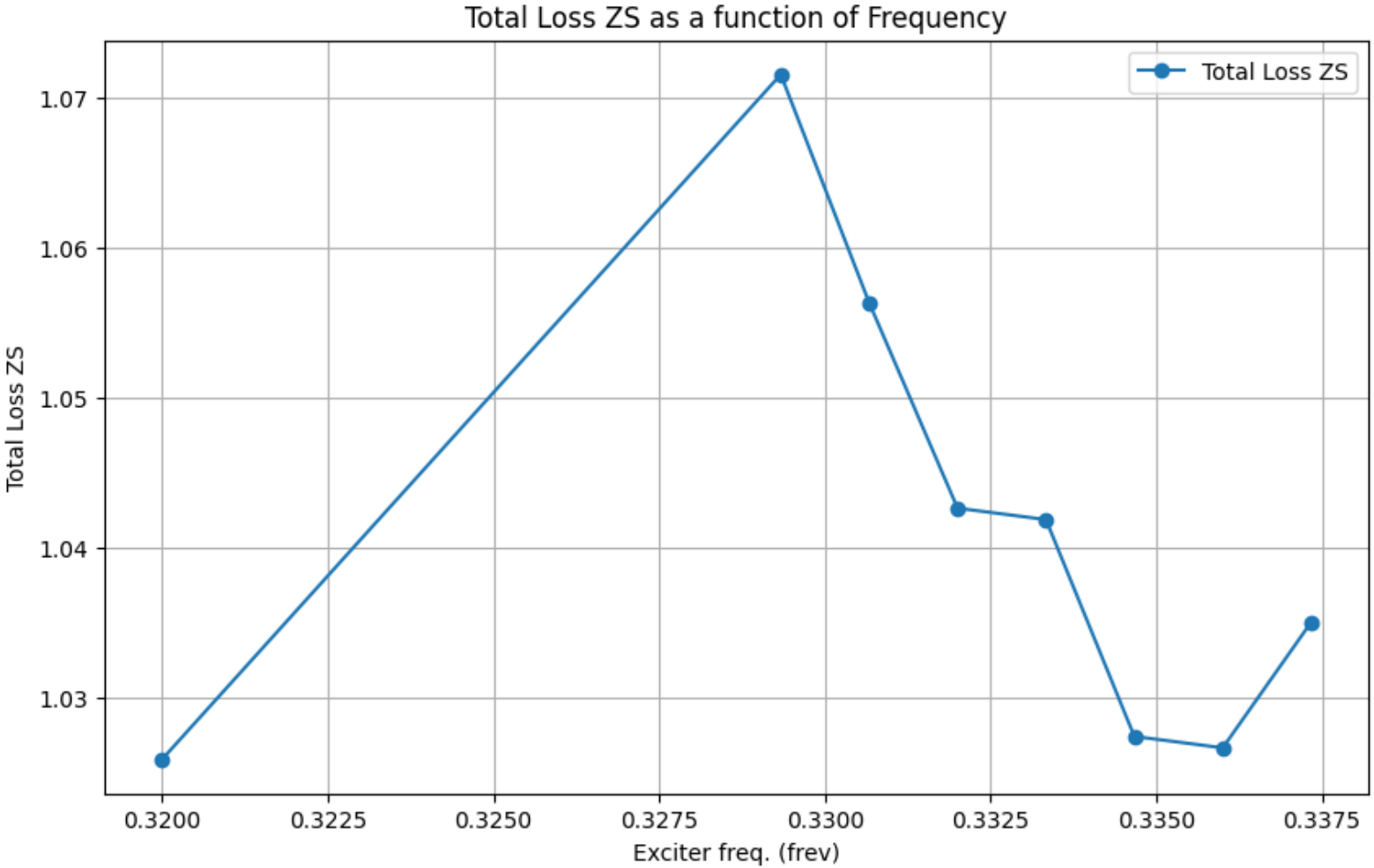
- Study interplay between this manipulation and empty-bucket channelling -> potential to combine them or to replace EBC (possibly easier to set up and maintain)

Request: 1 dedicated MD slot

Extra slides


Test operational cycle
DC power/Total Power
Exciter freq. (frev)
0.9
0.8
0.7
0.6
0.5
0.4
0.3200
0.3225
0.3250
0.3275
0.3300
0.3325
0.3350
0.3375
All freqs: Up to 800 kHz
Low freq only: Up to 200 Hz
Notch freq only
Reference All Freqs
Reference Low Freqs


Transverse Exciter
Off (std: 233.02)
On (std: 223.09)
Frequency
400000
300000
200000
100000
0
0
500
1000
1500
2000
Counts


Total Loss ZS as a function of Frequency
Total Loss ZS
1.07
1.06
1.05
1.04
1.03
Total Loss ZS
0.3200
0.3225
0.3250
0.3275
0.3300
0.3325
0.3350
0.3375
Exciter freq. (frev)