

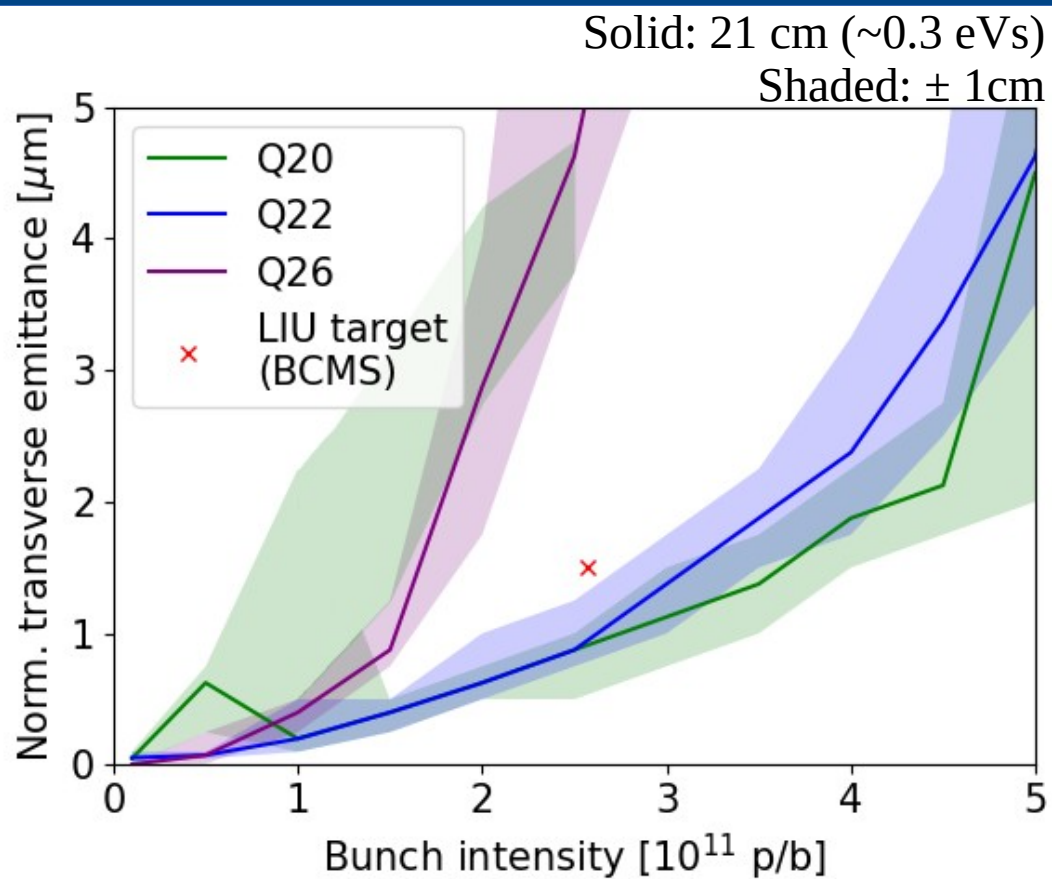


# Single bunch instability threshold with Q22

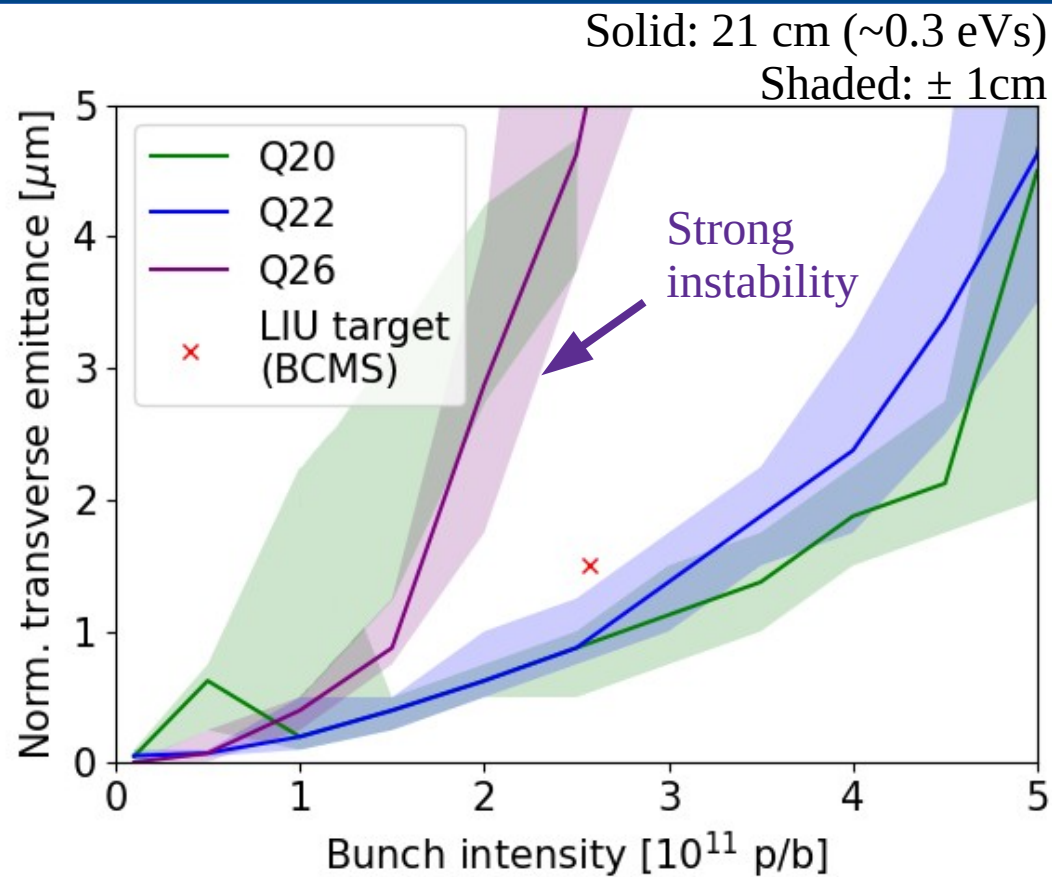
X. Buffat, H. Bartosik, A. Oeftiger and C. Zannini

- Introduction
- Results
- Summary

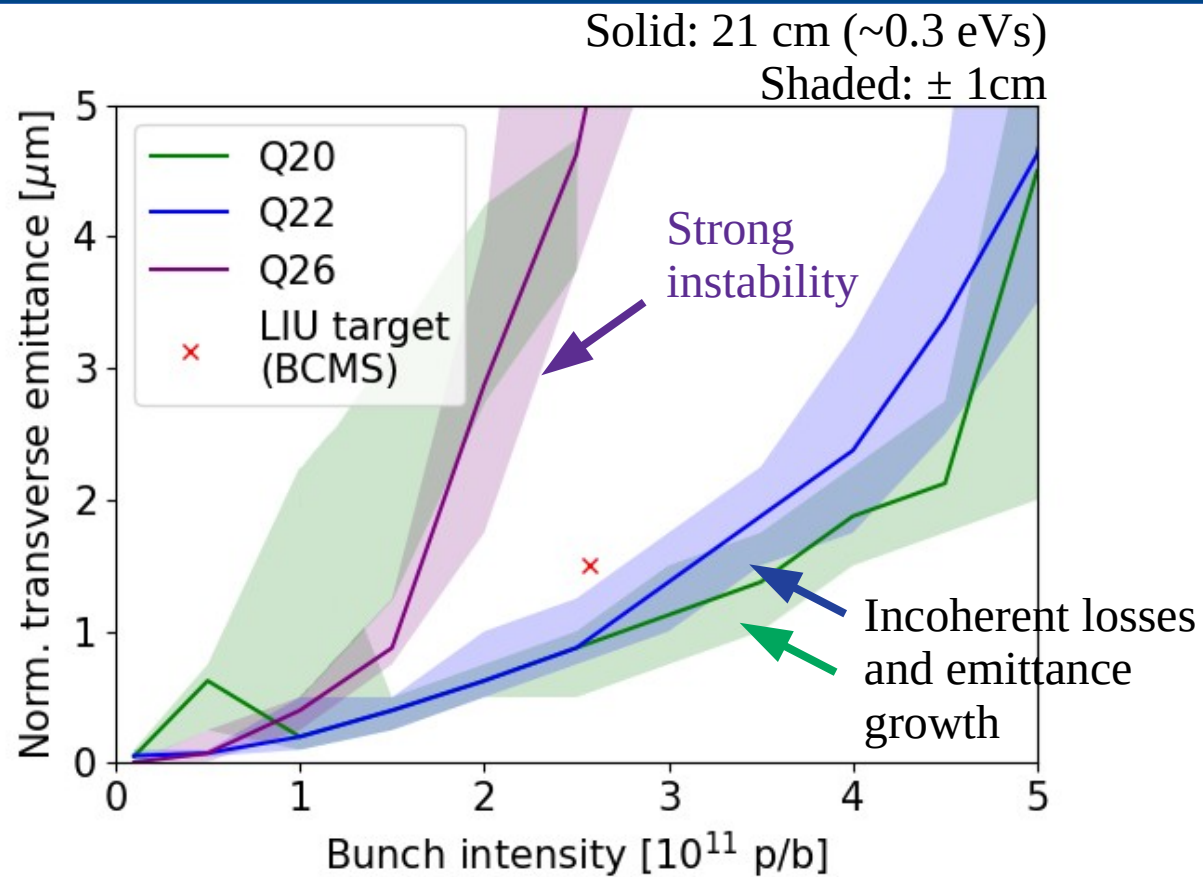
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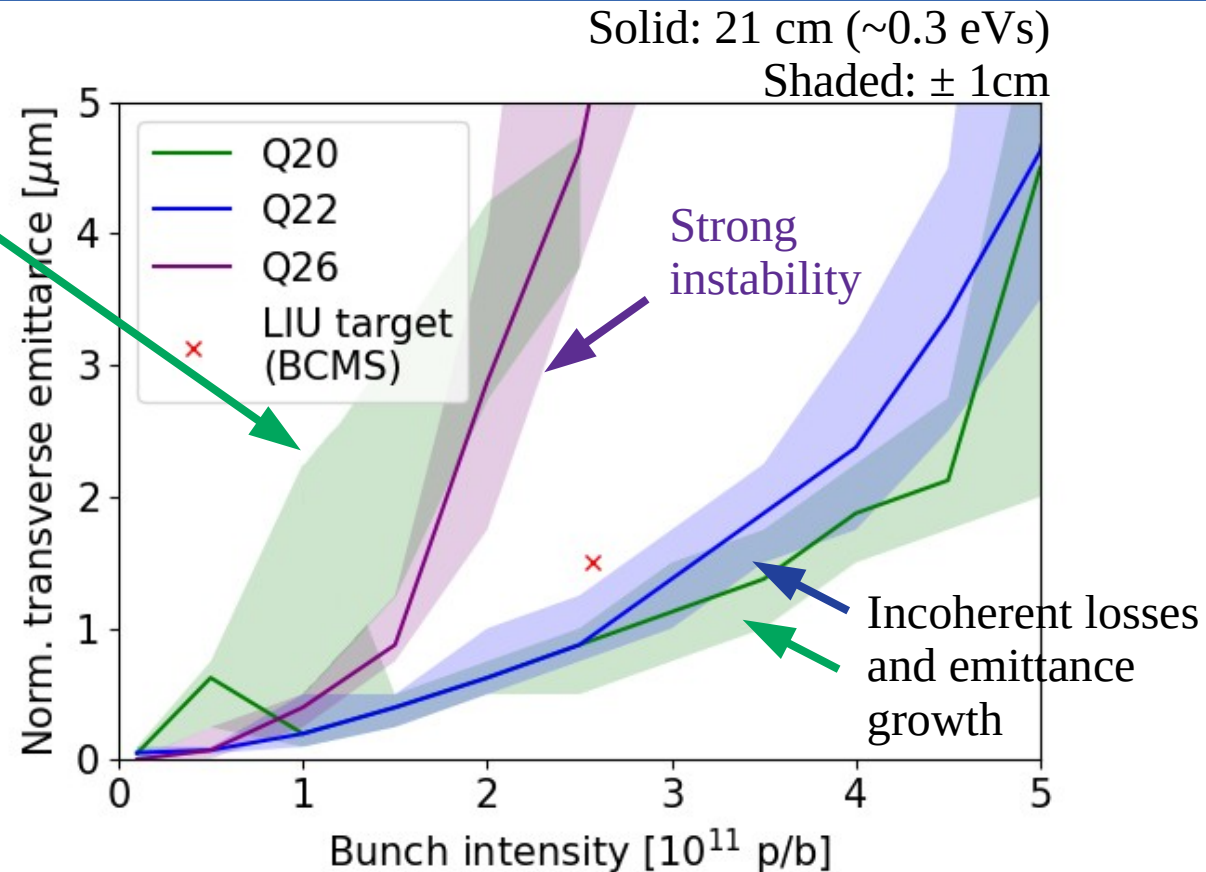
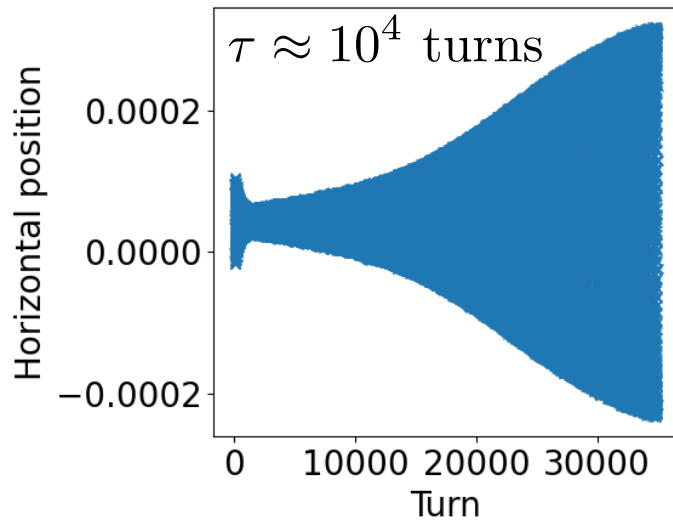


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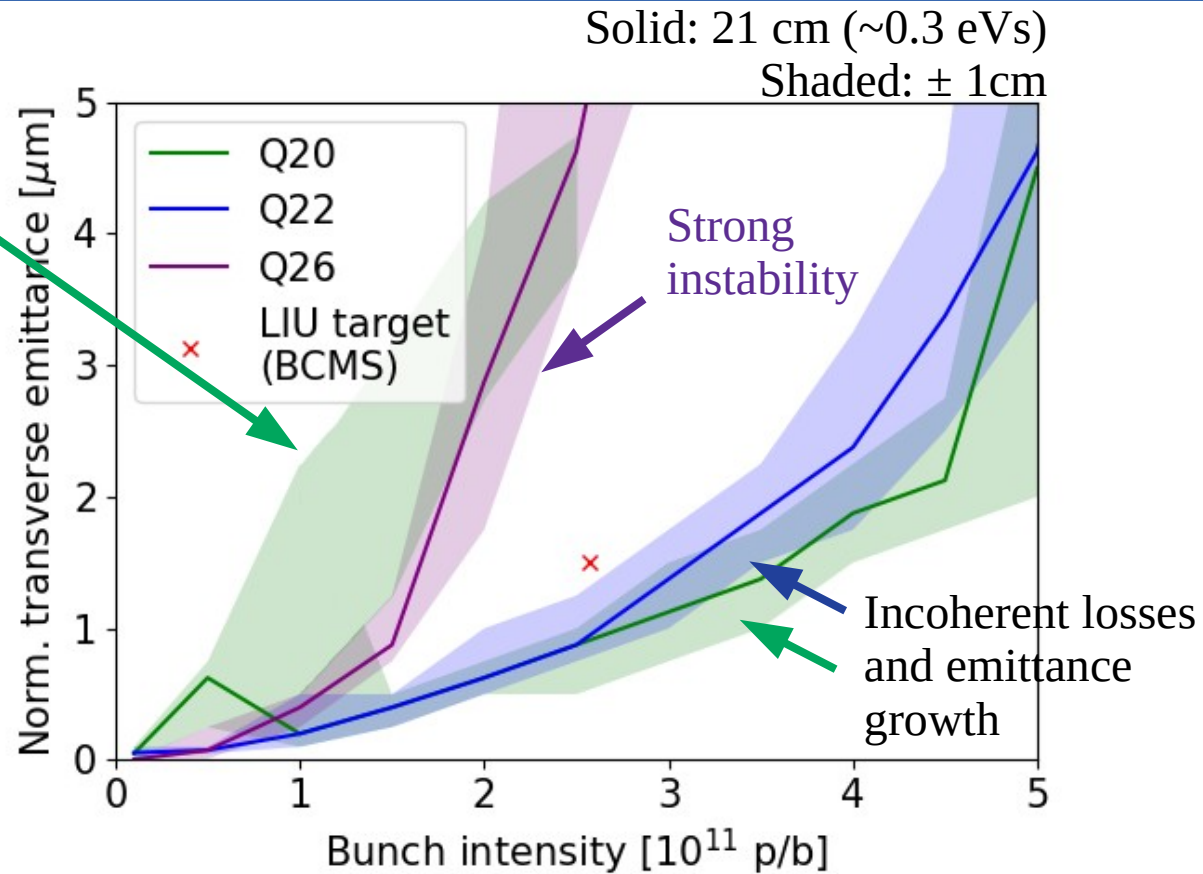
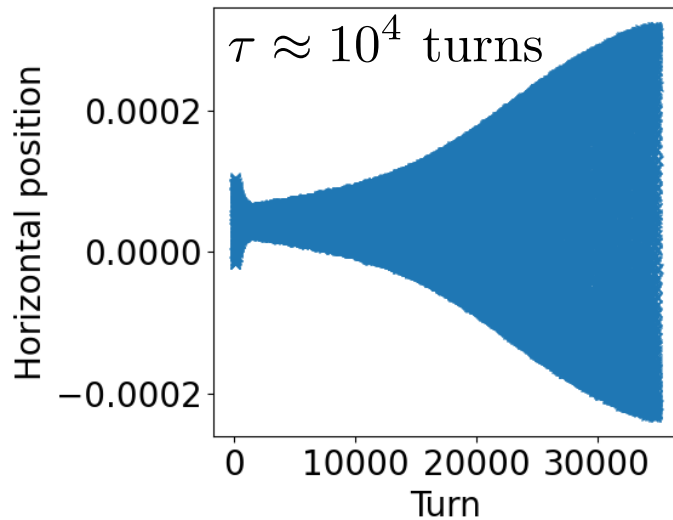
Weak instabilities with long bunches



- In simulations (Xsuite with a single bunch, lattice, self-consistent space-charge and wakefields), the Q20 features an island of weak horizontal instabilities for long bunches ( $\sim 0.4$  eVs)
  - This instability is fully suppressed with the **Q22** optics, while the TMCI remains well suppressed

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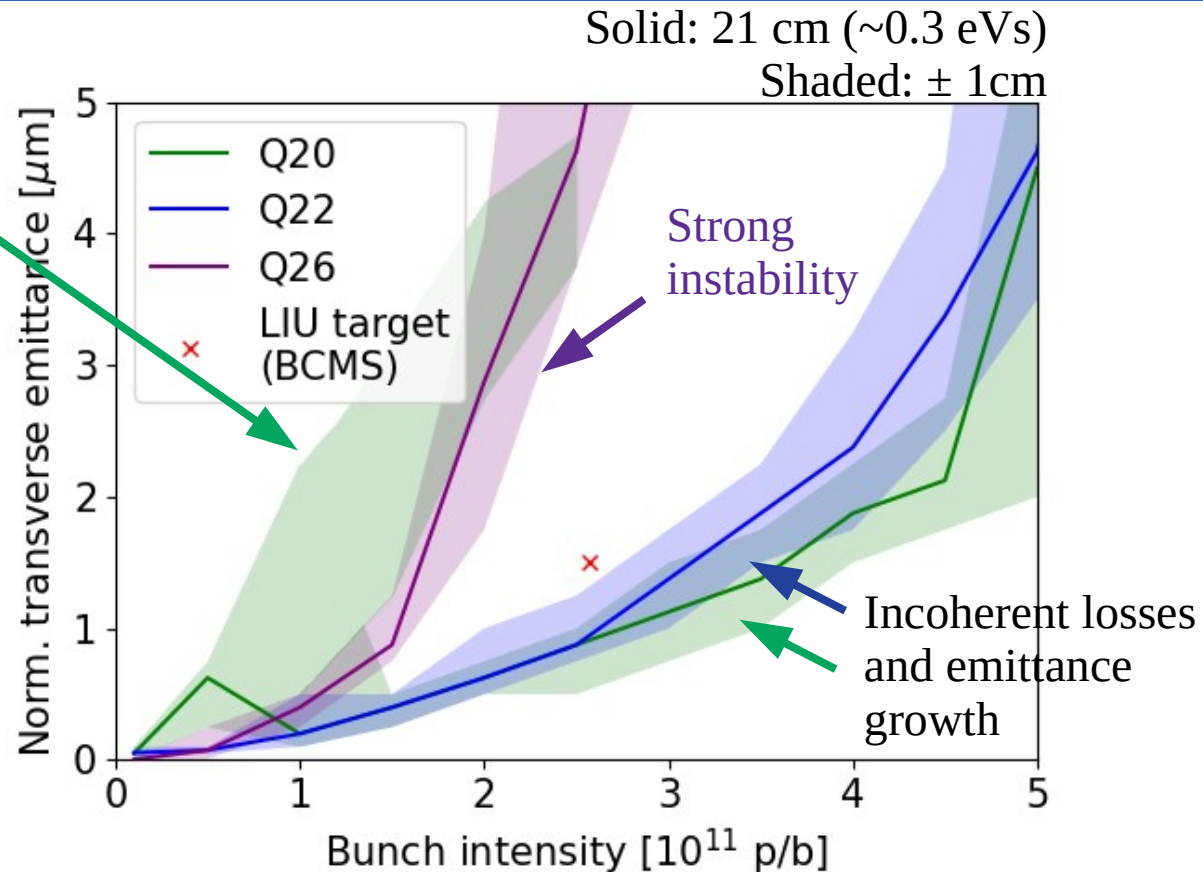
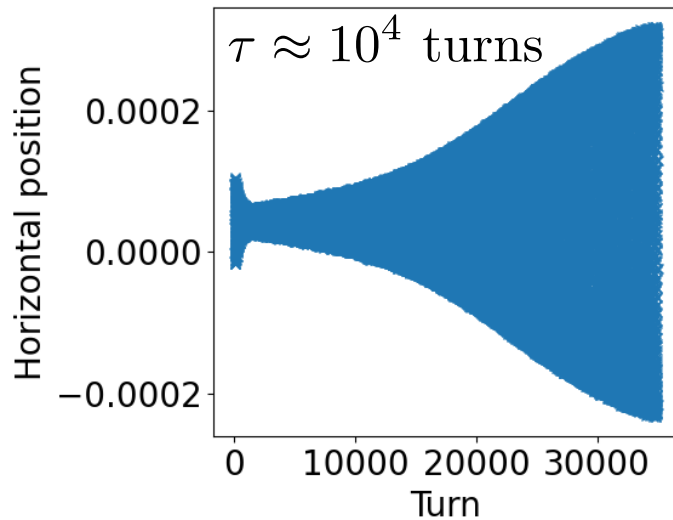
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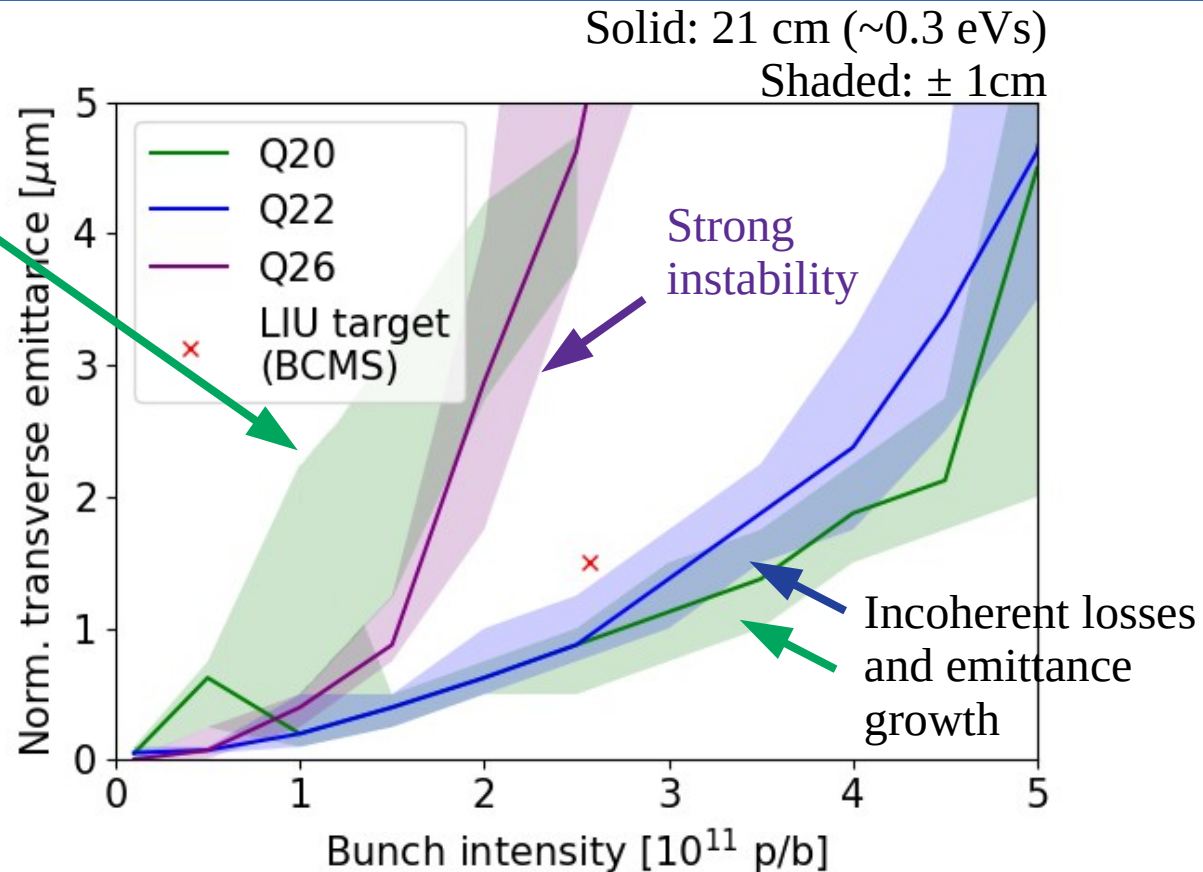
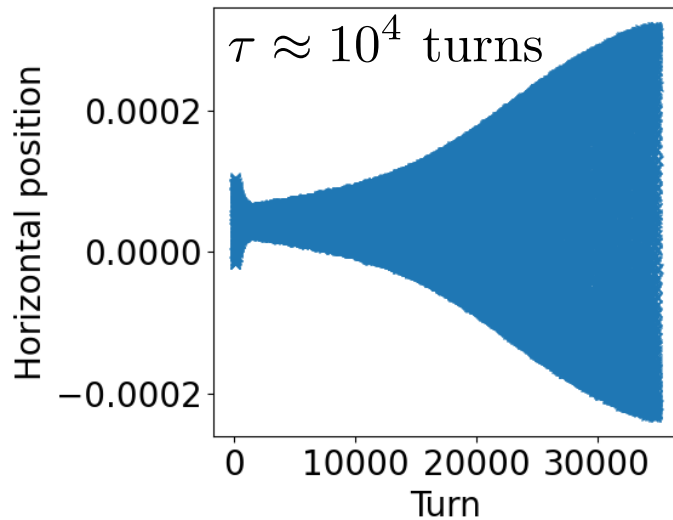
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- Is the improved stability of INDIVs with Q22 measurable ? → **Tentative in 2024**
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# Weak horizontal instability of INDIVs with Q20

Weak instabilities with long bunches

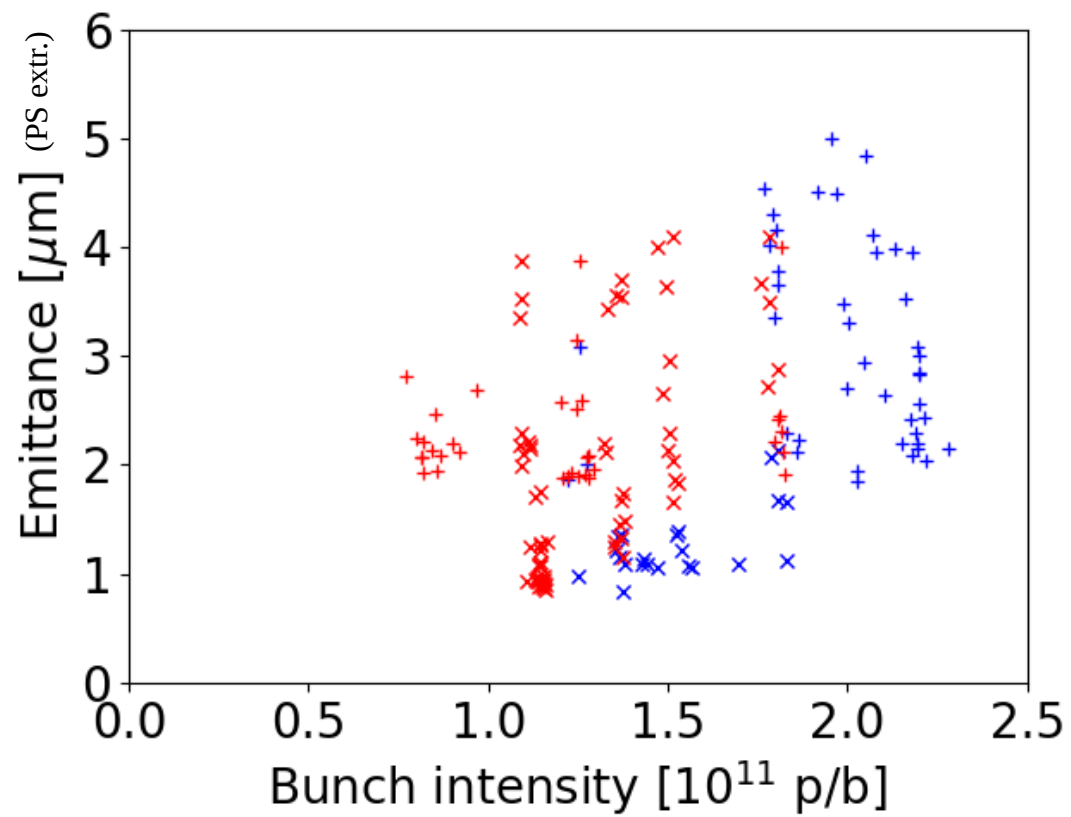


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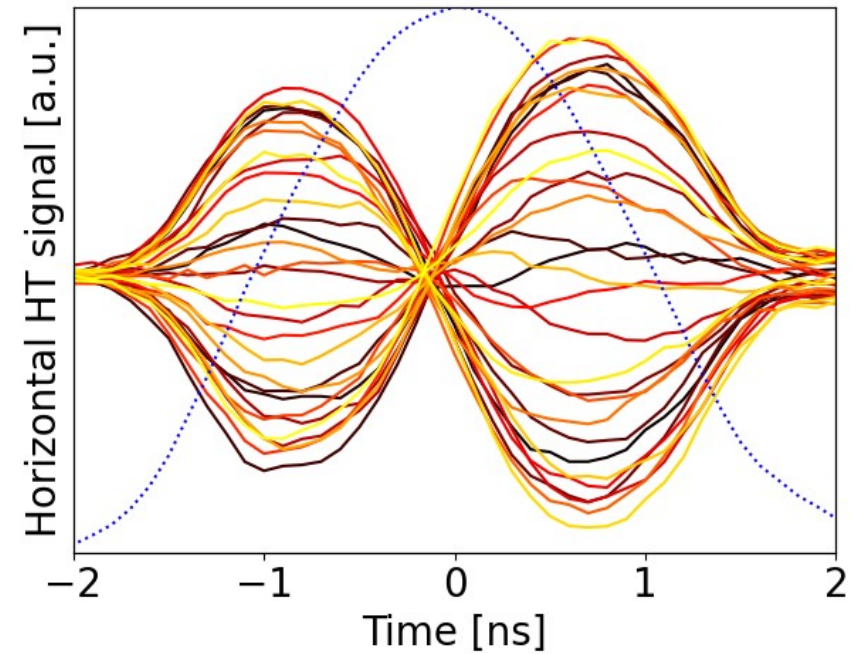
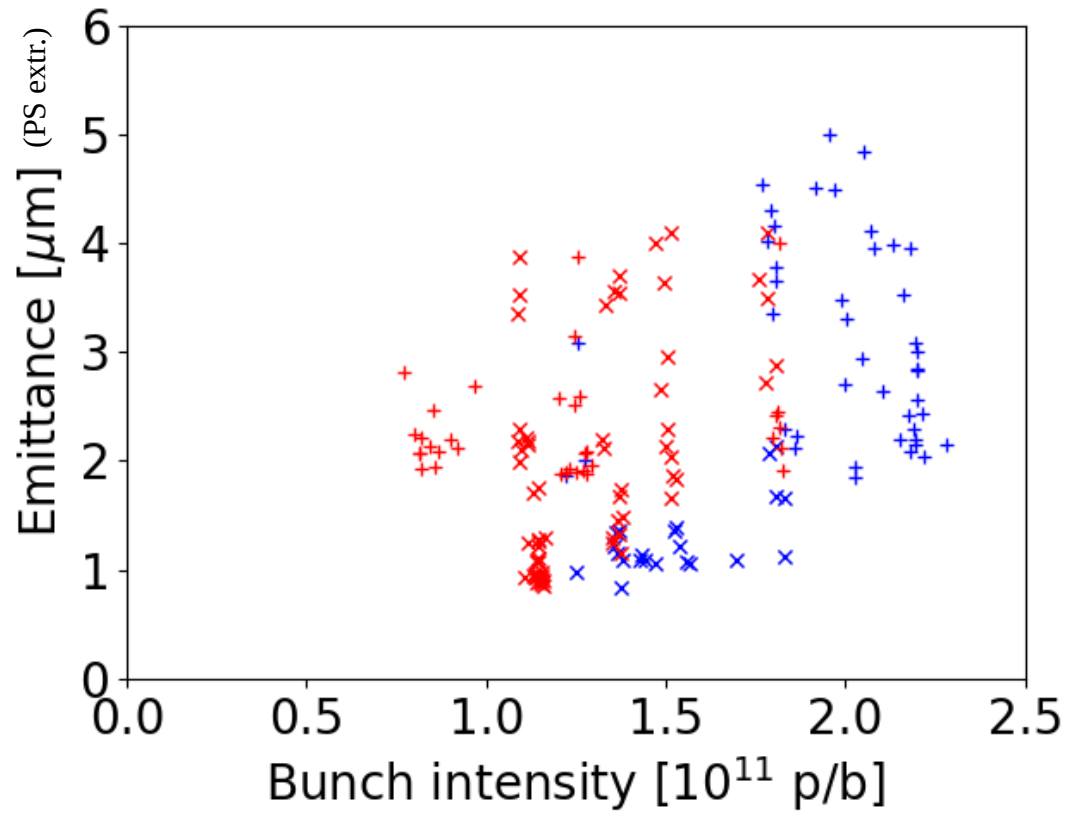
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- Is this island explained by a loss of Landau damping ? → **Tentative in 2025 ?**



# Q20 with long INDIV (ABWLM: 3.8ns, 28cm) (Reminder from 2023 MDs)

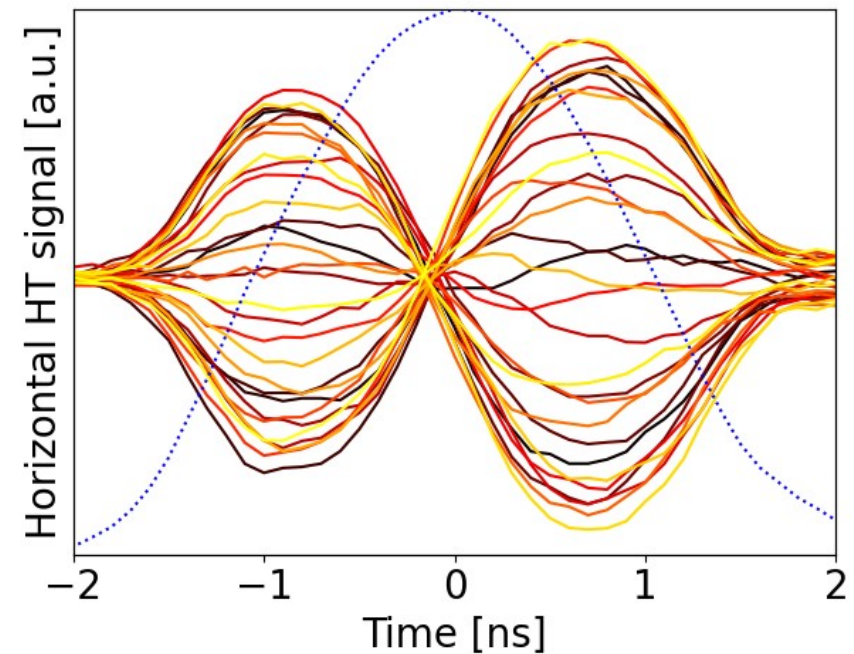
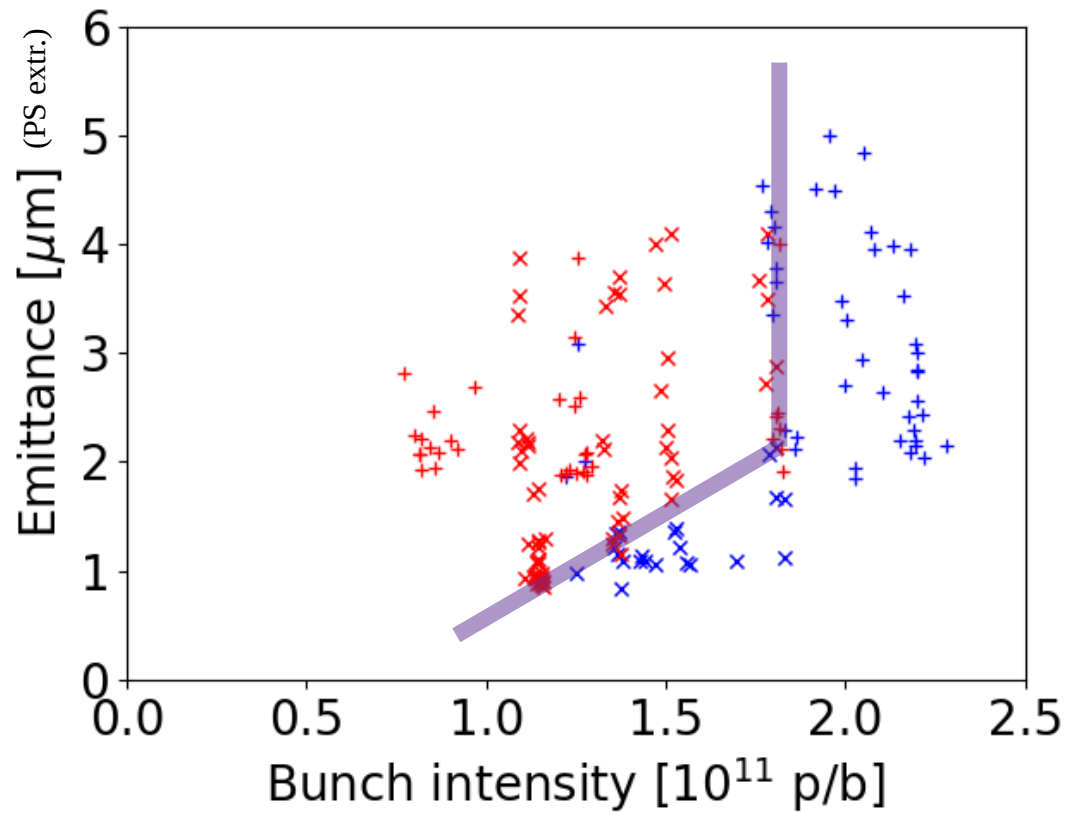


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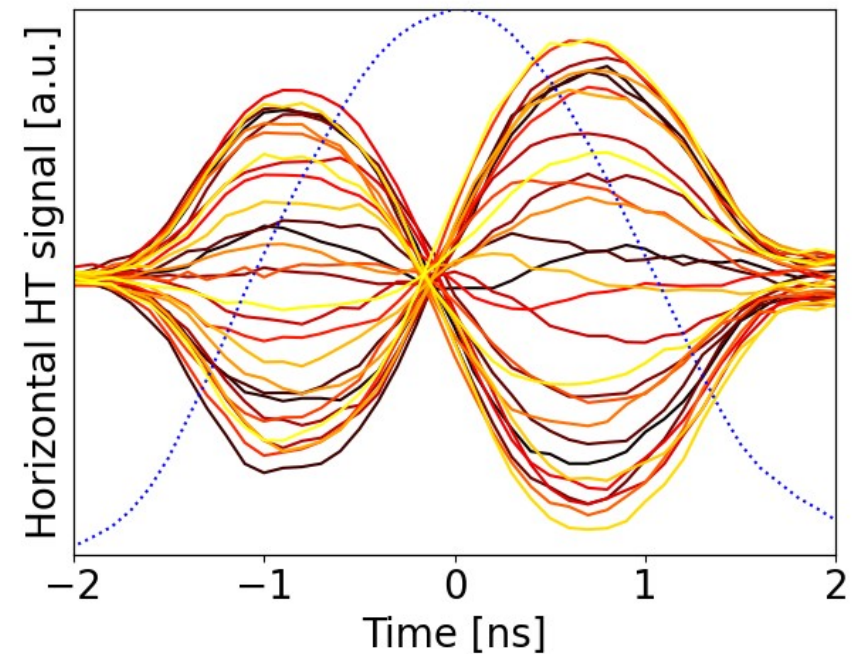
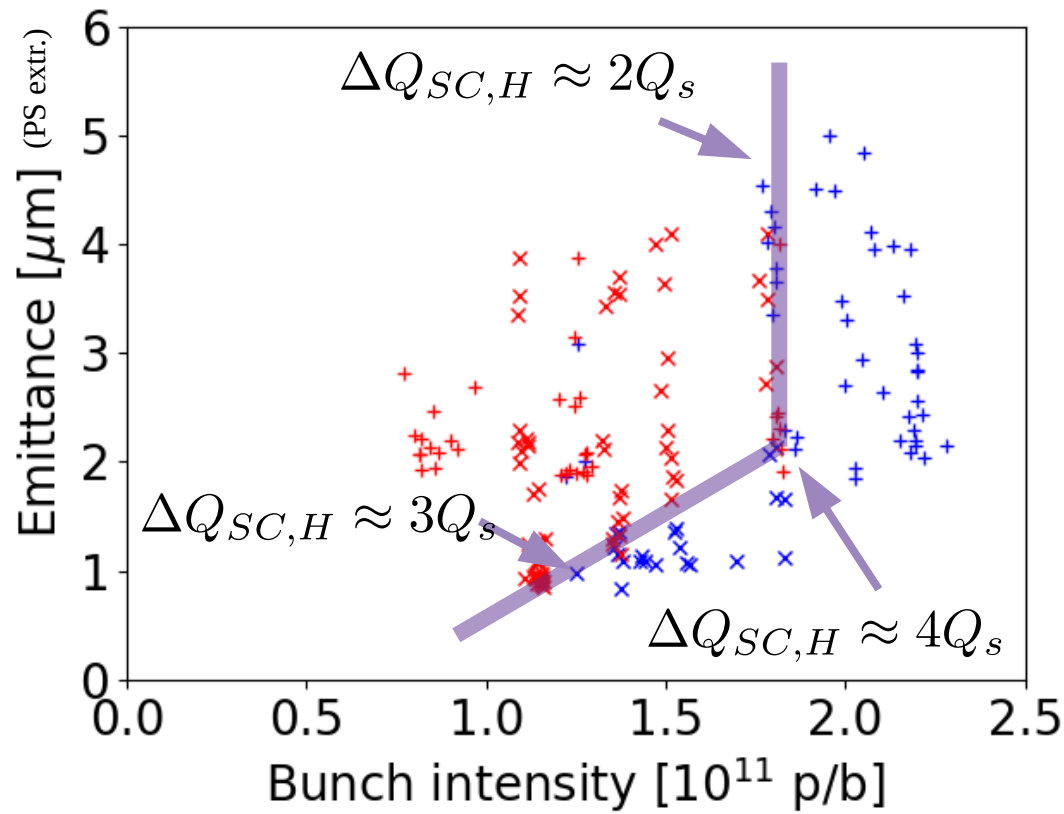
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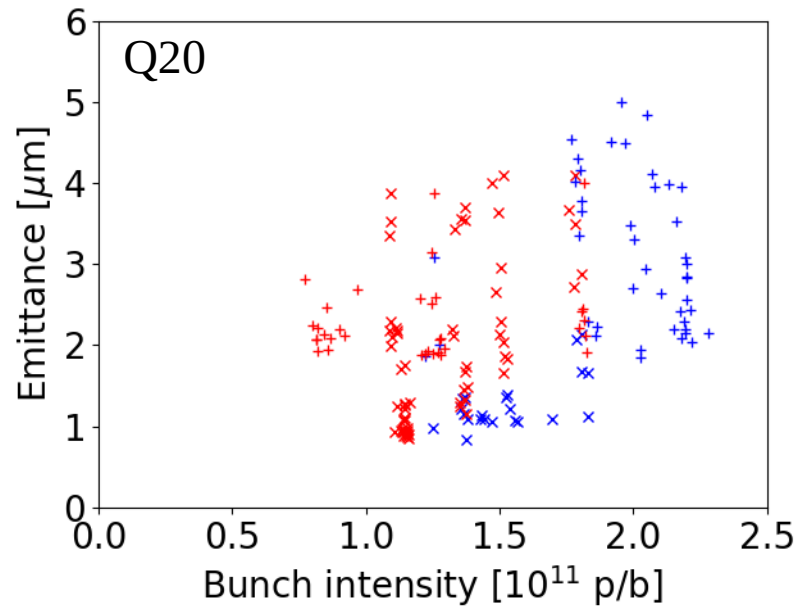
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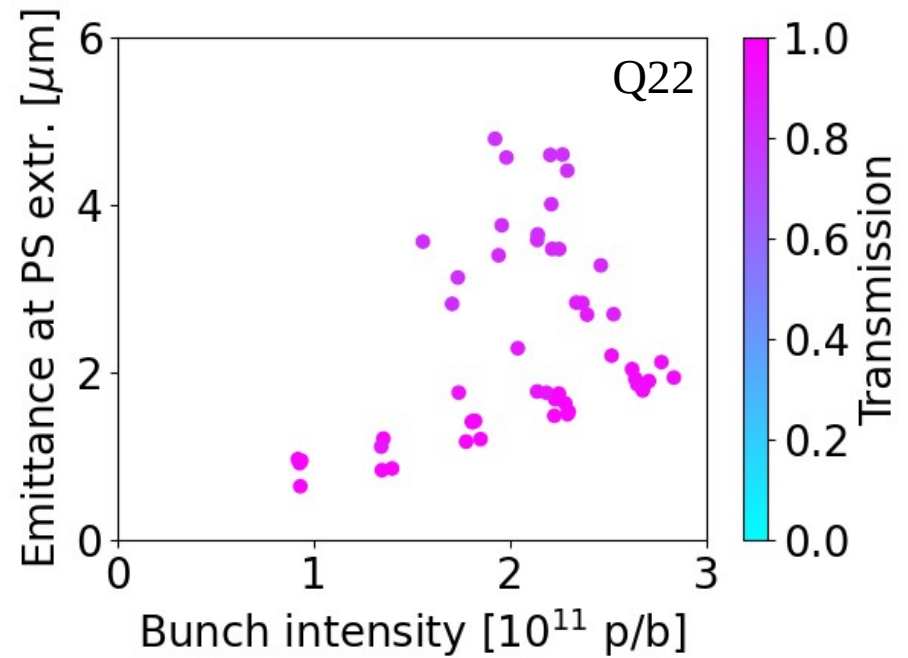
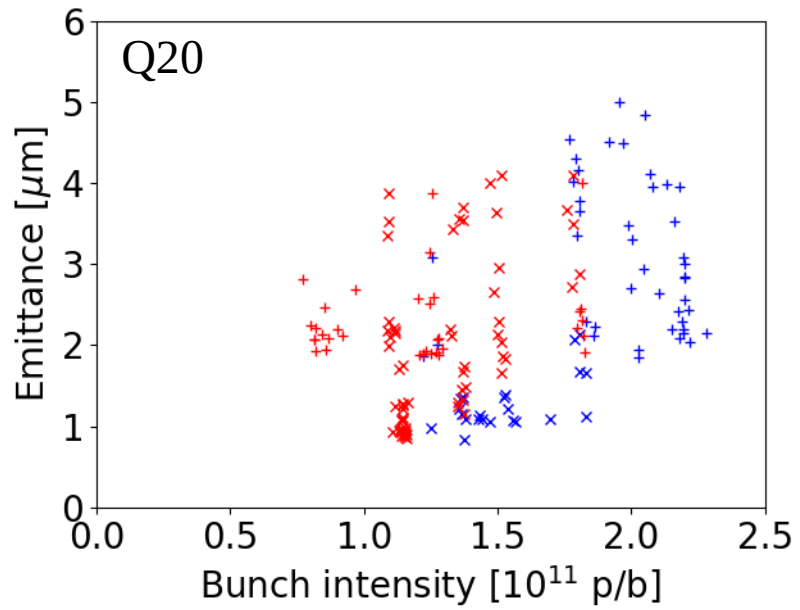


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- The stability threshold indicate two regimes with a brightness dependence and an intensity dependence
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- **Next step with Q20: Interplay with Landau octupoles in the ‘intermediate space charge regime’ (~1 day short parallel)**
  - Attempted in 2023, but spoiled by octupole feed-down to chromaticity

# Q22 with long INDIV (ABWLM: 3.8ns, 28cm)



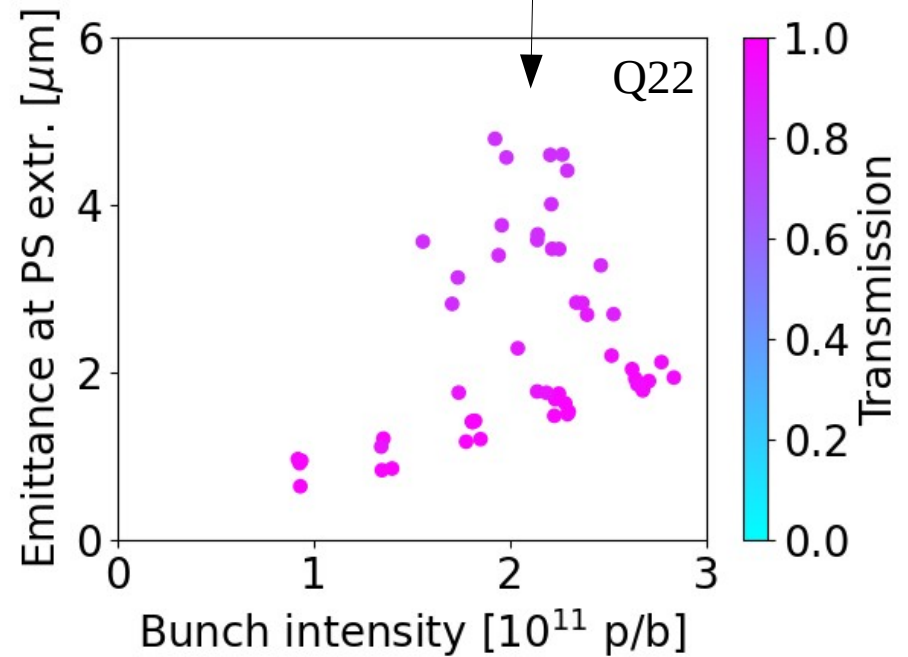
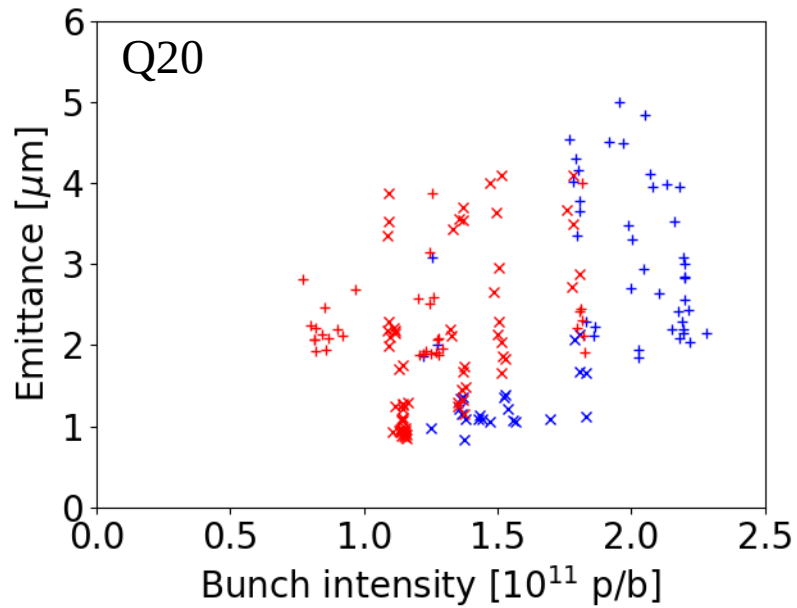
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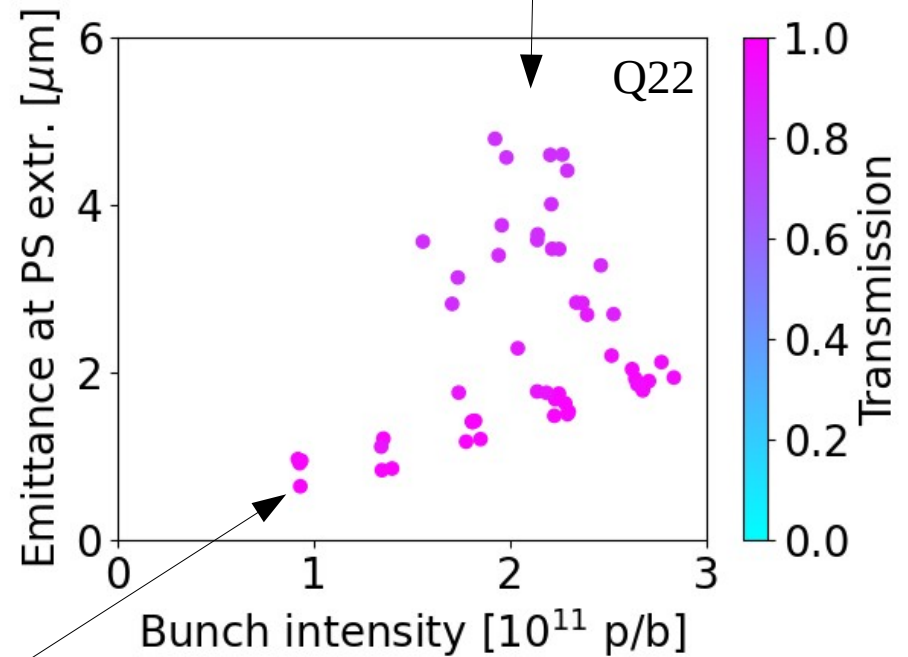
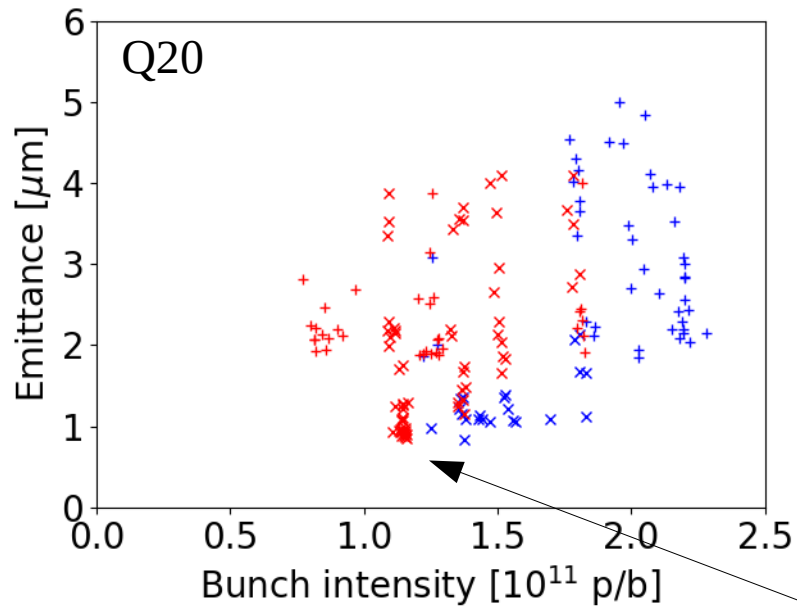
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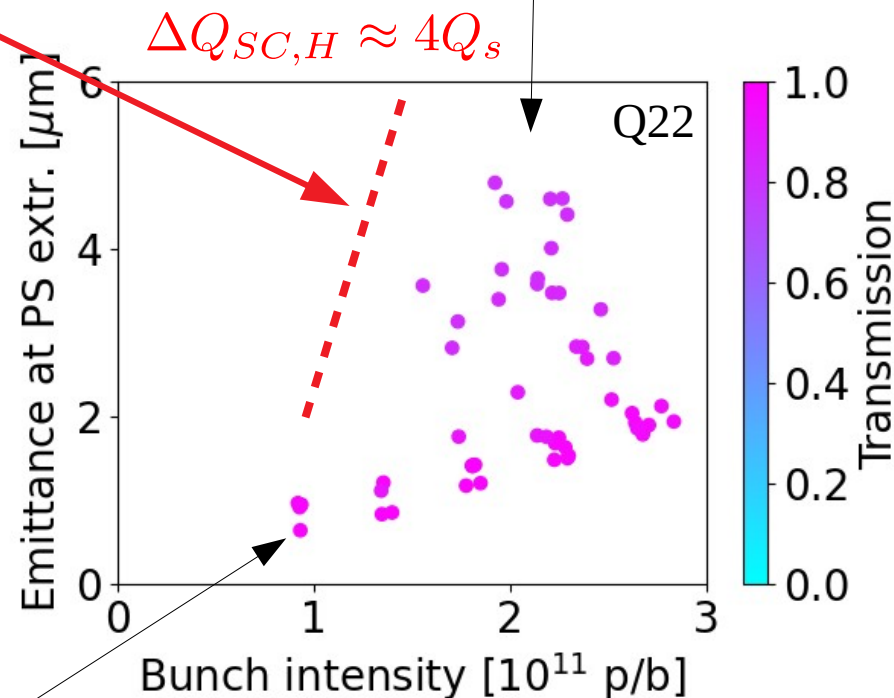
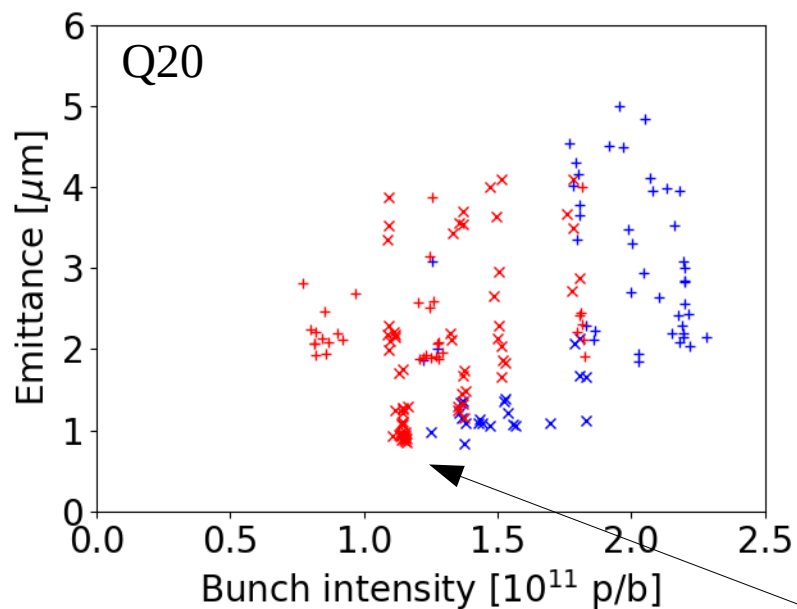
Improved stability at low bunch intensity

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Missing 'interesting points' due to issue with transverse blow up in the PS (by pushing the tune towards half integer on injection plateau)

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- Lots of time lost to control of chromaticity due to changes of super-cycle

LIU parameter range without instability even with higher longitudinal emittance (0.4 – 0.45 eVs)



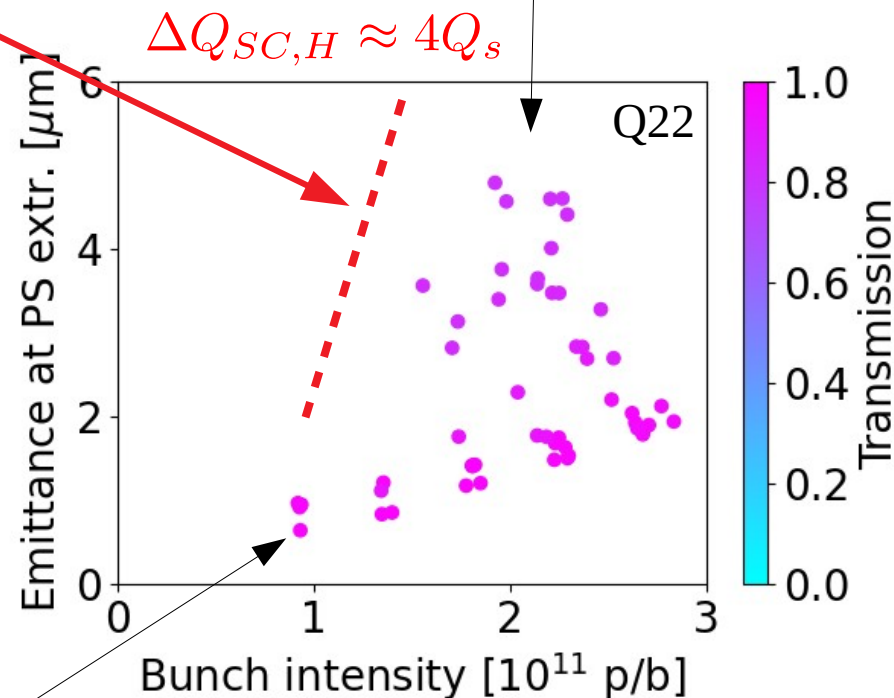
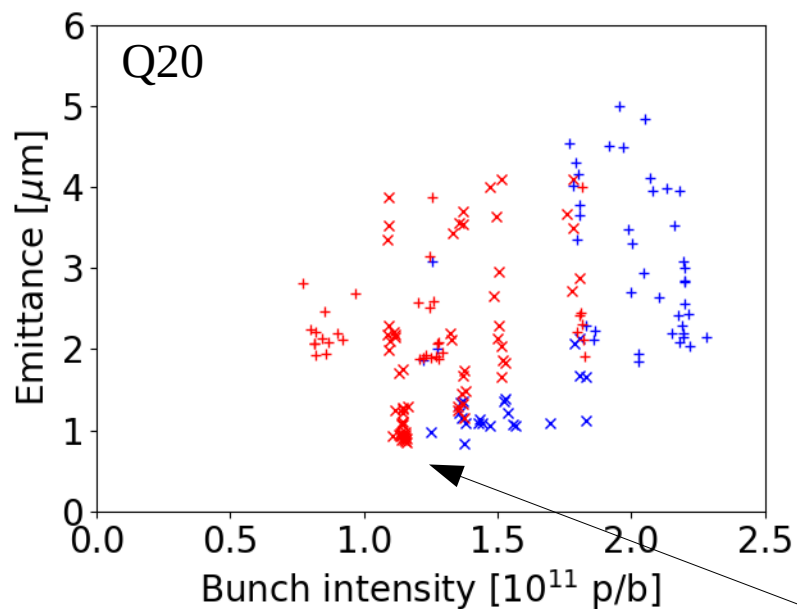
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→ Next step with Q22: Additional measurement in the intermediate space-charge regime (~1 day short parallel)

# Summary of next steps

- Next steps with the stability of single bunches in the SPS are mostly motivated by understanding, potentially for future projects but without direct impact on the performance of the current complex ( → Low priority, potentially 1 or 2 days of short parallel MD)
  - Landau damping of the weak horizontal instability (Q20 / Q22)
  - Landau damping of the strong vertical instability (Q26)

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- Next steps with the stability of single bunches in the SPS are mostly motivated by understanding, potentially for future projects but without direct impact on the performance of the current complex ( → Low priority, potentially 1 or 2 days of short parallel MD)
  - Landau damping of the weak horizontal instability ( $Q_{20} / Q_{22}$ )
  - Landau damping of the strong vertical instability ( $Q_{26}$ )
- Higher priority: Improved brightness preservation with split tunes optics ( $Q_h 20 / Q_v 26$ )
  - Setup and demonstration of the potential with INDIVs with 1-2 days of short parallel MDs
  - If successful: Demonstration with trains in dedicated MDs