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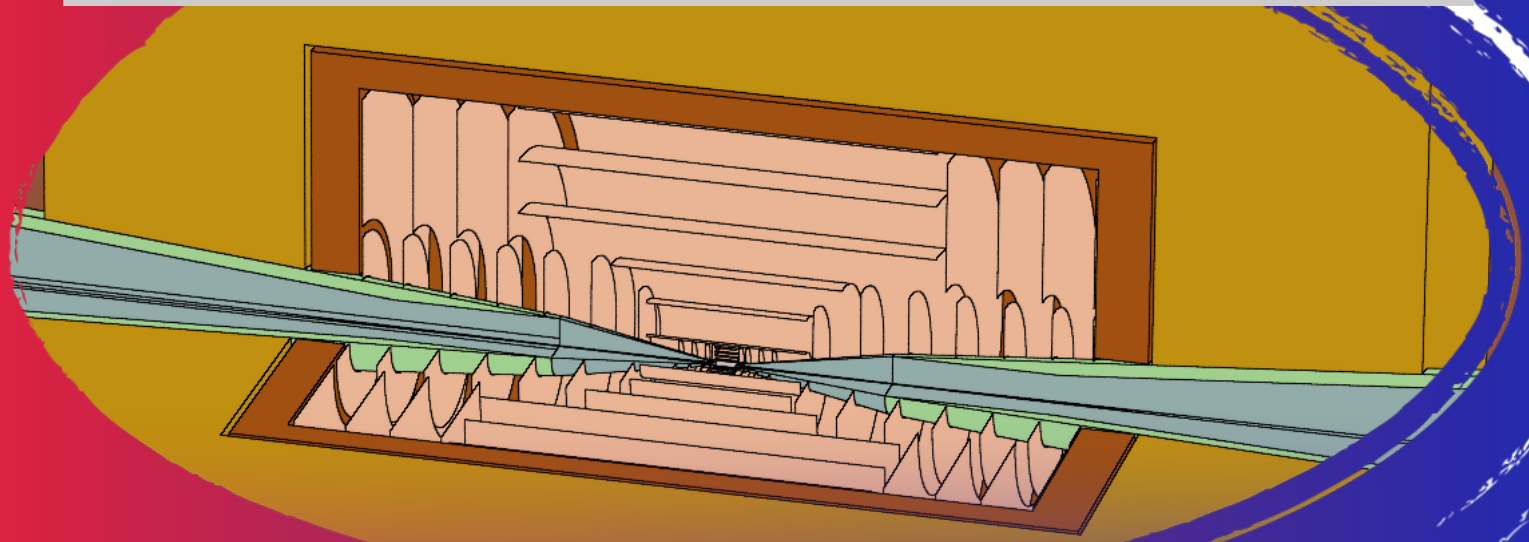
Muon Collider: MDI update



MAIA detector meeting, 20 Mar 2025

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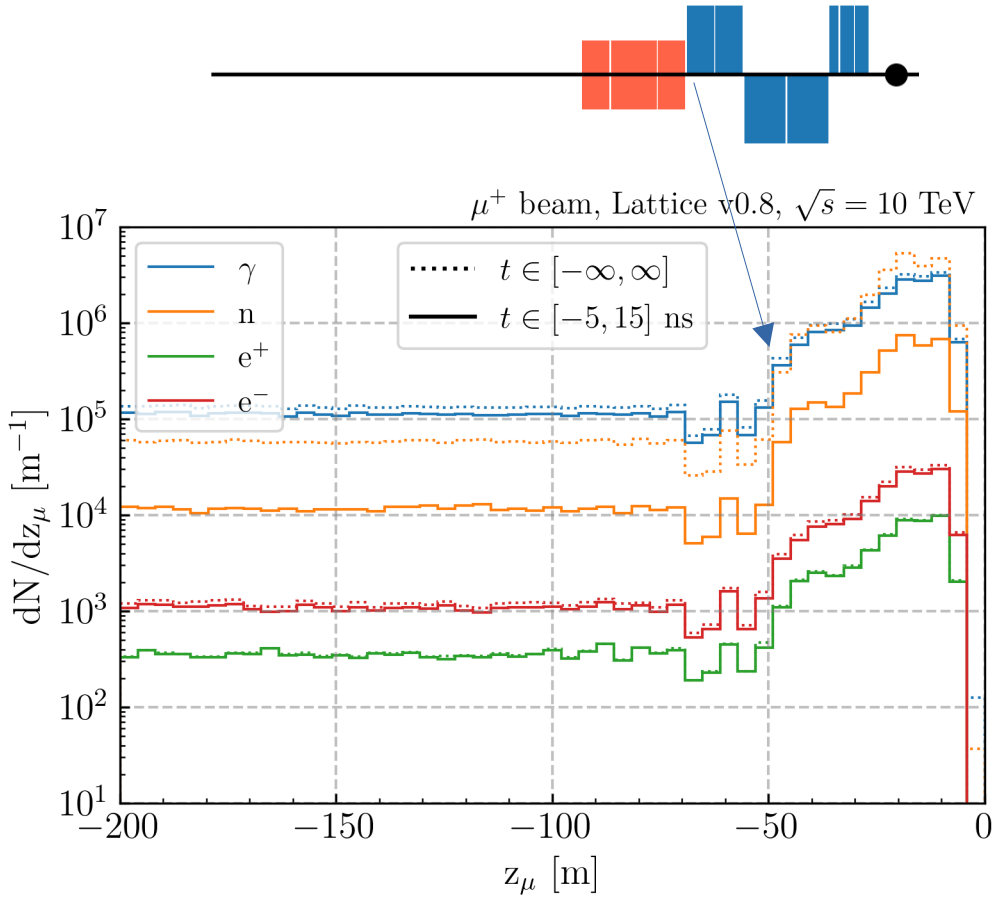
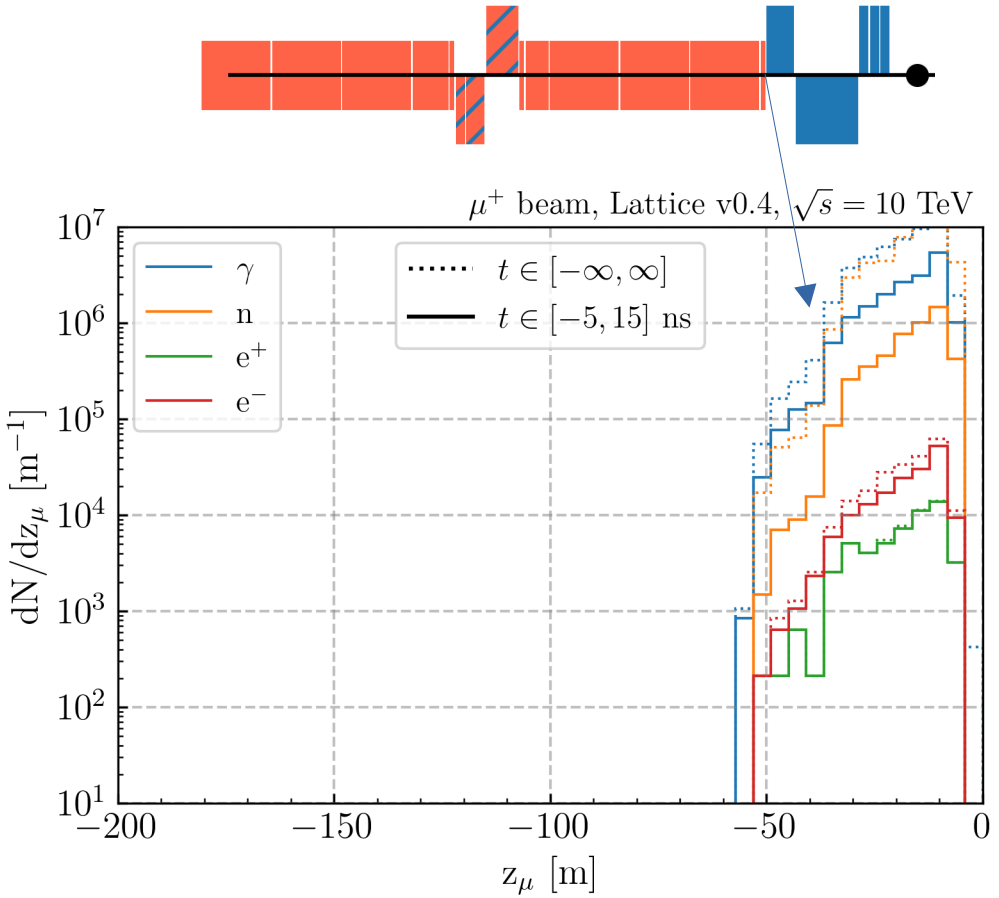
INFN sezione di Padova

Outlook

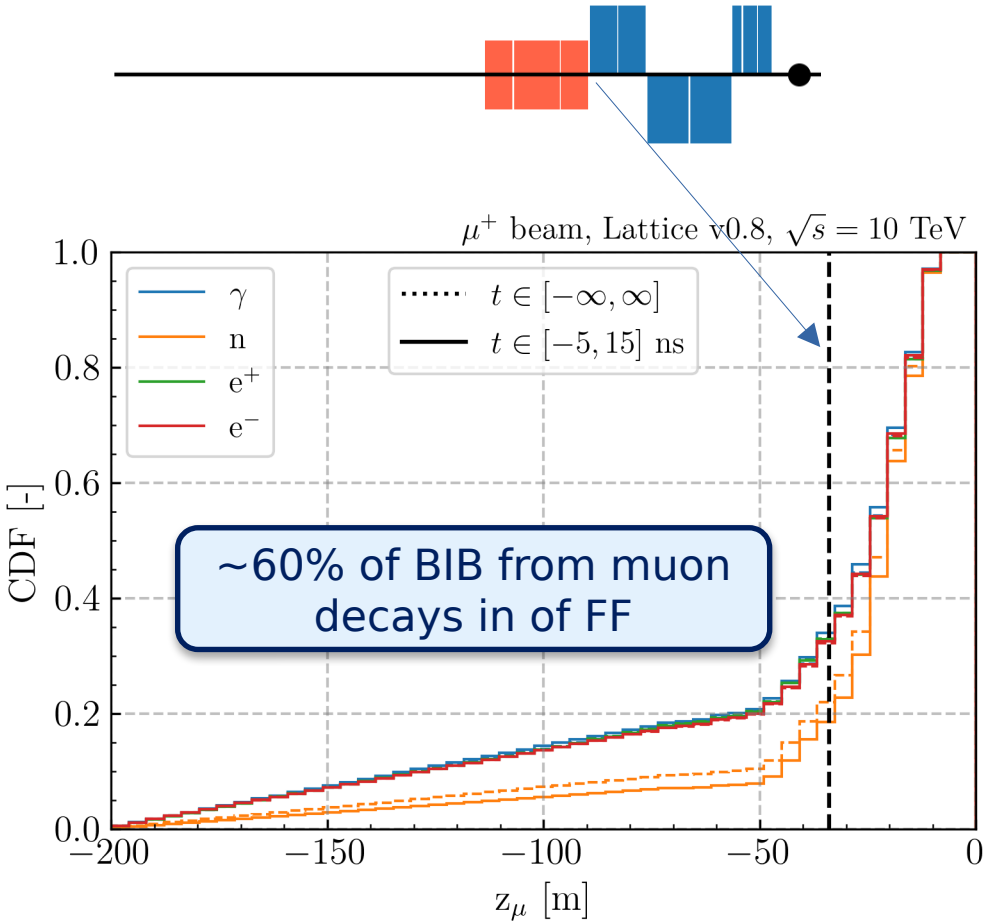
- BIB differences: lattice version 0.4 and 0.8
- Nozzle differences and effects
- Radiation enviroment in the tracker detectors

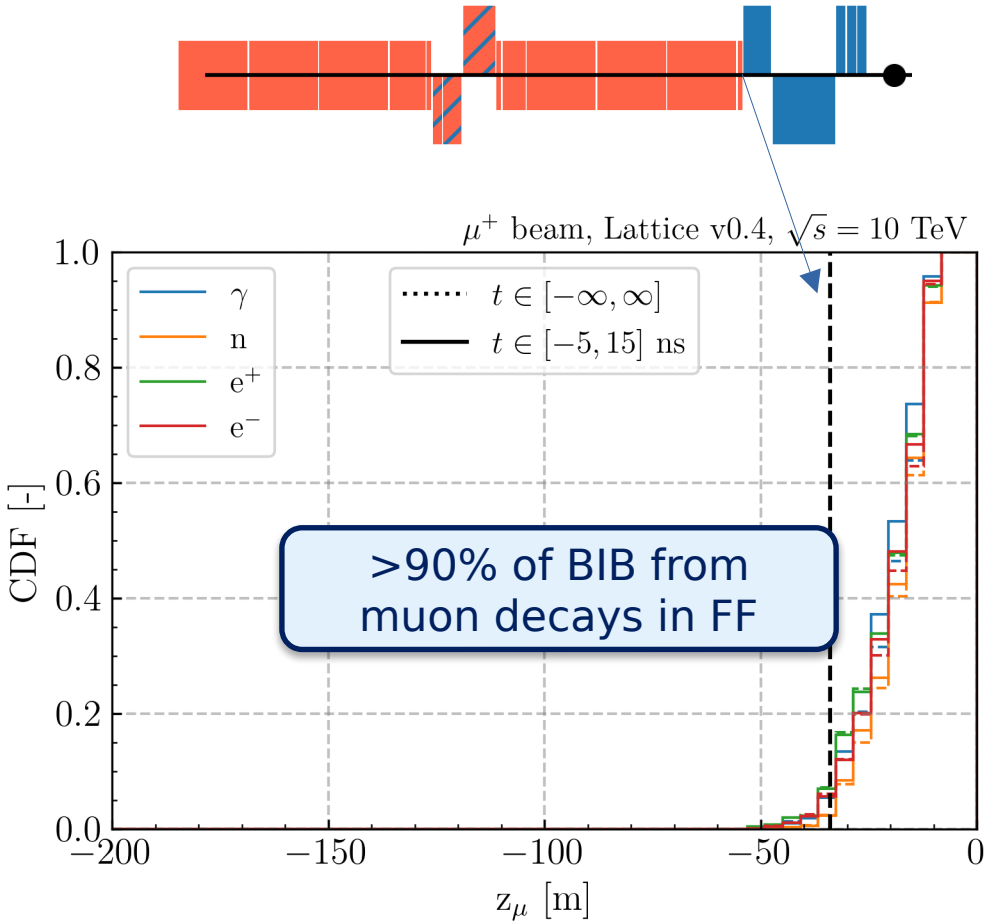
BIB differences: lattice version 0.4 and 0.8



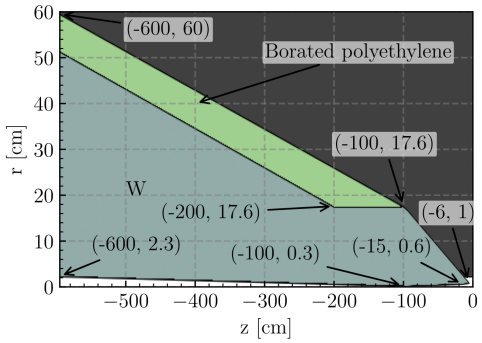


BIB differences: lattice version 0.4 and 0.8



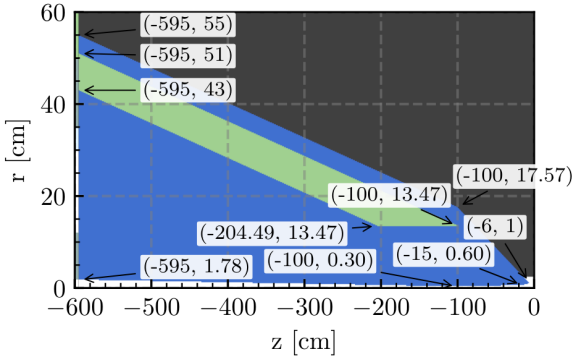


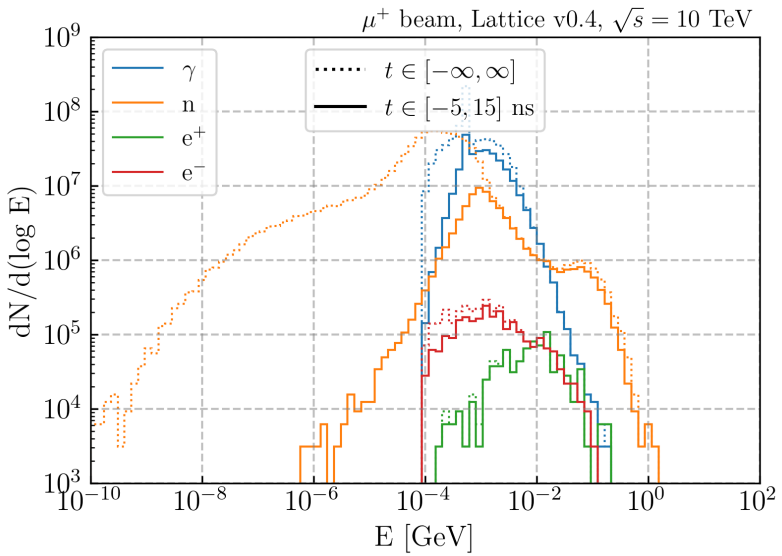
BIB differences: lattice version 0.4 and 0.8

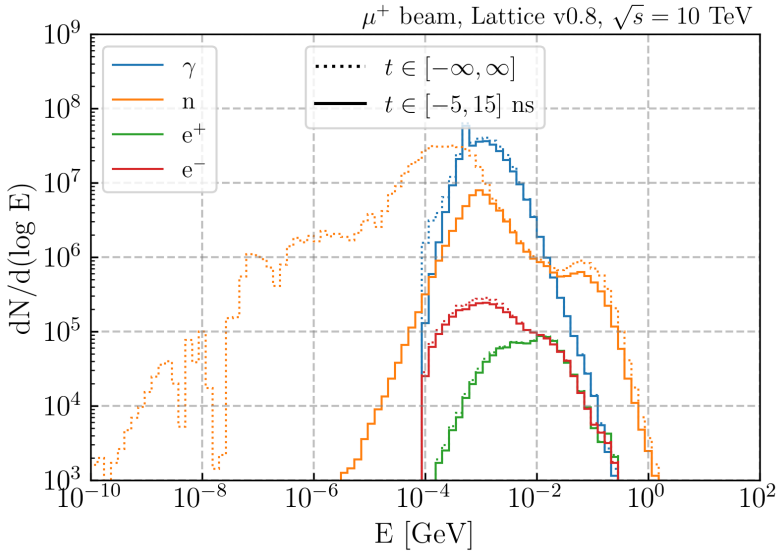


Notable changes in the nozzle:

- 10% less density (INERMET180 instead of W
- External layer to absorb characteristic gamma from neutron absorption







Radiation environment in the trackers

Three simulations presented here:

1)ESSPU: the current assumed for the ESPPU report. ~246 meters of line

2)0.4: the old lattice and nozzle. ~60 meters of line

3)0.4-bis: old lattice with the ESPPU nozzle (to decouple effects from line and nozzle). Low statistics

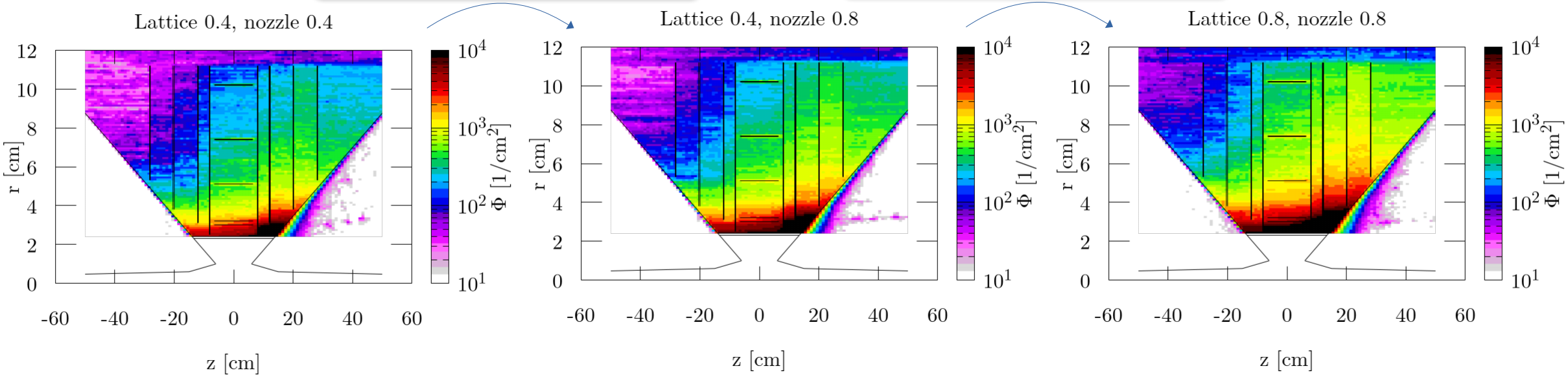
Name	Lattice version	Nozzle version	Number of original decays simulated	Total number of secondaries produced	Secondaries produced per decay	Expected number of decays	Fraction of beam simulated	Total amount of BIB particles expected
ESPPU	0.8	0.8	1.33E+06	1.99E+07	14.92	1.42067E+07	9.39E-02	2.12024E+08
0.4	0.4	0.4	3.12E+05	1.76E+07	56.45	3.46447E+06	8.99E-02	1.95586E+08
0.4-bis	0.4	0.8	7.66E+04	3.15E+06	41.14	3.46447E+06	2.21E-02	1.42538E+08

$e^{+/-}$ fluences in the trackers

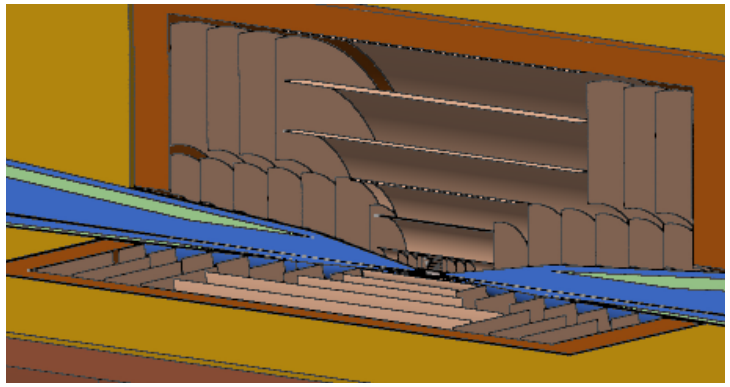
Name	Lattice version	Nozzle version	Number of original decays simulated	Total number of secondaries produced	Secondaries produced per decay	Expected number of decays	Fraction of beam simulated
ESPPU	0.8	0.8	1.33E+06	1.99E+07	14.92	1.42067E+07	9.39E-02
0.4	0.4	0.4	3.12E+05	1.76E+07	56.45	3.46447E+06	8.99E-02
0.4-bis	0.4	0.8	7.66E+04	3.15E+06	41.14	3.46447E+06	2.21E-02

Lower density due to INERMET

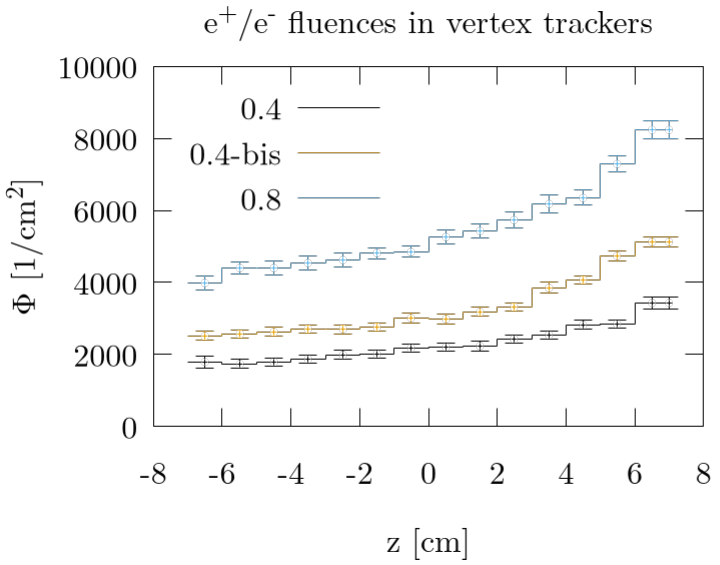
New lattice, higher BIB

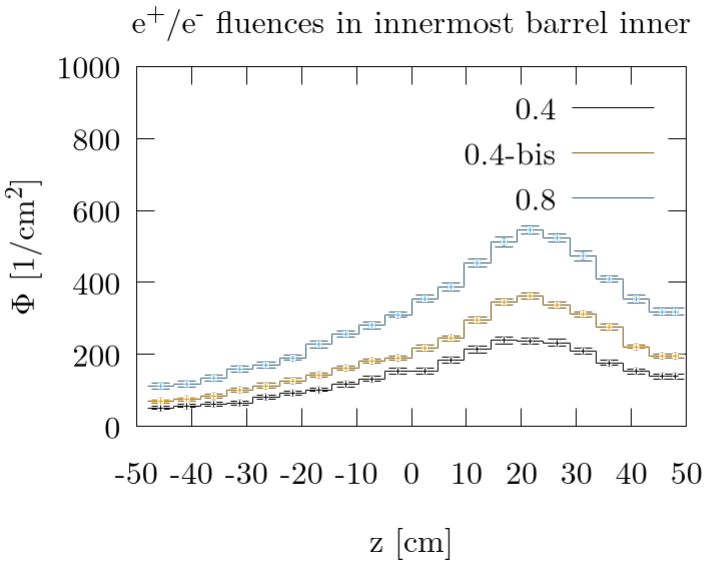


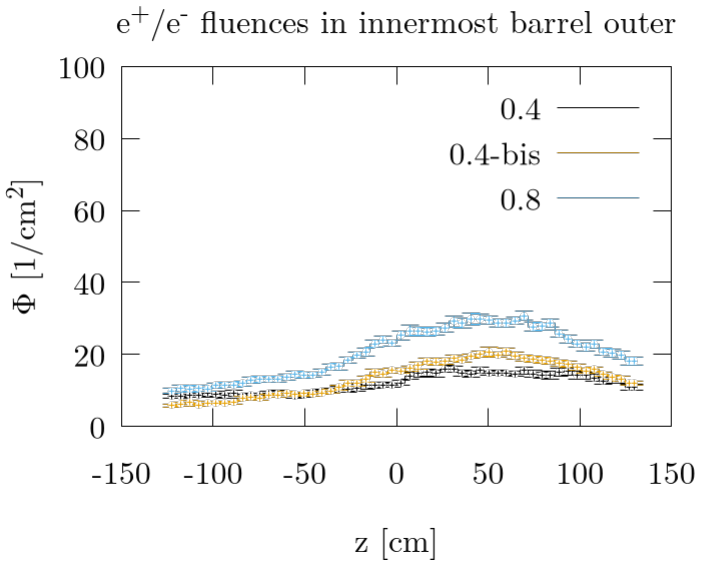
$e^{+/-}$ fluences in the trackers



Among the different simulations, up to a factor 2 difference. The difference in BIB is more evident in the innermost layers, and smothers out far away.







Conclusions

- There is a decrease in performance with the new lattice and nozzle version
- The new lattice is required for machine performance (immense β at FF)
- The new nozzle uses INERMET (~10% density reduction). Pure tungsten is not machinable. If needed, we can open the point of having local sections in pure tungsten close to the tip
- Looking at the $e^{+/-}$ fluences in the trackers (which ultimately dominate the occupancy) I see up to a factor 2 difference

Thank you!

…questions?