Acceptance study and quad tune

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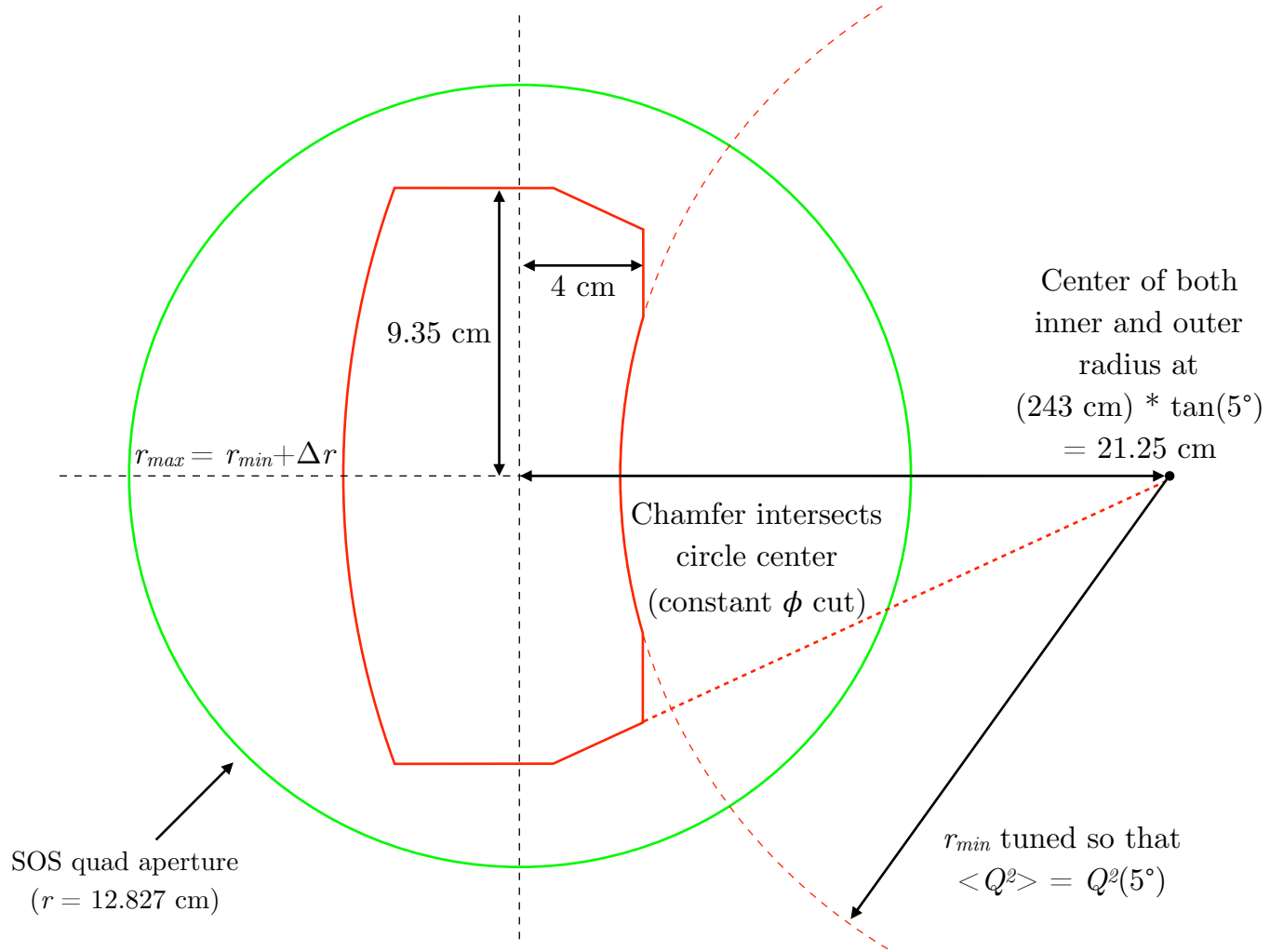
Topics

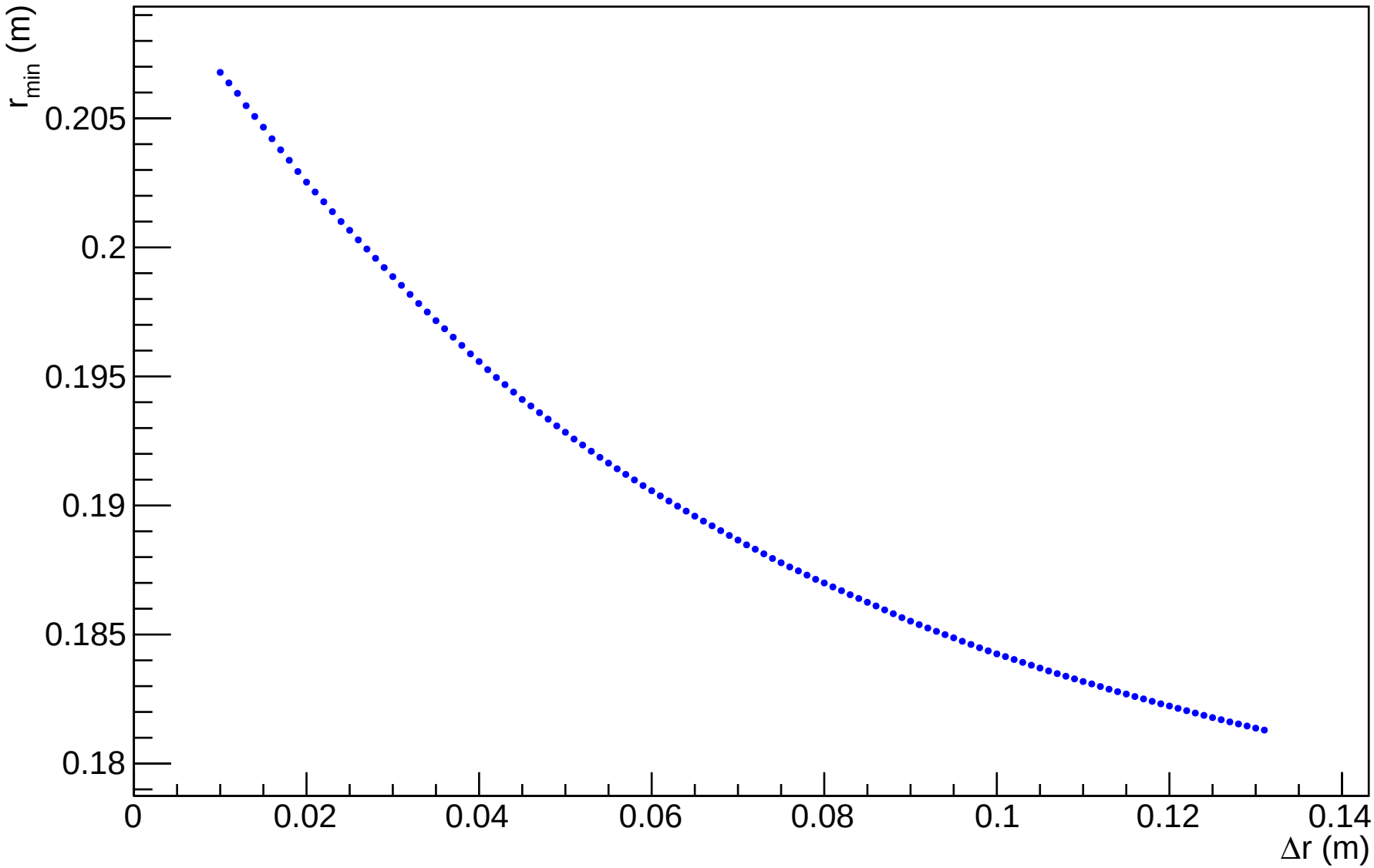
- Collimator acceptance scan
  - $\delta R/R$ problem
  - Impact on engineering
- Quad tune (ongoing)
  - Quad setting ratios
  - Investigating `G4MC/g4hrs`

Collimator design



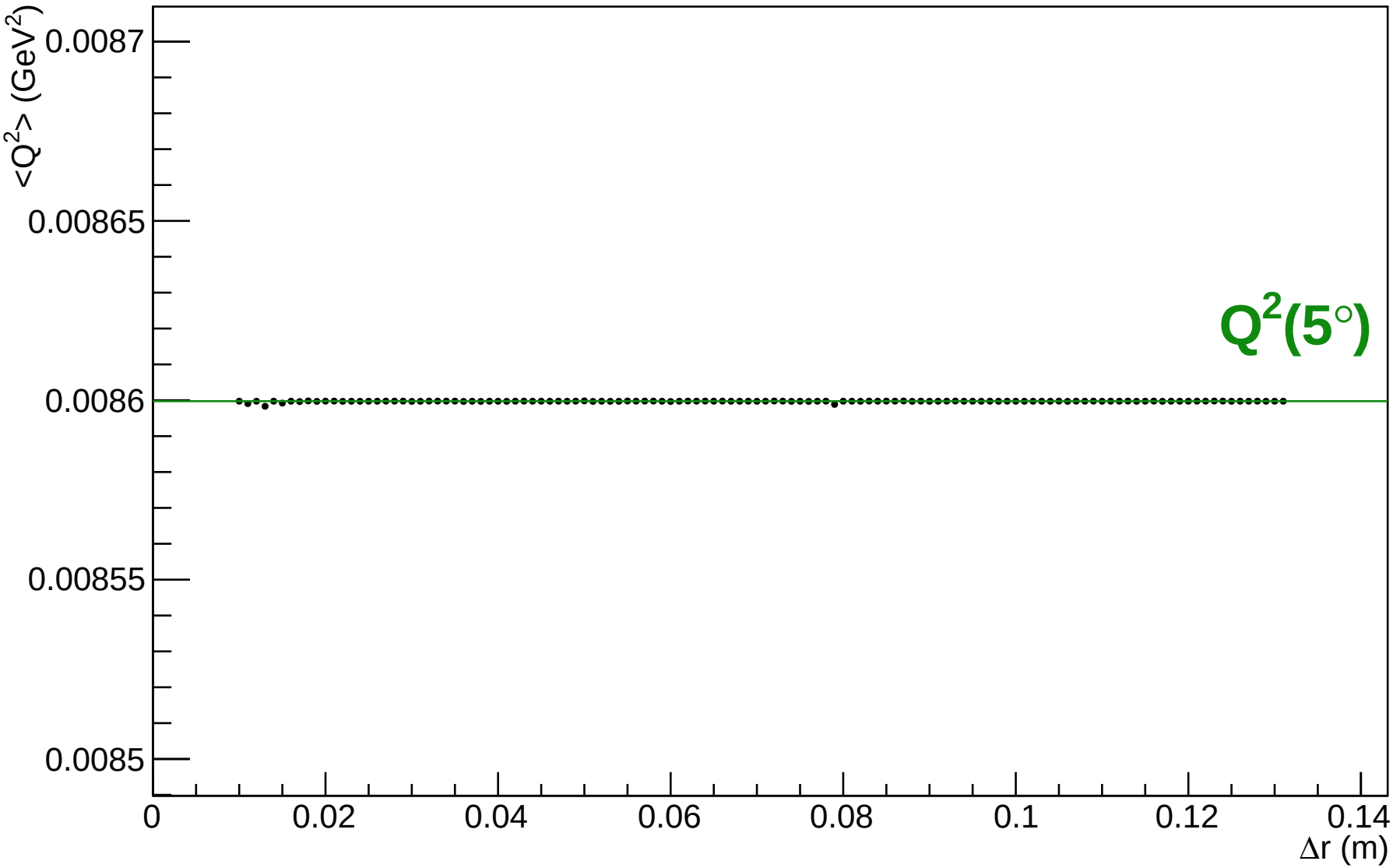
- Scan acceptance (parameterized by $\Delta r = r_{max} - r_{min}$)
- For each Δr, choose r_{min} such that $\langle Q^2 \rangle = Q^2(5°)$
- Calculate $\delta R/R$ for each acceptance point

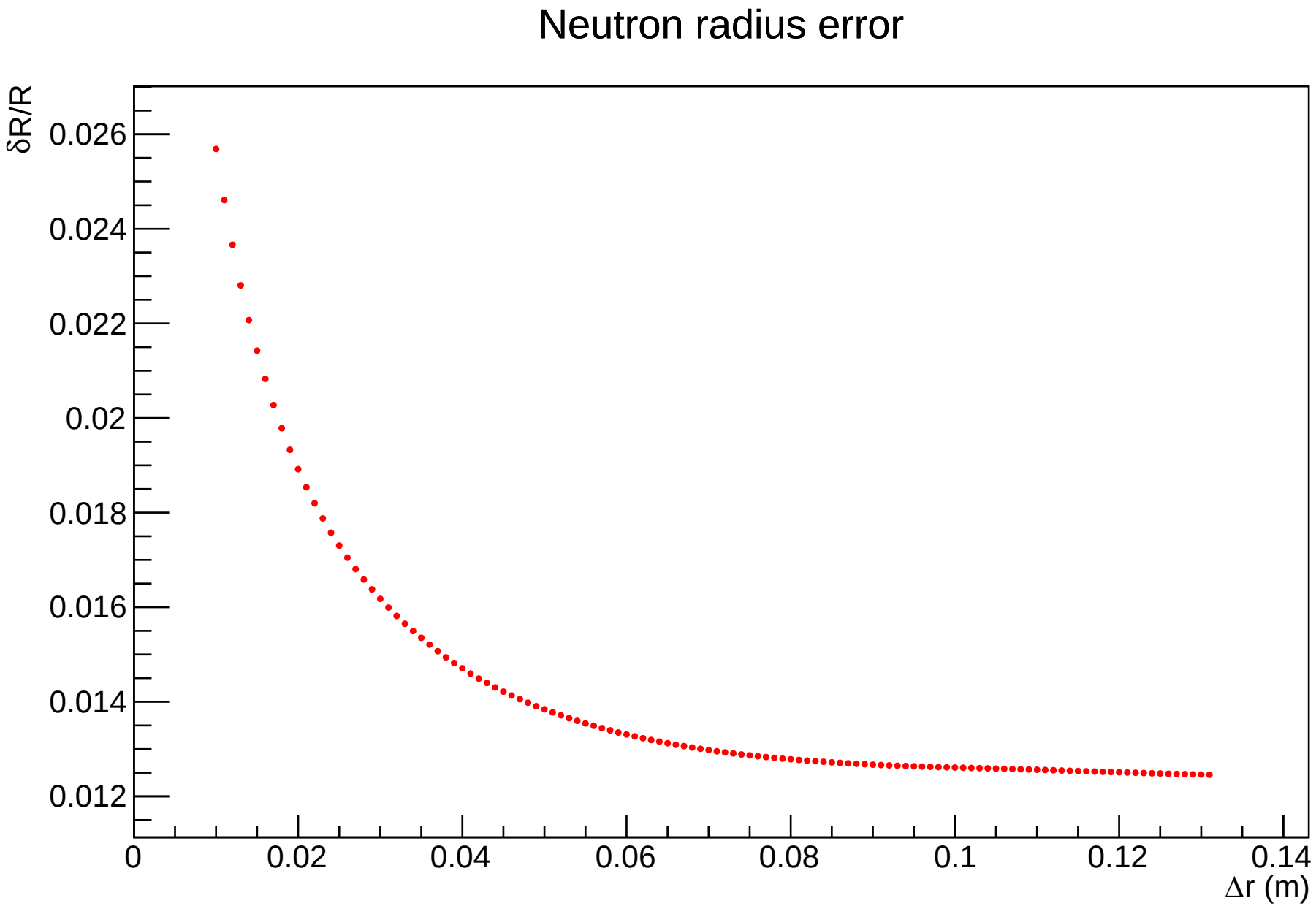
Minimum (inner) collimator radius



Note that for $\Delta r = 0.09$, $r_{min} \approx 18.55$ cm

Average momentum transfer





Not getting down to 1%!

Comments

- Why does $\delta R/R$ bottom out at 1.2%?
- For reasonable values of Δr, r_{min} is $\sim$a few mm larger than before
  $\rightarrow$ Could ease things up in the septum
- Next step: put virtual detectors at pinch points

Matrix

- Discovered bug in matrix element calculation
- Retuned quads with bug fix (no significant change)
- Matrix elements still show some problems:

$$
\begin{array}{c} \\ x \\ \theta \\ y \\ \phi \\ \delta p \end{array}
\begin{array}{c}
\begin{array}{ccccc} x_{tg} & \theta_{tg} & y_{tg} & \phi_{tg} & \delta p_{tg} \end{array} \\
\left(\begin{array}{ccccc}
\text{-1.993} & \text{-0.003043} & 0 & 0.05658 & 20.53 \\
\text{-0.2368} & \text{-0.5044} & 0 & 0.00784 & 2.972 \\
\text{-0.0001499} & 0.03543 & 3.141 & 0.00996 & 0.6584 \\
0 & 0.01125 & 1.097 & 0.3261 & 0.1816 \\
0 & 0 & 0 & 0 & 1
\end{array}\right)
\end{array}
$$

- Another problem: quad ratios don't agree with other TuneBs, e.g.
  HRSTrans: $q_2/q_1 = 1.368$, $q_3/q_1 = 1.771$, $q_3/q_2 = 1.295$
  g4hrs: $q_2/q_1 = 1.445$, $q_3/q_1 = 2.209$, $q_3/q_2 = 1.529$

Next steps

- Continue work on optimizing tune for `g4hrs`
- Compare to other tunes once finalized
- Verify physical interpretation of `g4hrs` quad setting