Efforts in the Negative Momentum Compaction Regime at KARA

Virtual MT ARD ST3 Meeting 2020
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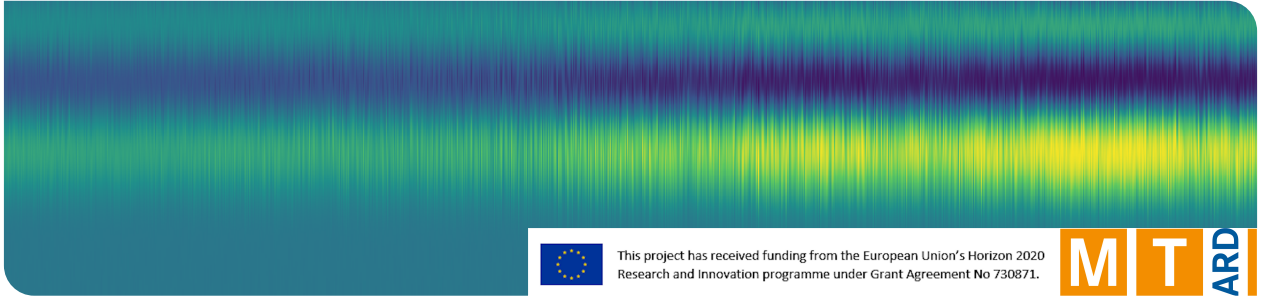

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Negative Momentum Compaction at KARA

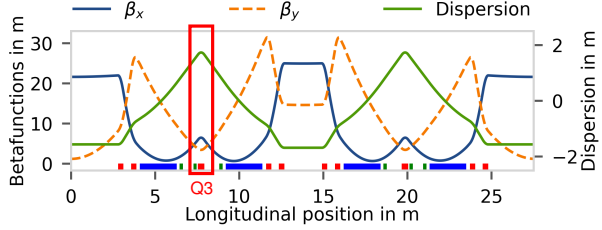
Motivation

- Beneficial for future low emittance rings due to possibility of reduced sextupole strengths

  $\Rightarrow$ increased dynamic aperture
- Interesting, scarcely investigated dynamics regime
- KARA as test facility flexible enough for implementation

Implementation at KARA

- Successfully implemented [1]
- Dispersion stretched via quadrupole Q3
- Beam currents up to 26 mA reached



[1] P. Schreiber et al., Status of Operation With Negative Momentum Compaction at KARA, IPAC'19, doi:10.18429/JACoW-IPAC2019-MOPTS017

Status at KARA

- Implemented at 0.5 GeV (injection energy) [1]
  - Multiple values of α_c established (-1.2×10^{-2} to -1.2×10^{-3})
  - Direct injection (top-up) possible
  - Long damping time
- Ramping up to 0.9 GeV established
  - Reduced damping time
  - Operation in decay-mode
- Comparisons of beam dynamics between positive and negative momentum compaction possible
  - Instabilities under investigation
  - Example: Microbunching instability previously studied at KARA
    - Existing diagnostics used for positive momentum compaction can be used

    $\Rightarrow$ Characteristic fluctuations of coherent synchrotron radiation in the THz range

Energy	Damping Time
0.5 GeV	184 ms
0.9 GeV	32 ms
2.5 GeV	1 ms

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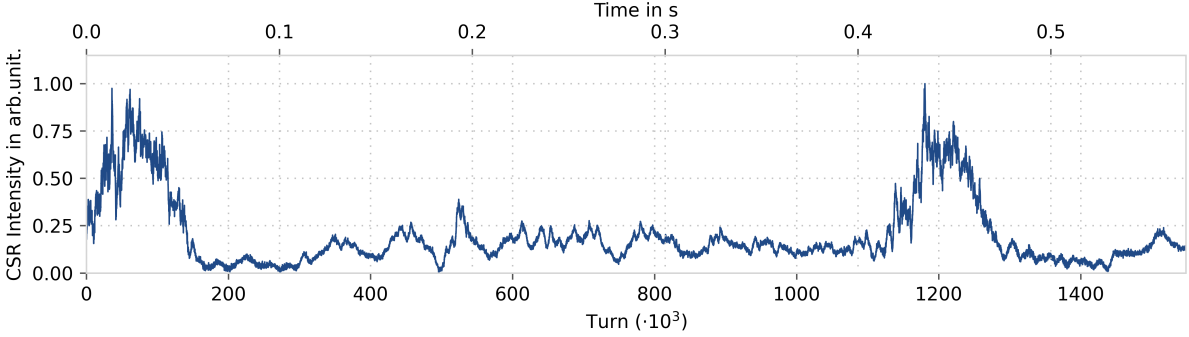
CSR Measurements



- CSR power fluctuations clearly visible
  - ⇒ Microbunching instability present at negative momentum compaction

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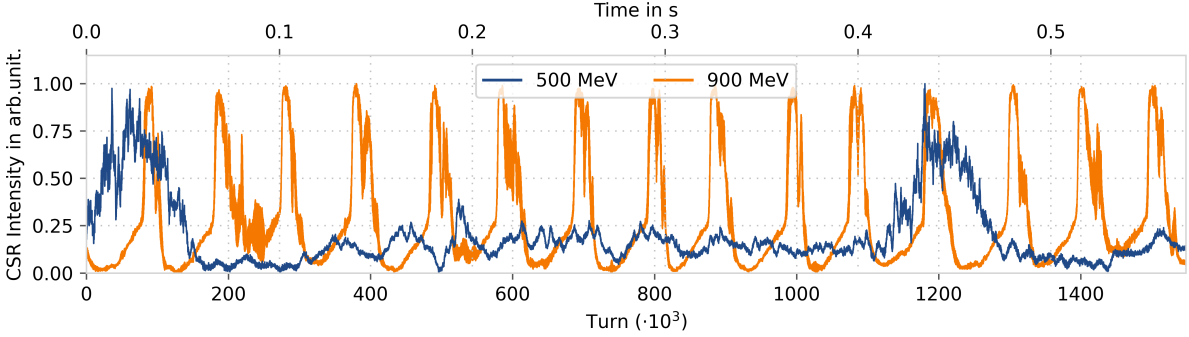

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  - ⇒ Damping time influence clearly visible (confirms expectations)

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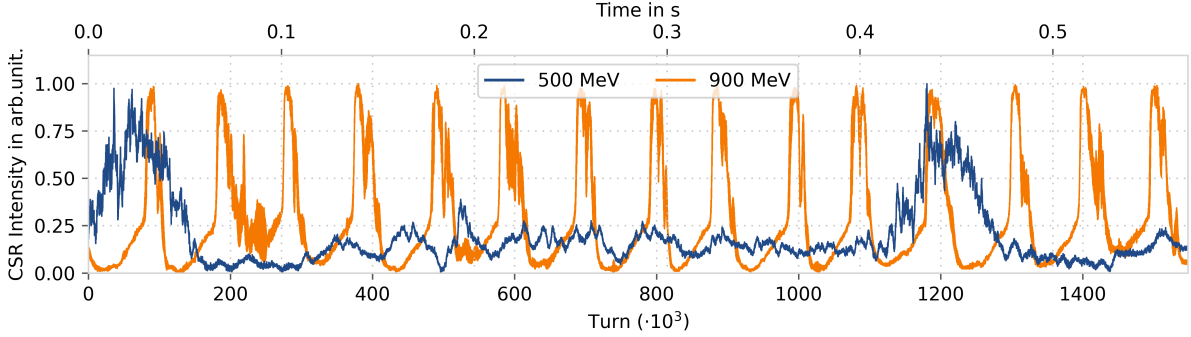

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  - ⇒ Microbunching instability present at negative momentum compaction
- Bursting repetition rate greatly reduced for lower energies
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- Detailed comparison to positive momentum compaction factor is ongoing
- Investigation of head-tail motion using a streak camera is under preparation