

G4-FLUKA + BIB muons updates

Simons team meeting
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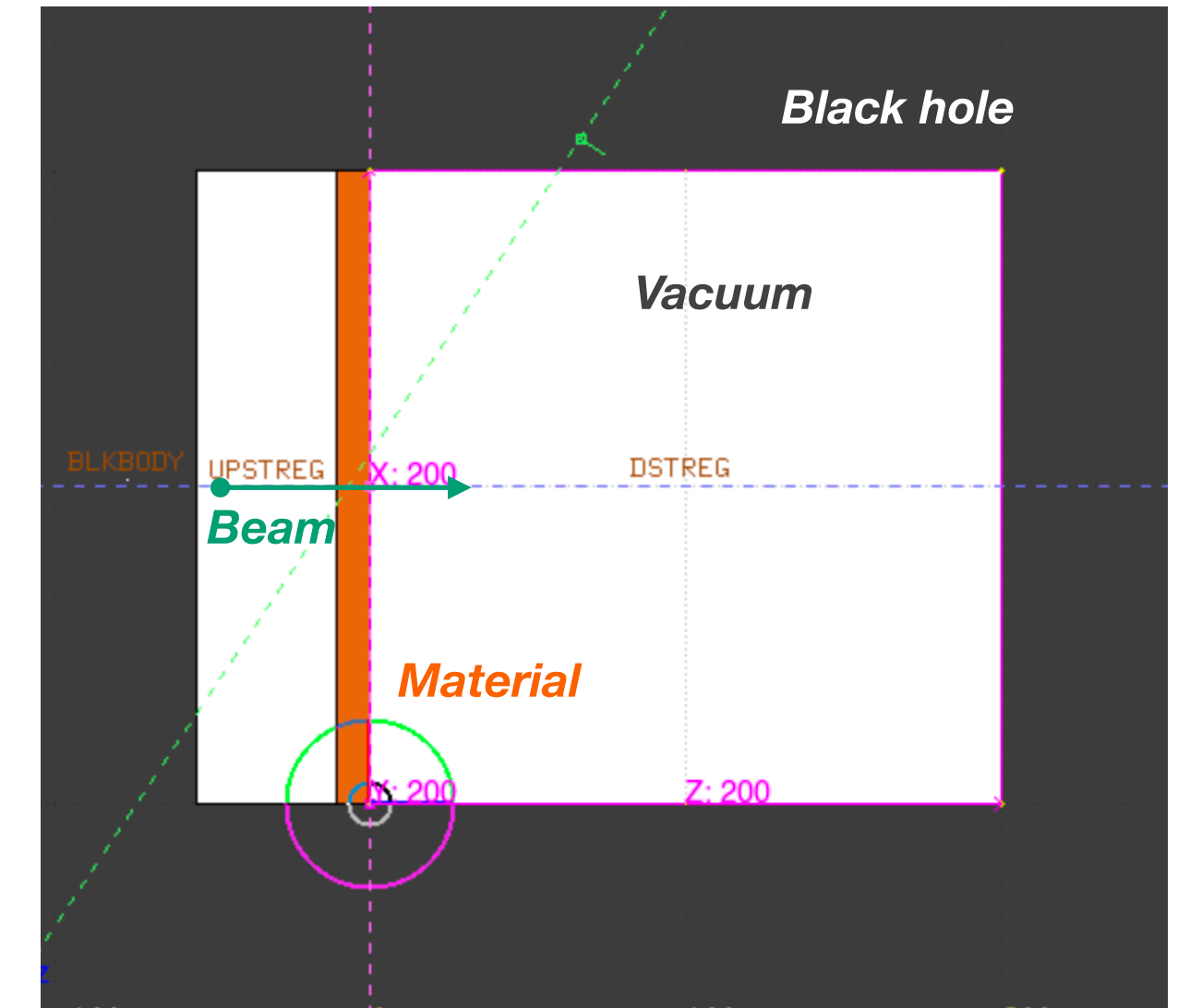
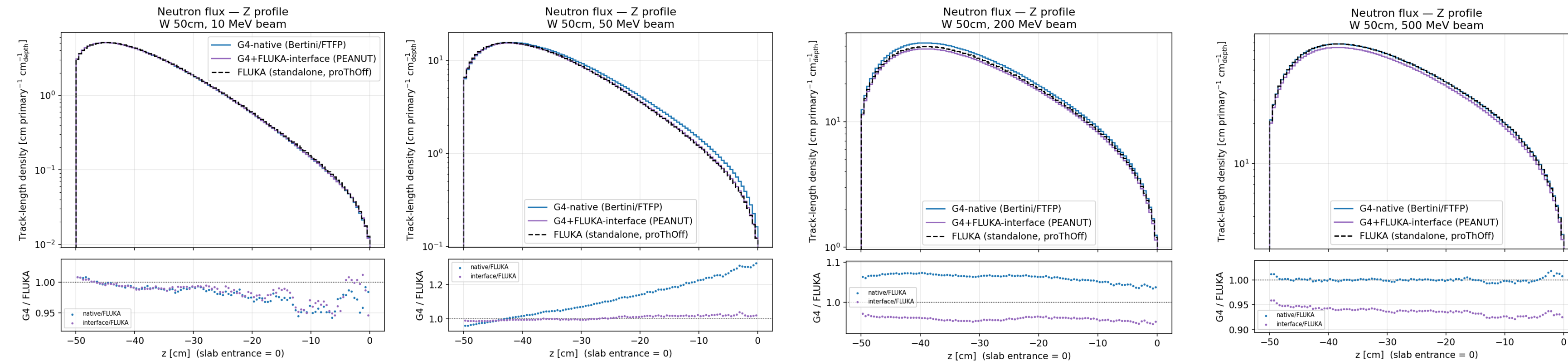
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G4 vs G4+PEANUT: two questions



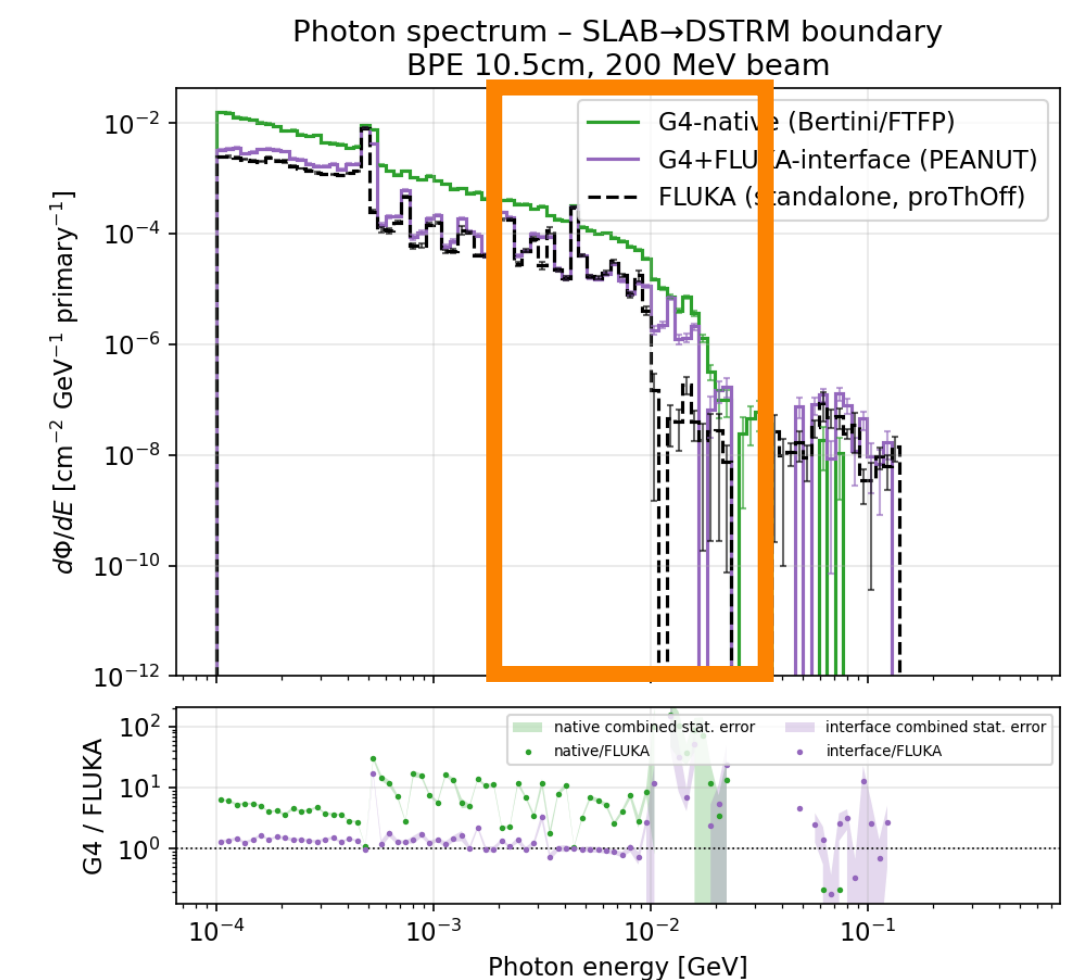
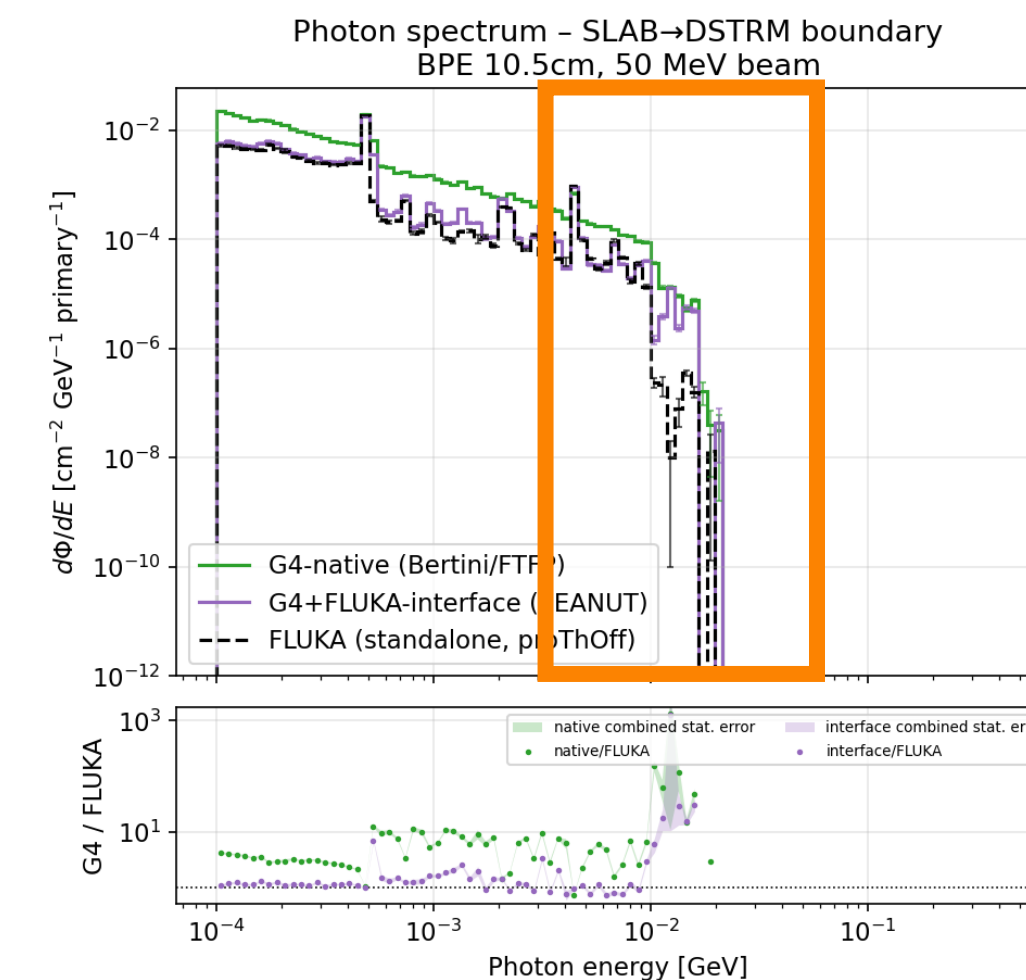
Longitudinal behavior of neutrons in tungsten

- Observed strong difference in estimated fluence at 50MeV → attributed to difference in encoded XS
- $E > 50\text{MeV}$ discrepancies suspected to be a counting method difference → TBC



Photons in BPE

- Secondary photon spectra exhibited shape difference in +PEANUT vs FLUKA
- Initial suspicion was some difference in thresholds (hidden parameters...)
- Attributed to γ s from neutron-carbon emissions + different handling of required conditions
 - FLUKA emits <1 per n-C collision and requires presence of residual excited nucleus
 - G4's native machinery emits $O(2)$ per collision
 - Split along neutron energy (above/below 20MeV)



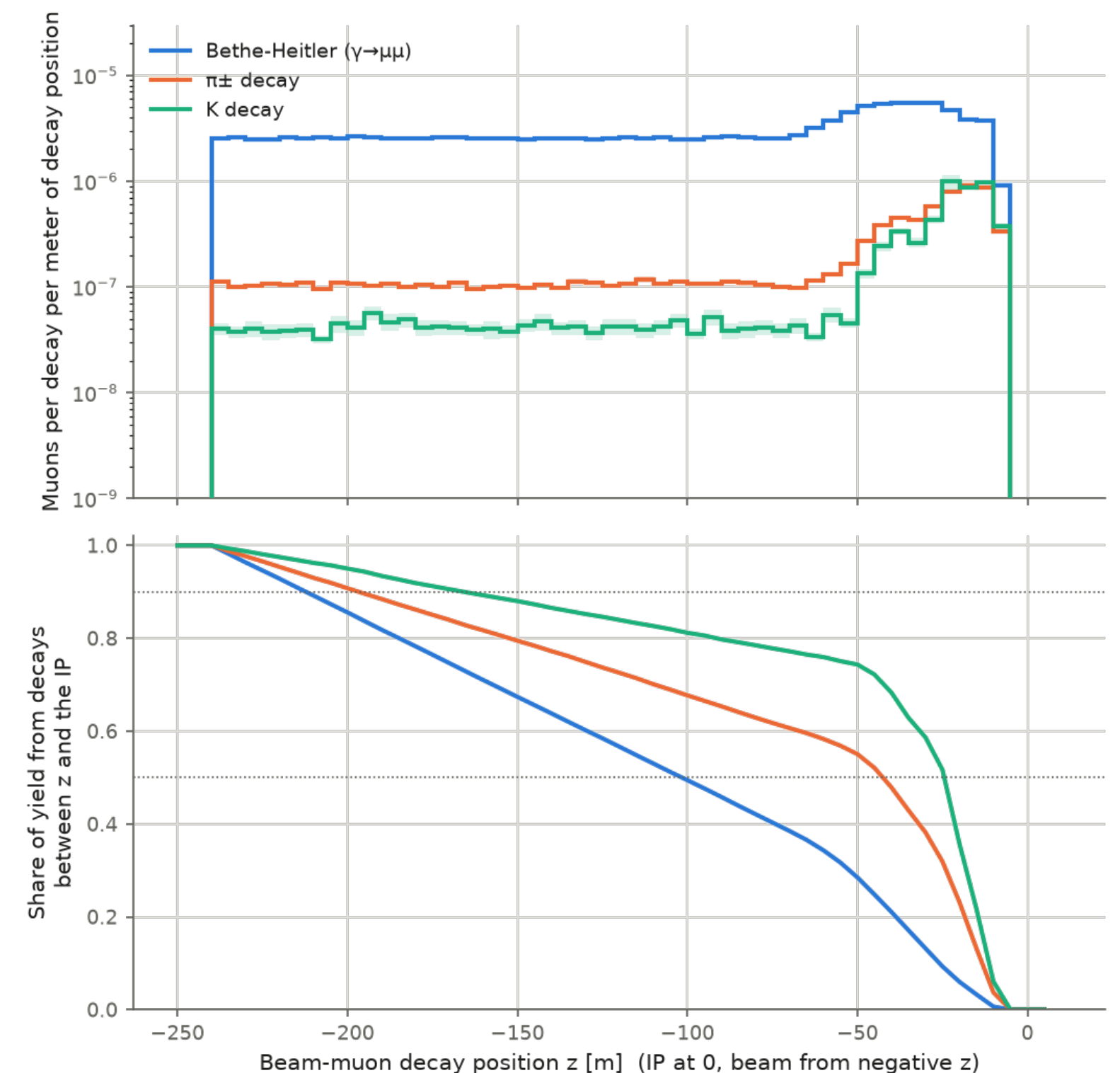
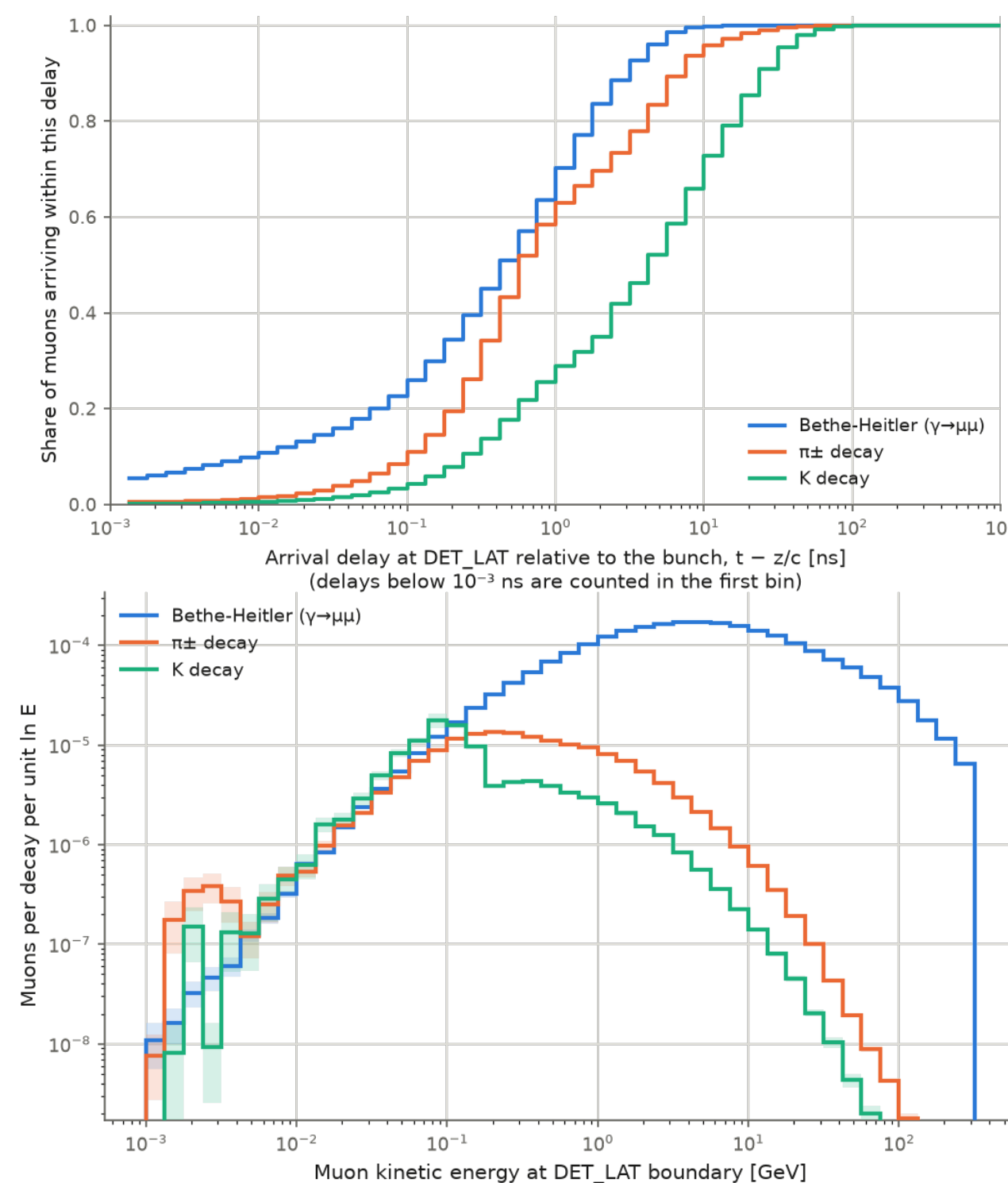
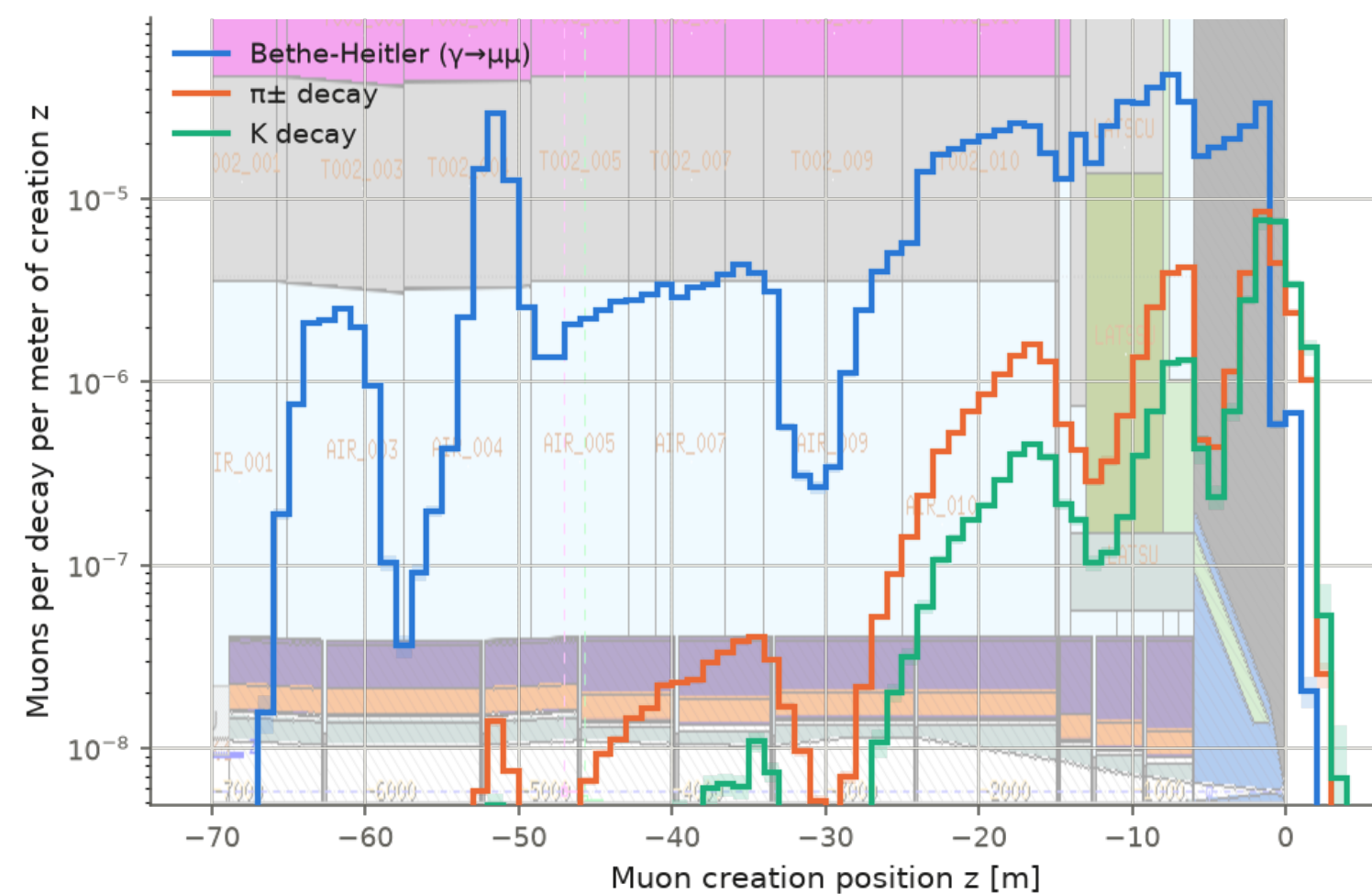
BIB muon oversampling

Overview + method

- BIB muon production
 - Bethe-Heitler process: $\gamma + N \rightarrow \mu^+ + \mu^-$
 - Photospallation + meson decay: $\gamma + N \rightarrow (\pi, K, \dots) \rightarrow \mu + \dots$
- FLUKA knobs
 - BH interaction length: PHOTONUC ... MUMUPAIR $\rightarrow$ shortens photon MFP for $\mu\mu$ production
 - Photonuclear interaction length: LAM-BIAS $\rightarrow$ increases frequency of hadron production from $\gamma + N$
 - π/K decay length: LAM-BIAS ... GDECAY $\rightarrow$ ceiling on sampling length (how finely decays are sampled along path)
- NB: FLUKA weighting scheme preserves underlying physical distributions for muon behavior—turning these knobs changes statistics, but not shapes!

*NB: muon biasing breaks all other physics!
We can't recover correlations within a single event*

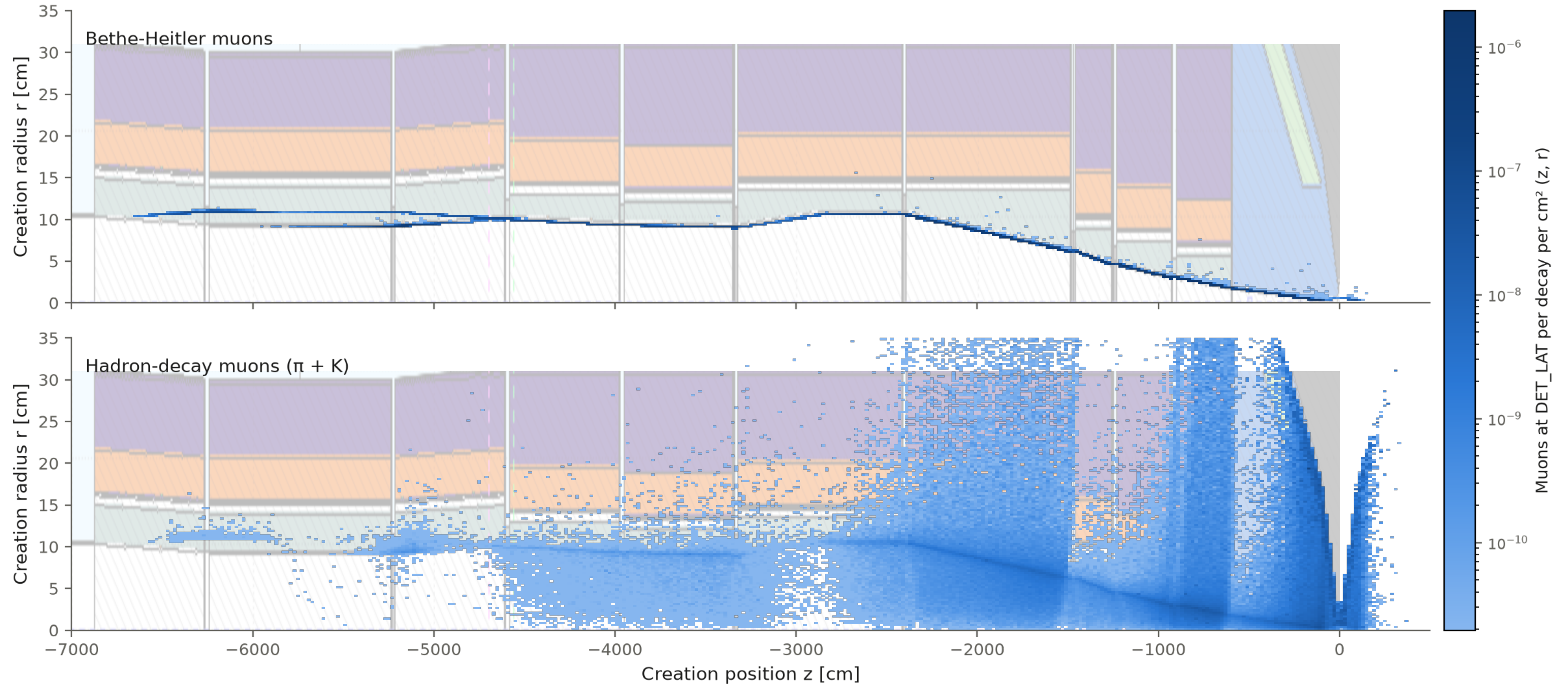
A handful of observables



BIB muon oversampling



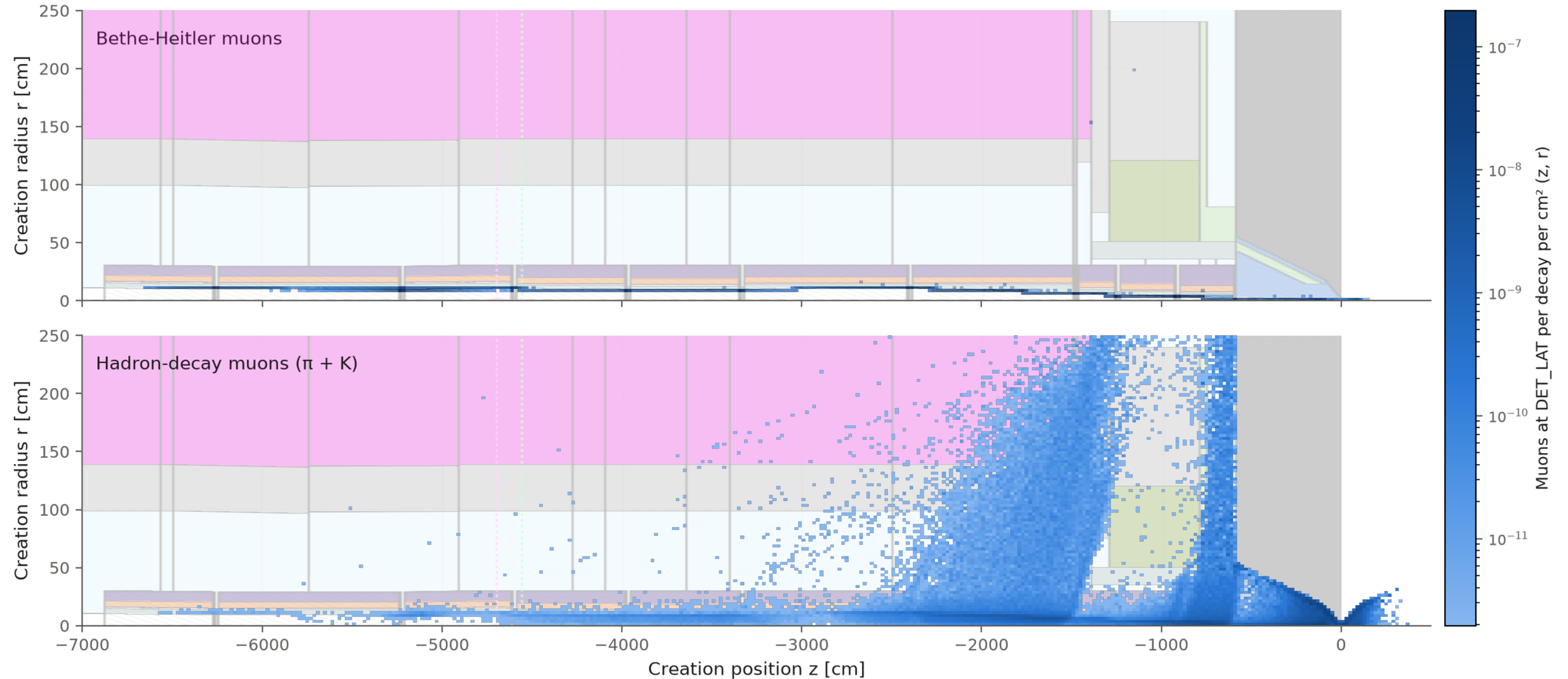
R-Z profiles: optics



BIB muon oversampling



R-Z profiles: support structure

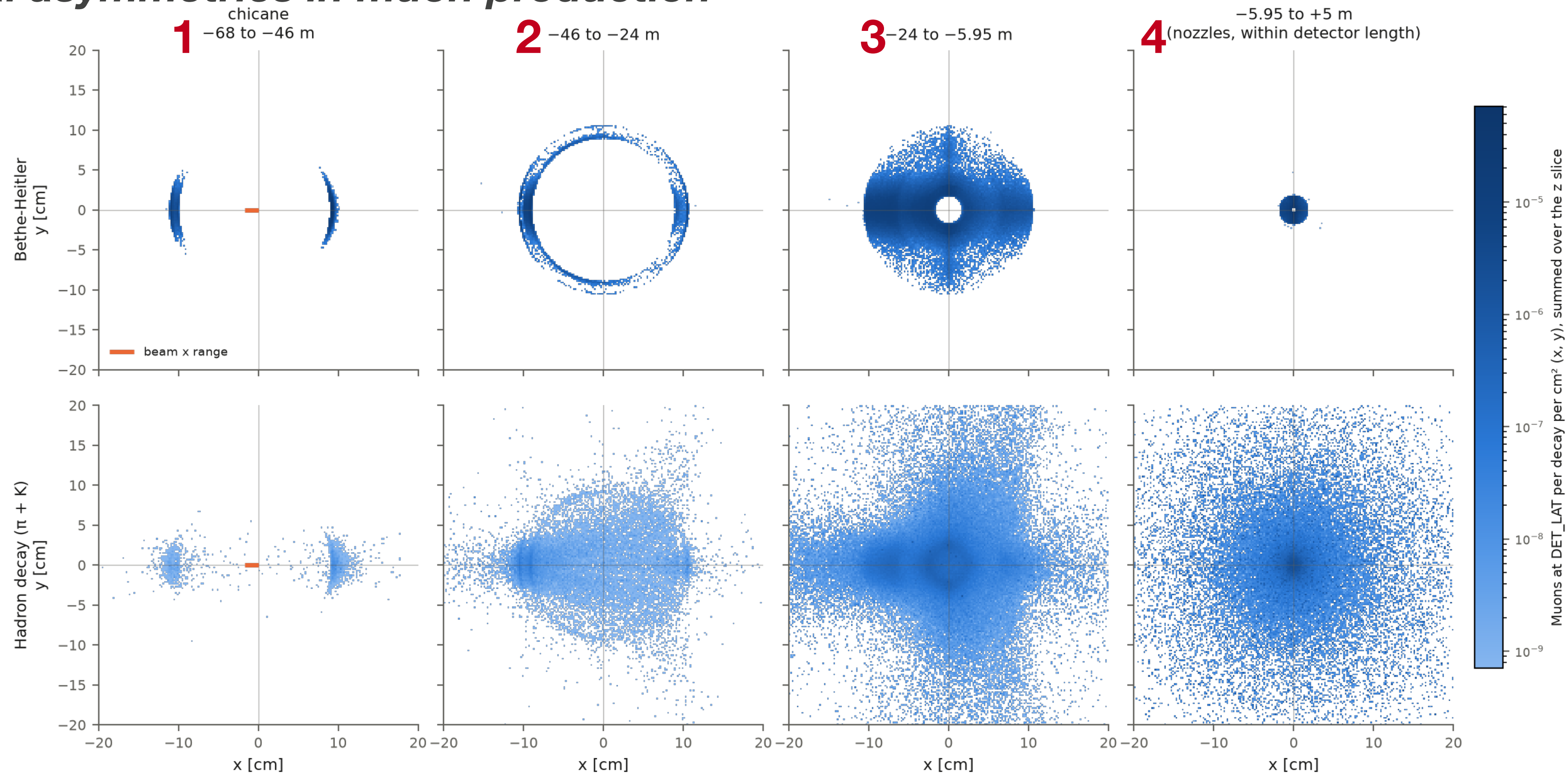


BIB muon oversampling

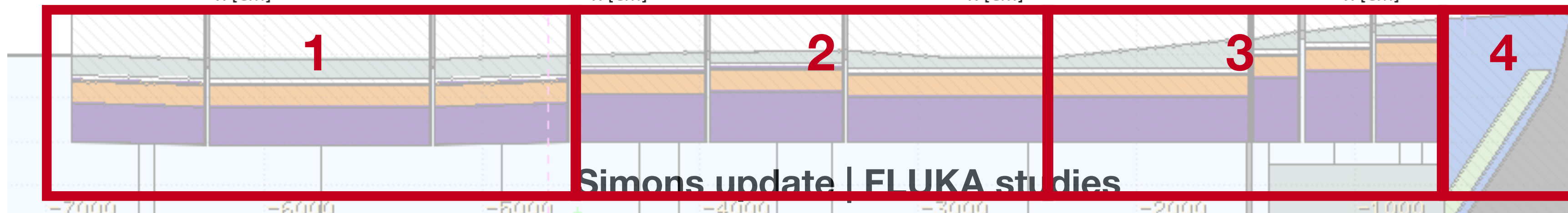


Azimuthal asymmetries in muon production

BH



π+K



BIB muon **oversampling**



Azimuthal asymmetries in arrival location

