XLS –Injector update

C. Vaccarezza

From Last meeting (Glasgow virtual)

- The energy of 300 MeV has been accepted as the BC1 entrance energy both at Low and High repetition rate, provided by 10 C-band sections at $E_{acc} = 15\ MV/m$.
- This study focuses on the replacement of the last 6 C-band sections with 8 X-band upstream BC1, even in this case at lower accelerating field i.e. $E_{acc} = 30\ MV/m$ to guarantee the operation at 1kHz rep rate
- NB the same consideration holds for the K-band sections, i.e. the applied field is considered at high repetition rate (feasible?)

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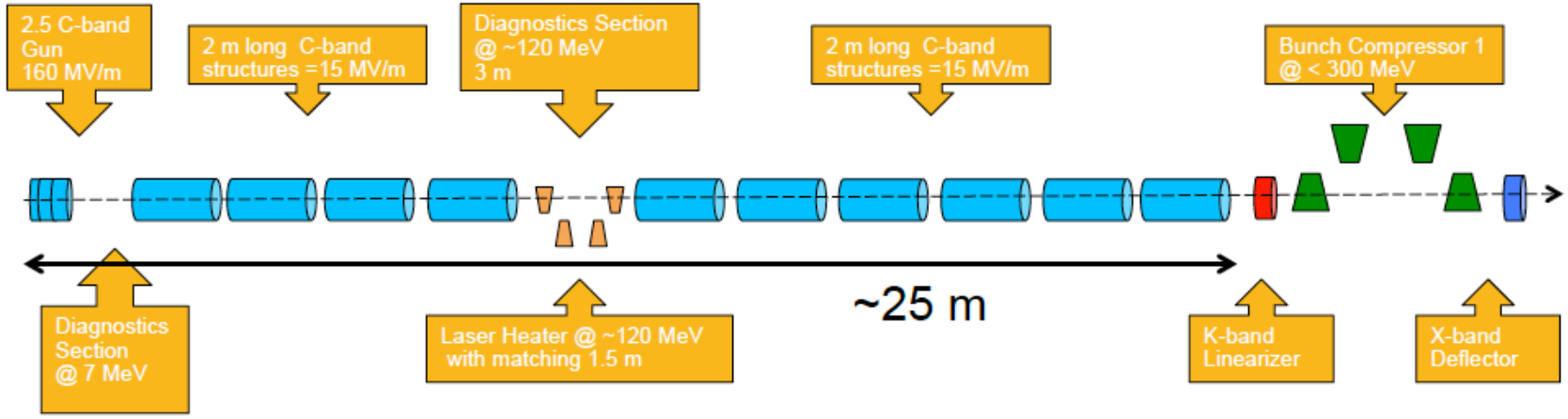
Full C–band XLS Injector

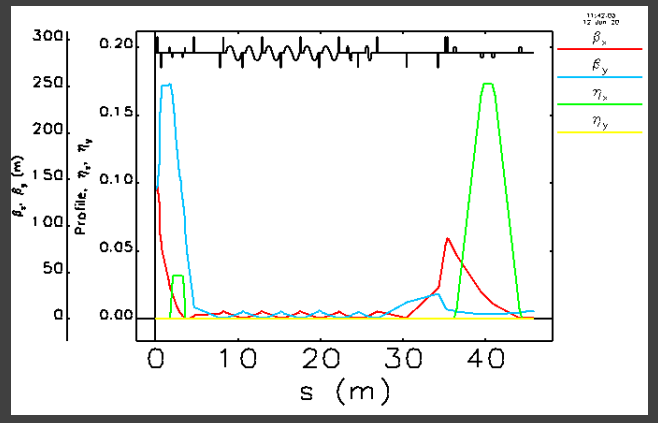
Compact

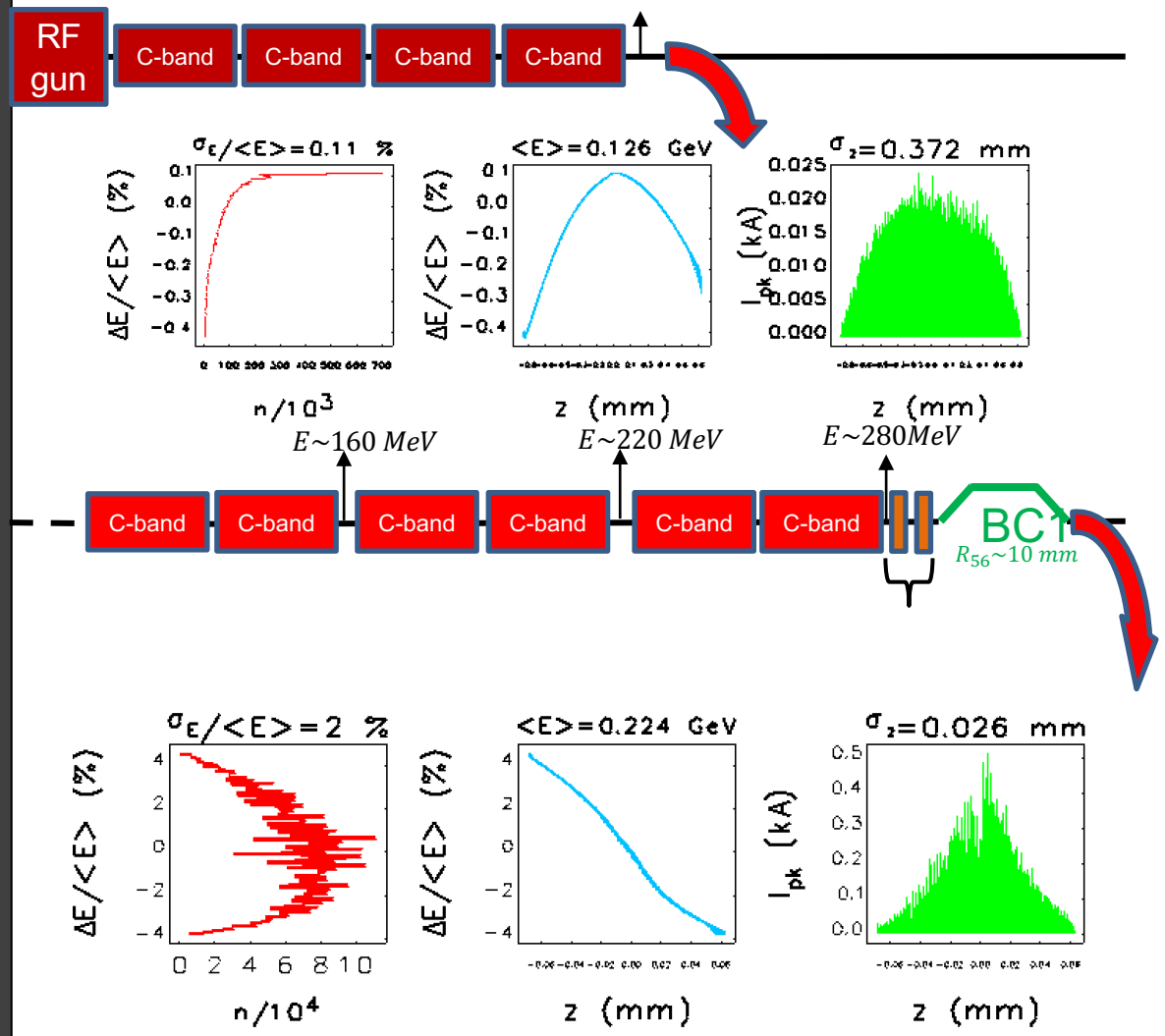
- One injector for all the operational modes (HRR and LRR)
  - 2.5 C-band gun with 160 MV/m cathode peak field => longer drift for diagnostics
  - Copper cathode and TiSa Laser
  - Same gradients 15 MV/m in the 2 m long C-band structures, max gain 30 MeV/structure
  - Same diagnostics positions (@ gun exit 7 MeV and in the drift parallel to the LH @ 120 MeV)
  - Same beam parameters at the linac exit
  - Matching with LH to be determined



- Optimal BC1 input energy (=> and position) to be determined
  - Without Velocity Bunching
  - With Laser Heater less than 2 m long
  - K-band Linearizer just before the BC1, X-band RFD downstream BC1
  - Same beam parameters at the BC1 exit

High rep rate oncrest beam from 2.6 cells PhInjector.





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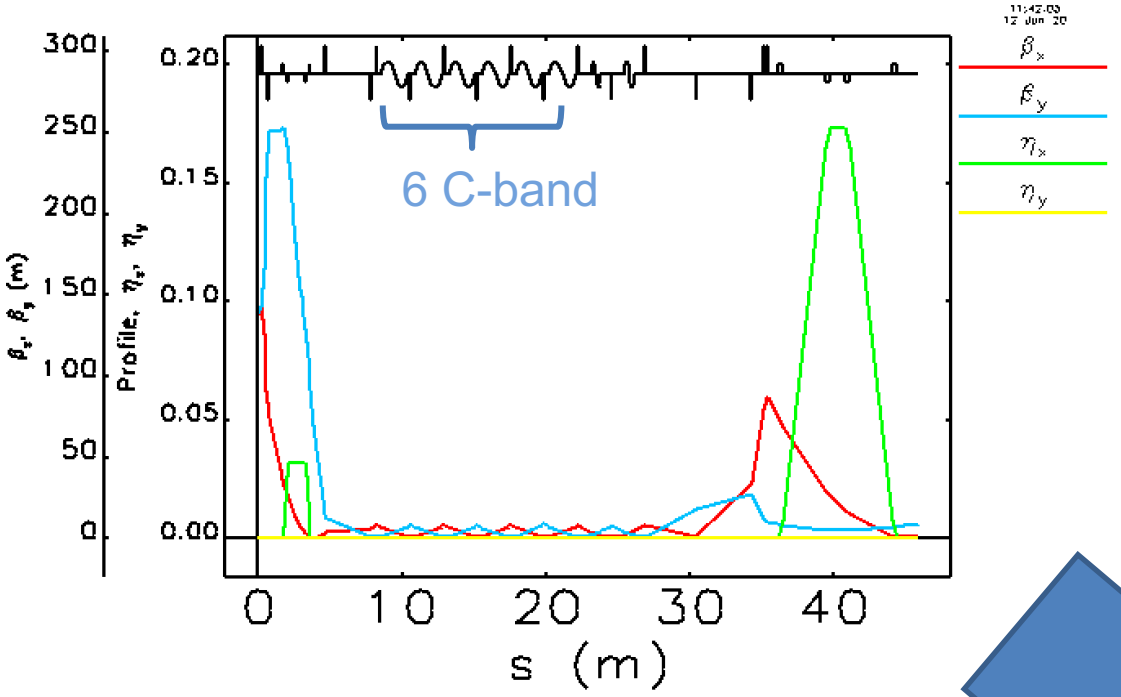
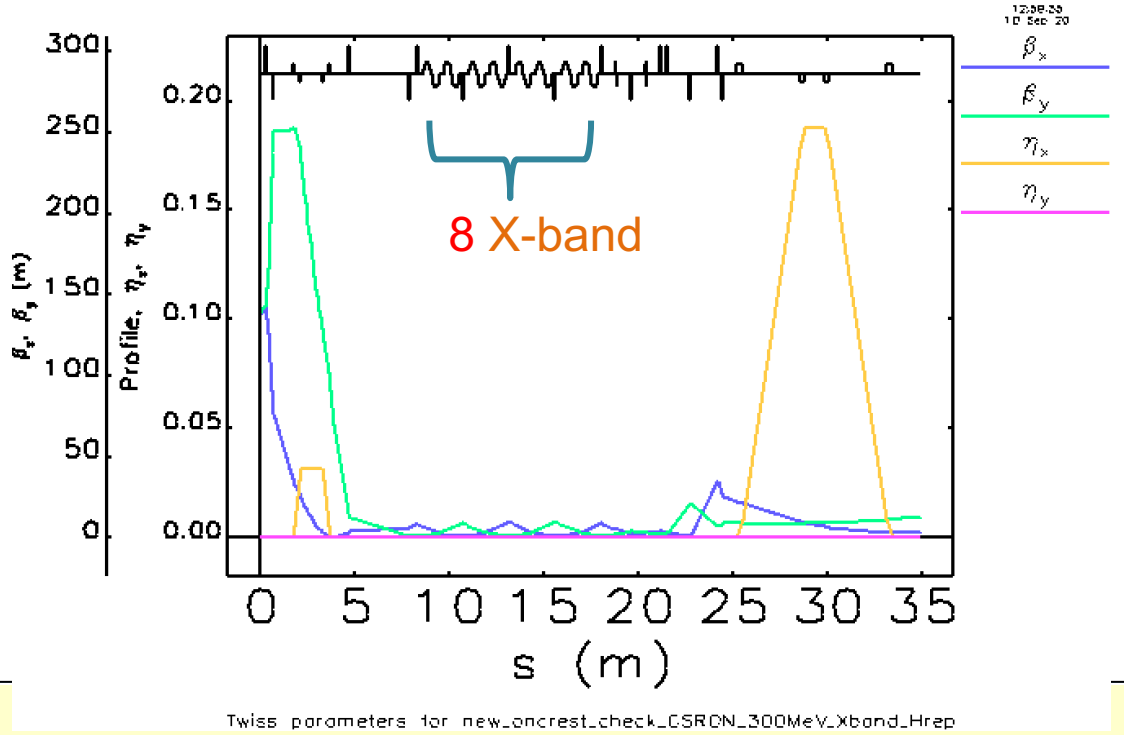
Replacing the 6 C-band





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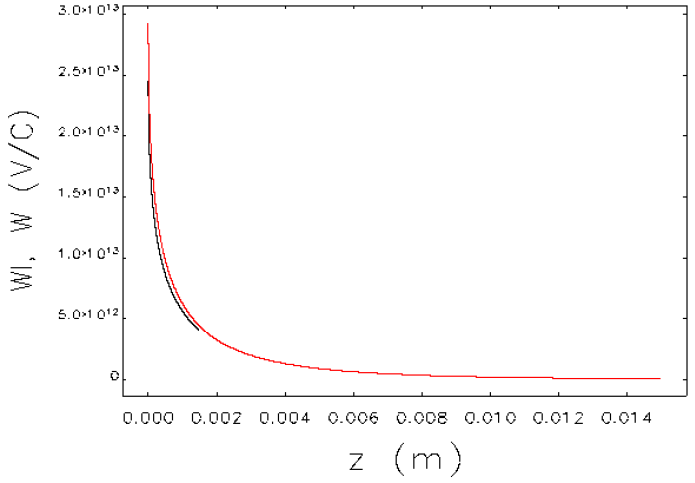
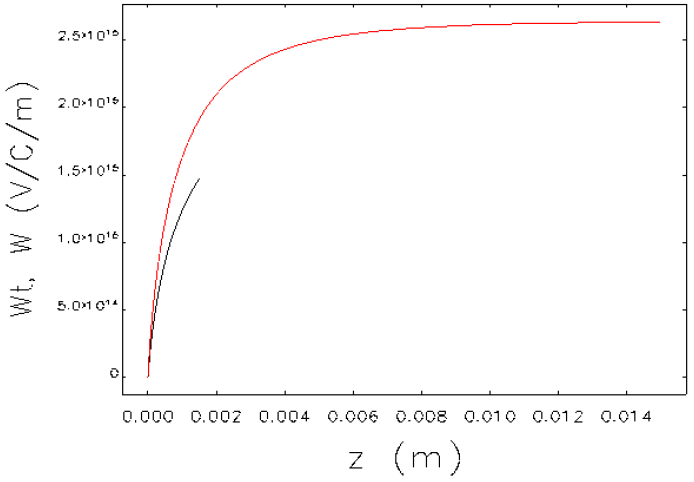
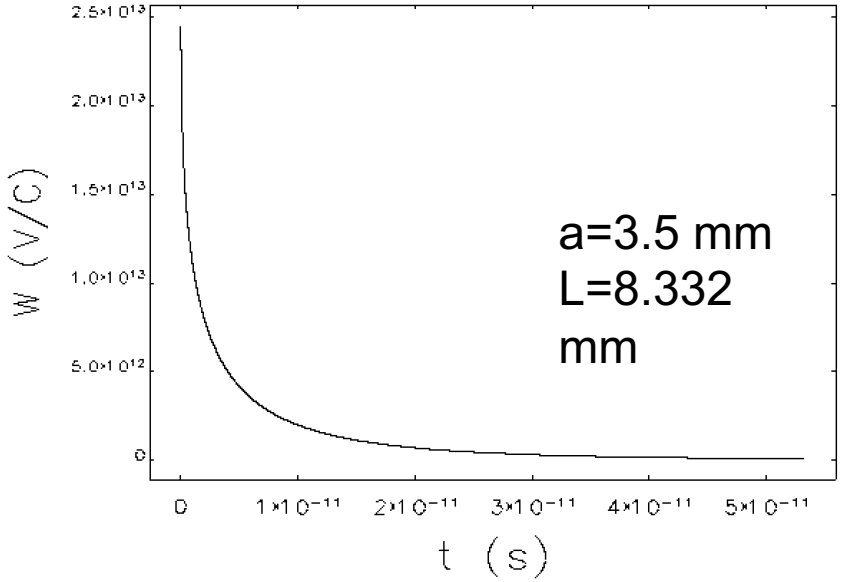
Usual check on calculated and applied wakes: X-band

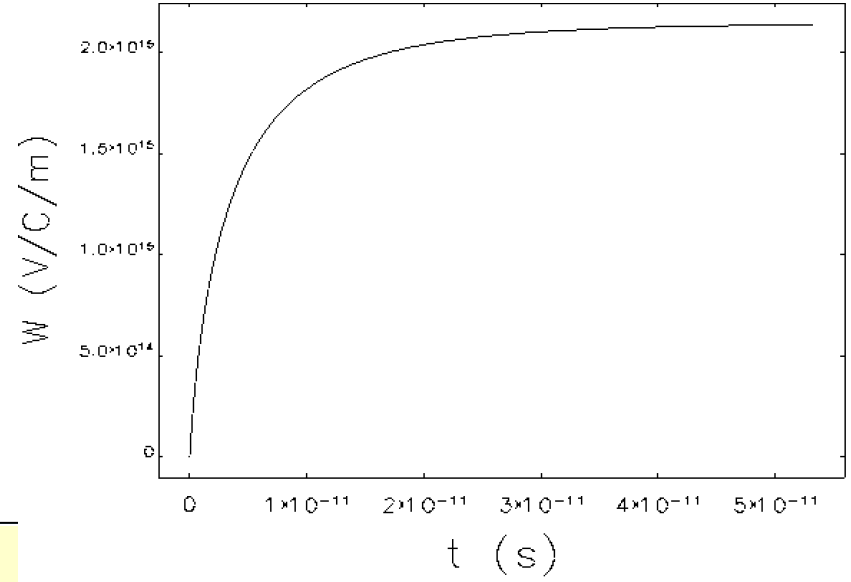




From XLS repository



From K. Bane and reported parameters (M. Diomede)



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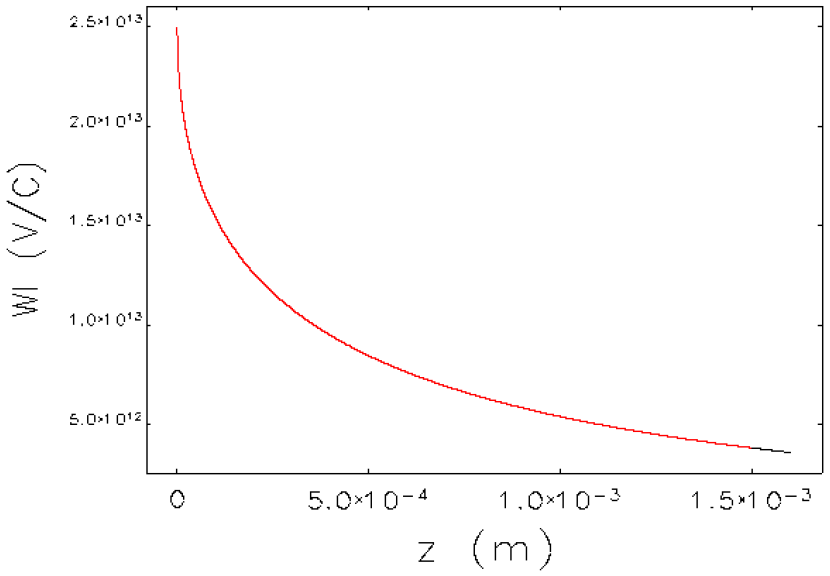
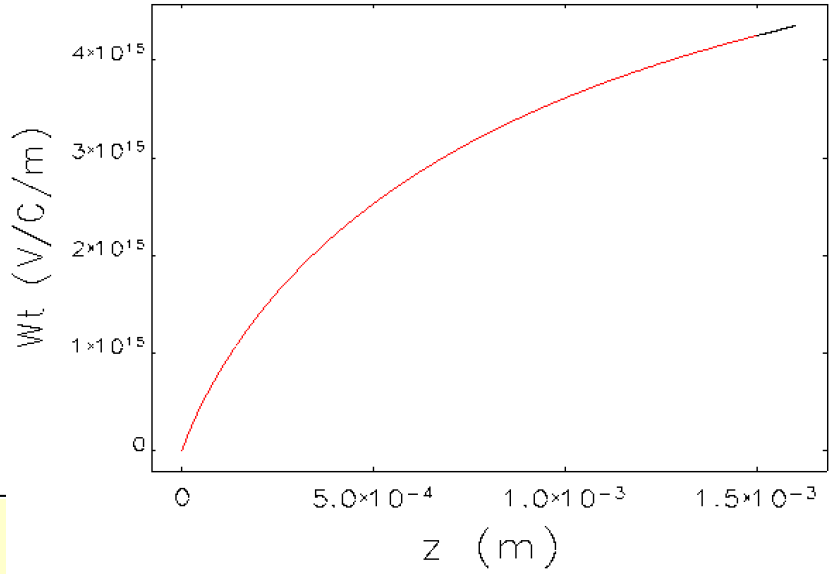
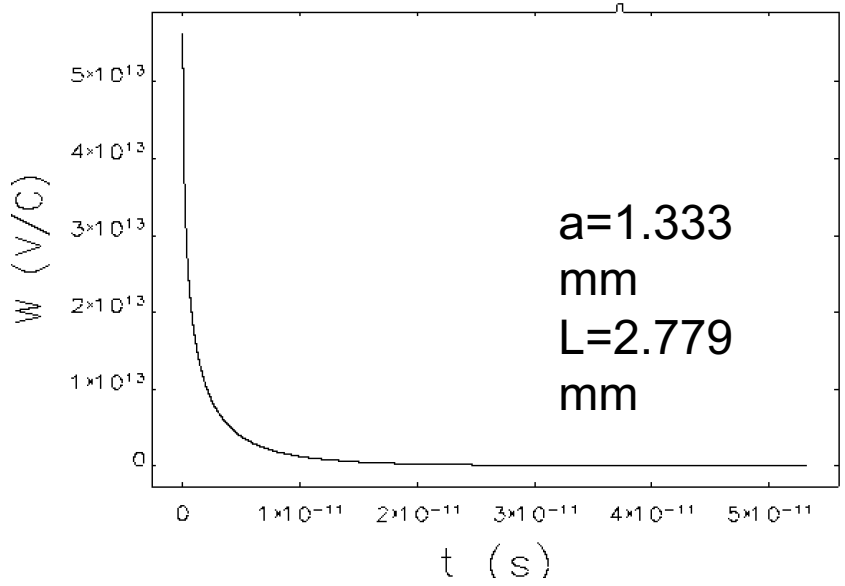
Usual check on calculated and applied wakes: K-band



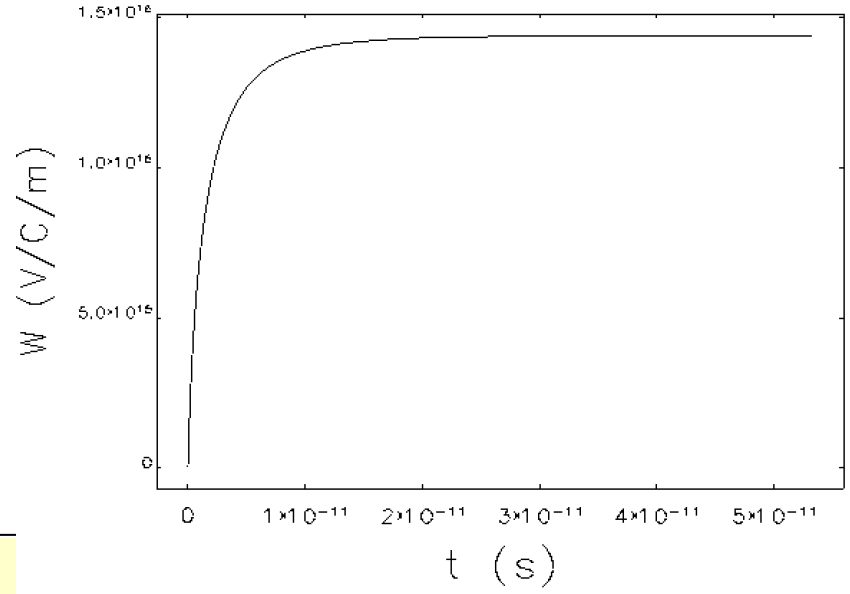


From XLS repository

From K. Bane and reported parameters (B. Spataro)



a=1.333 mm
L=2.779 mm



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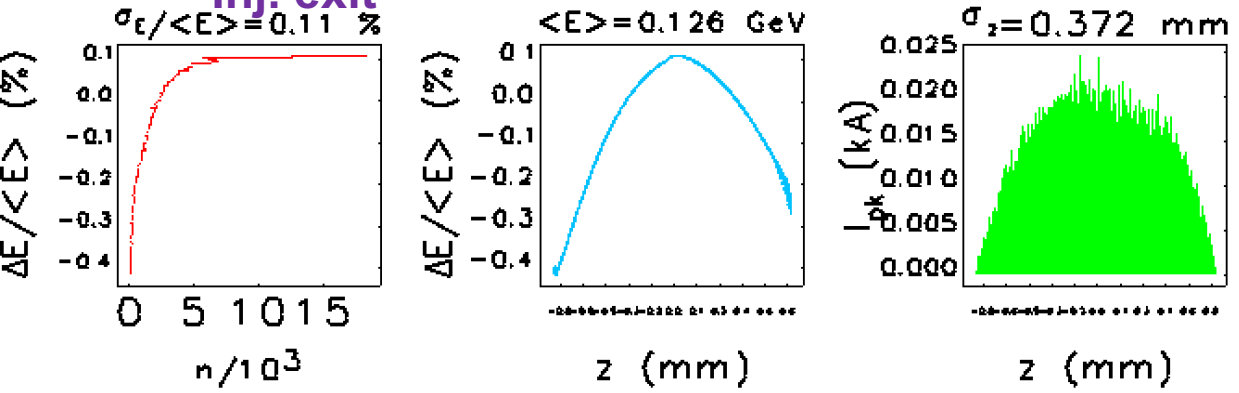
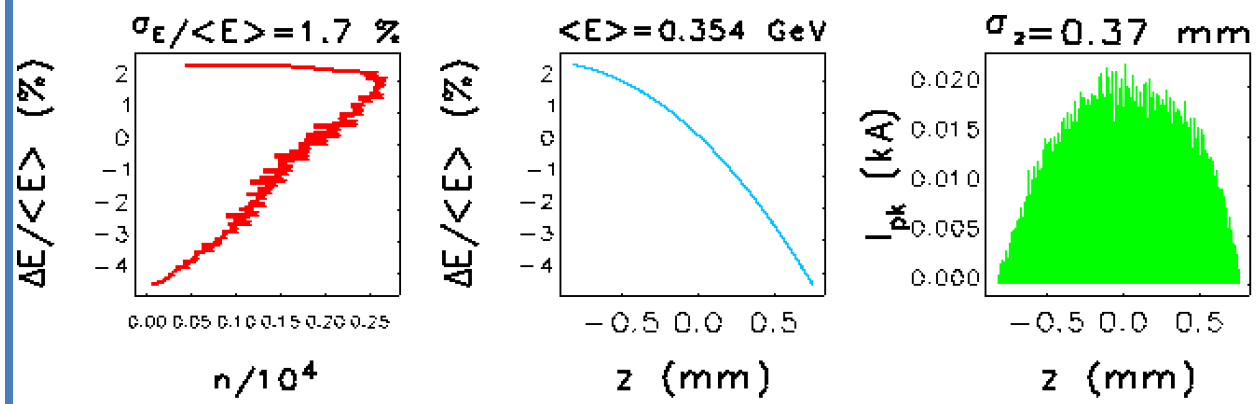
With 8 X-band ($E_{acc}^{int} \sim 30MV$)+ 2 k-band:

Compact

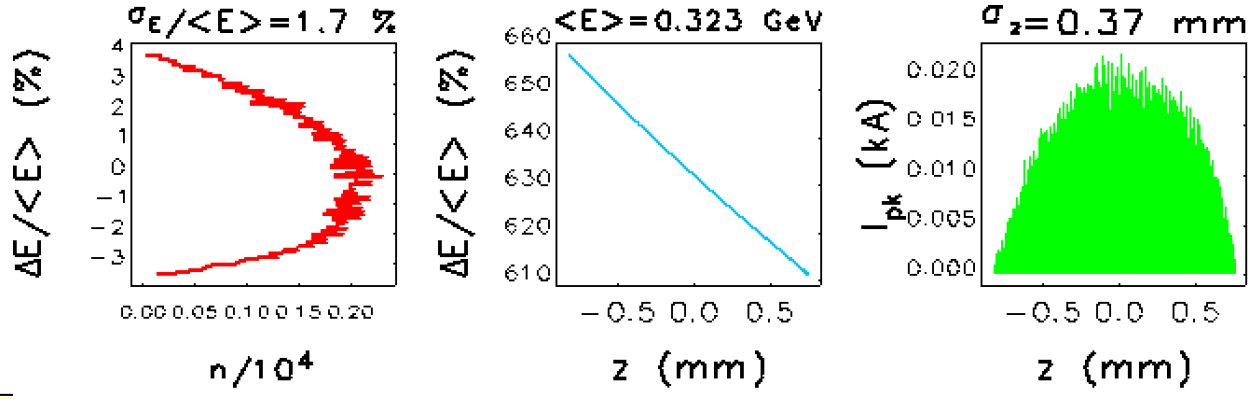
Low energy Ph-Inj. exit



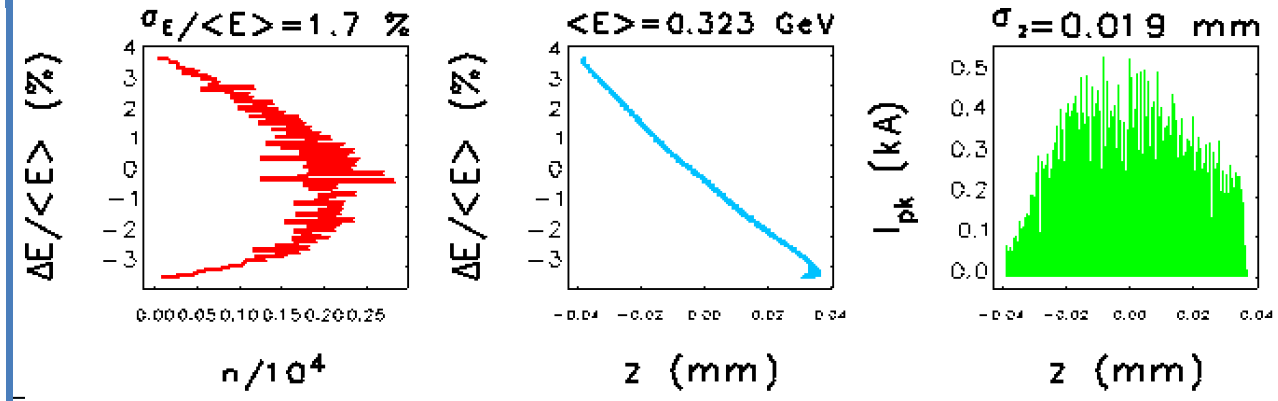
8th X-band exit



2nd K-band exit : 36 cells, L=10.004 cm, 16MV (integrated on each), ϕ= -92.5°

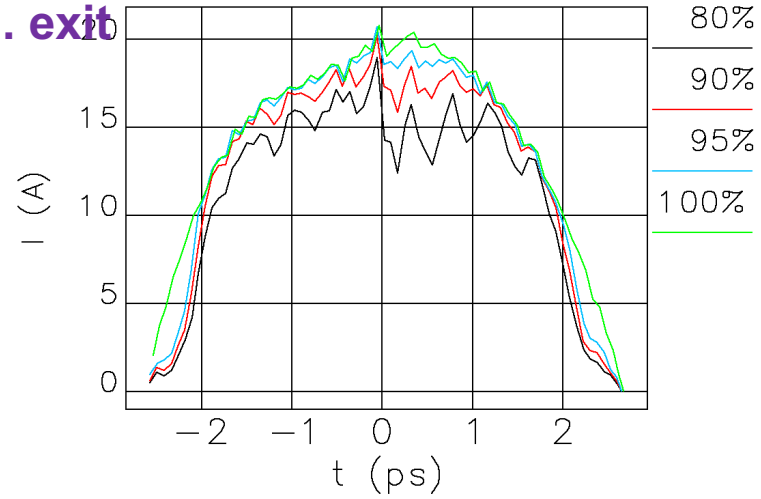


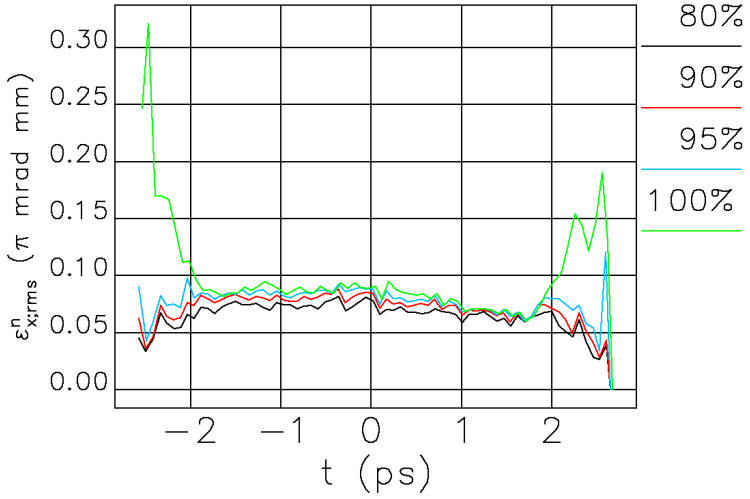
BC1 exit



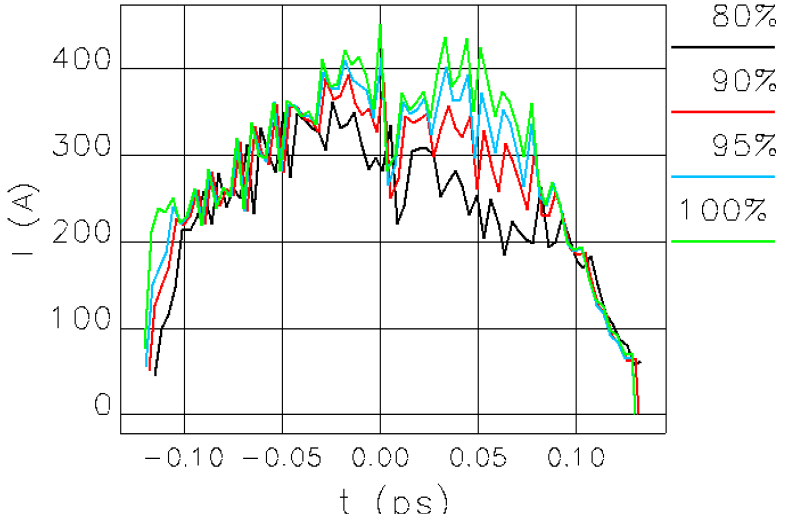
With CSR on:

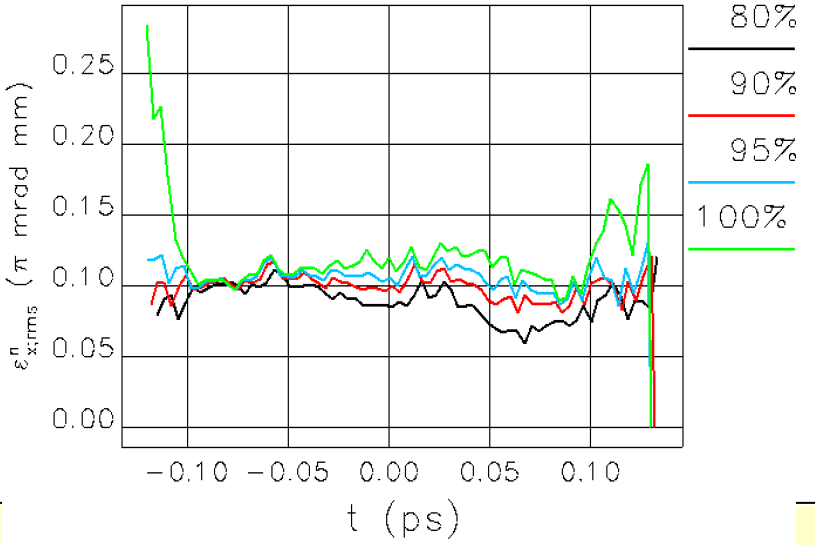
Low energy Ph-Inj. exit





BC1 exit: R_{56}= -20.6 mm, T_{566} = 31 mm





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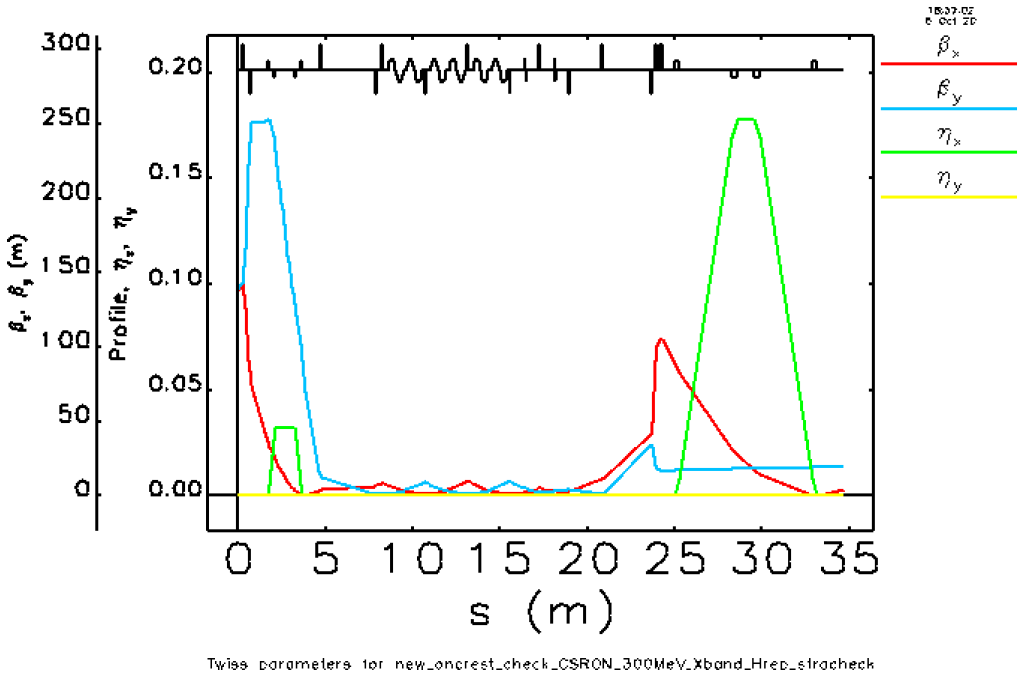
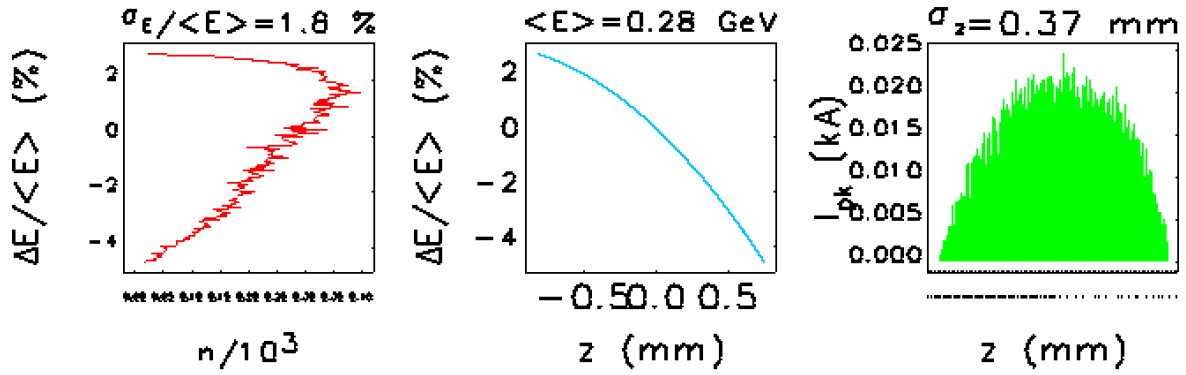
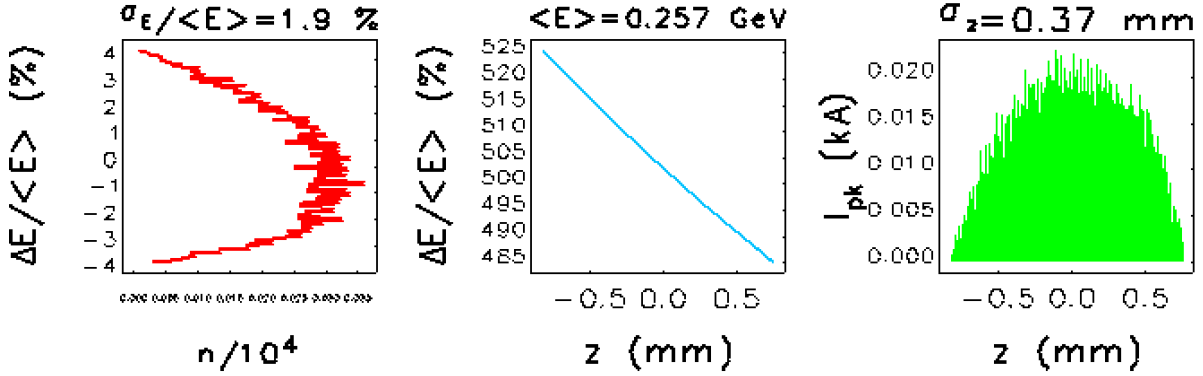
Further check with 6 X-band sections



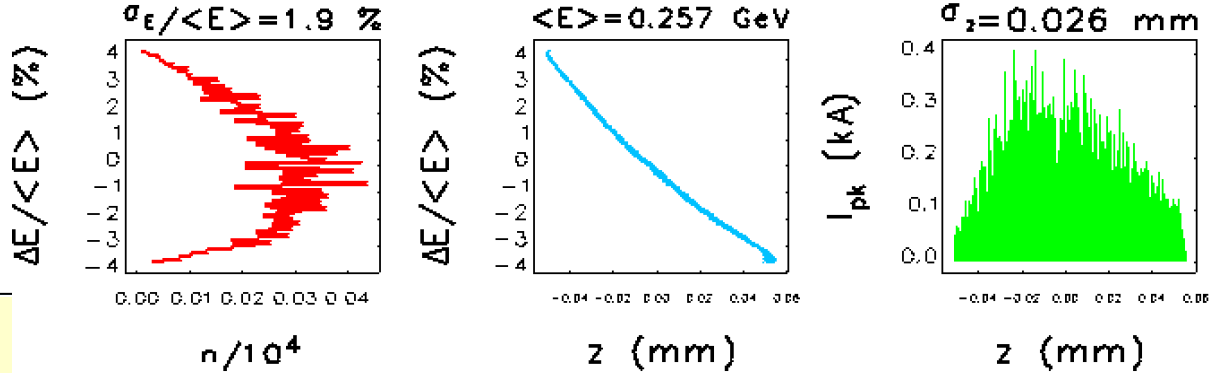
6 X-band exit



2 K-band exit (12 MV integrated on each), Phi=-92.5°



BC1 exit



		6 C-band 15 MV/m (1 kHz)	8 X-Band 30 MV/m (1 kHz)
Effective Accelerating Length	$L_{acc}^{eff}\ (m)$	11.4	7.4
Current	$I(A)$	300	300
Bunch length rms BC1 exit	$\sigma_z\ (\mu m)$	26	19
Slice Hor Norm Emittance	$\varepsilon_{nx}\ (\mu m)$	< 0.1	~ 0.1
Energy before BC1	$E(MeV)$	275	323

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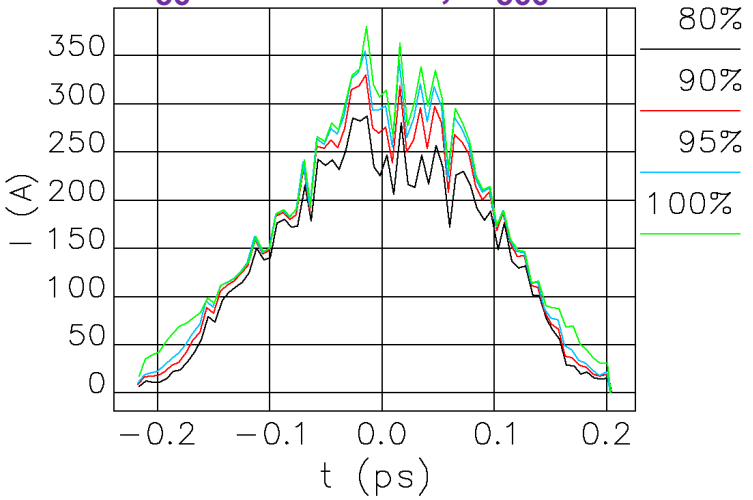
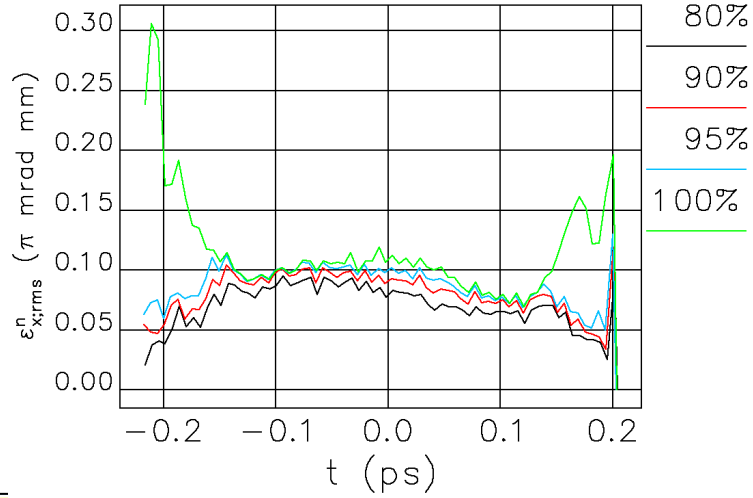
COMPARISON:

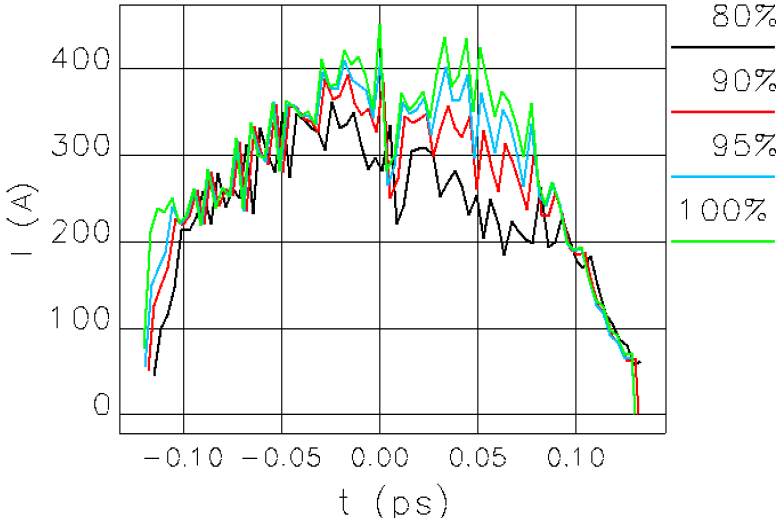
Not suitable for 300 MeV at High rep rate

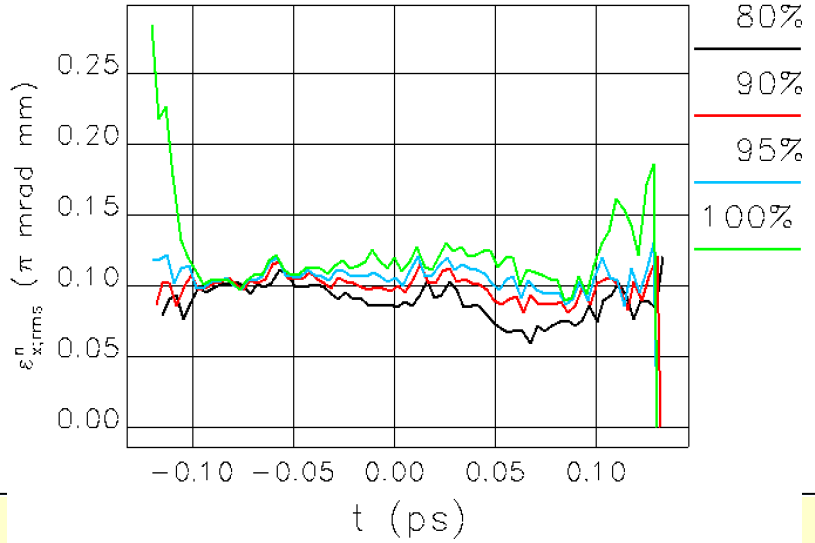
6 C-band - BC1 exit:
R_{56}= -10.9 mm, T_{566} = 16 mm



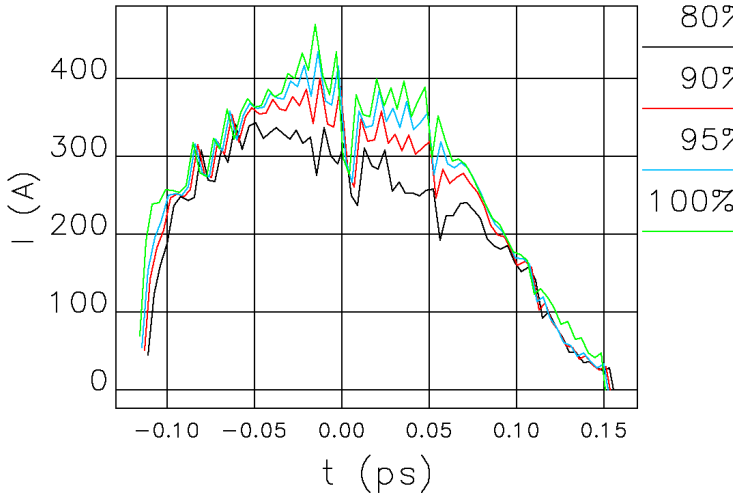


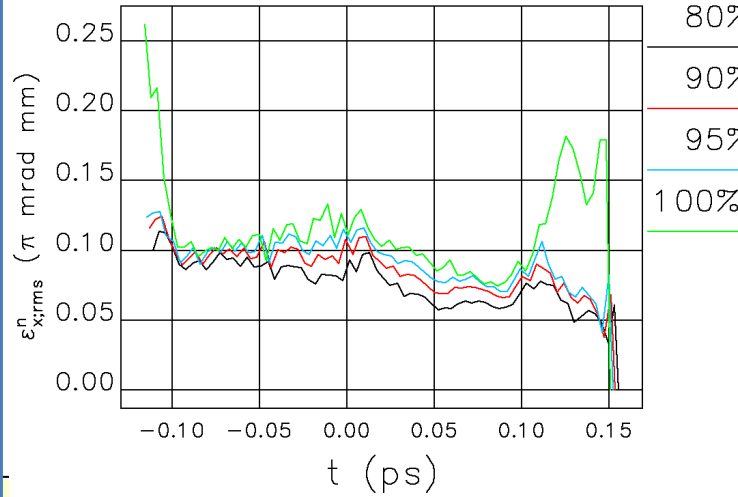
8 X-band - BC1 exit:
R_{56}= -20.6 mm, T_{566} = 31 mm





4 X-band - BC1 exit:
R_{56}= -20.6 mm, T_{566} = 31 mm





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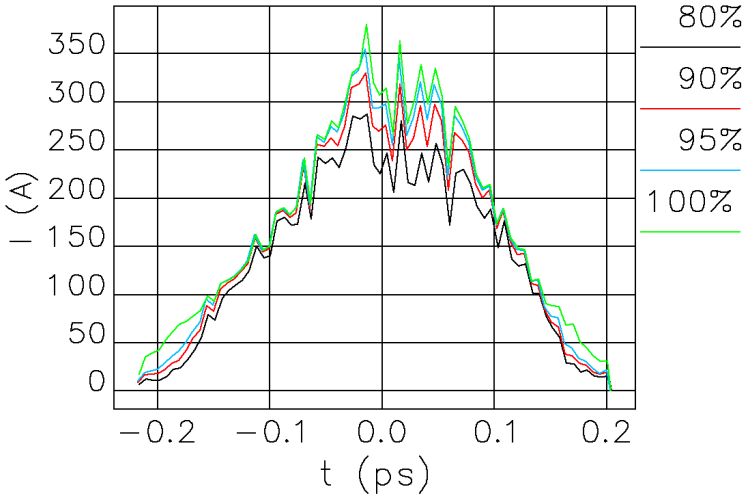
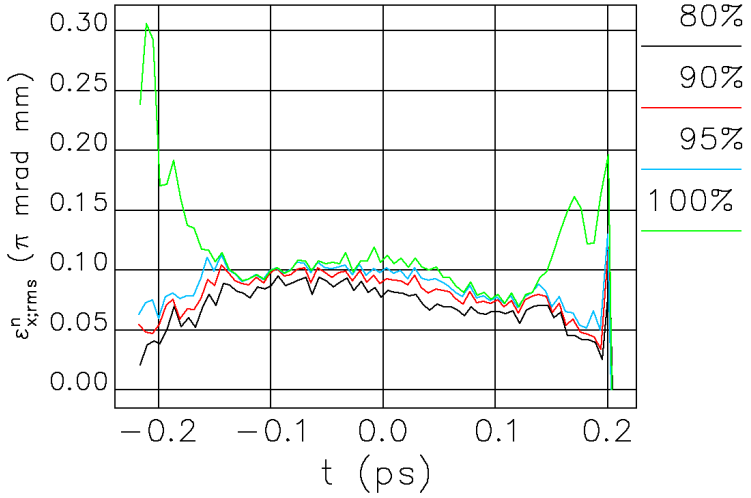
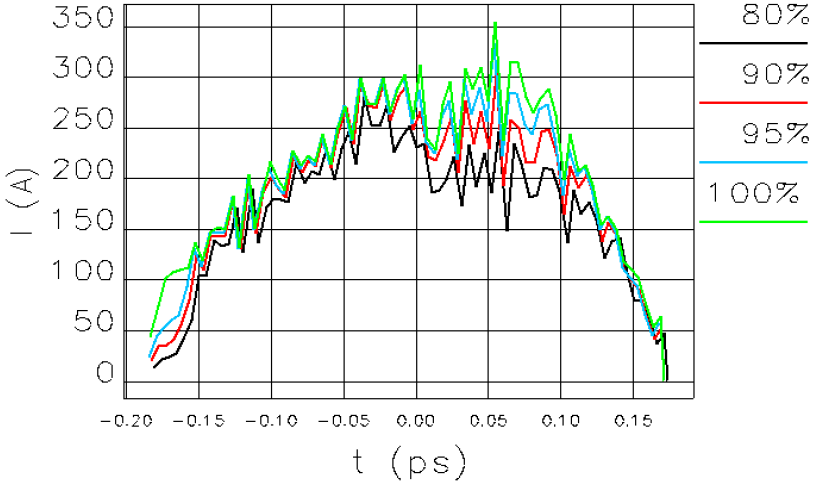
COMPARISON:

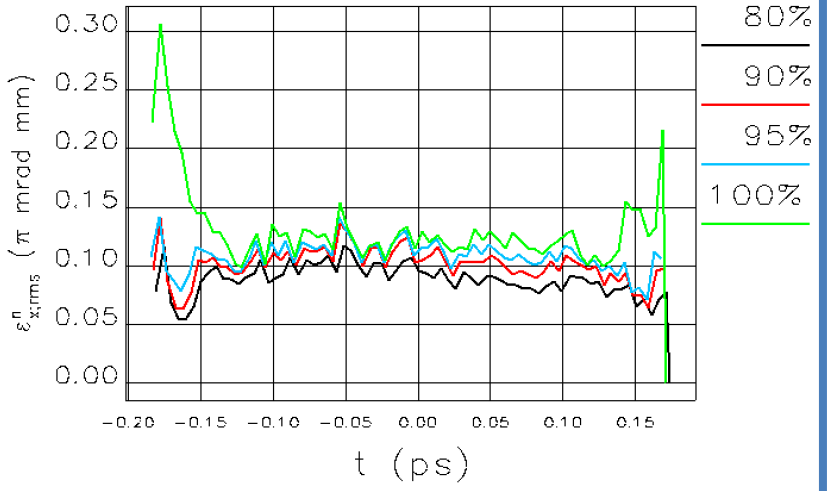
6 C-band - BC1 exit:
R_{56}= -10.9 mm, T_{566} = 16 mm





6X-band - BC1 exit:
R_{56}= -18.5 mm, T_{566} = 27 mm





Conclusions

- The replacement of 6 C-band sections with **8** X-band ones does not show obstacles from first simulations, even though the R_{56} is higher right now but this can be optimized in the next
- Iterations with the adopted K-band structure have to be performed (see A. Latina talk on August 2020), check on the hrr operation as well
- Benchmark with also SC effect up to the BC1 exit to be done

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Compact

Thank you!

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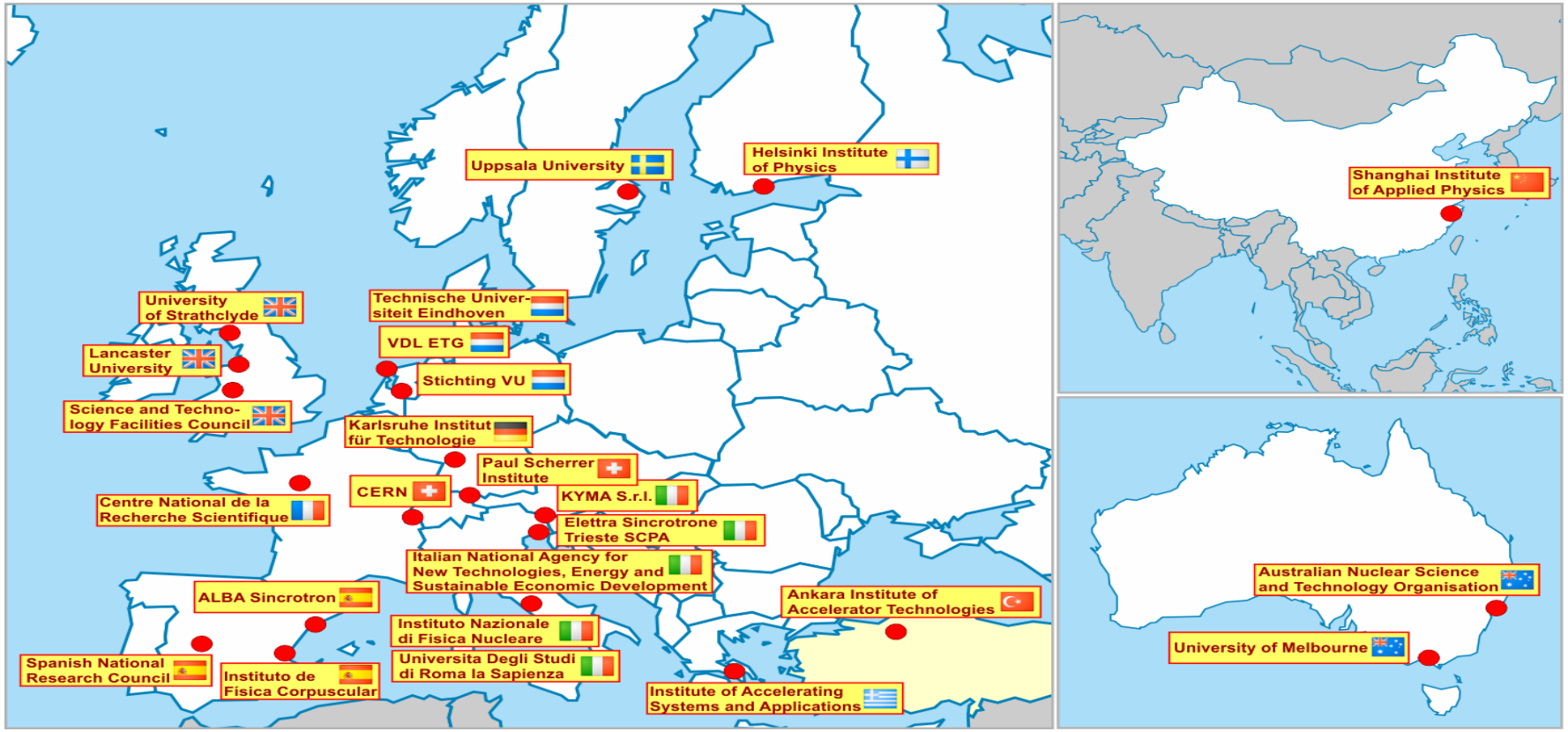
www.CompactLight.eu



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