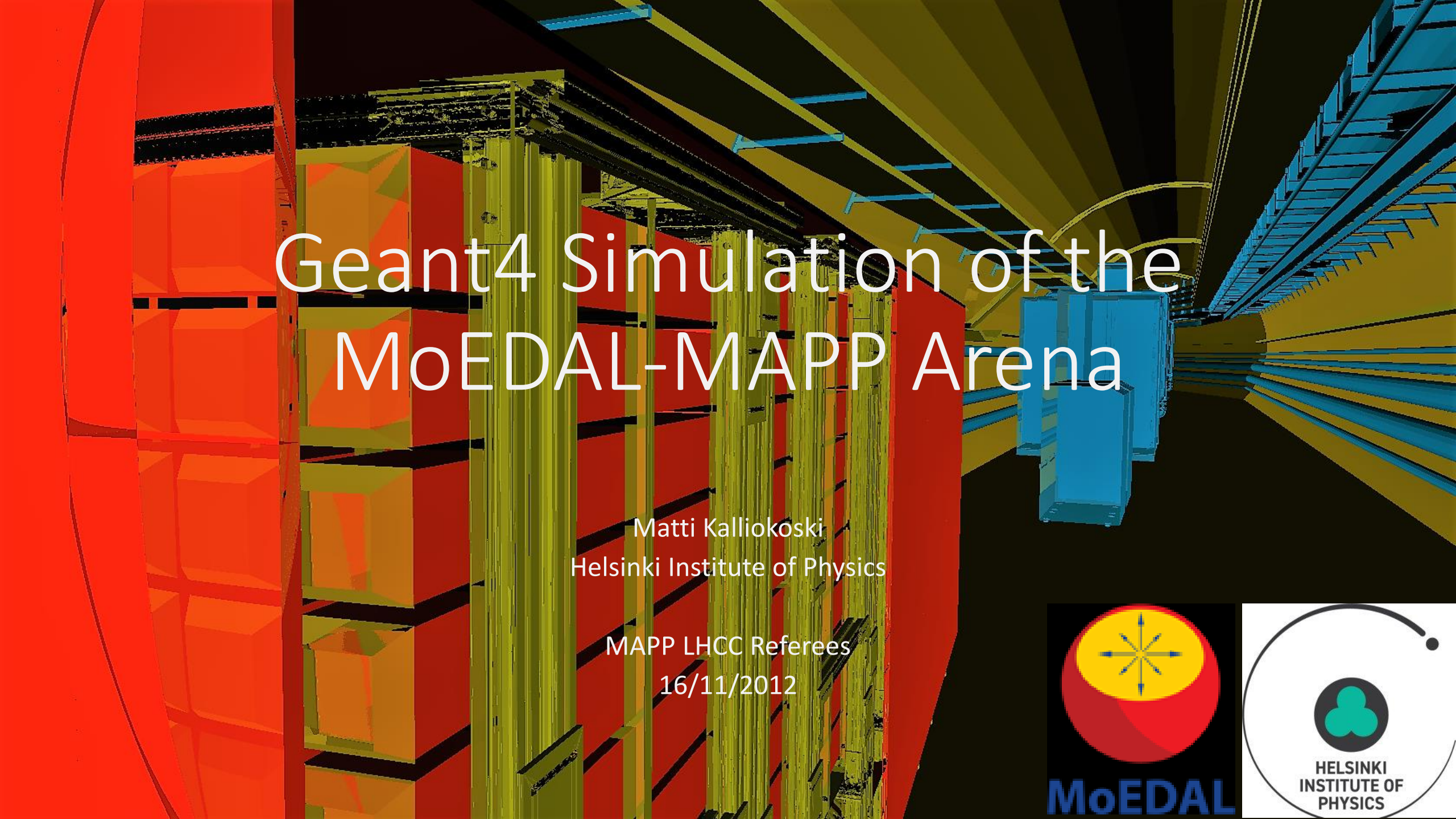


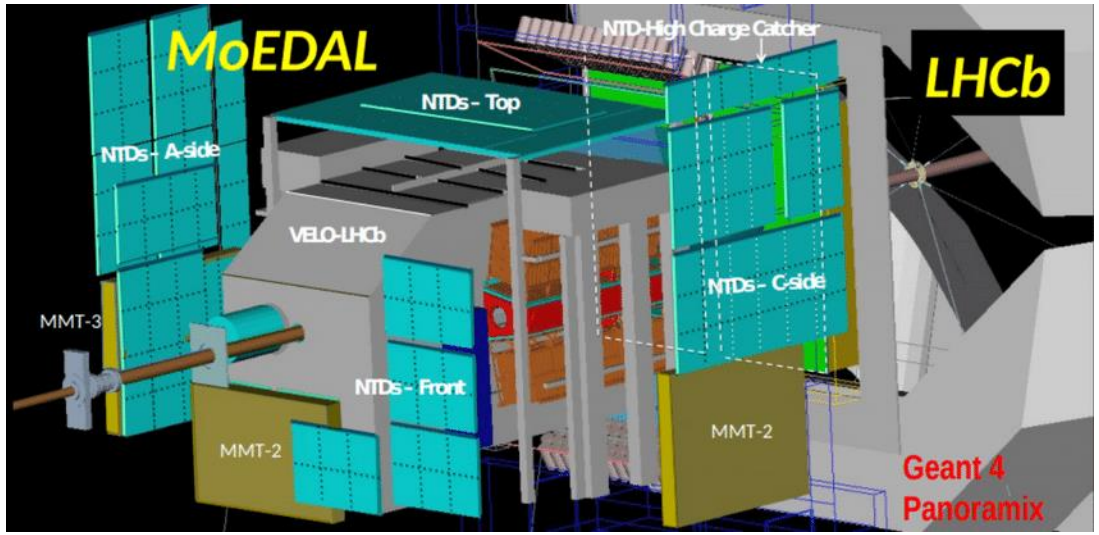
Geant4 Simulation of the MoEDAL-MAPP Arena

Matti Kalliokoski
Helsinki Institute of Physics

MAPP LHCC Referees
16/11/2012

MoEDAL Simulation Group

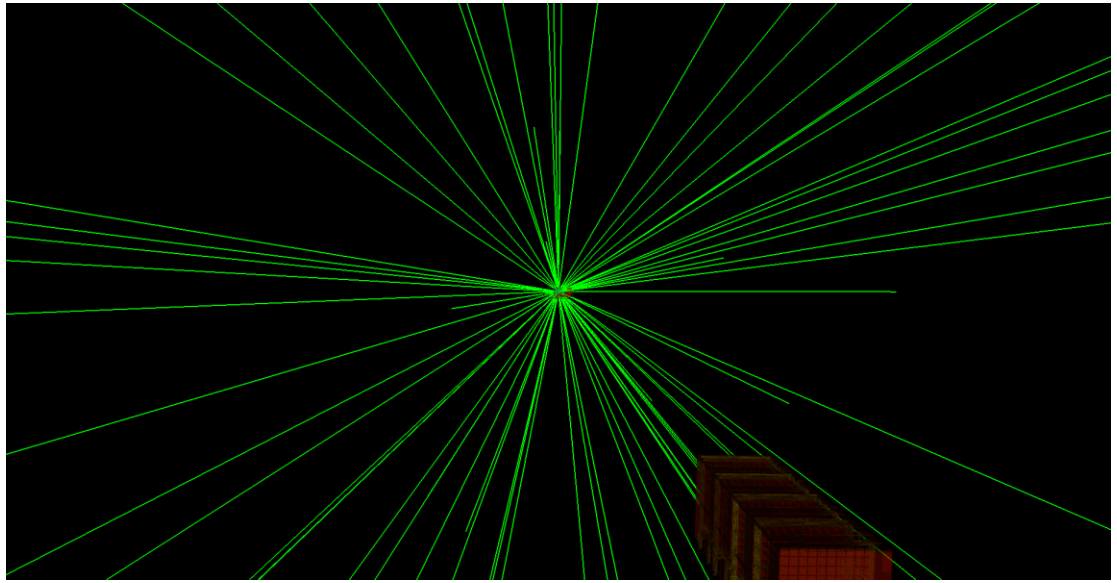
- MoEDAL software group was formed to develope MoEDAL simulation environment around the location of the LHCb
  - Gauss software can be easily extended to include the MoEDAL components at the IP8
- MAPP detector is located outside the IP8 region
  - No existing simulation model had the full material budget of the LHC tunnels implemented
    - Machine components are implemented in various models, walls and the ground layers are not
  - New models were required to include the material budget to a model
  - MoEDAL simulation group was formed to address these issues



MoEDAL Simulation Group

- Matti Kalliokoski, Helsinki Institute of Physics, Technical Simulation Coordinator
- Zouleikha Sahnoun, INFN Bologna
- Ameir Shaa Bin, Michael Staelens, University of Alberta
- Aditya Upreti, The University of Alabama

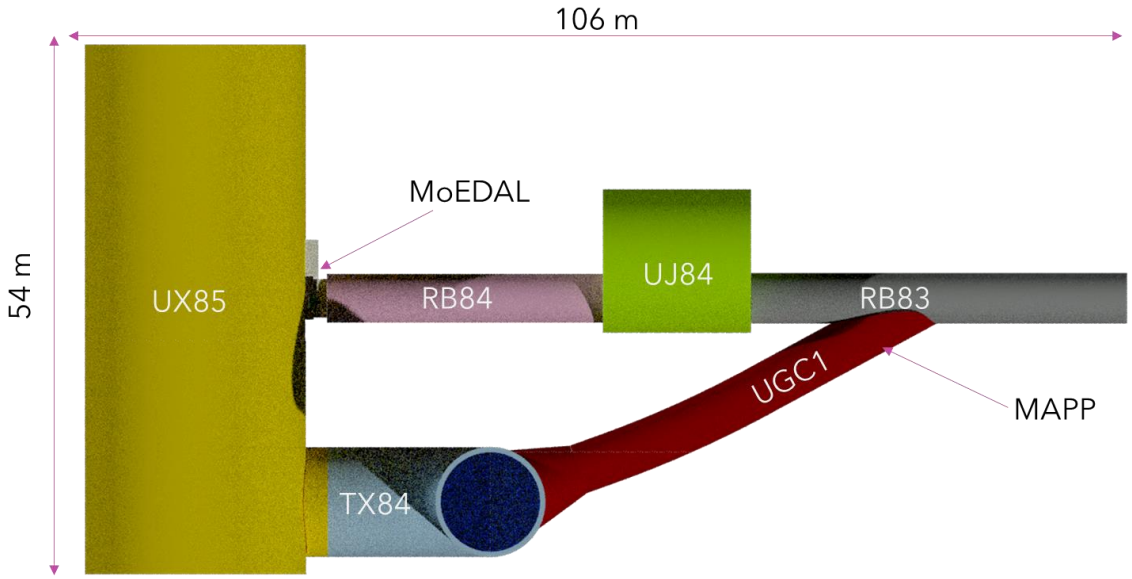
MAPP Simulations

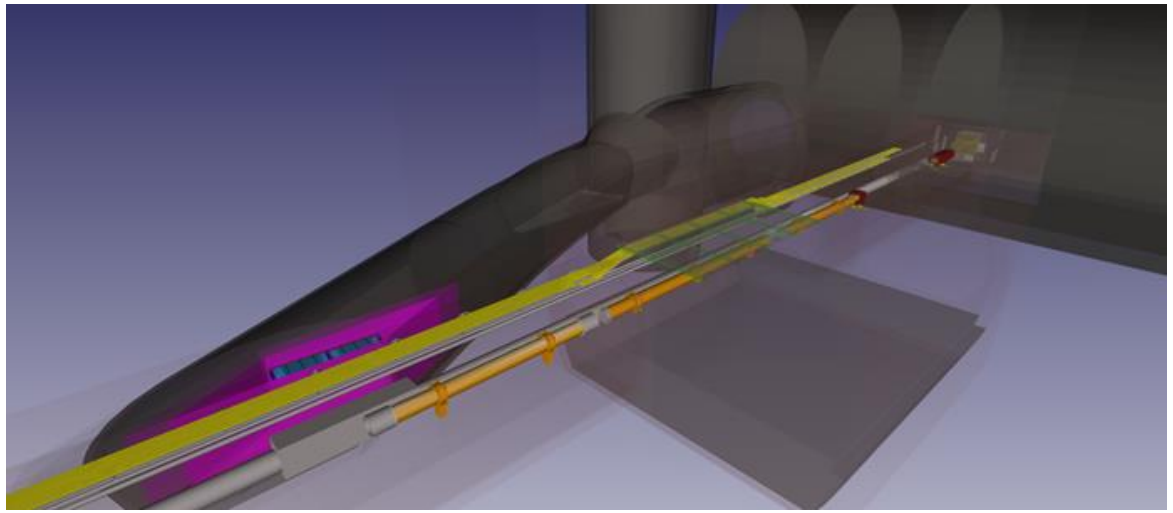


- Track secondaries
- Analyse the beam background
- Sensitivity of the detector to new physics models
- Cosmic background effects
- Scintillator response
- Full model with the impact of LHC components, tunnel materials and ground

Compact MoEDAL-MAPP Arena (COMMA)

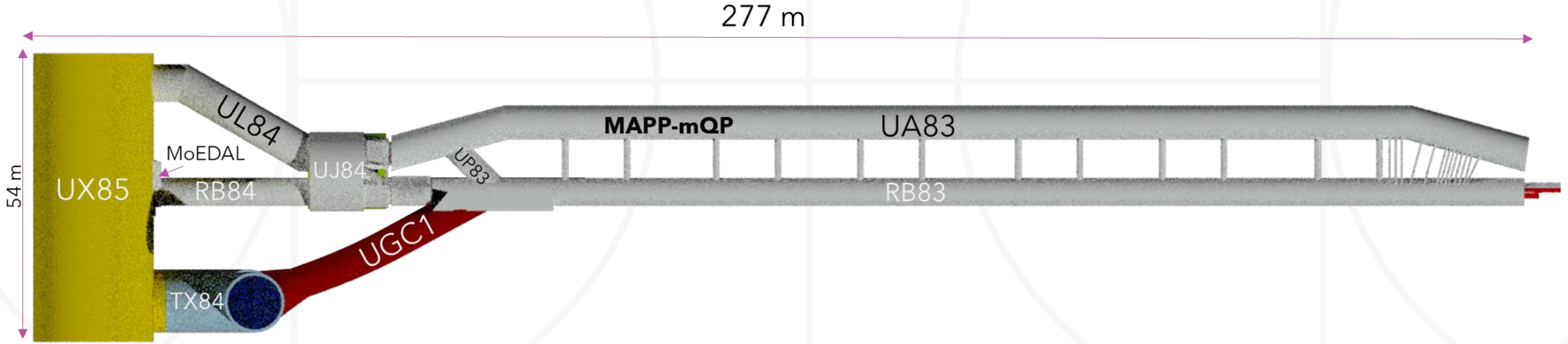
- The model to simulate the performance and background of MAPP detector at UGC1
- GDML model with accelerator tunnel elements and soil
- About 2000 elements with MAPP model included
- Model was developed up until last July





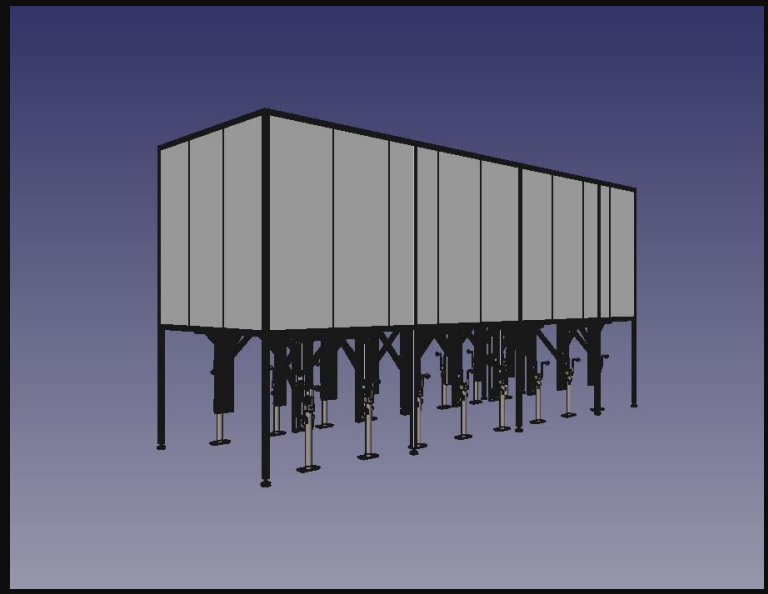
Massive MoEDAL-MAPP Arena (MAMMA)

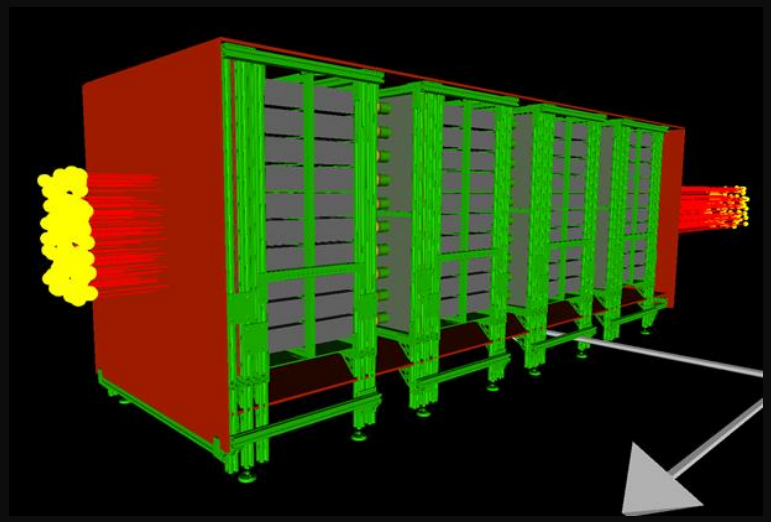
- New location for the Run3 requires larger simulation arena
  - Started from scratch after moving the MAPP-mQP to new location
  - Simulation model development started in August
- Implementation of new tunnels and elements between the IP8 and the detector location
- Possible background from the accelerator needs to be studied with higher detail
  - More accelerator and tunnel elements implemented in the model



mQP detector model

- New CAD model for mQP for UA83
- Some optimization that has no effect on the detector response is done to reduce the model size
- The detector model consists of about 2000 elements which are grouped by type and material budget
- Standalone detector model is used for studying the performance of the detector and for model validation





Physics

Primary interactions and secondary particles

- Factory lists
  - FTFP_Bert model for hadronic showers
  - QGSP_BERT_HP for neutron fluxes

Transportation and decay processes

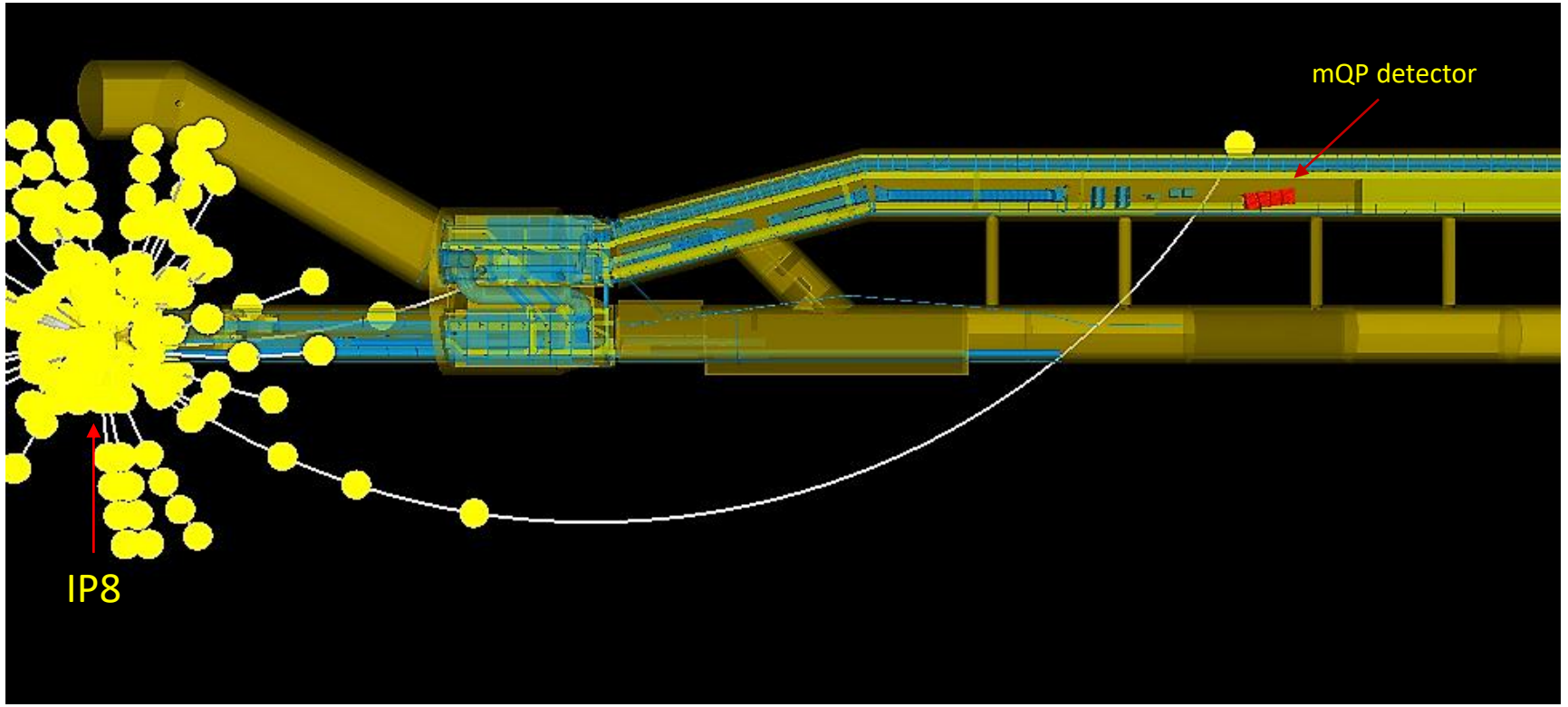
EM interactions

- Gamma conversion, Compton scattering, photoelectric effect for gamma
- Multiple scattering, ionization, bremsstrahlung for e- (+annihilation for e+)
- Multiple scattering, ionization, bremsstrahlung and pair production for μ+ and μ-
- Multiple scattering and ionization for others

Scintillation processes

- Cerenkov and scintillation for particles
- Absorption, Rayleigh scattering, Mie scattering and boundary processes for optical photons

Geant4 Simulation of the Arena



- All elements are implemented with a simple material budget
- Standard physics lists with pgun and gps sources are available
- All elements and tunnels are implemented as modules
  - Can be commented out and moved as standalone objects

Coming updates

- Implementation of physics lists and response of the scintillators
- Implementation of overburden module for cosmic background
  - Aditya’s talk
- Implementation of generators for new physics models
  - Michael’s talk
- Selection of scoring volumes for ntuple production
- All additions are planned to be included in the full simulation model by mid-December