

background studies for a soft-photon measurement with the Forward Conversion Tracker



Quark Matter 2022 - Krakow

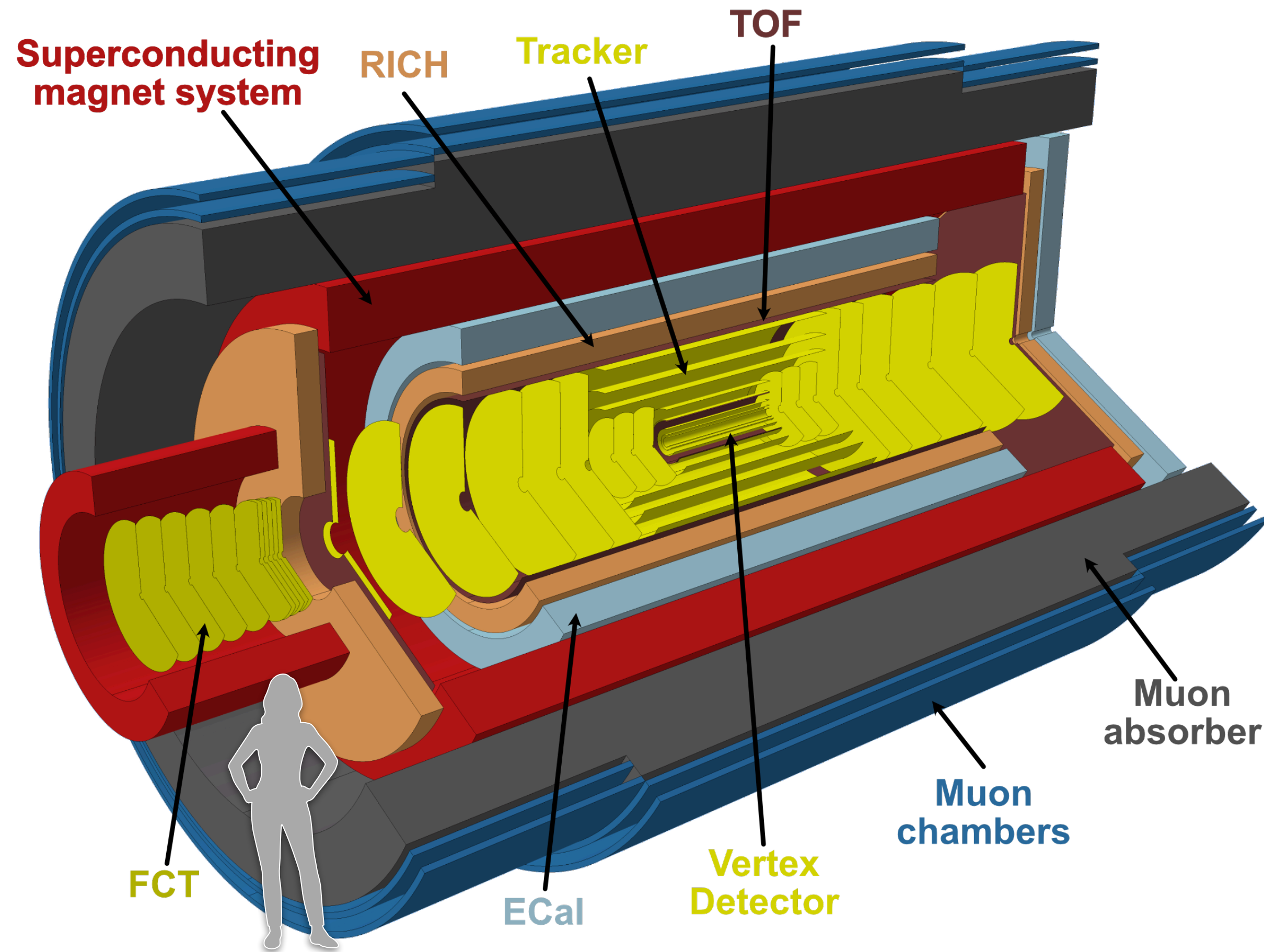


Tim Rogoschinski
Institut für Kernphysik
Goethe Universität Frankfurt



motivation: soft photons with ALICE 3

ALICE 3: a new compact all-silicon multi-purpose detector proposed for 2032 at LHC



this poster:

background studies for a forward soft-photon measurement with the Forward Conversion Tracker (FCT) in ALICE 3 in context of the Letter of Intent: ALICE 3

soft photons: photons with $p_T \leq 5$ MeV

- ▶ inner Bremsstrahlung from initial and final state hadrons

theoretically via Low's theorem:

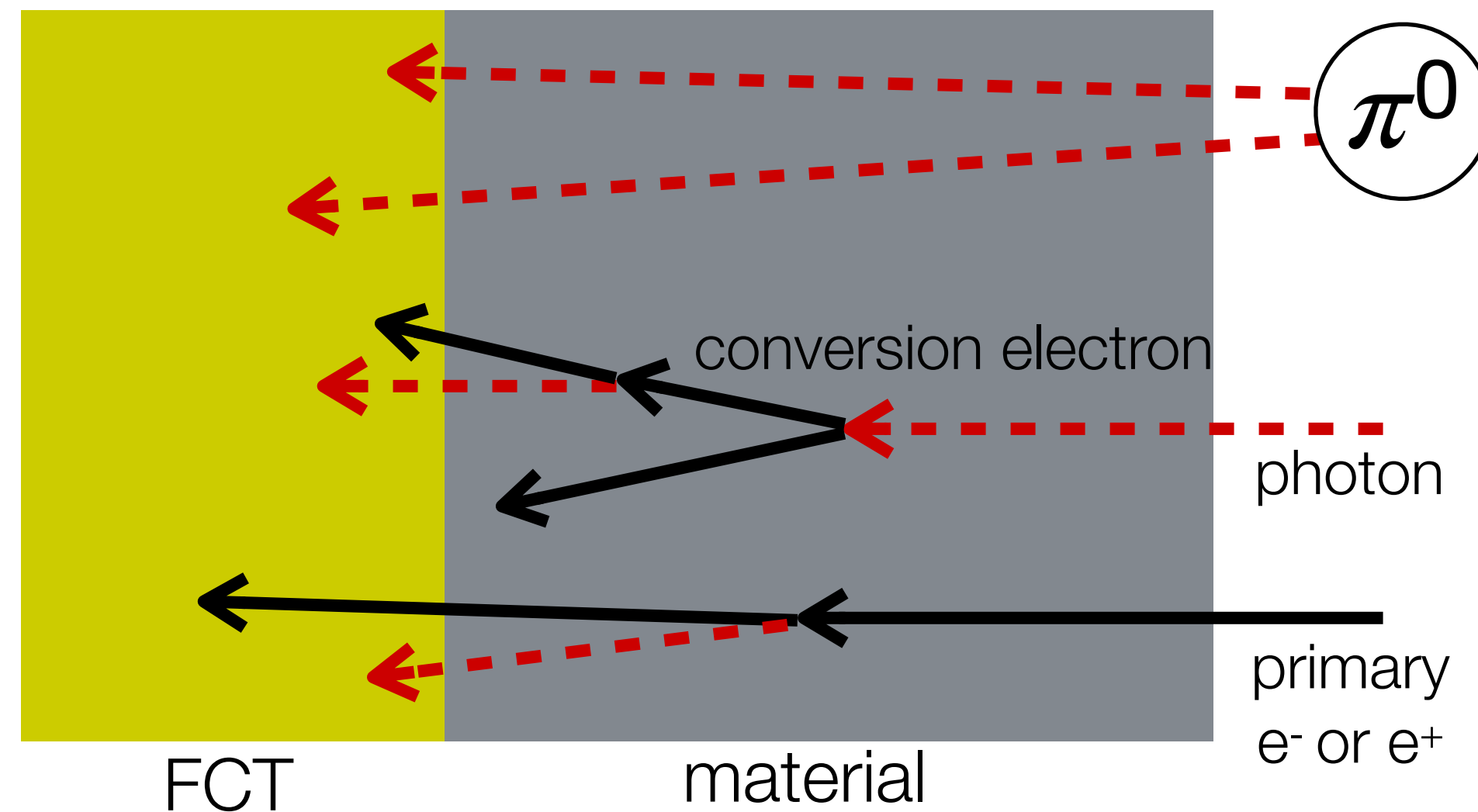
- ▶ relates soft-photon production and charged-hadron spectrum

soft-photon puzzle:

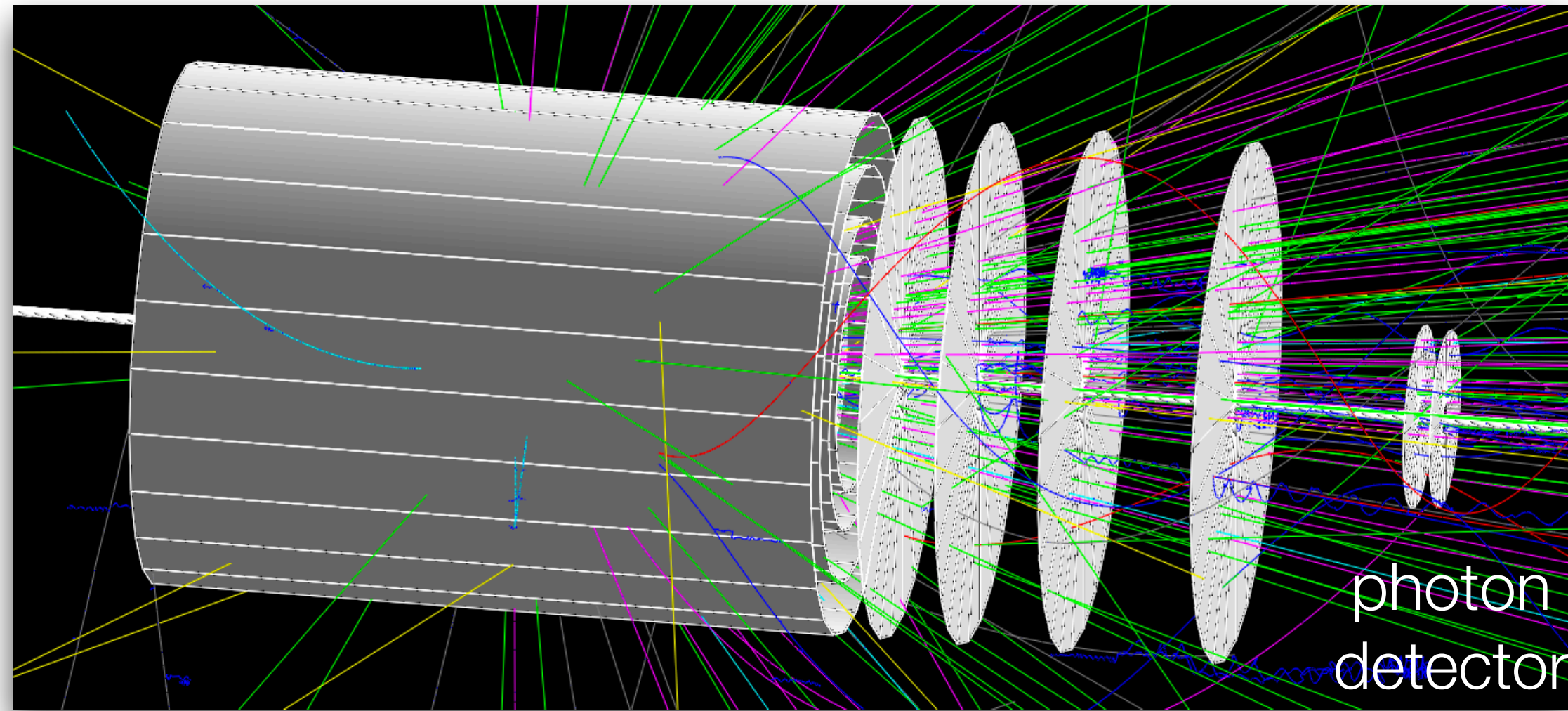
- ▶ several experimental measurements show factor 2–5 enhancement w.r.t Low's theorem prediction

background photons under study:

- ▶ external Bremsstrahlung from material
- ▶ decay photons



GEANT4 setup for simulation studies of background photons



propagation of particles through ALICE 3 detector system

current, default GEANT4 ALICE 3 setup:

- ▶ standard, cylindrical beam pipe
- ▶ barrel tracking layers
- ▶ forward disks

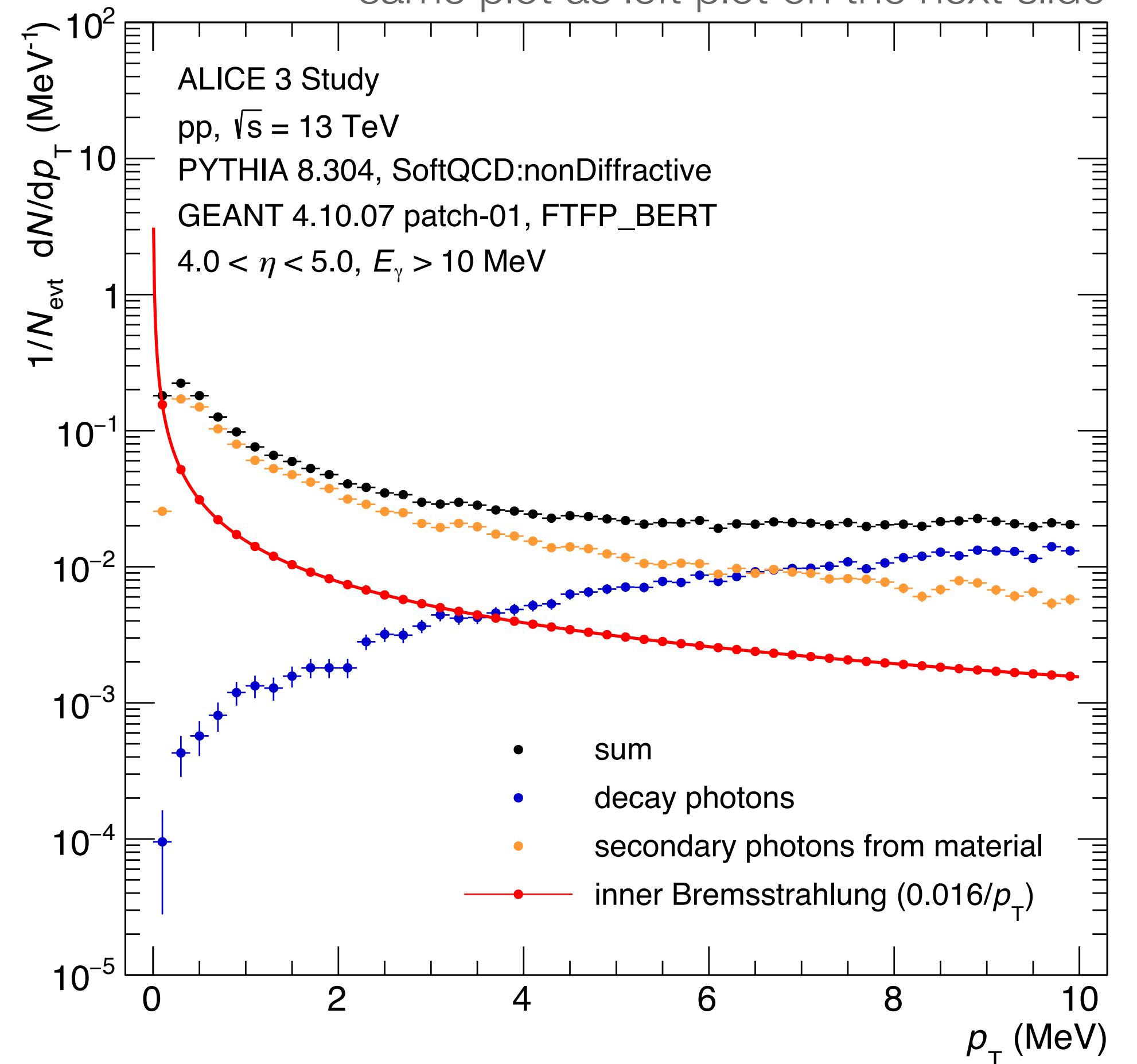
GEANT4 input:

- ▶ pp collisions at 13 TeV (PYTHIA)

inner Bremsstrahlung's signal = soft-photon expectation
(derivable from Low's theorem) [calculation by Martin Voelkl]

external Bremsstrahlung = secondary photons from material

same plot as left plot on the next slide



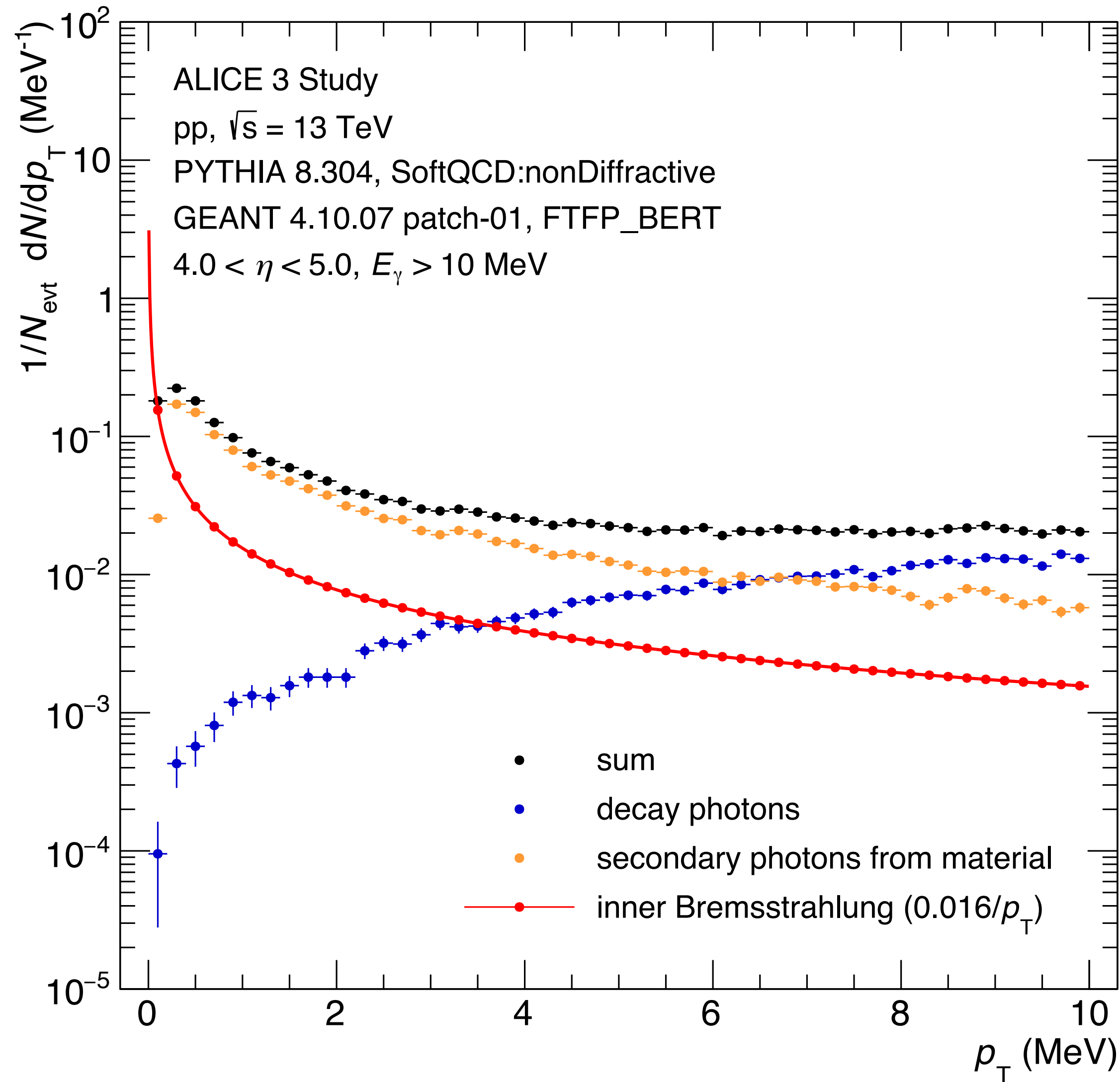
suppression of background from

external Bremsstrahlung:

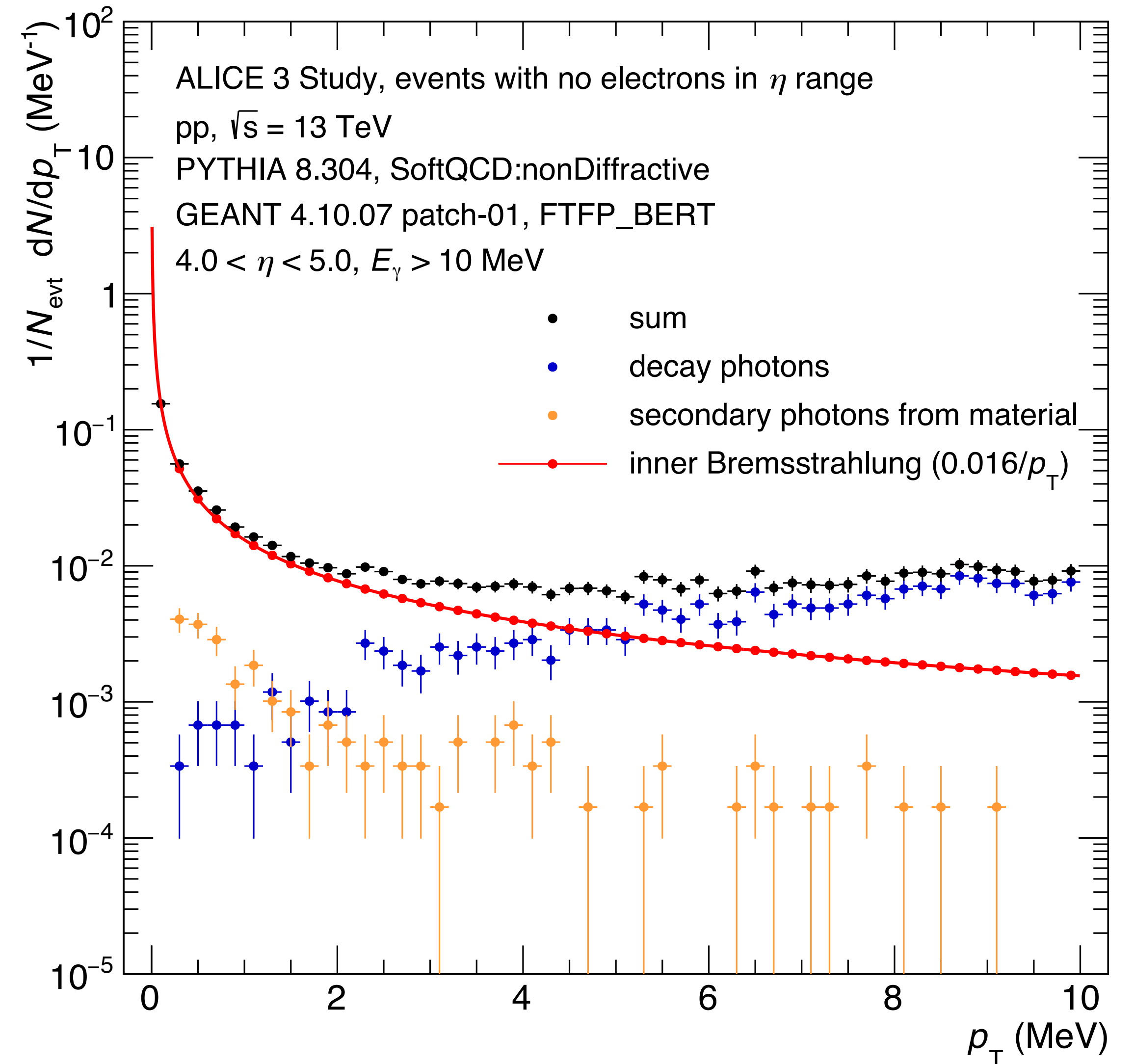
- ▶ VETO on electrons or positrons in the acceptance of FCT (1)
- ▶ minimisation of detector material in front of FCT (2)

background reduction (1): events without e^- or e^+ in FCT η range

all events



events without e^- or e^+ in FCT η range

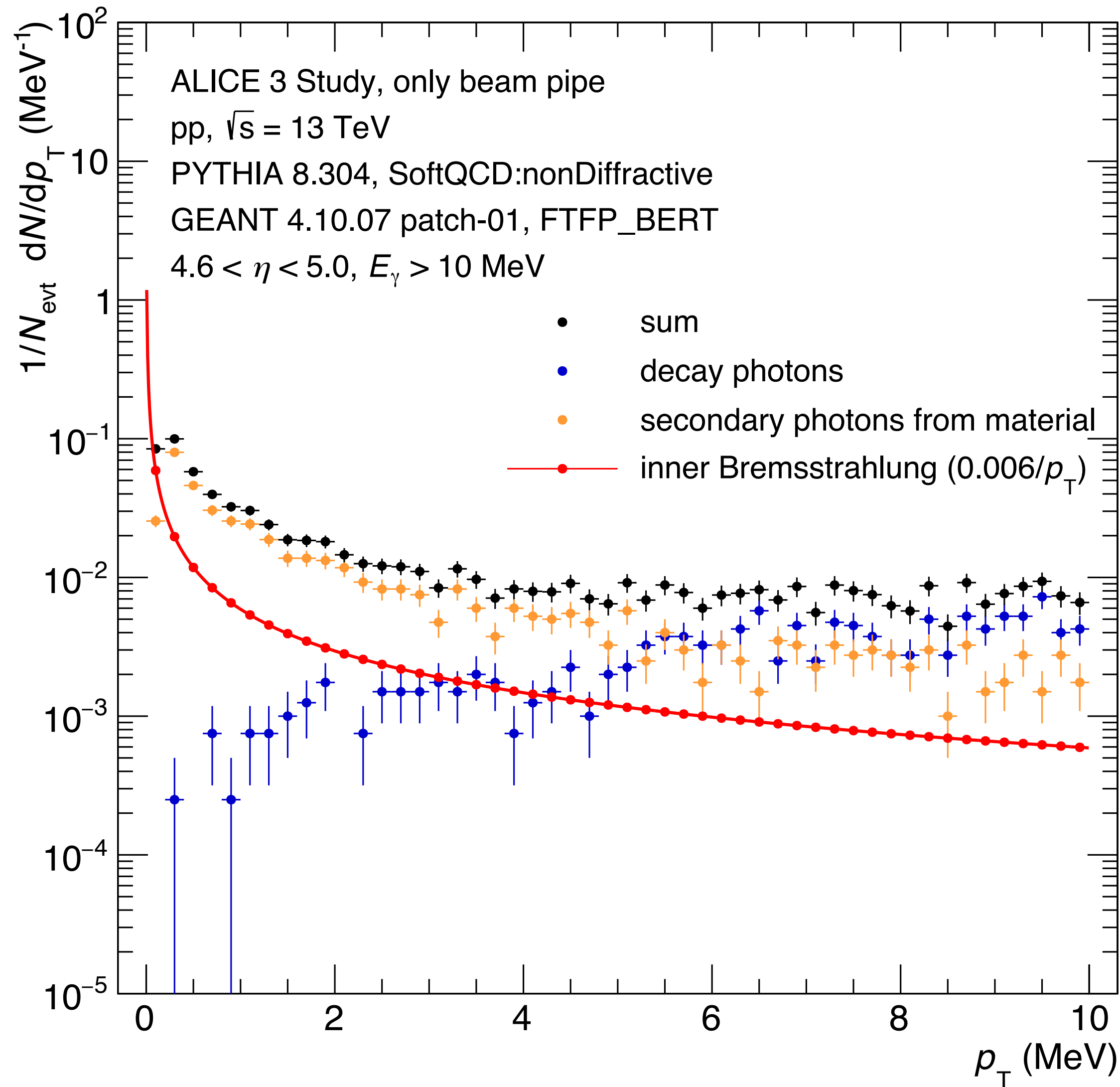


a successful measurement strategy:

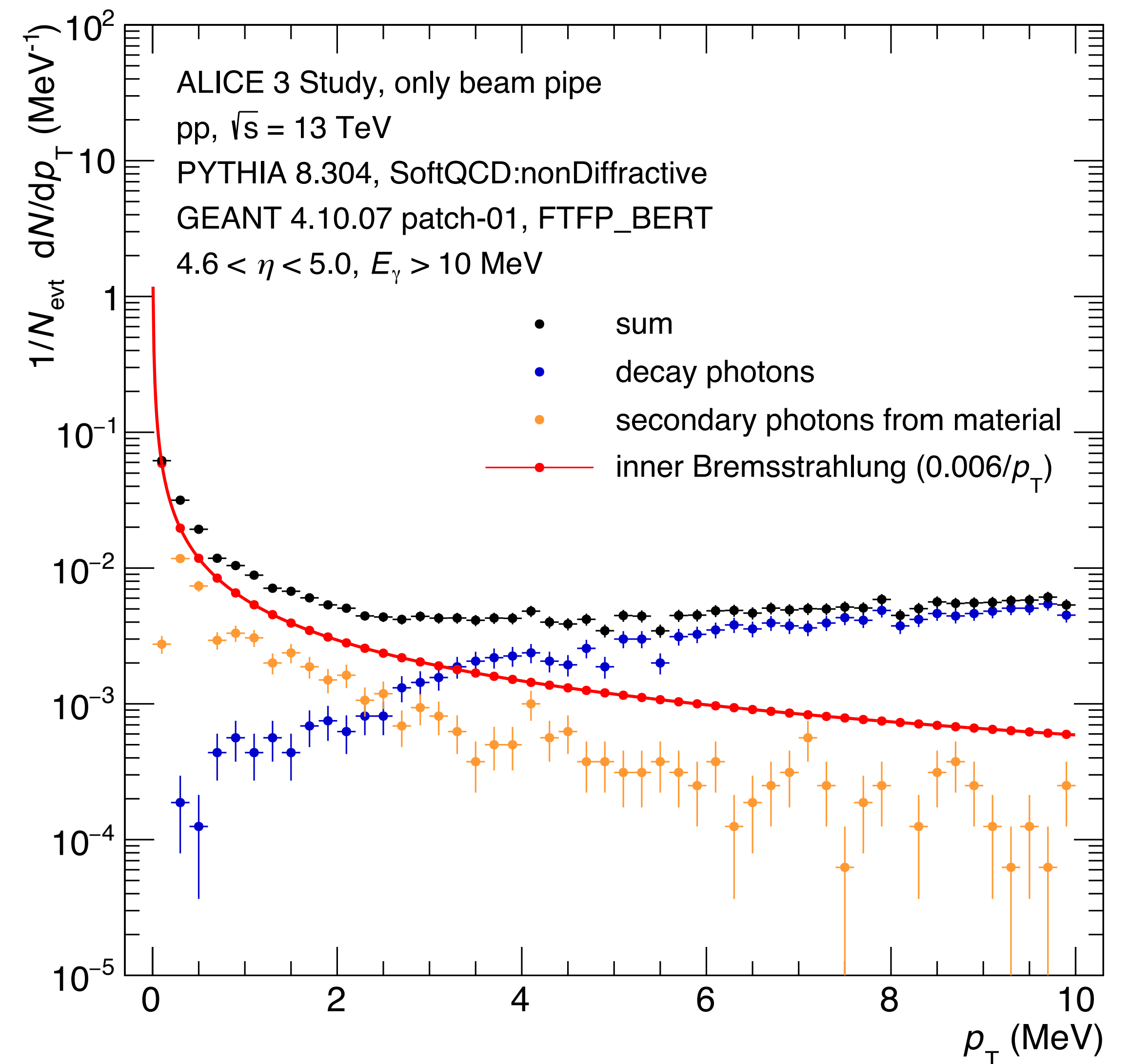
- ▶ event rejection based on PID of electrons or positrons in the η range of the FCT

background reduction (2): utilising a shaped beam pipe

only standard, cylindrical beam pipe



only shaped, conical beam pipe



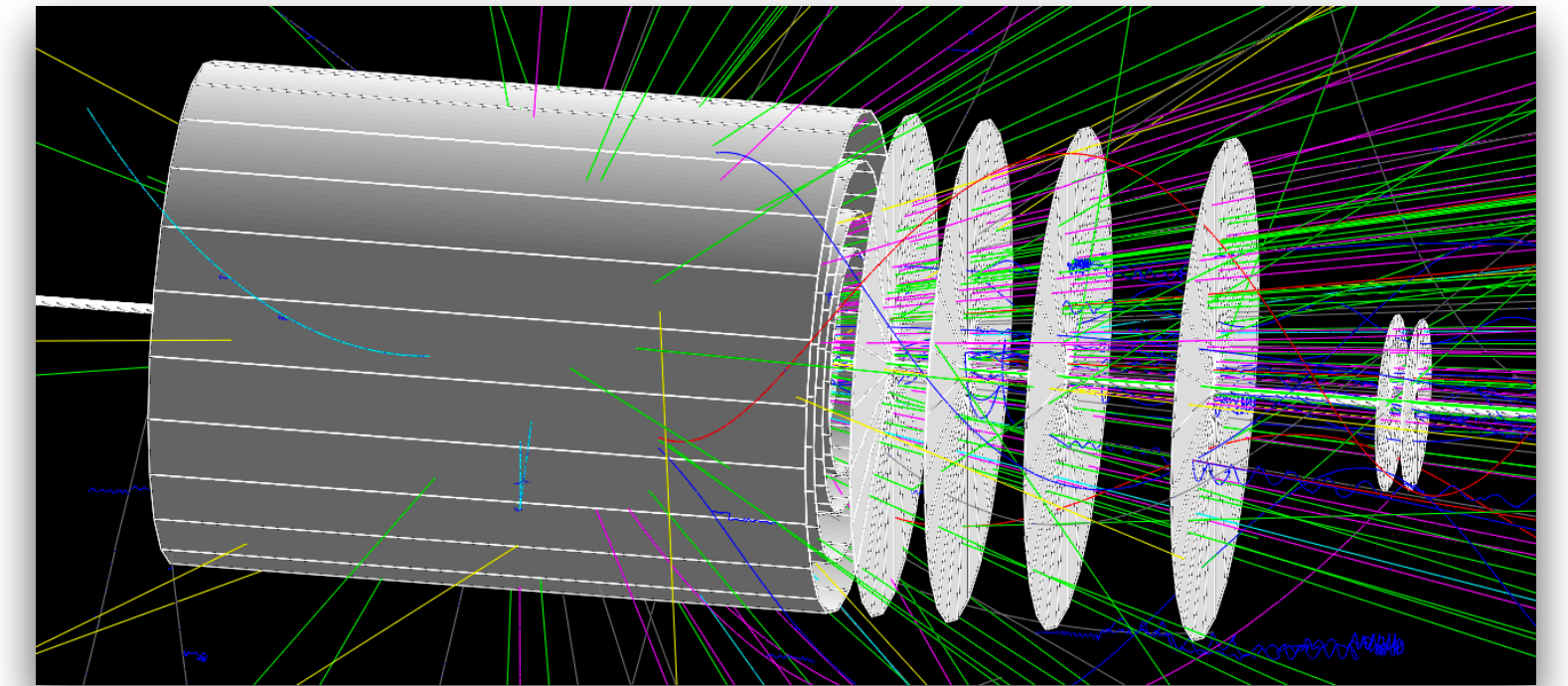
- ▶ reduction of background achievable with lowering the detector material in front of FCT
e.g. a beam pipe optimised for FCT

summary

motivation: **soft-photon measurement could resolve soft-photon puzzle**

challenging measurement

- ▶ dominant background from external Bremsstrahlung produced by electrons or positron from photon conversion



promising prospects for background reduction

- ▶ identification and rejection of events with an electron or positron in η range of FCT
- ▶ minimisation of the material budget in front of FCT, e.g. optimised beam pipe

outlook

detailed study of a soft-photon measurement in full MC simulation

- ▶ inclusion of forward tracking and injection of a pseudo soft-photon signal

