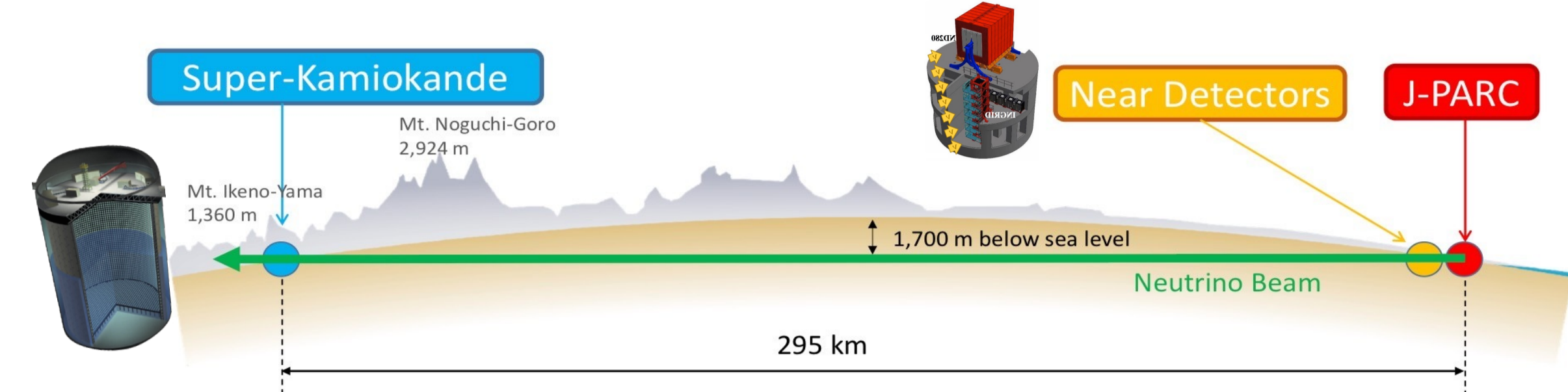


The T2K Experiment

T2K (Tokai-to-Kamioka) is a long baseline neutrino experiment in Japan.

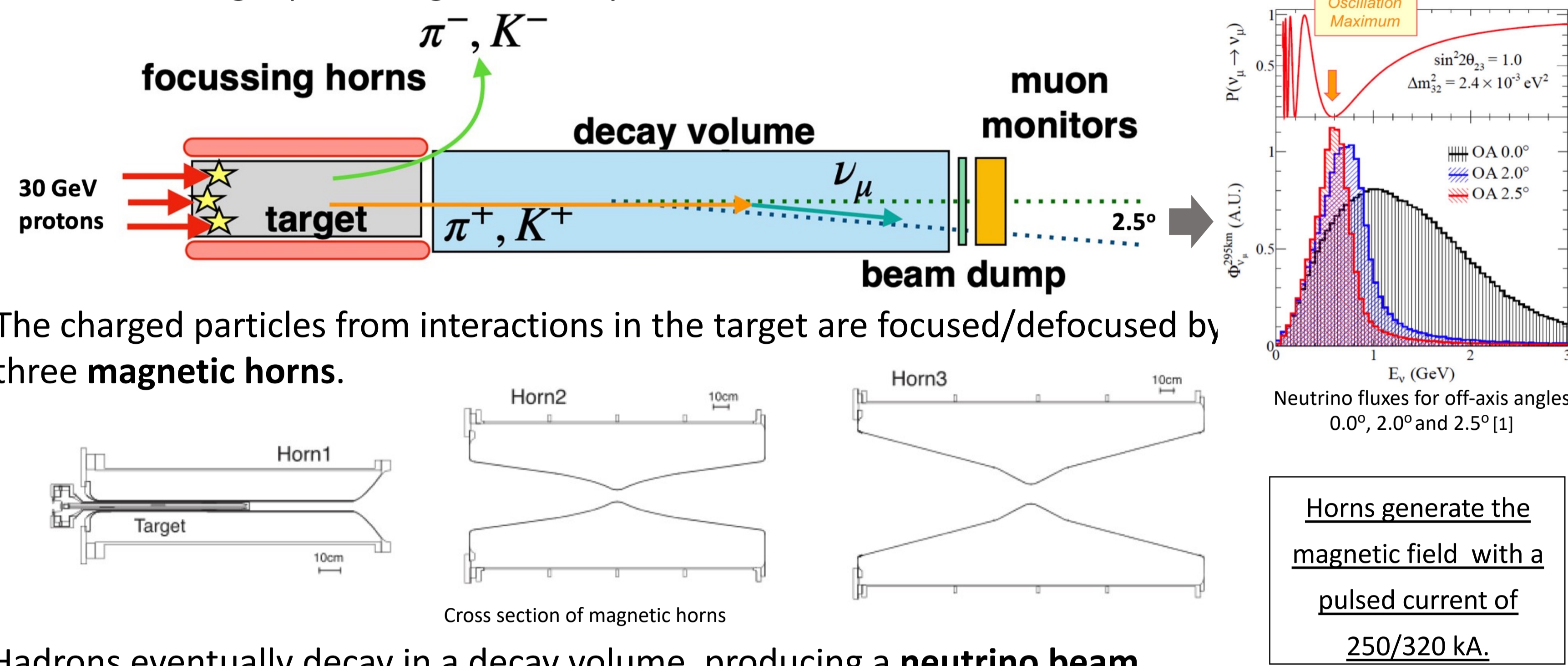


T2K studies the oscillation of neutrinos, observing the disappearance of ν_μ and appearance of ν_e . The beam is measured in steps:

Near detector complex (280 m): ND280, INGRID, WAGASCI/BabyMIND.

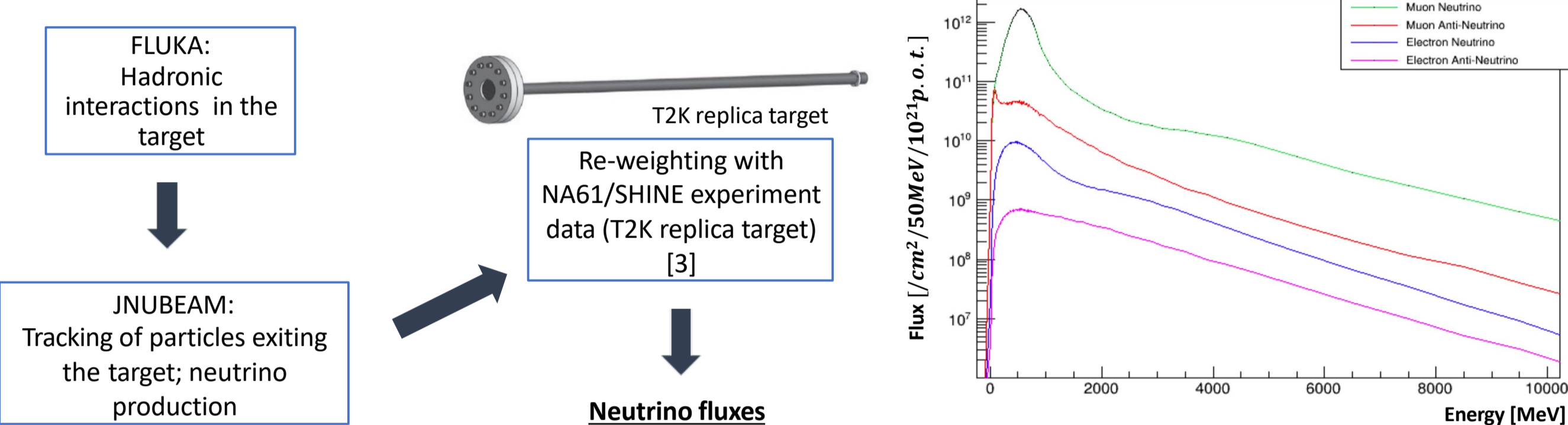
Far detector (295 km): Super-Kamiokande.

A 30 GeV proton beam produced at the Japan Proton Accelerator Research Center (J-PARC) impinges on a carbon target producing secondary hadrons.



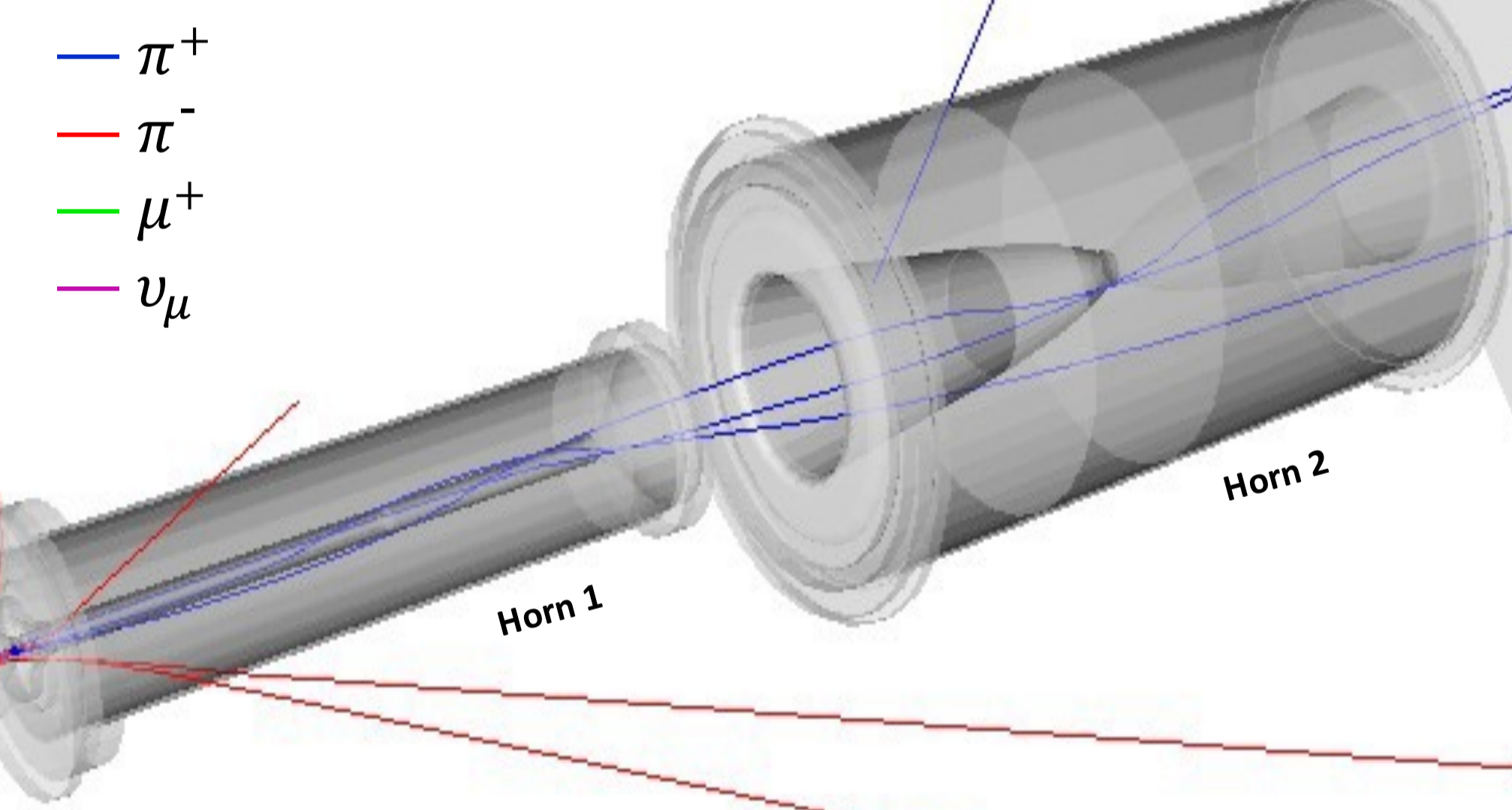
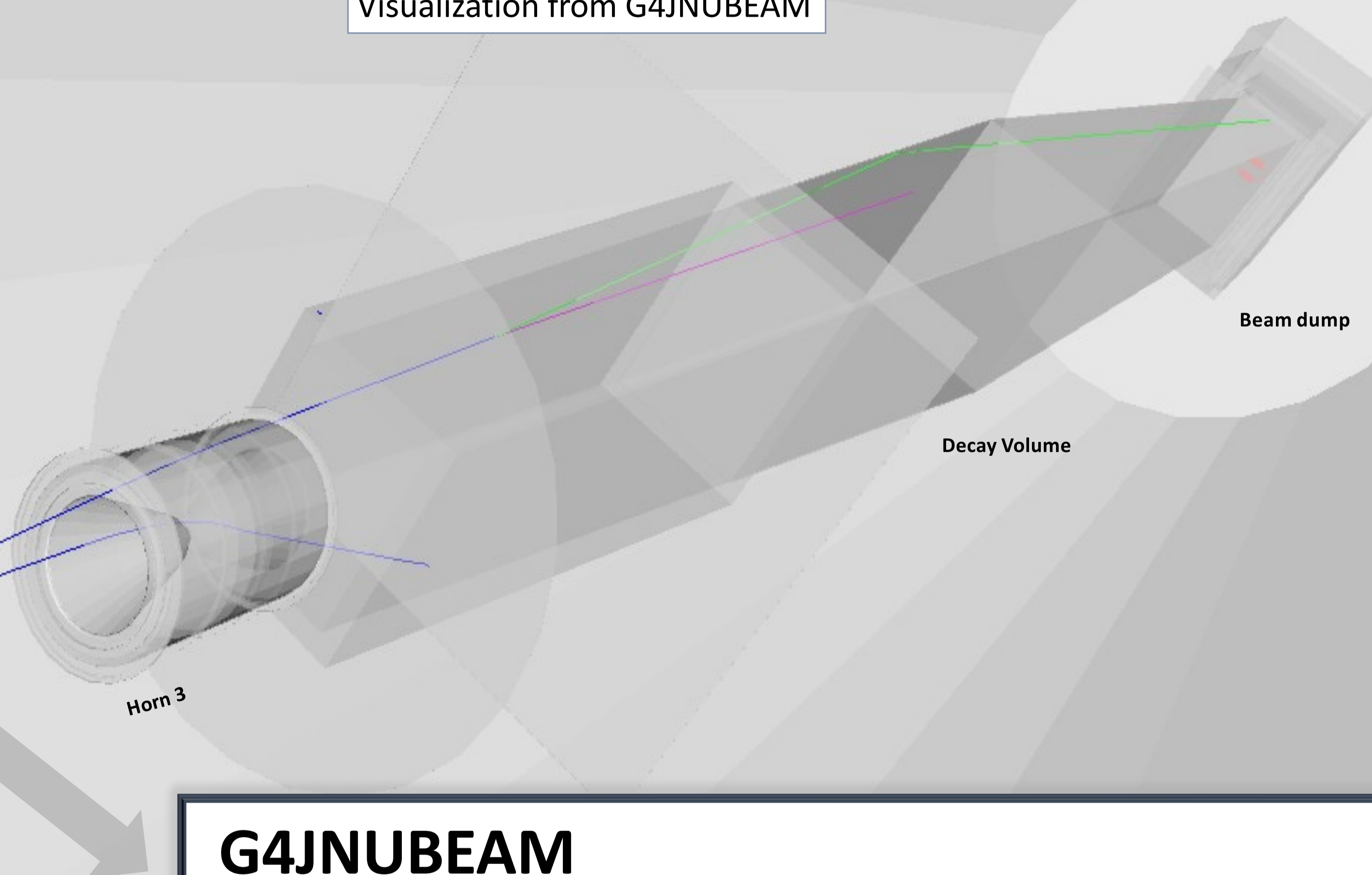
T2K Beam Simulations: JNUBEAM

The current T2K beam Monte Carlo simulation, JNUBEAM [1], is based on a combination of GEANT3 [2] (no-longer maintained) and FLUKA [3].



Using GEANT4 [4] would be a modern approach to generate simulations, replacing both GEANT3 and FLUKA.

Visualization from G4JNUBEAM



Recent improvements to magnetic field (inside conductors, accuracy).

The geometry is stored in GDML (Geometry Description Markup Language) format.

G4JNUBEAM

Monte Carlo simulation based on GEANT4, aiming to describe the physical processes from proton interactions in the target to the decay of hadrons and muons producing neutrinos – under development.

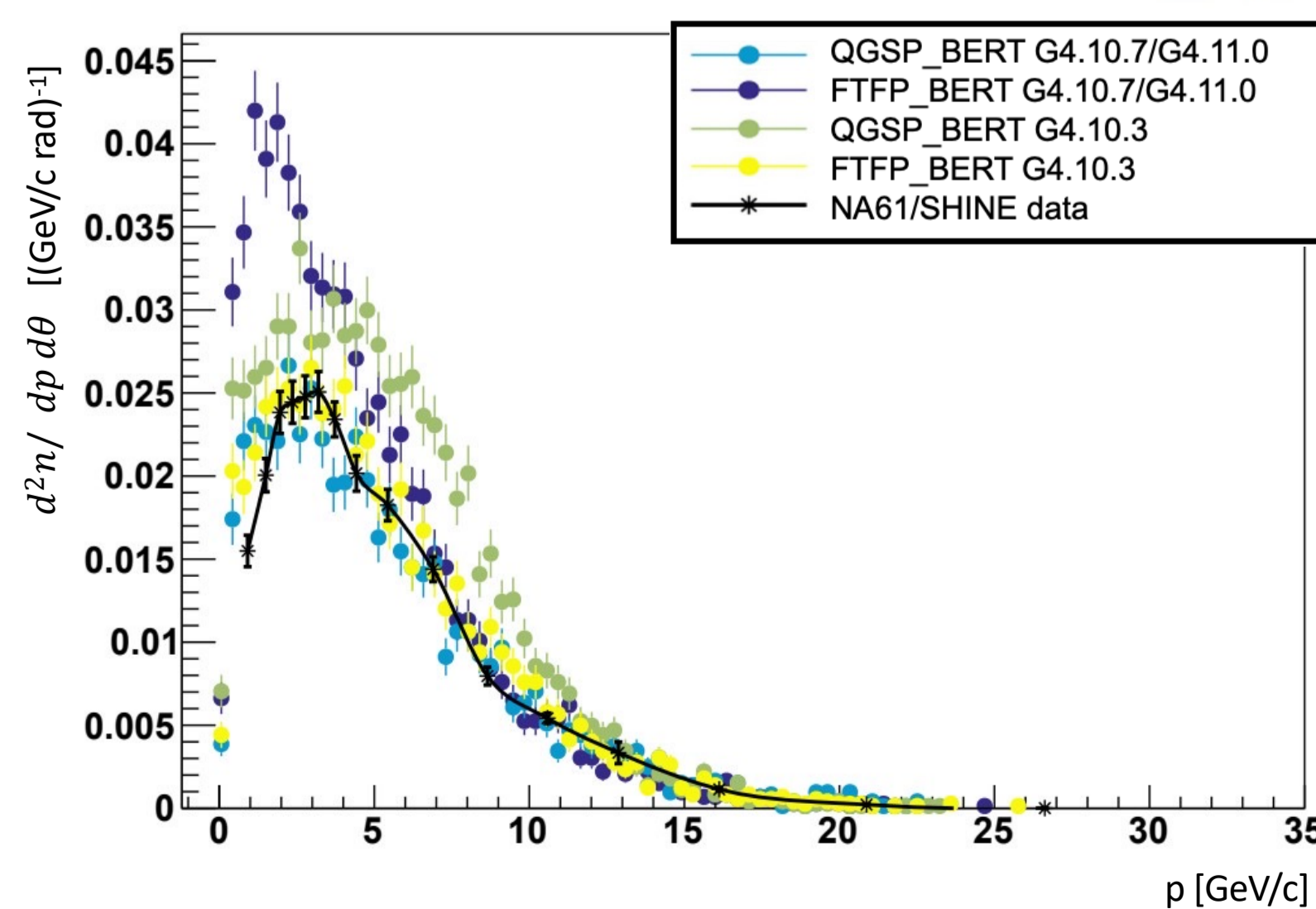
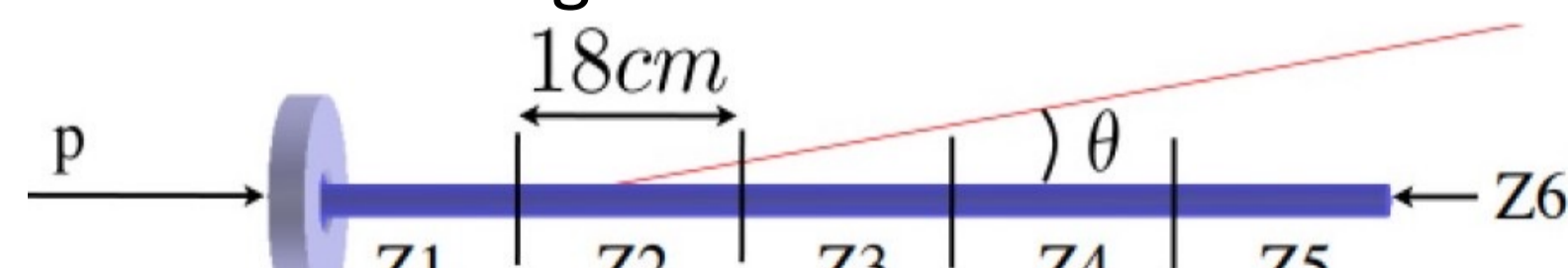
- Successfully converted the JNUBEAM geometry from GEANT3 to GEANT4;
- Pion yield simulations comparison to NA61/SHINE data;
- Framework is almost complete, already available to T2K collaborators;
- Preliminary neutrino flux diagrams in GEANT4.

Currently testing in the T2K flux tuning code (for NA61/SHINE reweighting).

Validation with NA61/SHINE data

NA61/SHINE data from 2010 run [6] is provided for six different segments: five 18 cm segments and downstream face of the target.

This data can be used for the validation of G4JNUBEAM.



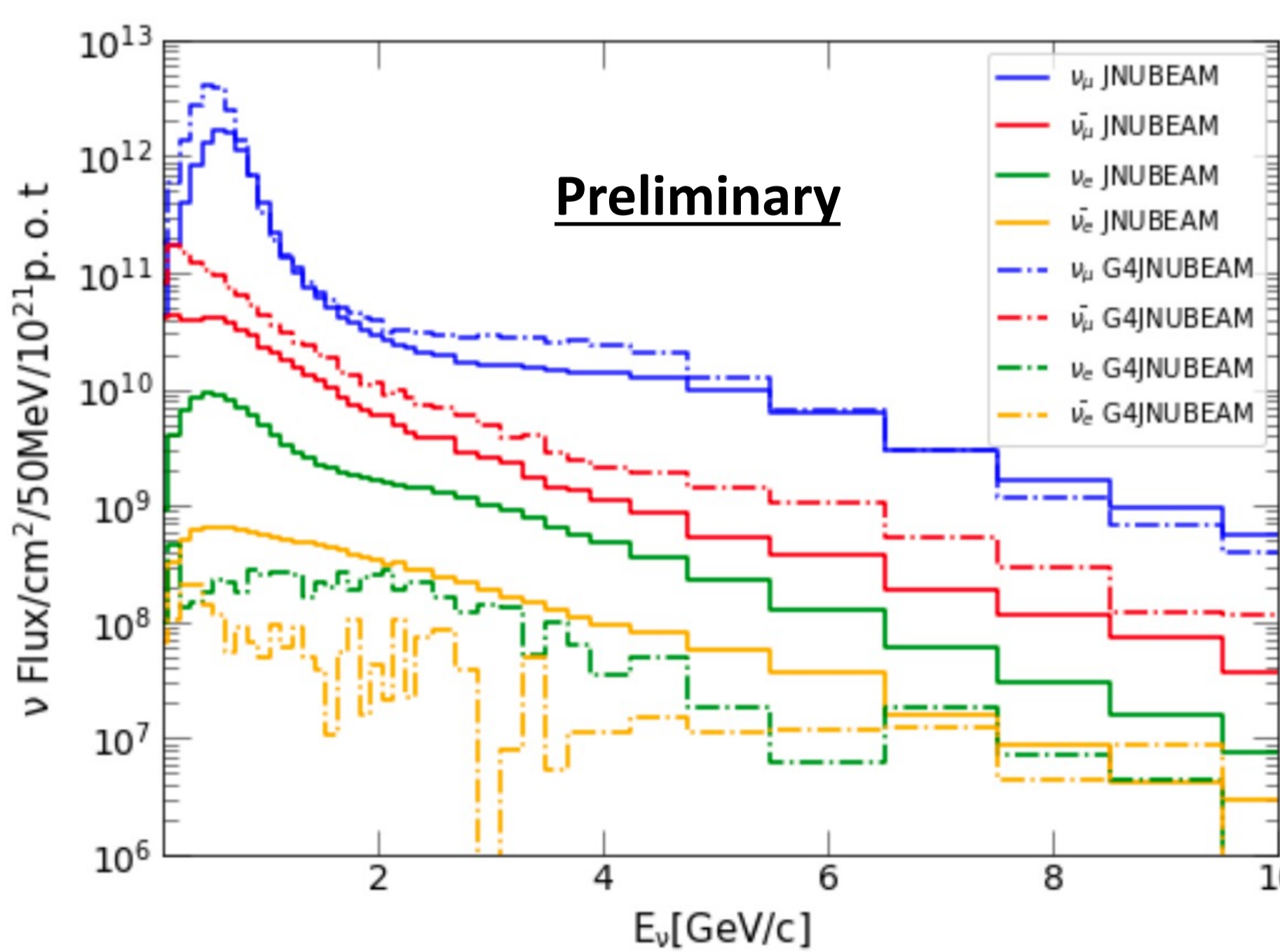
Benchmark, by checking the consistency between pion-yields simulation and data:

- Physics list (QGSP_BERT, FTFP_BERT)
- GEANT4 version (G4.10.3, G4.10.7, G4.11.0)

For new versions of GEANT 4, there was better agreement from QGSP_BERT.

Preliminary Results

G4JNUBEAM is still under development, but some preliminary neutrino flux diagrams can already be obtained and compared to JNUBEAM:



Using GEANT 4.11.0, with QGSP_BERT model.

Good overall agreement with JNUBEAM.

Currently improving the framework to reduce time for simulation and to make it compatible to reweighting procedure.