Novel injection scheme (I)
Monday afternoon

- NLK R&D at Bessy-II, Olaf Dressler, HZB
- NLK R&D at Soleil, Patrick Alexandre, Soleil
- Injection into Small Aperture Ring using an “Anti-septum”, Michael Böge, PSI
- Injection Schemes for HEPS, Zhe Duan, IHEP
- Developments in APS-U Injection, Aimin Xiao, ANL
- Collective Effects in APS-U Injection, Louis Emery, ANL

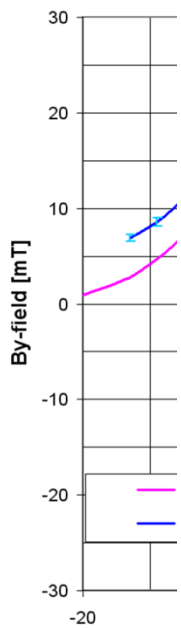
NLK R&D at Bessy-II

O. Dressler

Symmetry by Positioning of Coils and Connections

Magnetic Field Measurement vs. ANSYS Calculation

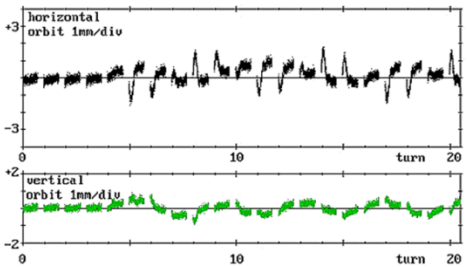
Conventional vs. Non-linear Kicker Injection

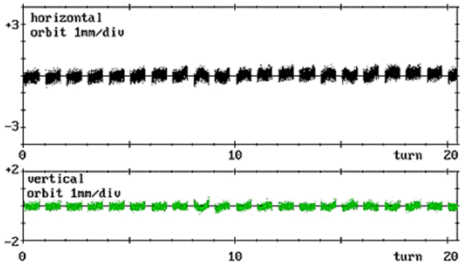


Local Orbit Bump Injection
Neighboring kicker magnets (K1 + K2 and K3 + K4) are powered in pairs to form a local pulsed orbit bump for beam accumulation.

Non-linear Kicker Magnet Injection
One pulsed non-linear kicker magnet located outside the injection straight at an effective phase advance of 45° in reference to the injection point.

Turn-by-turn measurement of horizontal and vertical beam oscillations due to kicker schemes.





- 4-kicker injection bump optimized for small excitation.
- Injection efficiency ~ 80%
- ***rms orbit perturbation***
  horizontal ~ 1.000mm
  vertical ~ 0.500mm
- Standard injection, beam current 300mA
- Perturbation of the stored beam in both planes

- Single non-linear kicker injection, not completely optimized.
- Injection efficiency ~ 80%
- ***rms orbit perturbation***
  horizontal ~ 0.060mm
  vertical ~ 0.015mm
- Injection up to a beam current of 300mA possible

NLK R&D at Soleil

P. Alexandre

Magnetic design of the MIK : basic dimensioning

Making a pulsed magnet system…

Complete system and magnetic measurements

MIK for MAX-IV 3 GeV : how it looks like !…

Injection into Small Aperture Ring using an "Anti-septum"

M. Böge

Roll Kickers to Null Vertical Movement

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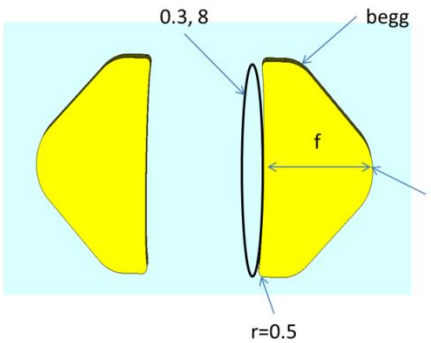
Description of Antiseptum Scheme

Optimising Conductor Shape



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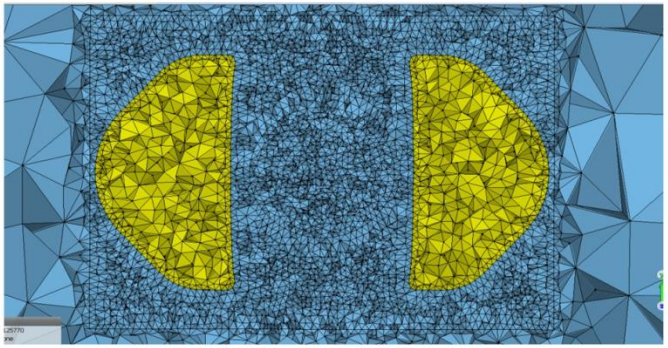
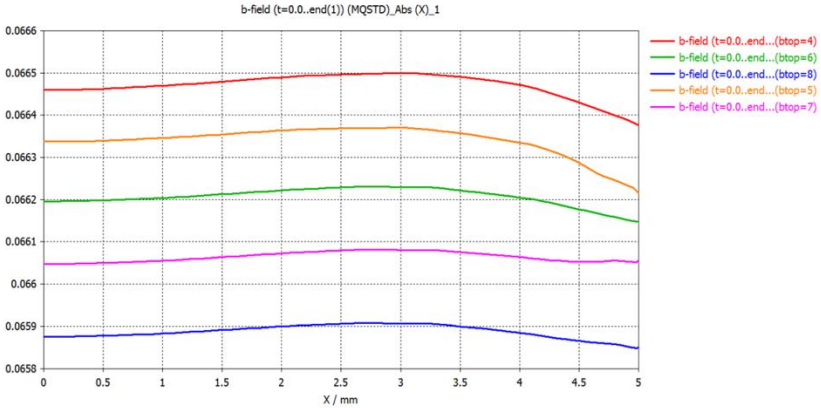


One example of optimising conductor shape for horizontal field homogeneity.

Difficult trade-off of mesh size and simulation run time.

As before, field plot from axis (x=0) to 1mm away from conductor at 6mm.



Injection Schemes for HEPS

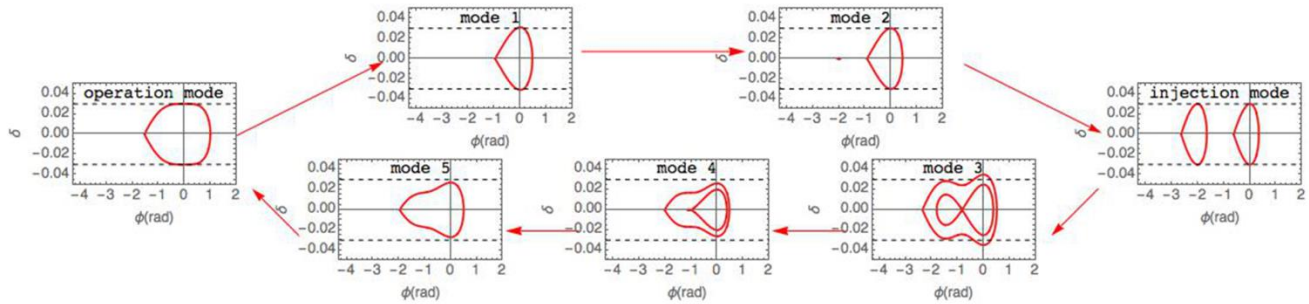
Z. Duan

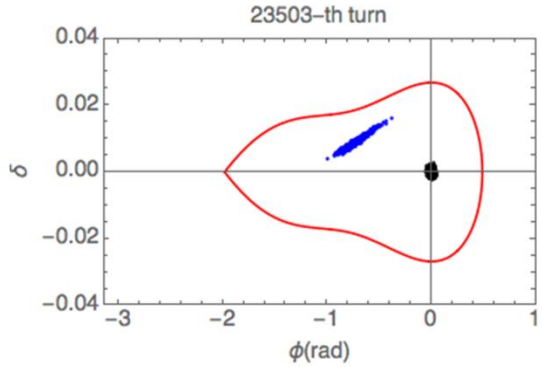
Trade-off between emittance & DA

Injection considerations for HEPS

Swap-out scheme for HEPS

A complete injection cycle (~ 200 ms)





Elegant simulation

- Design the RF buckets according to the ring acceptance and U_0.
- Circulating bunches experience no large amplitude synchrotron oscillation.
- **Each step takes 0.5 ms, injection mode costs 100 ms to inject up to 30 bunches. A complete injection cycle takes about 200 ms.**

Developments in APS-U Injection

A. Xiao

Reasons to choose on-axis swap-out vertical injection

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Argonne NATIONAL LABORATORY

Pulser timing requirements

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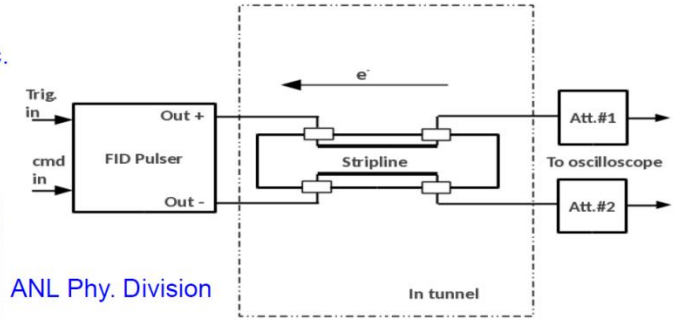
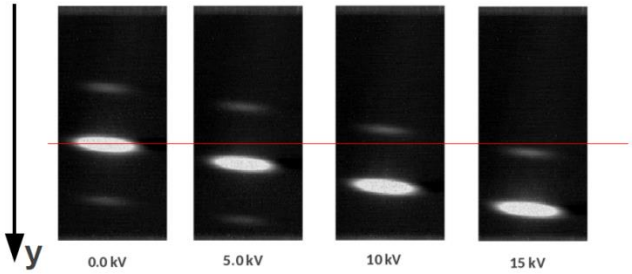
Argonne NATIONAL LABORATORY

Beam test with FID pulser[1,2,3,4]

Cosmotec Inc.



ANL Phy. Division



[1] C. Yao et al., IPAC 15,3286.
[2] C. Yao et al., NAPAC16, 952
[3] X. Sun et al., NAPAC16, 943.
[4] A. Xiao et al., AOP-TN-2017-027

Collective Effects in APS-U Injection

L. Emery

Introduction and motivation

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Injection from the booster results in longitudinal dy

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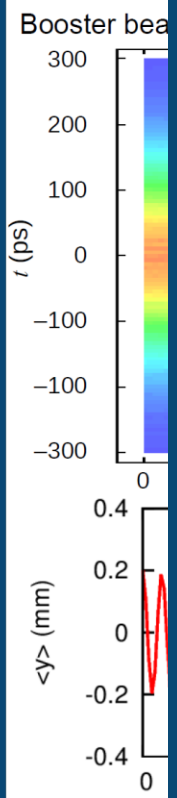
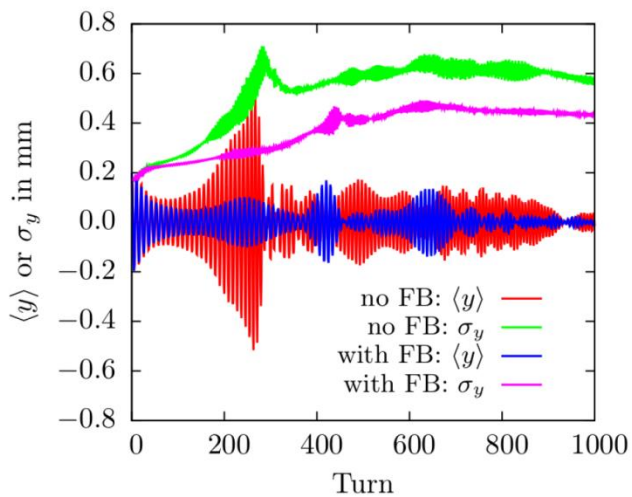
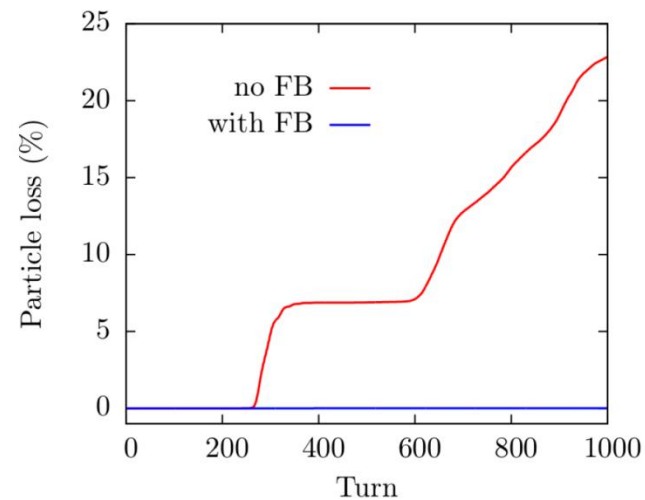


Transverse feedback can control the transient instability at injection





- Element-by-element tracking with prescribed higher harmonic cavity voltage set to flatten rf potential
- The transverse feedback is limited to 1 microradian maximum kick

Summary of summary

- Nonlinear kicker has become *available*
- Future machines, despite their tighter constraints, still find solution:
  - SLS-2: Conventional scheme with anti-septum
  - APS-U, HEPS: Swap-out injection