



Phase and Amplitude Setup of the RF Cavities of the ESS Linear Accelerator

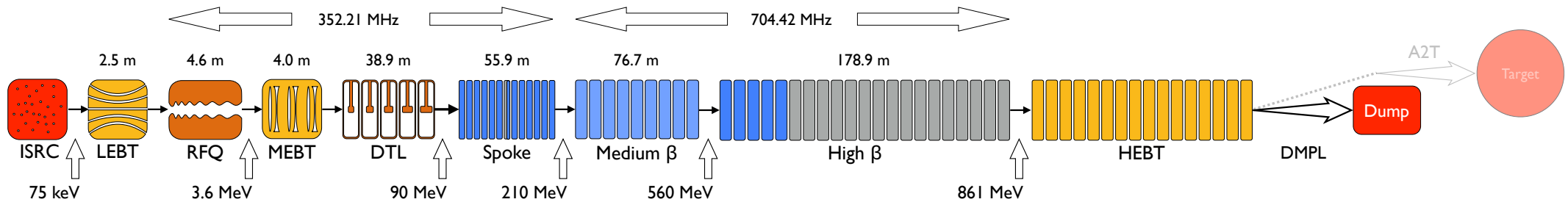
PRESENTED BY DANIEL NOLL
FOR THE ESS BEAM COMMISSIONING TEAM

2026-08-20

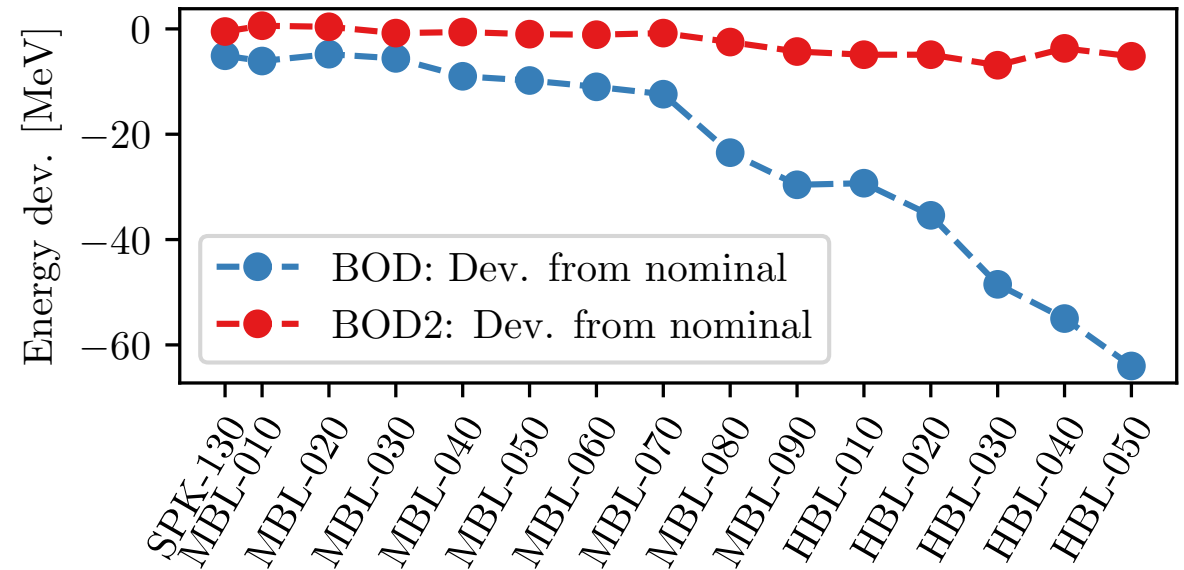
The European Spallation Source Linac



Energy setup as one of the first steps of beam commissioning and operation

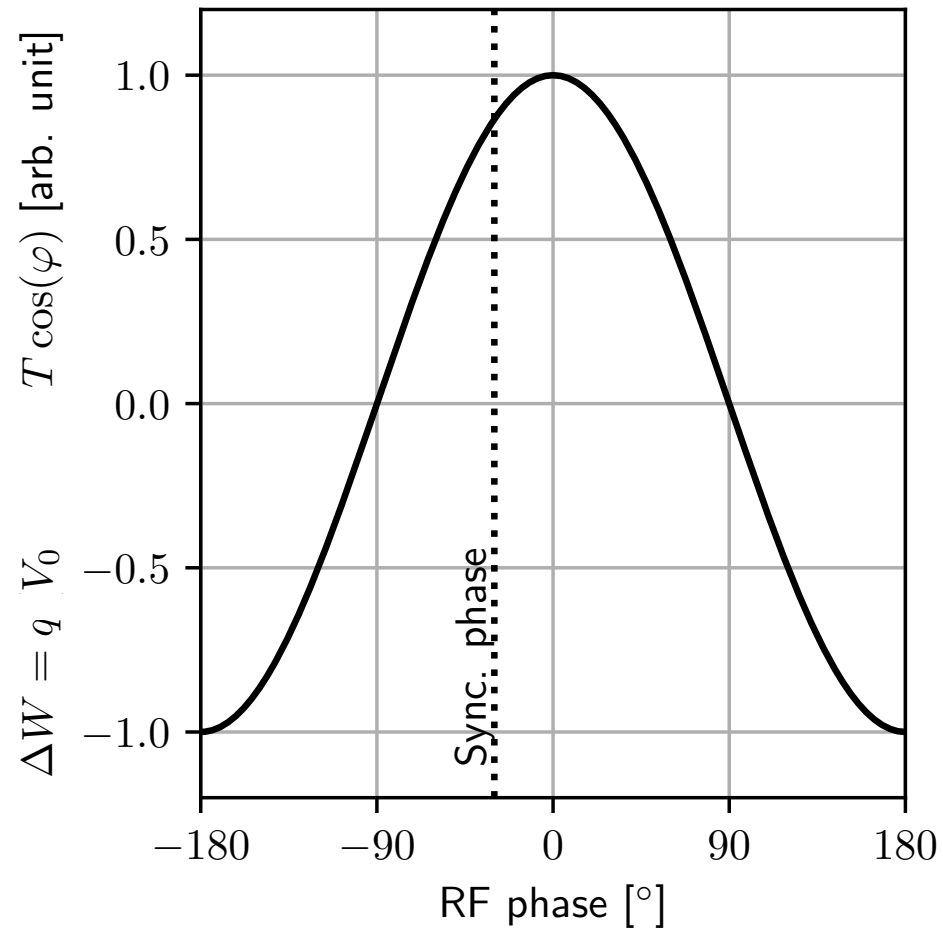


- Two beam commissioning periods of the full linac to the beam dump since 2025.
- 89 cavities configured in a – now – fully automatic phase scan procedure
 - Approximately 3 hours in fastest case



Why do we need a phase scan?

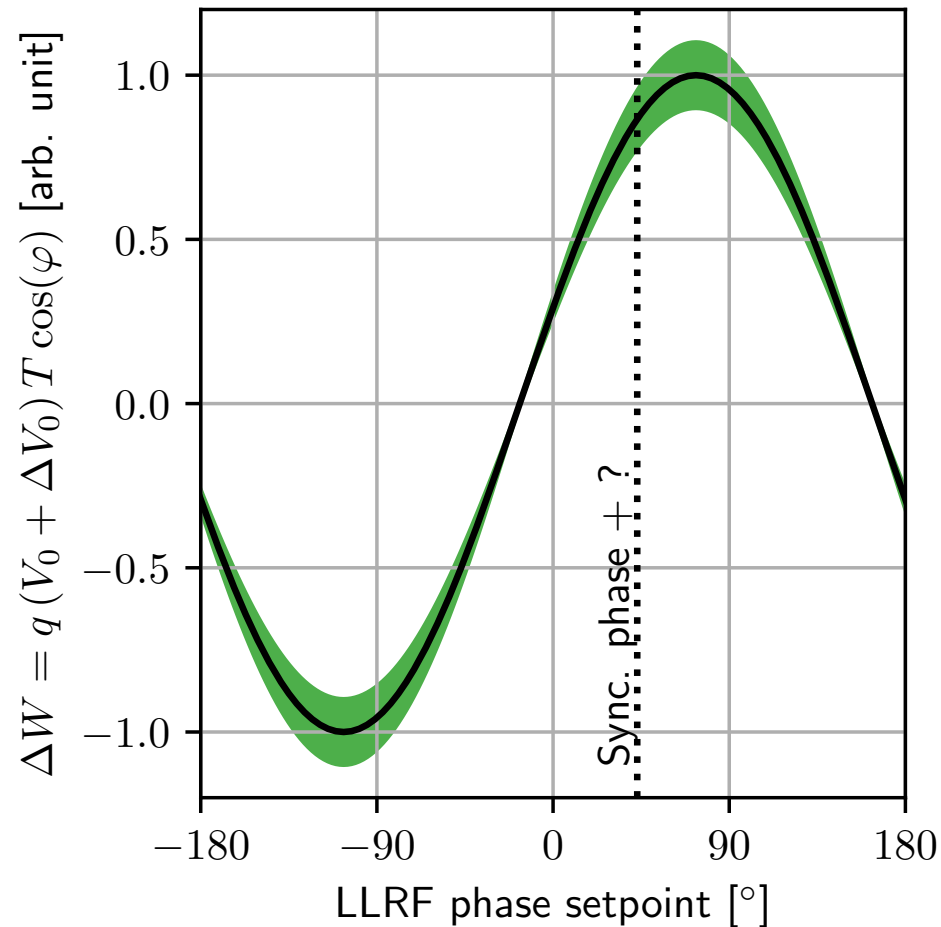
Phase scan as beam-based cavity gradient calibration



Error studies have determined accuracy requirements for cavity gradient (1 %) and phase settings (1 °).

Why do we need a phase scan?

Phase scan as beam-based cavity gradient calibration

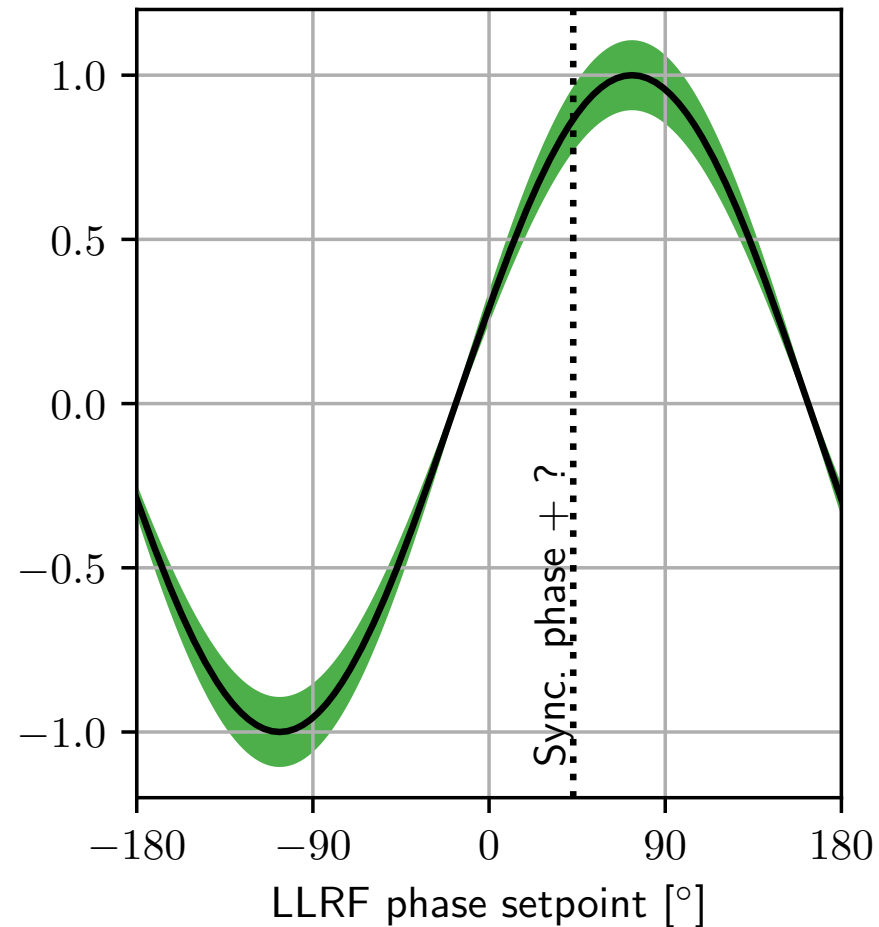


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RF calibration of accelerating gradient is **less accurate**. RF phase offset considered unknown.

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Phase scan as beam-based cavity gradient calibration



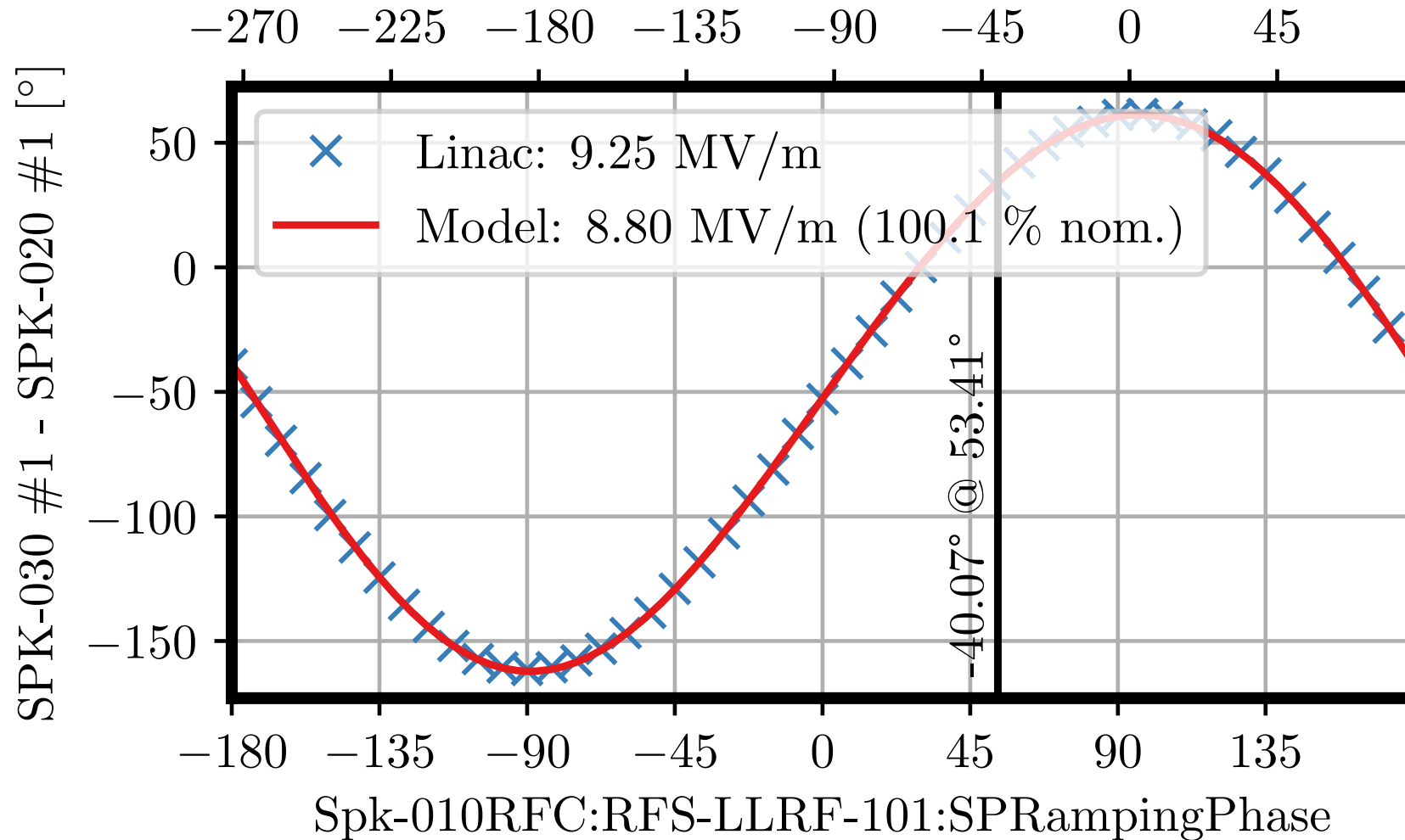
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Only two BPM pairs in the entire linac calibrated for direct energy measurement... and the measurement is entirely **manual**.

But we can measure variation of the **beam phase** on the BPMs.

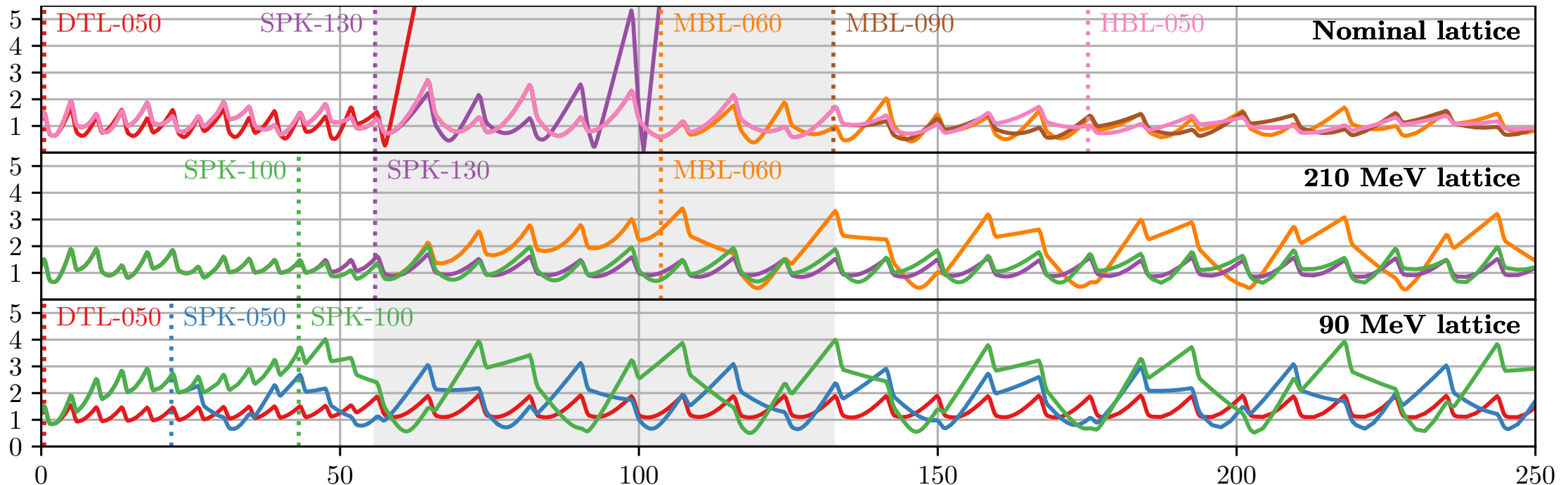
Single cavity example



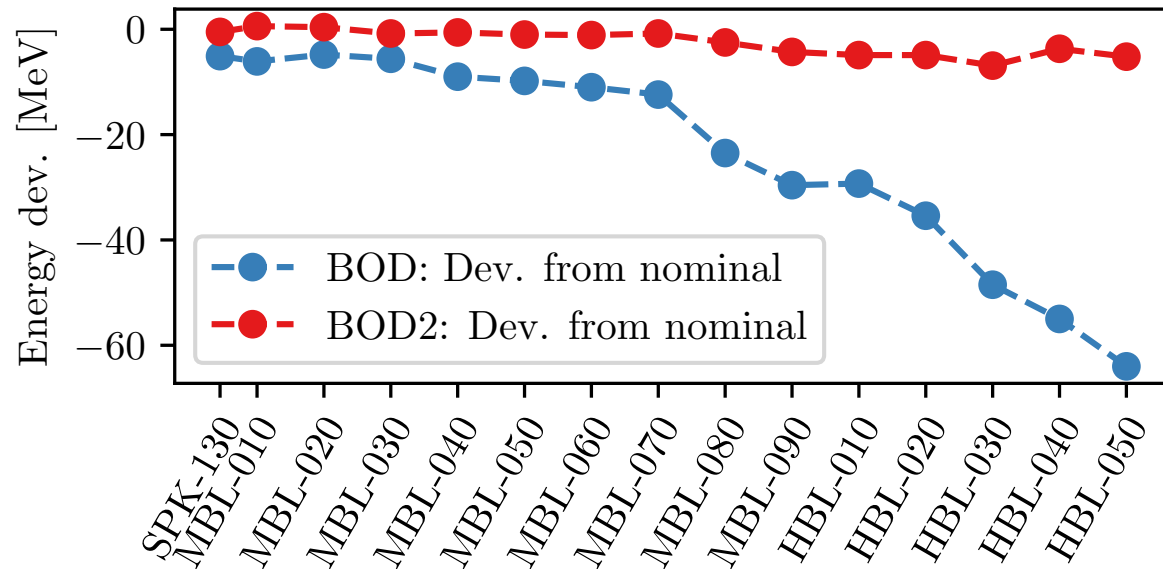
Lessons learned from BOD

Phase scans use a "Probe" – 5 us, 6 mA beam determined to be non-damaging.
Full loss of the Probe allowed by the Machine Protection System...

... but not the cavity protections (arc detectors)

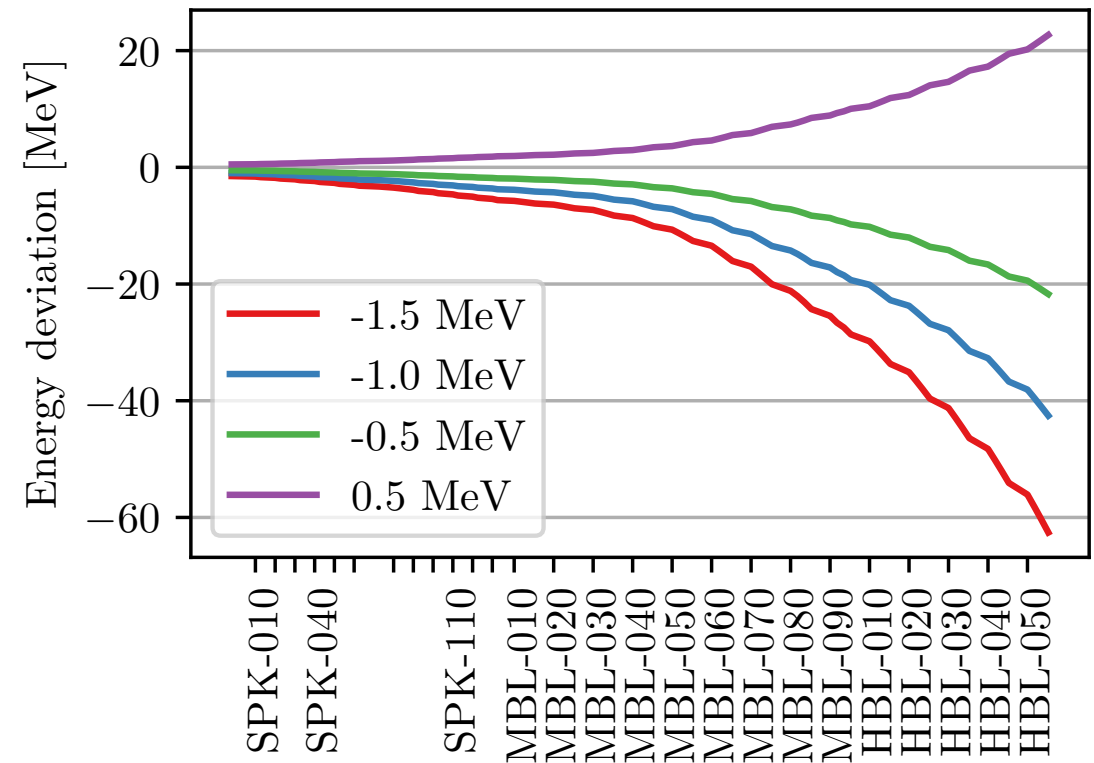


Lessons learned from BOD



The correction of the accelerating gradient will cause a beam with lower incoming beam energy to gain less energy than nominal.

The amplitude of the phase scan depends on the cavity gradient... but also the incoming beam energy.





Want to know more?

See you at poster THPO002!