

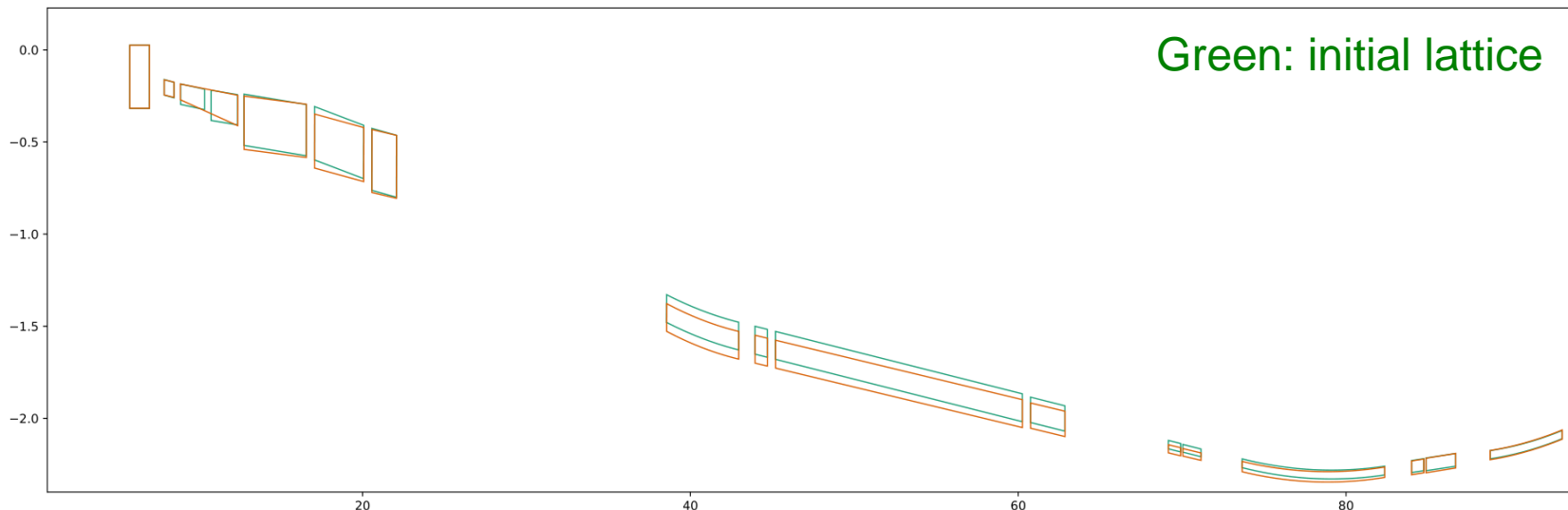
IP-6: 0.5m Shift in Outgoing Hadron Beam Direction

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Brookhaven National Laboratory
Electron-Ion Collider Department

- **Request from Physics community**
 - Need 0.5m more space for detector on forward side
- **Effects have been studied**
 - Leave magnet apertures unchanged
- **Results**
 - Lattice/Match
 - Magnets / magnet locations
 - Synrad
 - Effect on physics results/clipping
- **About to submit to Change Control Board**
 - **Reminder: this does not have to be perfect**
 - **(there should be no show-stoppers though)**

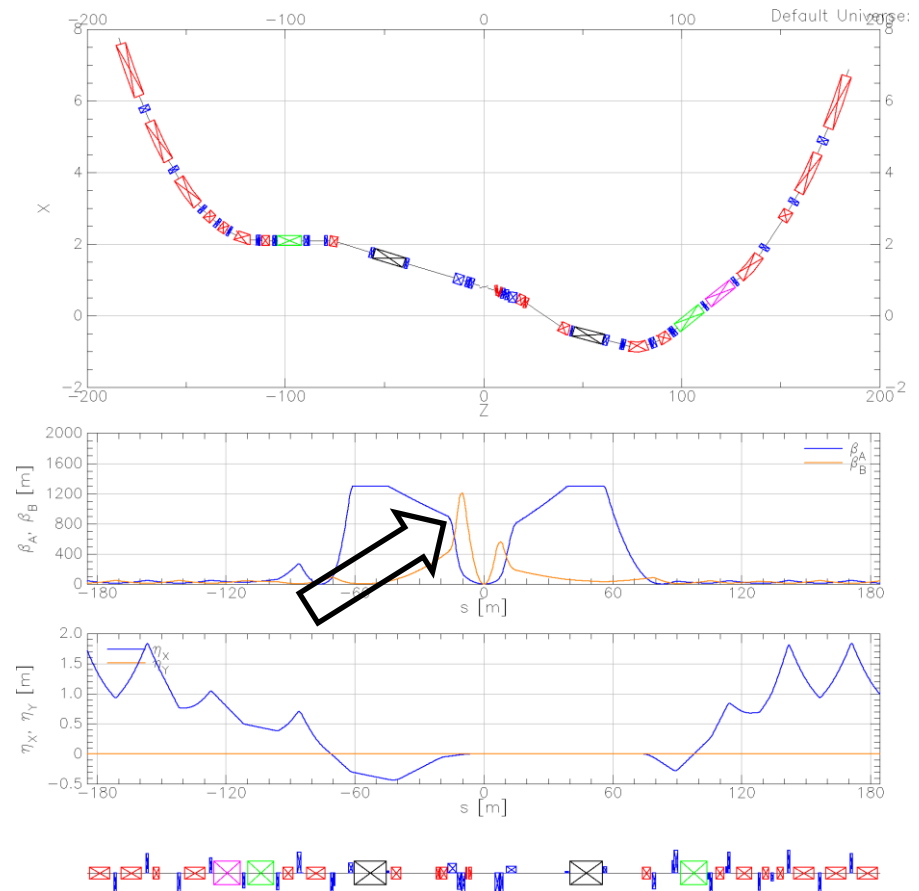
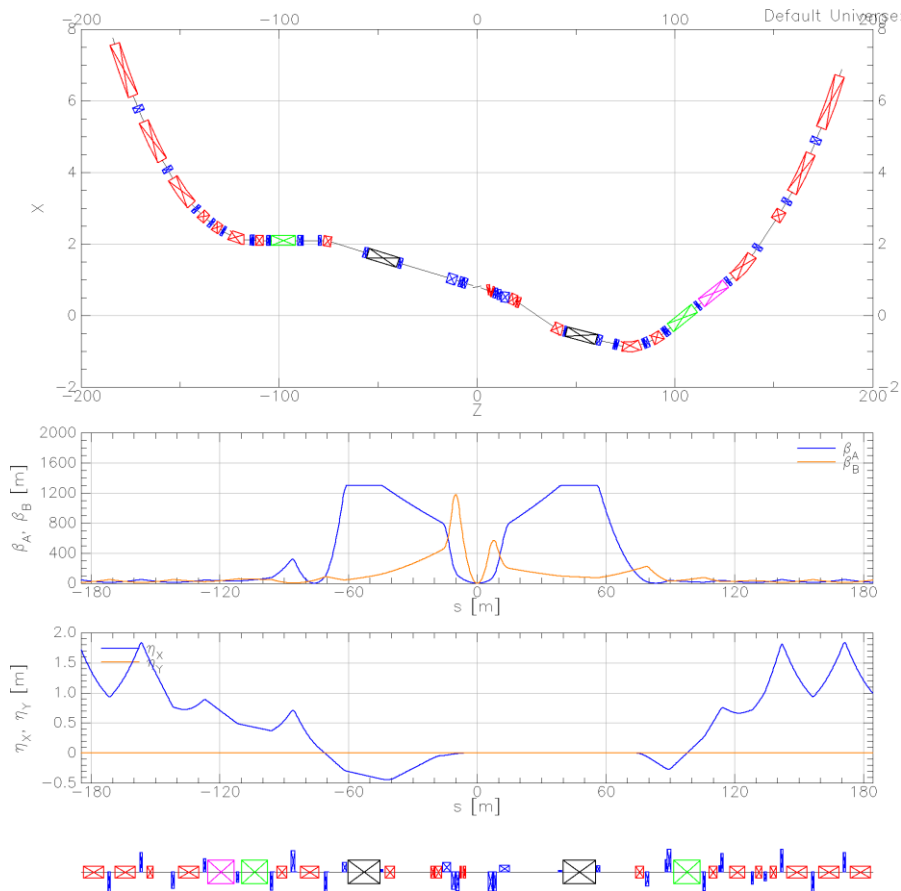
- Acceptance studies with initial lattice
 - Magnets not properly aligned
 - Can probably do a bit better
- Figure on the bottom shows most recent lattice in comparison to initial lattice
 - This is not going to make results worse
- Both lattices matched to RHIC

By J.S. Berg



Before

After



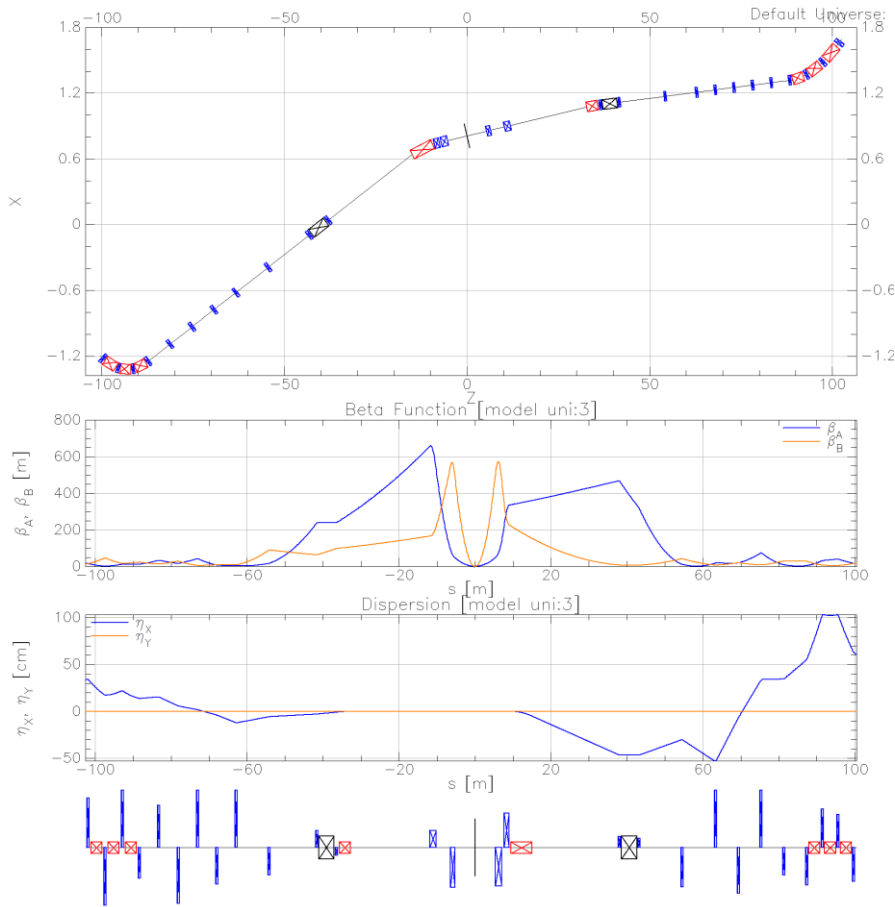
Same β^*

Larger β in low-beta quad on forward side (larger beam size)

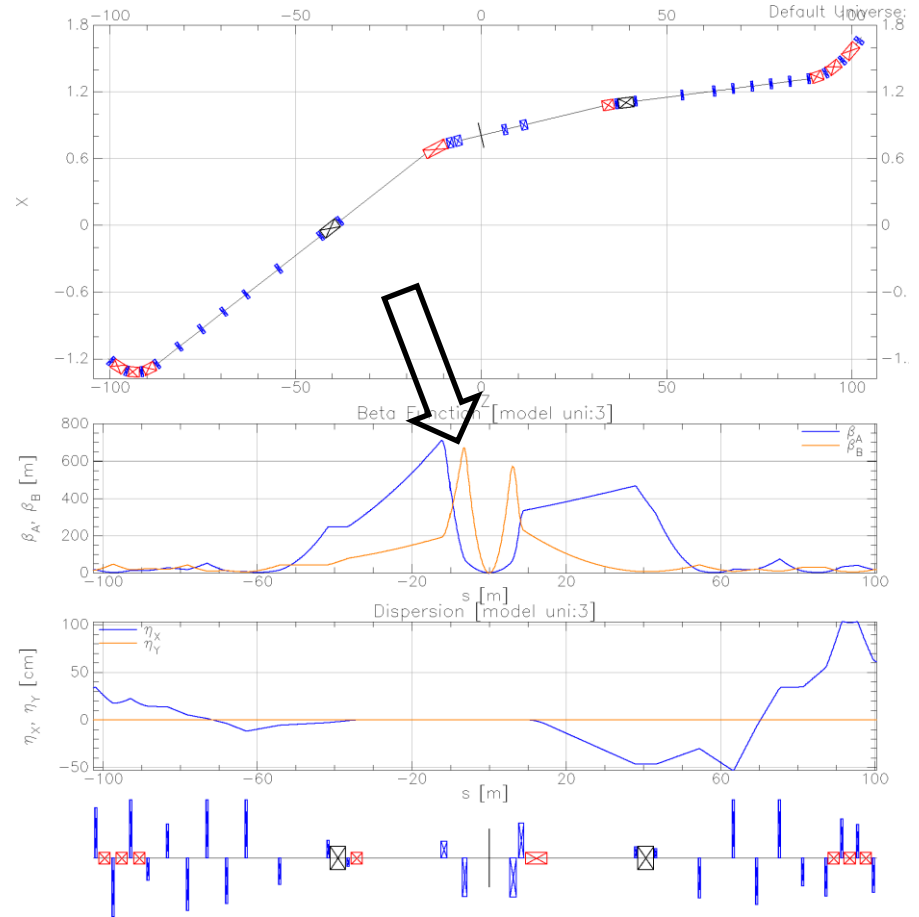
Magnet apertures unaffected

By J.S. Berg

Before



After

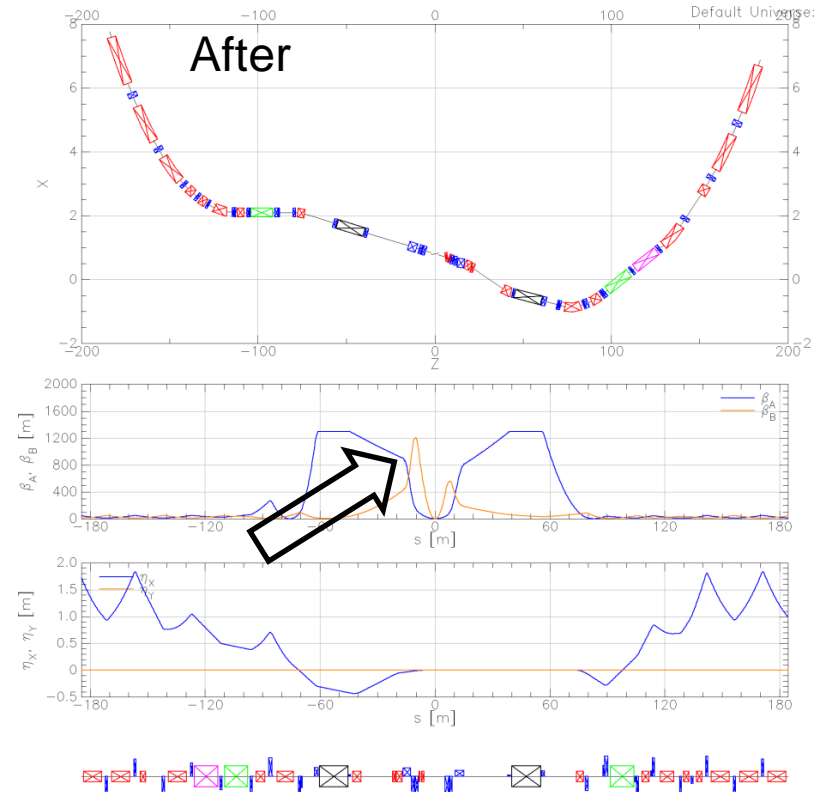
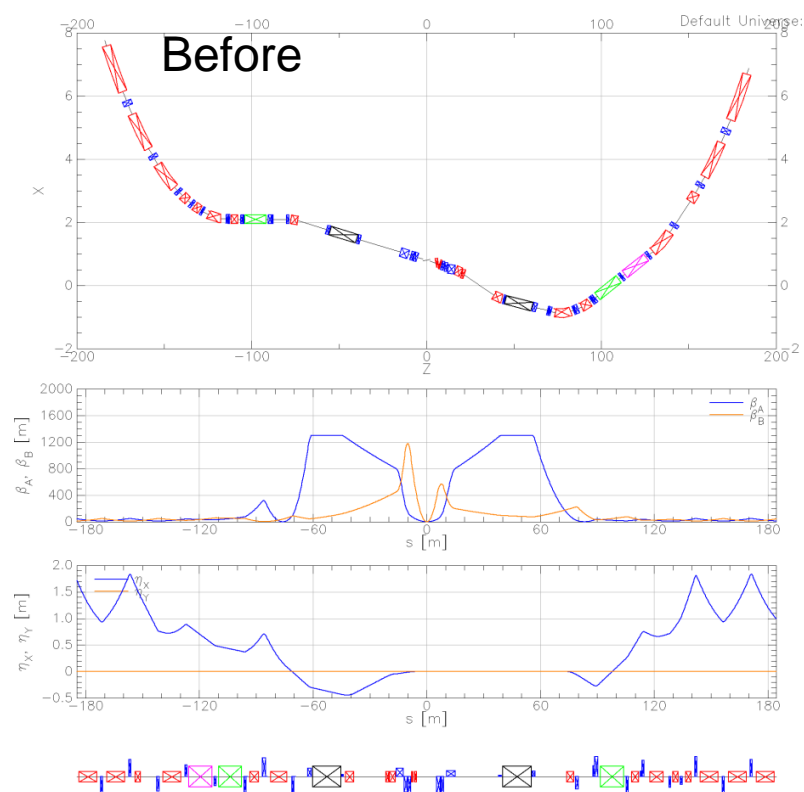


Same β^*

By J.S. Berg

Back to the Hadron Lattice...

So why does the vertical β function not increase?



- ... because it is not a true comparison – B0pF magnet has a small vertically focusing gradient (which helps arresting the growth of the β function)
 - Increase is only from 1179 to 1209m (hard to see)

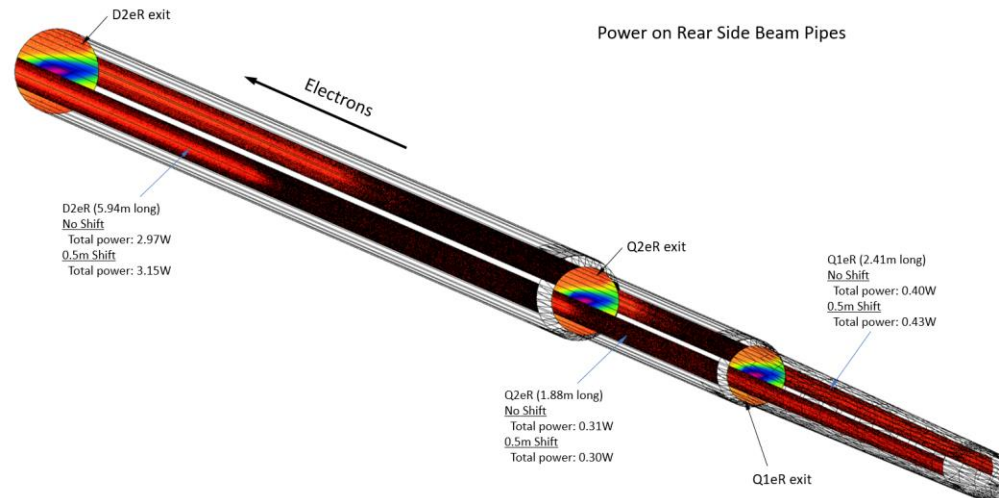
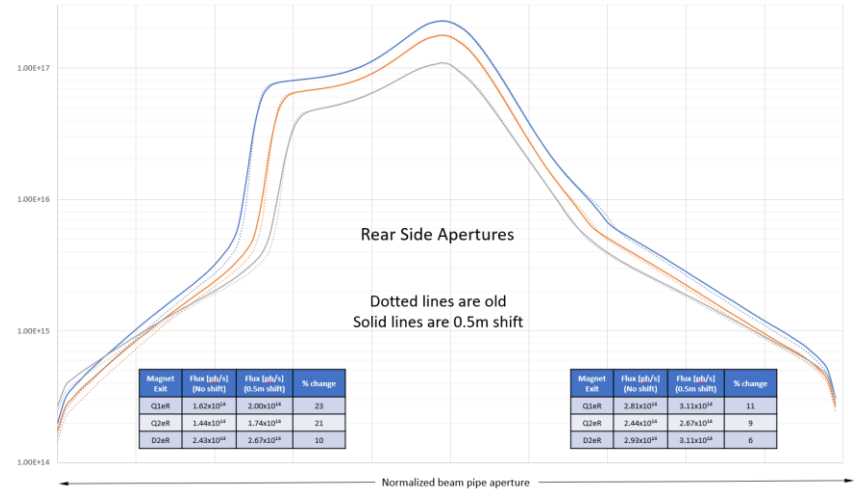
By J.S. Berg

- Hadrons
 - Increase by 0.3/0.8 units (hor./vert.)
 - Totals:
 - Crab to crab: 11.4/22.3
 - Arc-to-arc: 27.1/24.8
- Electrons
 - Increase 0.4/1.0
 - Total: 15.9/23.9

By J.S. Berg

Synchrotron Radiation

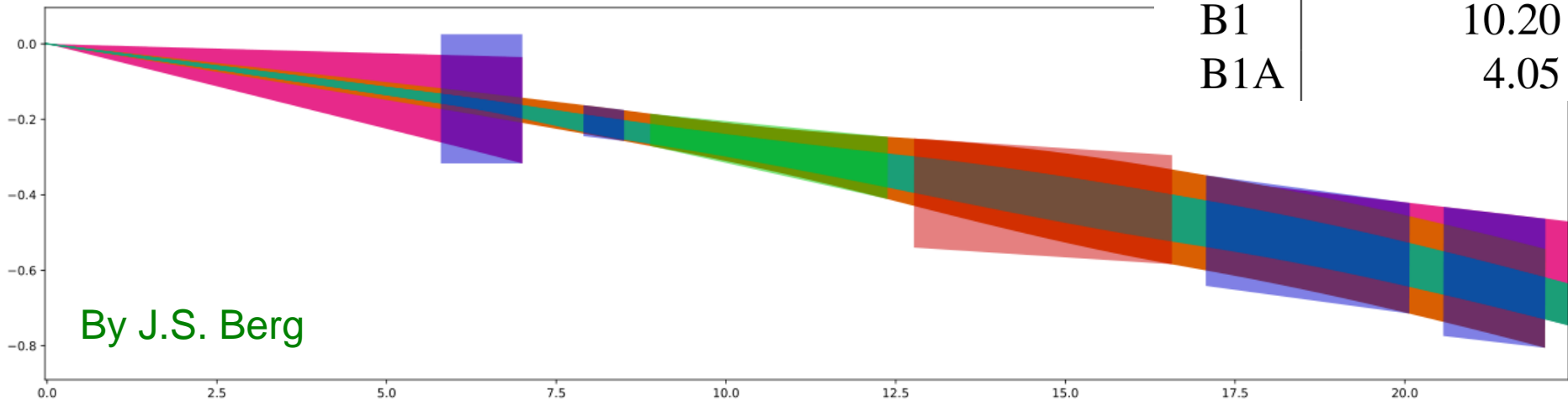
- Studied using Synrad3D
- Small changes in Synrad
- No significant increase in photon hits in central chamber
 - ... and can probably still be improved



By C. Hetzel /
M. Sullivan

- Apertures and gradients/fields stay the same*
- Spacing between hadron and electron beam increases (approx. 12mm)
- Not worse / slightly easier
- Exception: B0pF
 - Looks ok

	Field Integral (T m) or (T)
B0A	1.98
Q1	+200.0
Q2	-132.8
B1	10.20
B1A	4.05

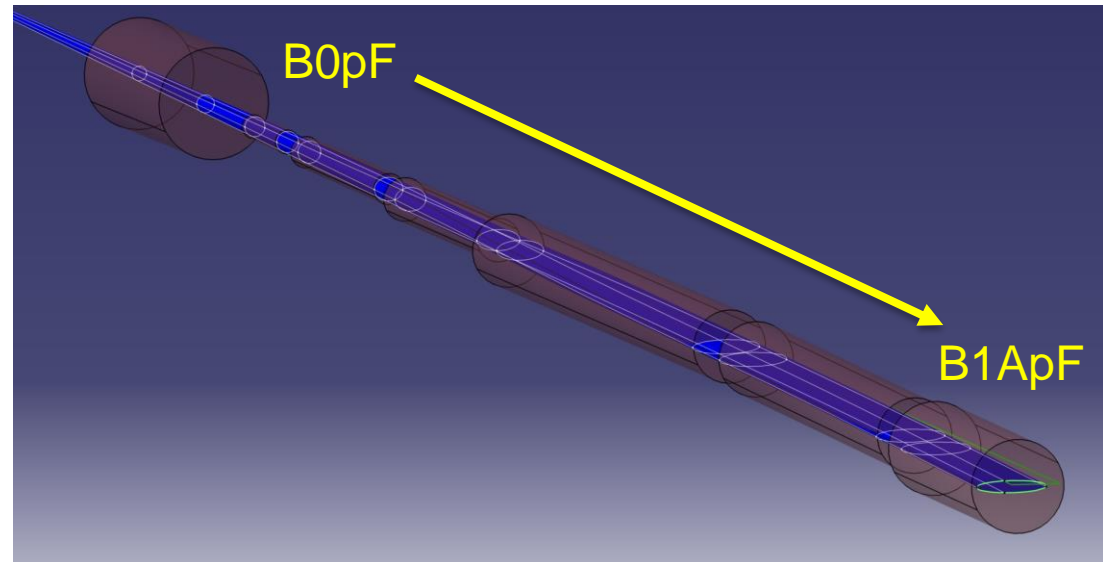
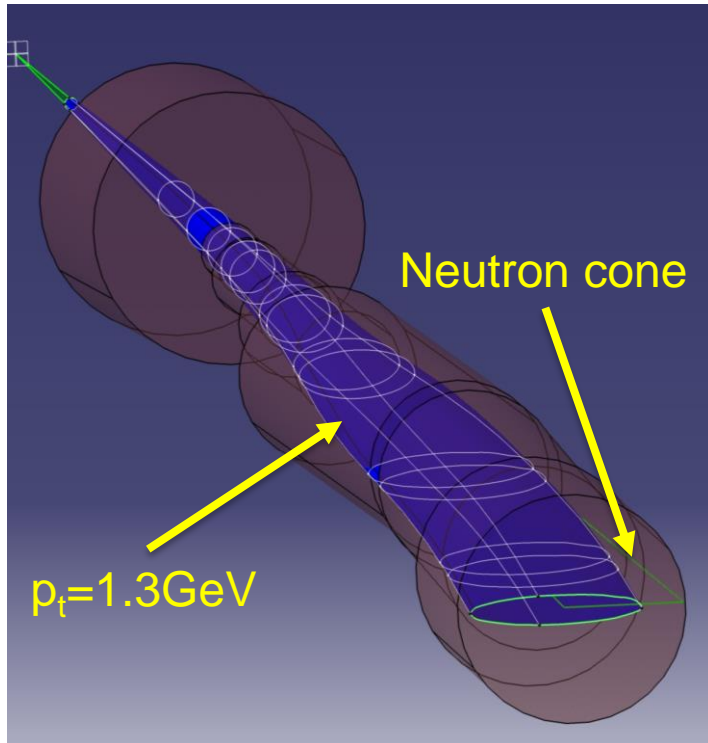


- Apertures: 13.5σ / 23σ
- 275 GeV on 18 GeV
 - Q0eF: 24.4 mm \rightarrow 26.6 mm
 - Radius is 25mm
 - Aperture can grow, minimal impact on space in B0pF
 - Q1eF: 52.6 mm \rightarrow 54.6 mm
 - Radius is 63mm
 - (275 / 10 GeV: 56.1mm \rightarrow 58.5mm)

By J.S. Berg

Acceptance Studies

- Checked with two codes
 - BMAD – general purpose tracking code
 - Geant4 (friends from Physics)
- Cross-check allowed to identify error
 - Now perfect agreement

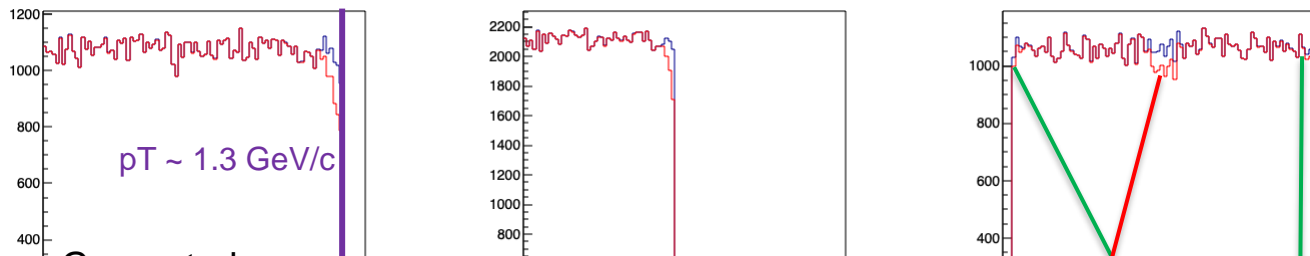


Generate cone for particles with $p_t=1.3\text{GeV}$
Rendered in CAD program with magnet apertures

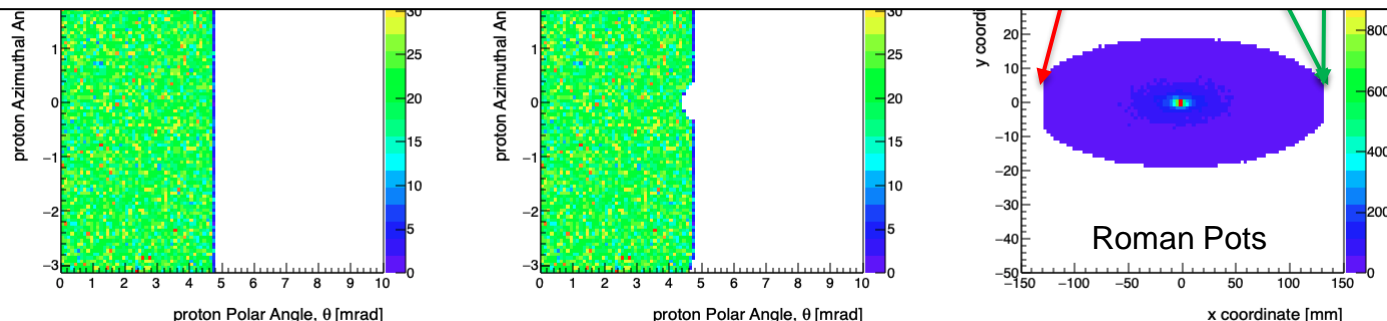
Summary of Detector Acceptance

By A. Jentsch

- Alex passed a 100k events through the simulation after we worked out the technical issues in GEANT.



Overall, the shifted IR performs very similarly to the nominal one, and there are no red flags or showstoppers.



- Some very small amounts of clipping are observed on the edges (at $\phi = 0$ and $\phi = \pi$), but overall the acceptance is 100% up to $p_T \sim 1.2 \text{ GeV}/c$

- Cannot go much further without significant effort
 - Probably the right time to present this to the TCC
- No showstoppers
 - Lattice looks ok
 - Detector acceptance looks ok
 - (N.b.: bug in early results, which were too pessimistic)
 - Synrad looks ok
 - Magnets unchanged