Studies on a Different Optics and a Low Impedance Solution for Cleaning Insertion IR7

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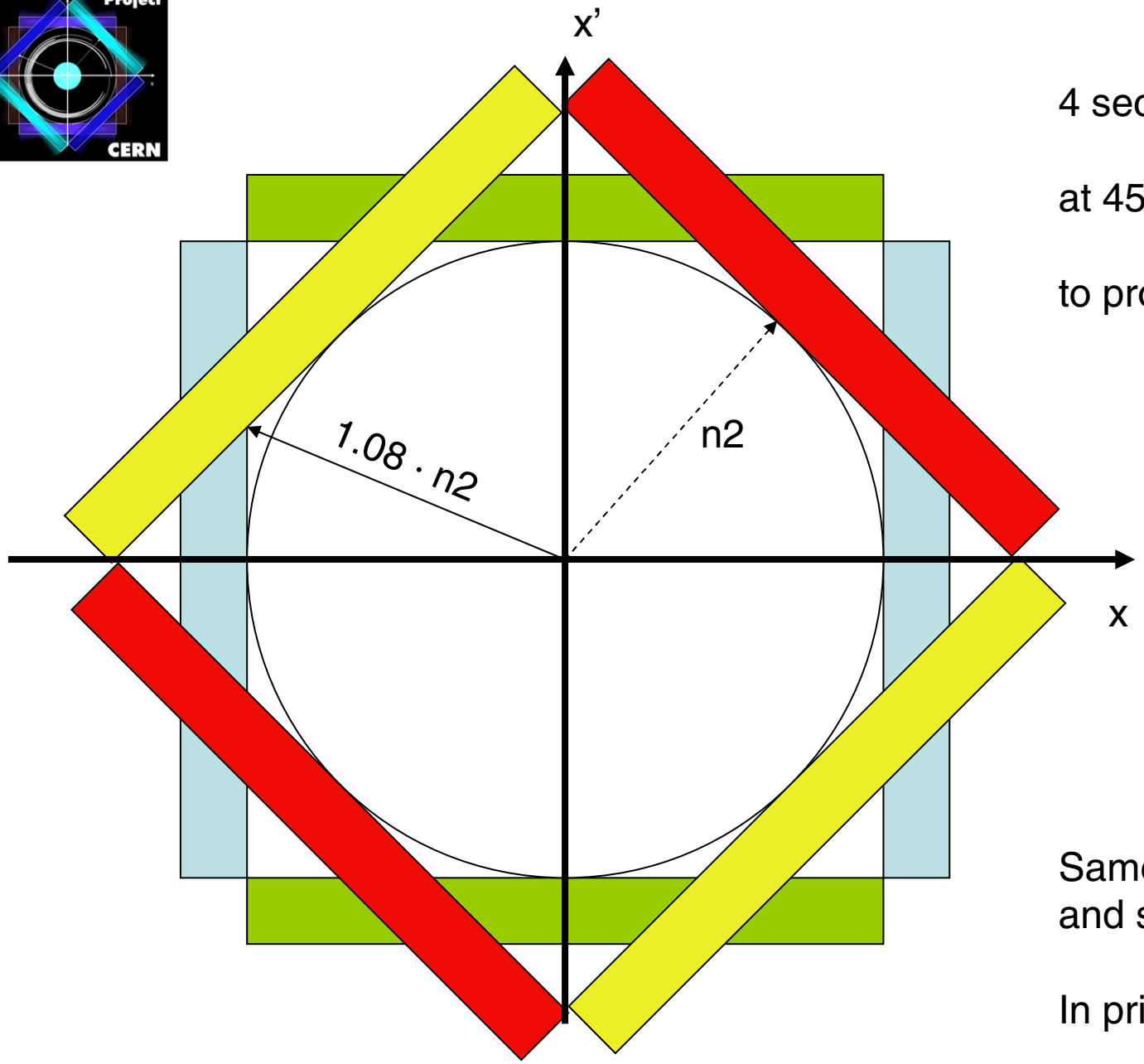
Idea

- For many collimators do not rely on phase advance conditions between TCP and TCS! Crucial only for a small number of collimators?
- Instead use TCS collimators to close phase space: 45˚, 90˚, 135˚, 180˚
- Do not care about source of halo, just constrain maximum amplitude.
- Easiest solution: 90˚ FODO lattice.
- Put collimators at locations with almost equal beta functions to have minimum impedance!



4 secondary collimators

at 45˚, 90˚, 135˚, 180˚

to protect in x, x' plane!

Same required for y-y' and skew plane!

In principle 16 collimators.

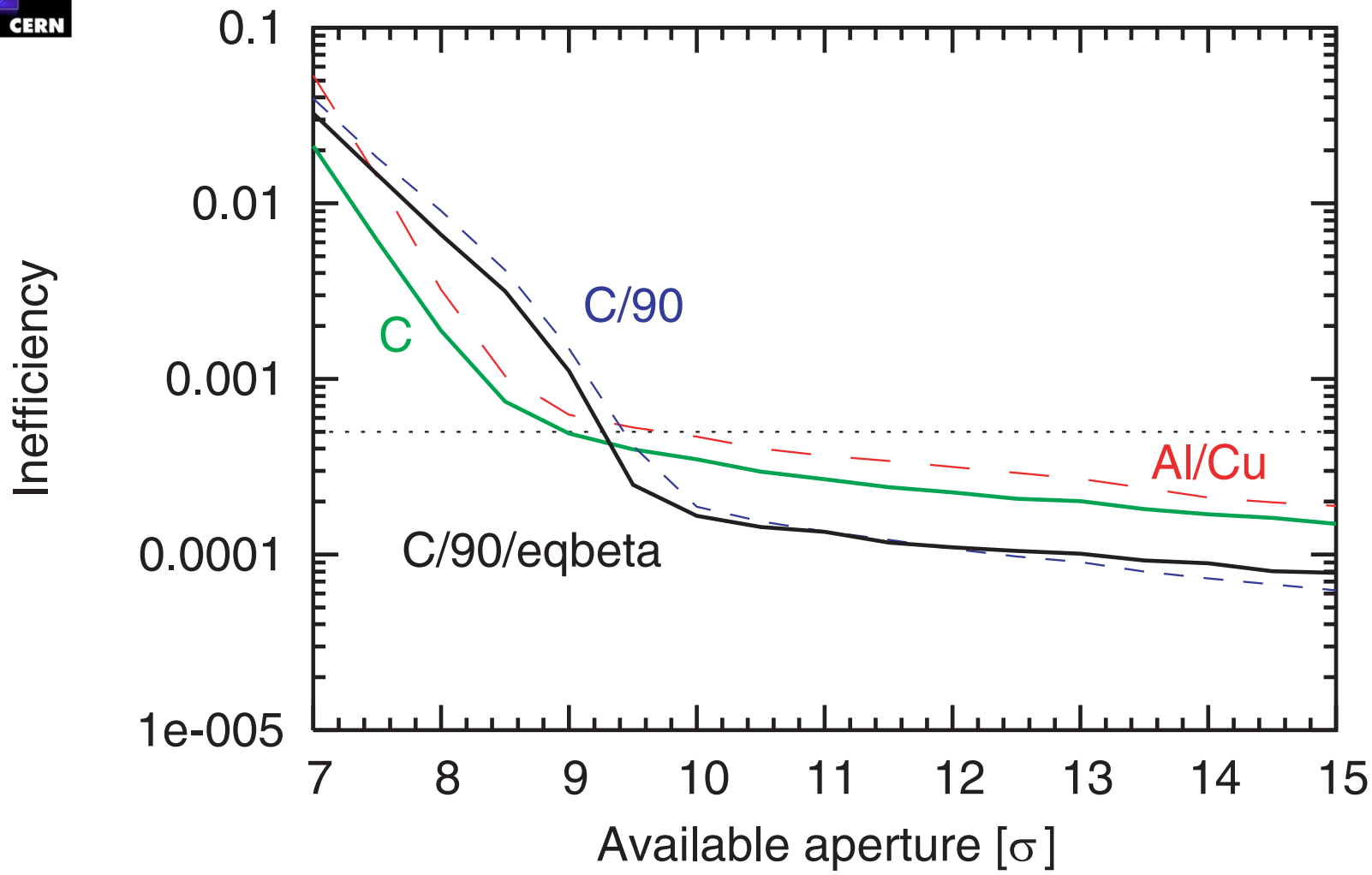
Optics solution (VK)

- Overview present solution (beta at collimators, impedance, space problems).
- A simple 90˚ FODO cell:

  Beta functions and phase advance
  Compare to old solution
  3 m space per collimator
  Location of collimators (possibility 1 and 2)
  Beam1 and beam2

  Beta functions and gaps at collimators (impedance?)

Cleaning efficiency: Full system



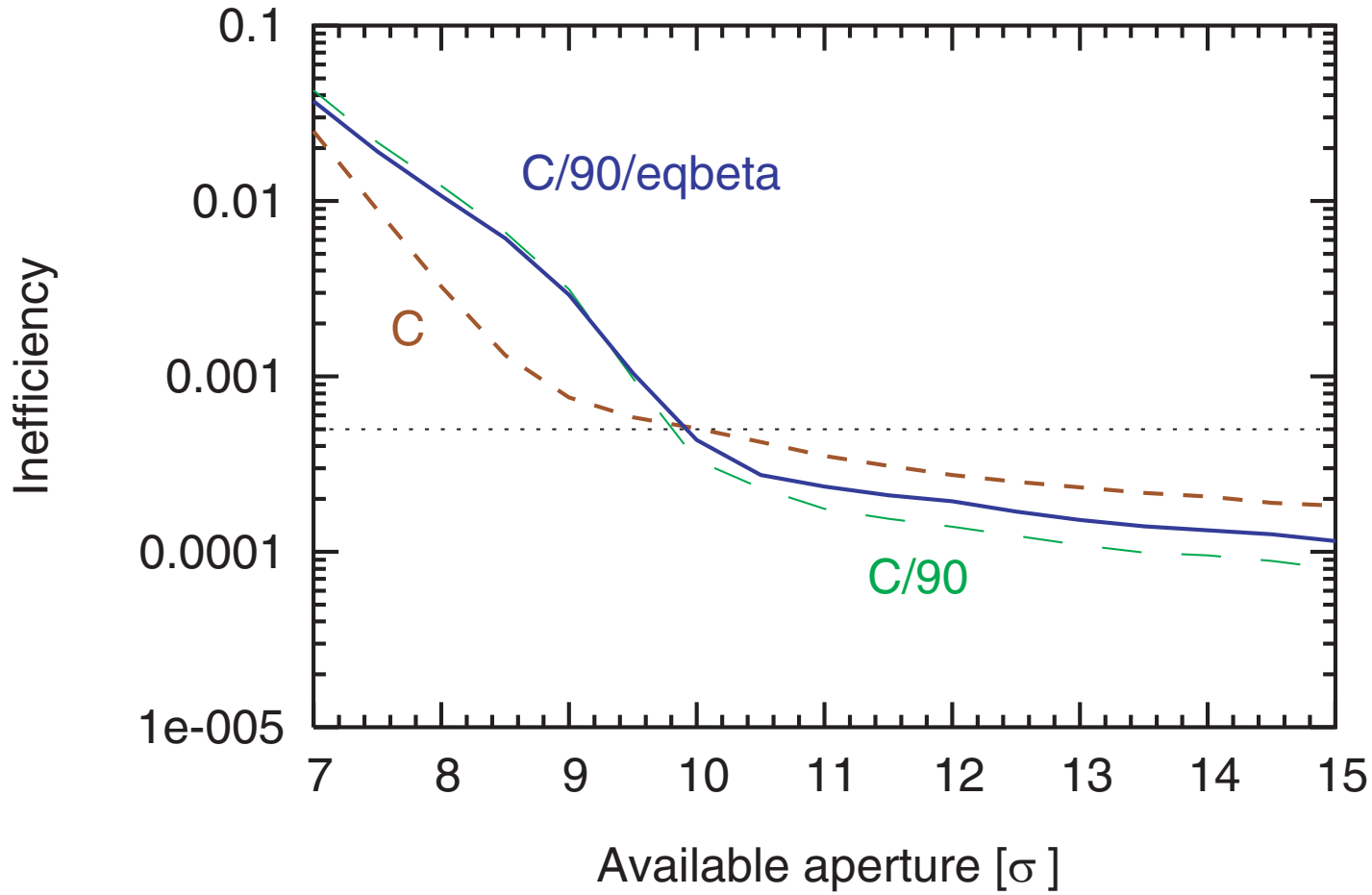
At 10 σ: $3.49 \cdot 10^{-4}$ (full C, V6.2) → $1.66 \cdot 10^{-4}$ (full C, 90)

Observation

- Different solution works fine.
- Nice improvement in inefficiency above 9.5 σ.
- More halo below 9.5 σ.
- Impedance should be significantly better. At least factor 2!? (preliminary estimate for worst collimator by L. Vos)
- My estimate: ≤ 90 MΩ/m instead of 180 MΩ/m for IR7 secondaries. Primary IR7 collimators (20 MΩ/m with old optics) and IR3 become important!
- However, can we eliminate collimators as in V6.2 (cost, impedance, complexity)?

Cleaning efficiency: Reduced system

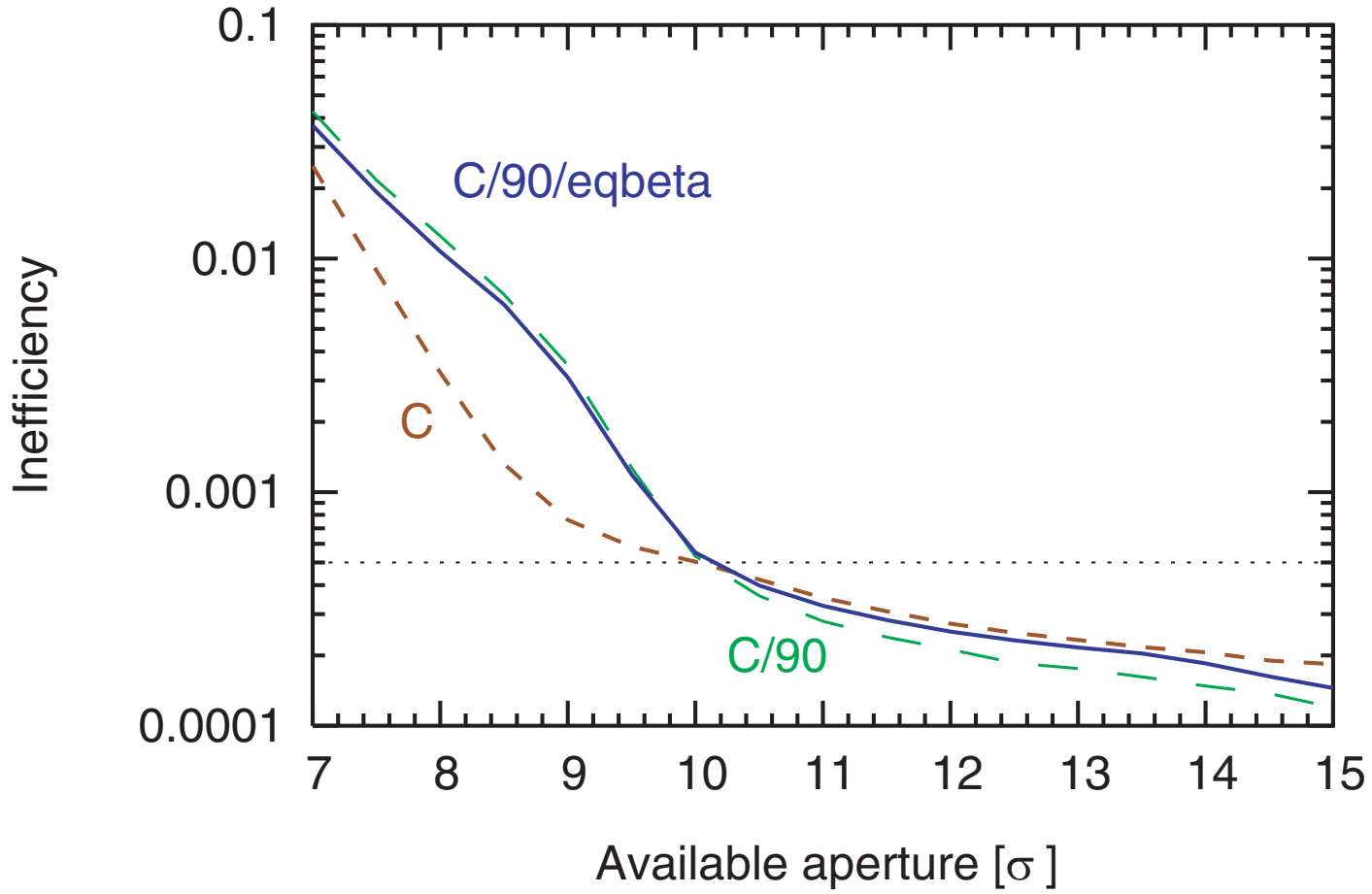
For V6.2: Remove 6 collimators. For 90 option: Remove 5 collimators.



At 10 σ: $5.04 \cdot 10^{-4}$ (C-6, V6.2) → $4.33 \cdot 10^{-4}$ (C-5, 90)

Cleaning efficiency: Reduced system

For V6.2: Remove 6 collimators. For 90 option: Remove 7 collimators.

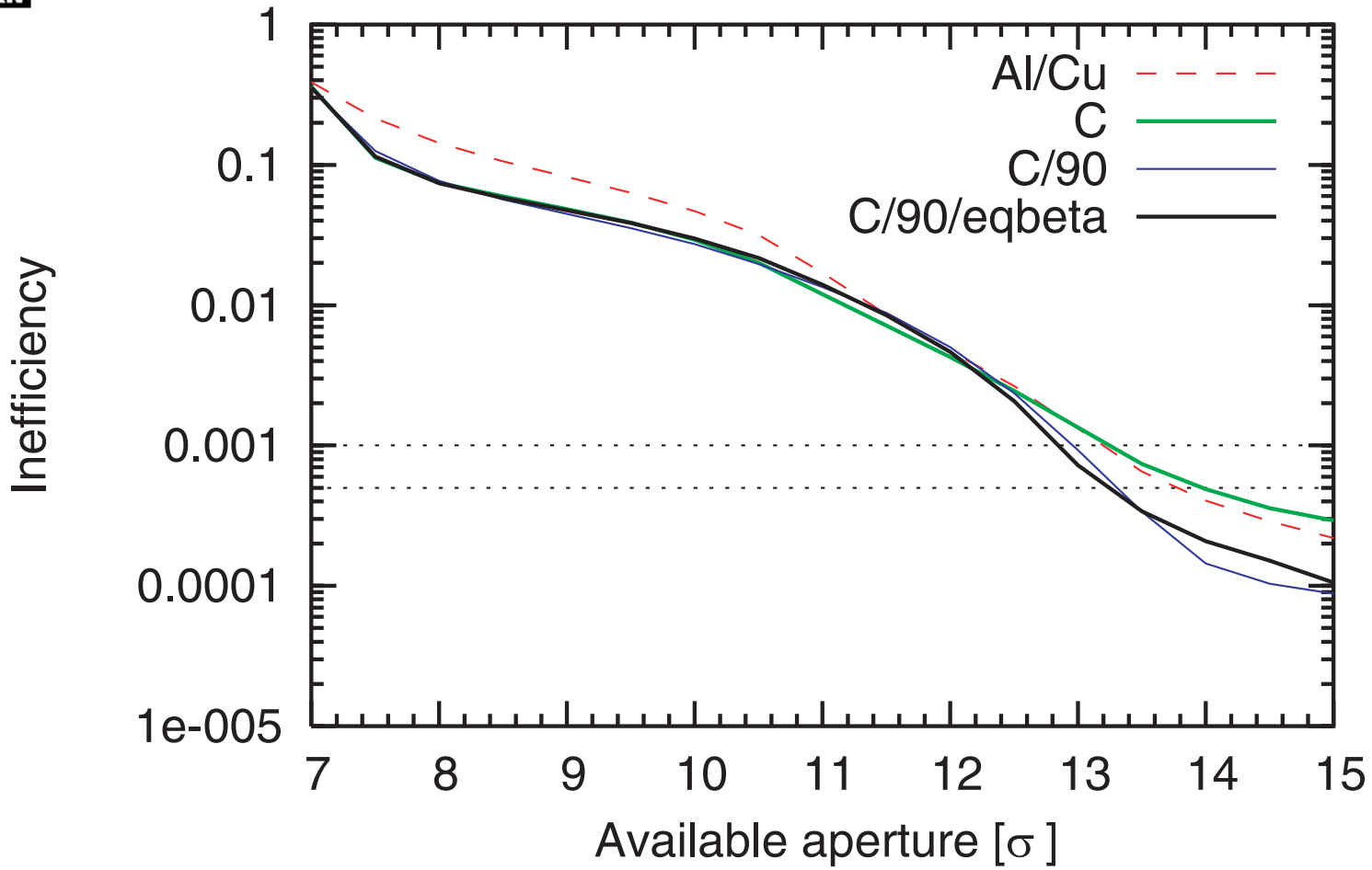


At 10 σ: $5.04 \cdot 10^{-4}$ (C-6, V6.2) → $5.52 \cdot 10^{-4}$ (C-7, 90)

What happens for the settings that we proposed for phase 1 collimation?

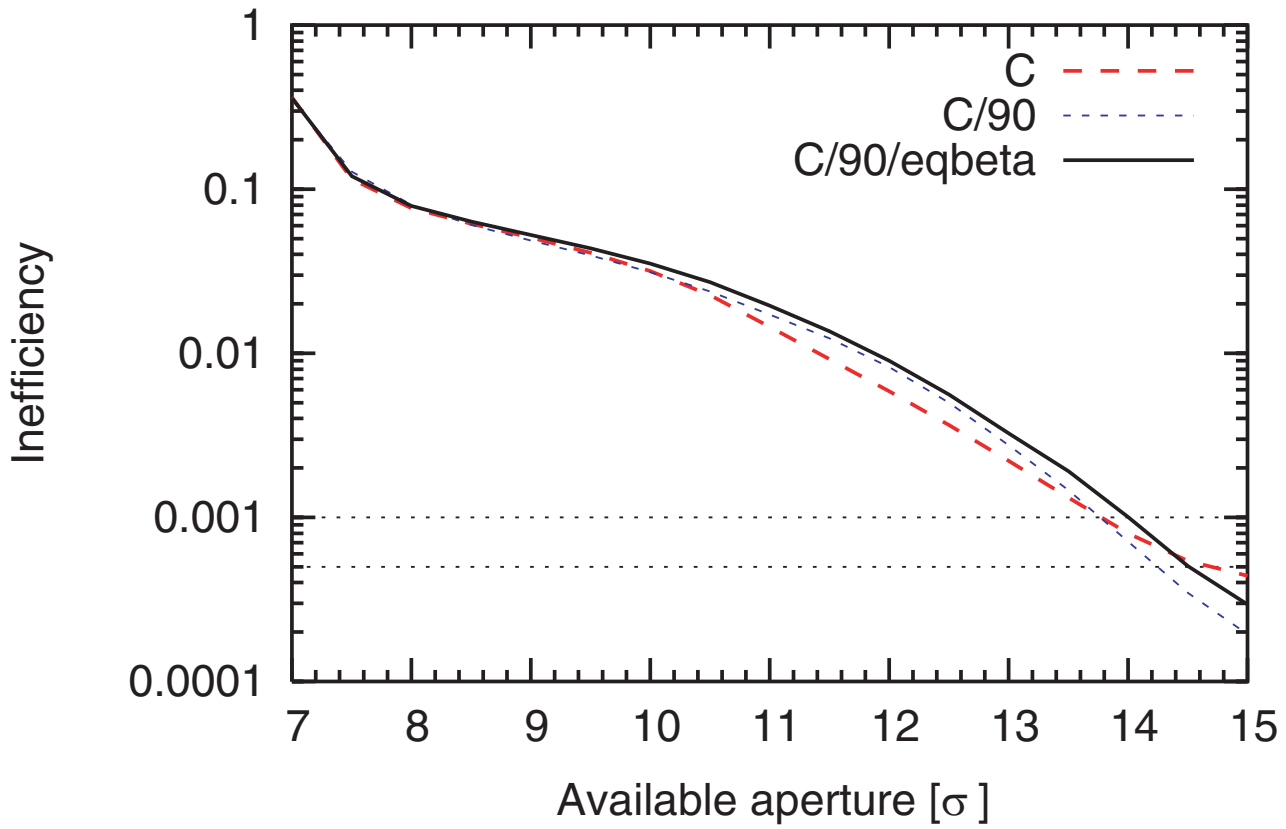
7 σ and 10.5 σ

Situation for 7/10.5 σ settings



Full system: Better above 12.5 σ! Would allow for somewhat smaller β^*!

Situation for 7/10.5 σ settings – Reduced system



Reduced system: Removed 6 in V6.2 solution, 5 in 90 degree option.

Somewhat worse situation for 90 degree at equal beta functions!
Removal done for 90 degree first option and just applied to second solution.
Smaller impedance: We can move collimators closer in!

Conclusion and Recommendation

- A 90˚ FODO optics with large space allocations (3m/coll) seems to work fine for cleaning efficiency (better at high amplitudes, worse for low amplitudes).
- It offers a similar flexibility to suppress 1/3 of collimators.
- A 90˚ solution with collimators at equal beta functions promises **reducing impedance by a factor of ≥ 2**.
- If this was proven to be true, collimators gaps could be reduced and smaller β^* could be supported.
- **Calculate impedance for the full IR7 system! (RA, VK, LV)**
- **Ask the optics team to match an IR7 optics as close as possible to a 90˚ FODO lattice. (RA, VK, DK)**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