

VMC based T2K Beamline Simulation Studies

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Introduction

T2K simulation based on FLUKA (target) + GEANT3 (beamline)

- FLUKA problematic for various reasons (licence, old versions...)
- GEANT3 also not very convenient (old FORTRAN code, 32-bit compilation...)

➡ At some point, one should migrate all to GEANT4

- For transition process, extensive comparisons between FLUKA and GEANT4 (target) and between GEANT3 and GEANT4 (beamline) should be made
- Tool needed for easy comparisons between MCs

➡ TNUBeam Virtual Monte Carlo

TNuBeam Virtual Monte Carlo

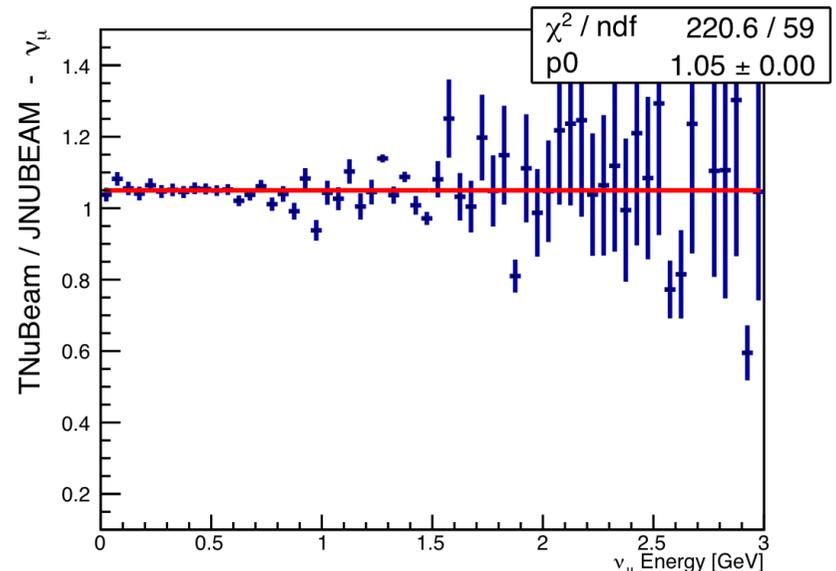
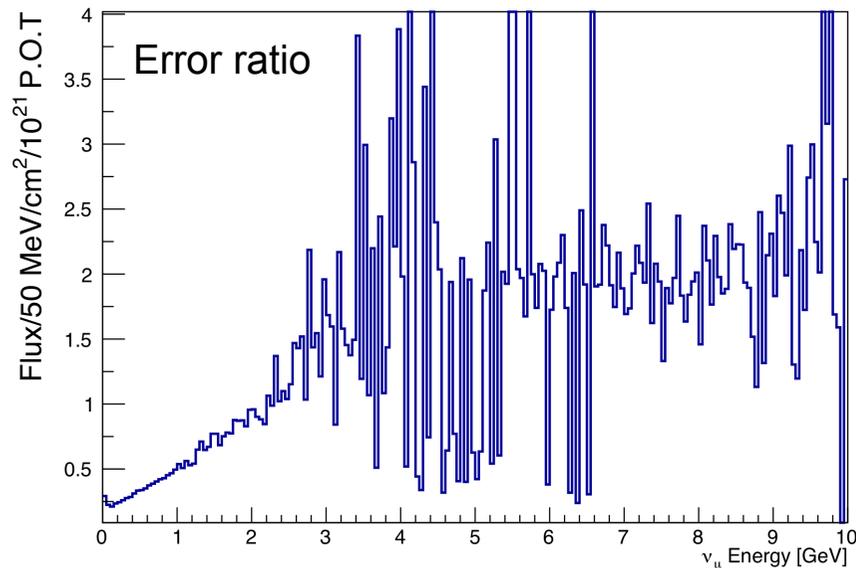
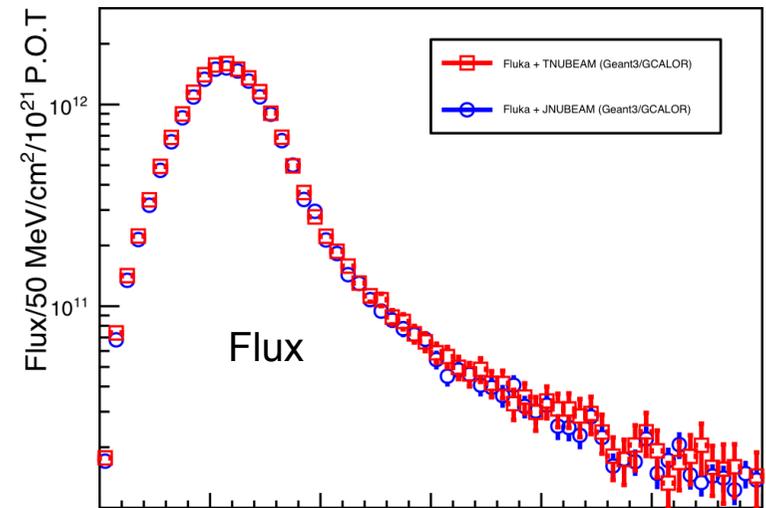
- VMC (Virtual Monte Carlo) is a Root-based C++ framework developed first for ALICE, providing a common interface to different MCs.
- Aimed to run in the same framework FLUKA, GEANT3 and GEANT4, but FLUKA interface not working at the moment
- User is supposed to provide some Classes for detector description, beam definition, output variables, then VMC manages event generation in the same way for GEANT3 and GEANT4.
- TNuBeam is a software developed at LPNHE by A. Robert, B. Popov and L. Zambelli in the VMC framework.
- It provides T2K (target and/or beamline) simulation based on GEANT3 and GEANT4, as well as simulation of various NA61 configurations (Thin Target, Replica Target, ...) and of HARP experiment for comparison with hadron measurements
- It can take FLUKA simulation as input for comparison with T2K (JNUBEAM) simulation

ν flux comparison - TNUBeam vs JNUBEAM

- Target simulation based on FLUKA for both simulations
- Comparison based on ν flux in ND280 detector

Reminder status of comparison

- **Error calculation** (error ratio, χ^2 fit)
- **Timing** (TNUBeam / JNUBEAM ~ 1.5)
- **strange observation on JNUBEAM:**
lower cut-off \rightarrow 5 % lower cross-section?



✓ flux comparison - TNUBeam vs JNUBEAM

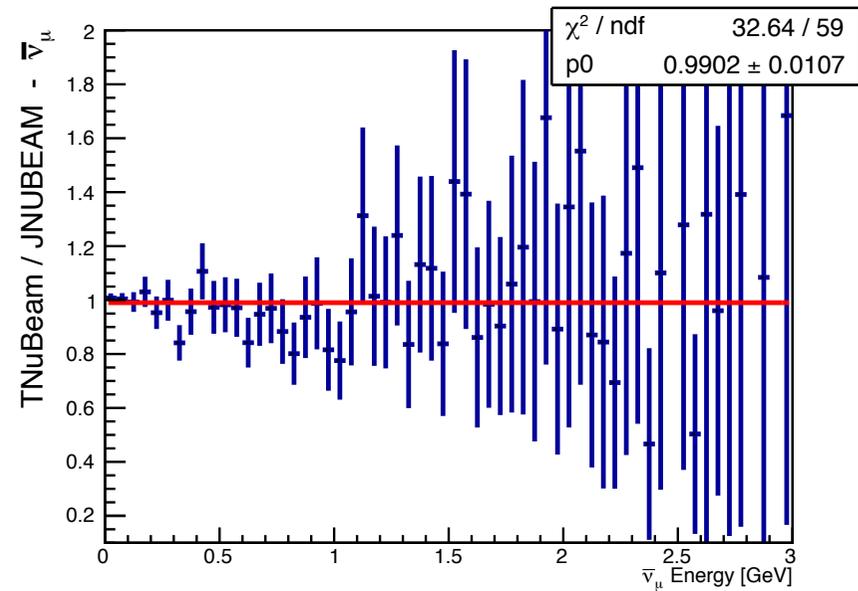
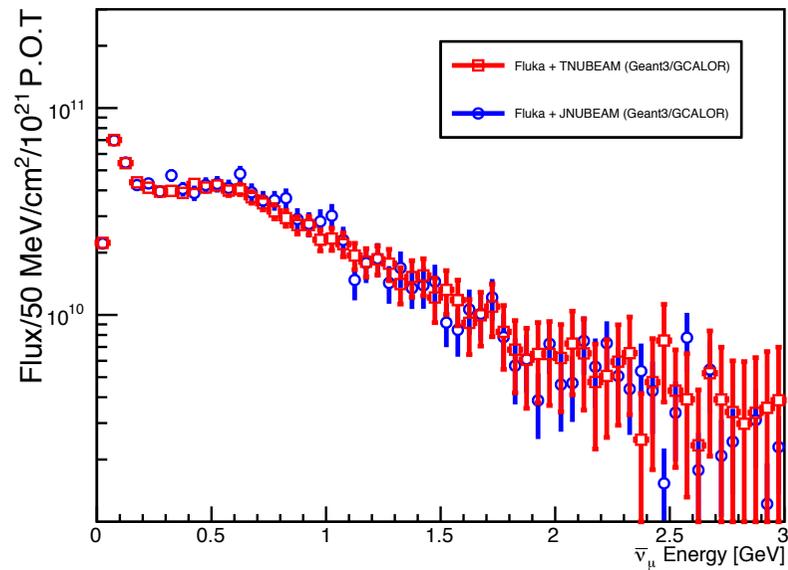
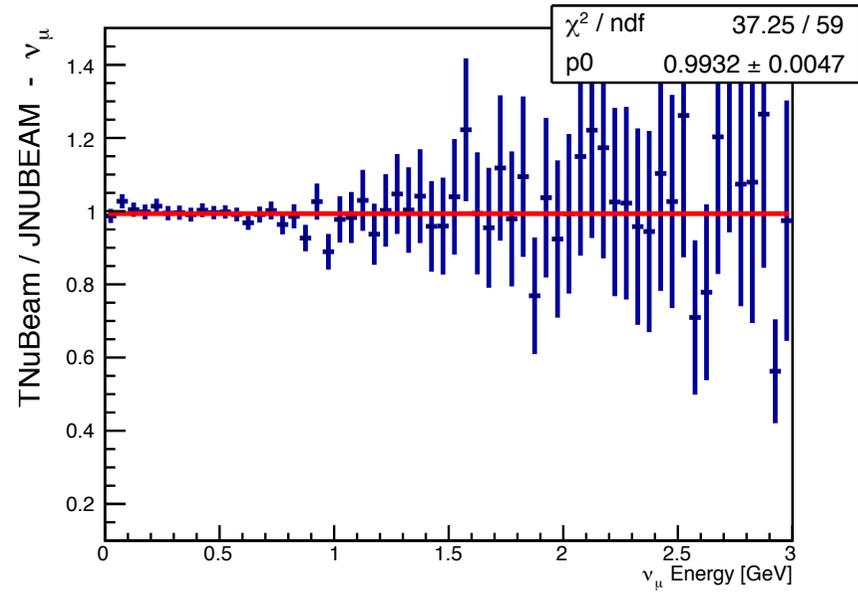
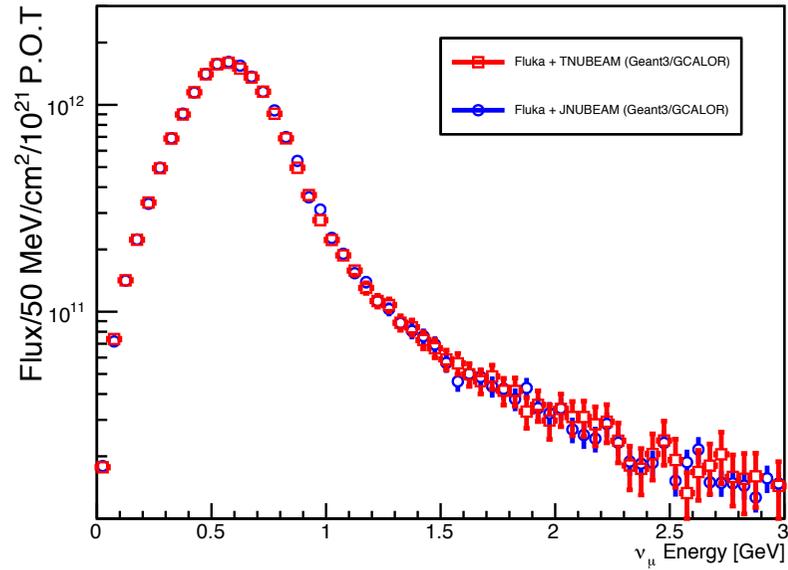
Check JNUBEAM production

- unnoticed problem in 1 out of 20 files (infinite loop) due to change in value of CUBD (cut-off on kinetic energy in Beam Dump)
- default value: 1.0 GeV in JNUBEAM, previously set to 0.0001
- now set to 0.001, solved problem

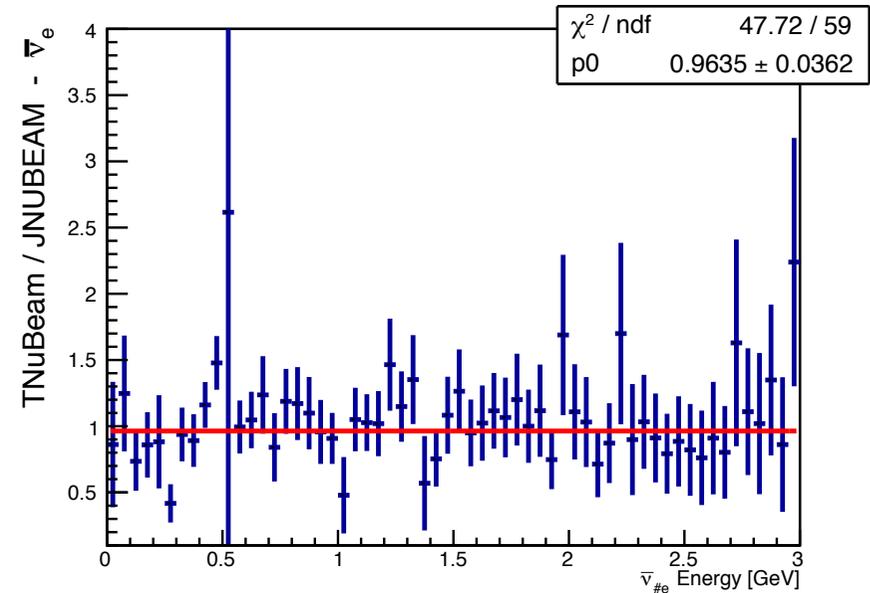
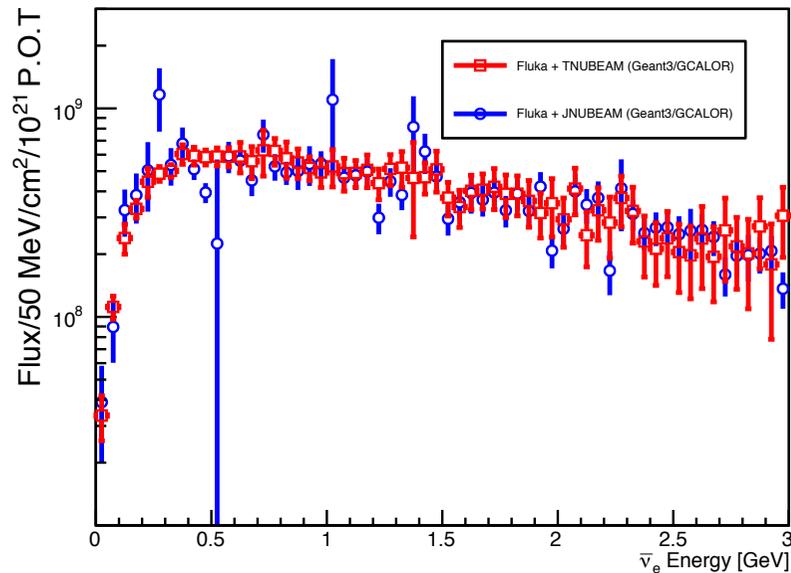
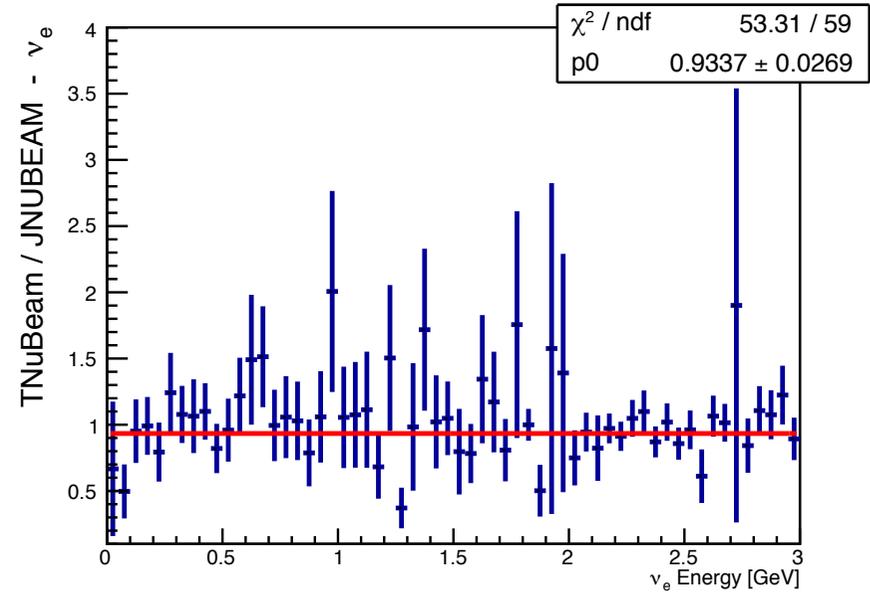
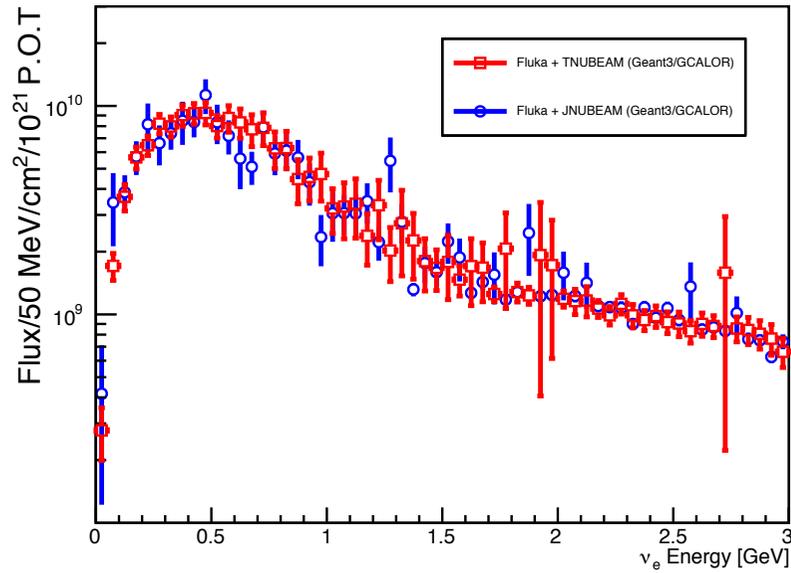
Check error calculation in ratio

- stupid error! (option 'B' in root for binomial error in histograms ratio...)
- χ^2 fit improved, some problems remaining (see next slides) better identified

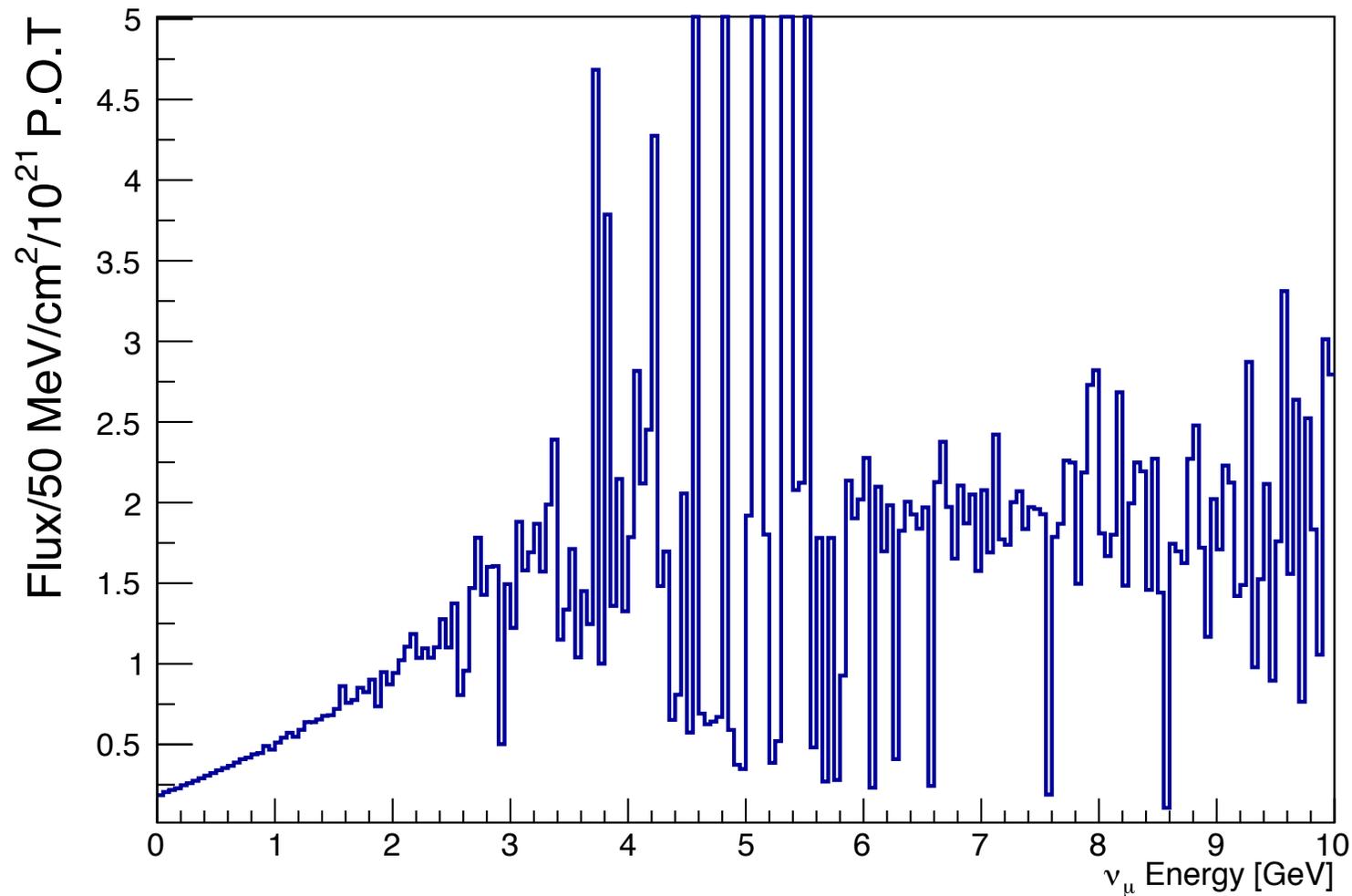
ν flux comparison - TNUBeam vs JNUBEAM



flux comparison - TNUBeam vs JNUBEAM



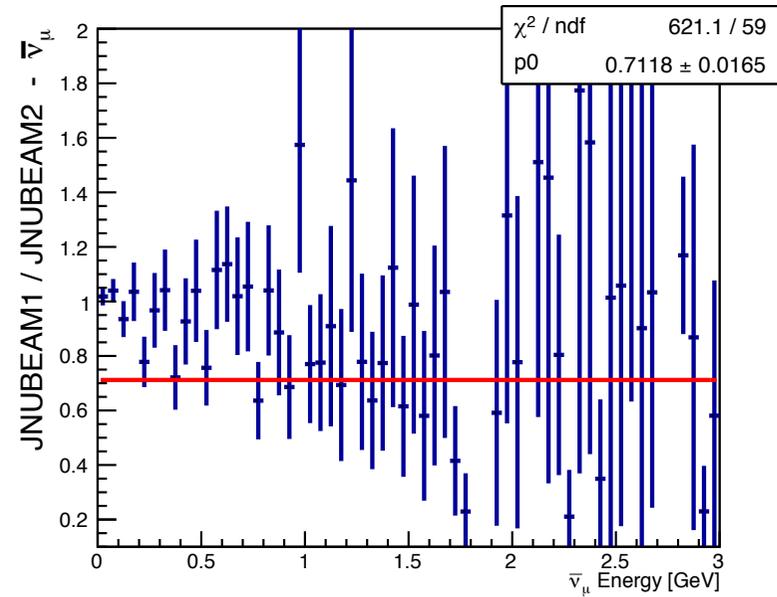
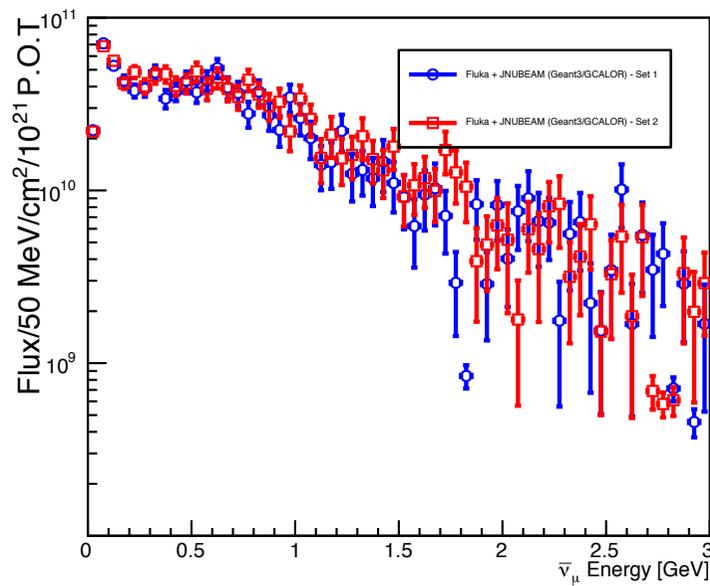
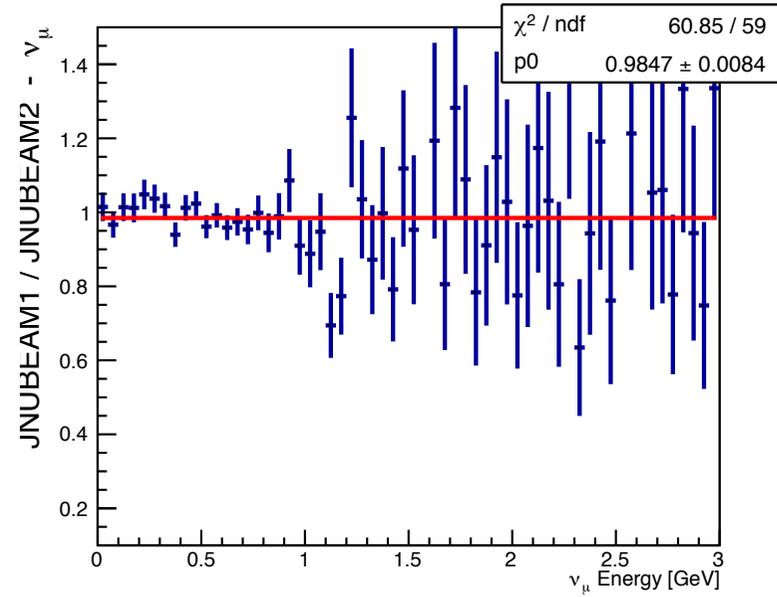
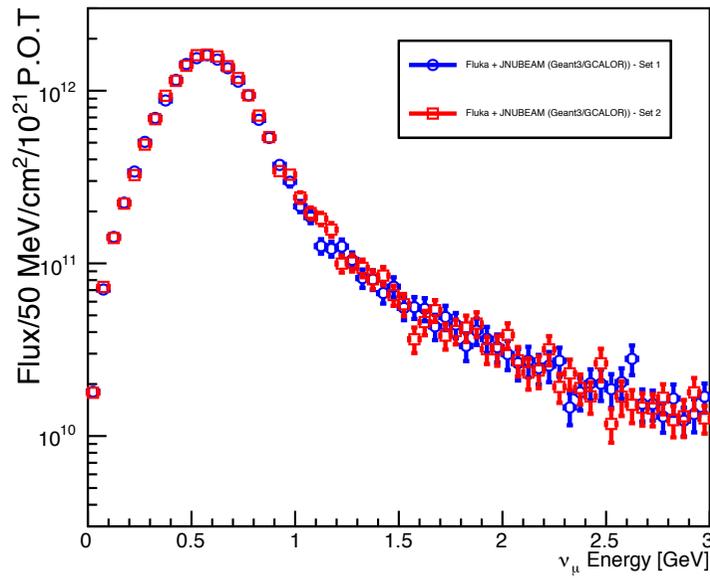
ν flux error comparison - TNUBeam vs JNUBEAM



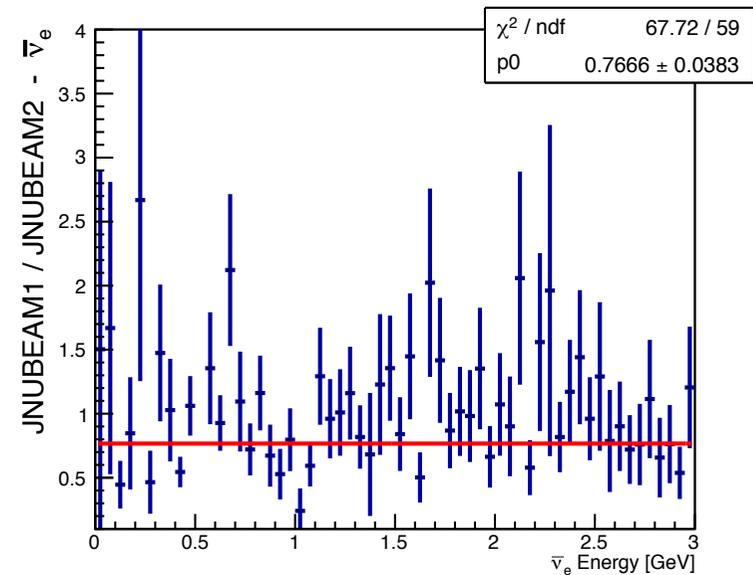
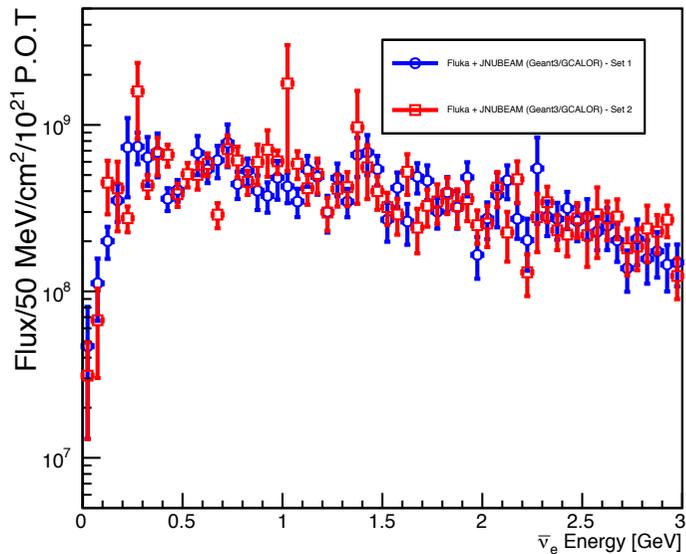
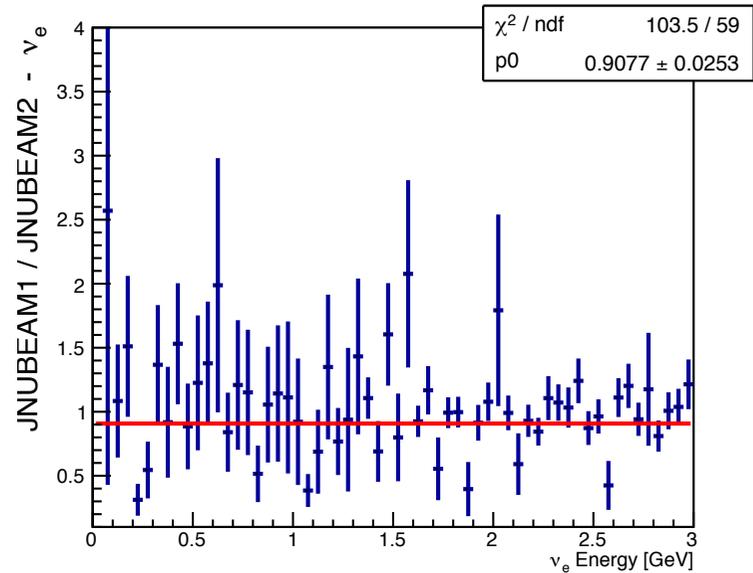
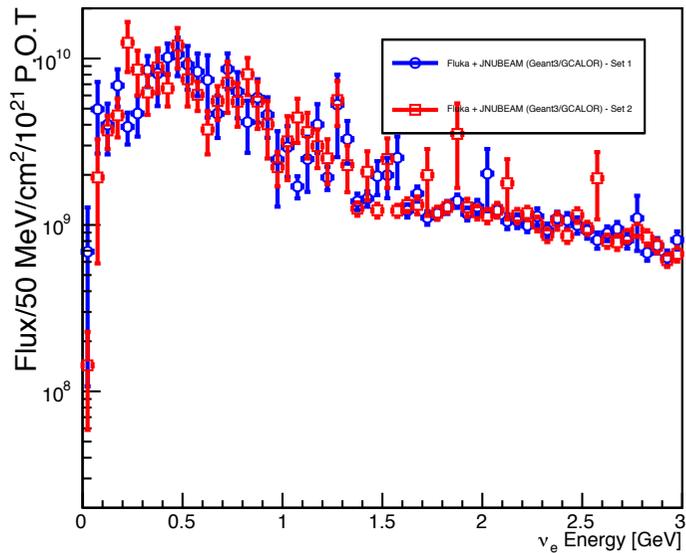
No change in error ratio, still problematic

→ check statistical self-compatibility of JNUBEAM and TNubeam (next slides)

ν flux comparison - JNUBEAM vs JNUBEAM

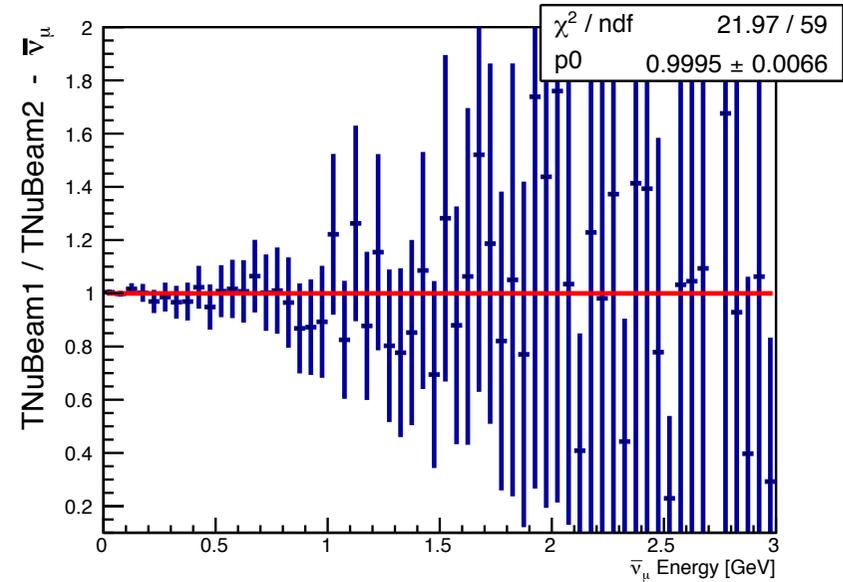
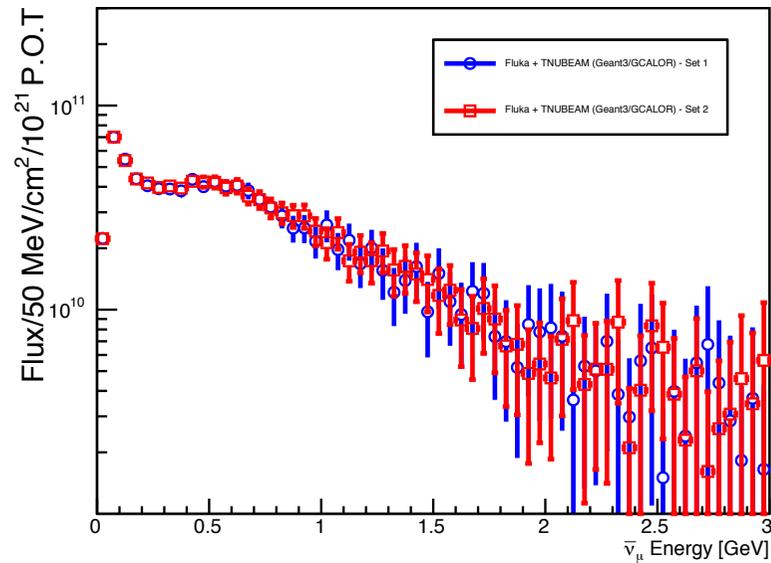
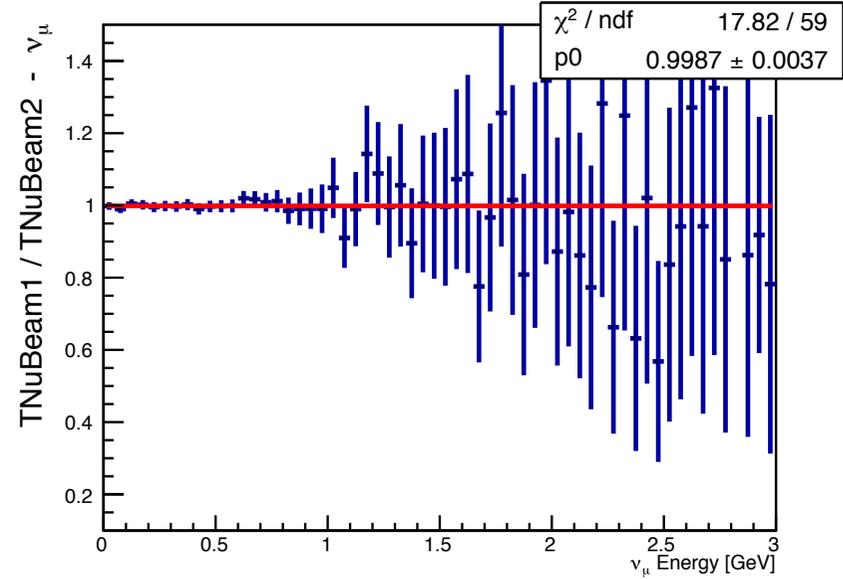
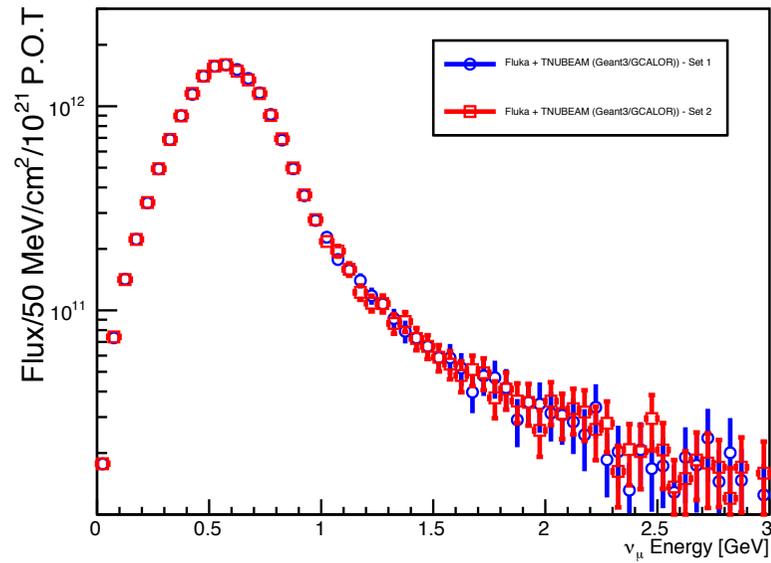


flux comparison - JNUBEAM vs JNUBEAM

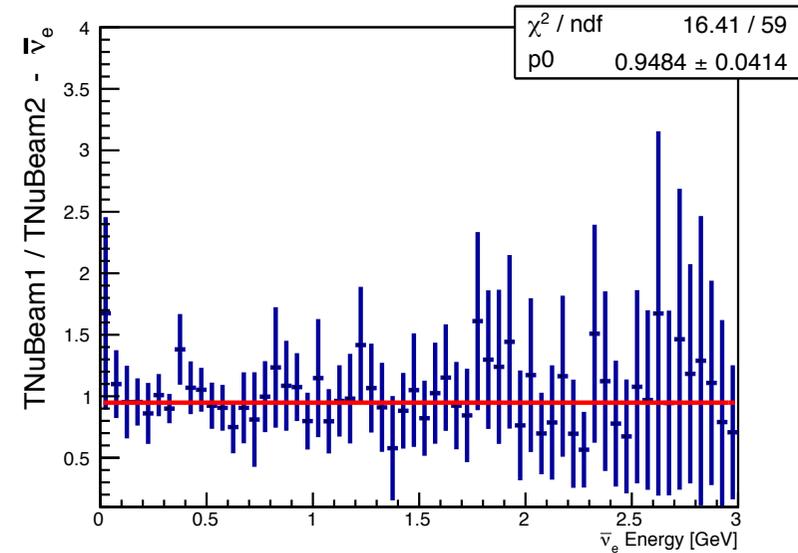
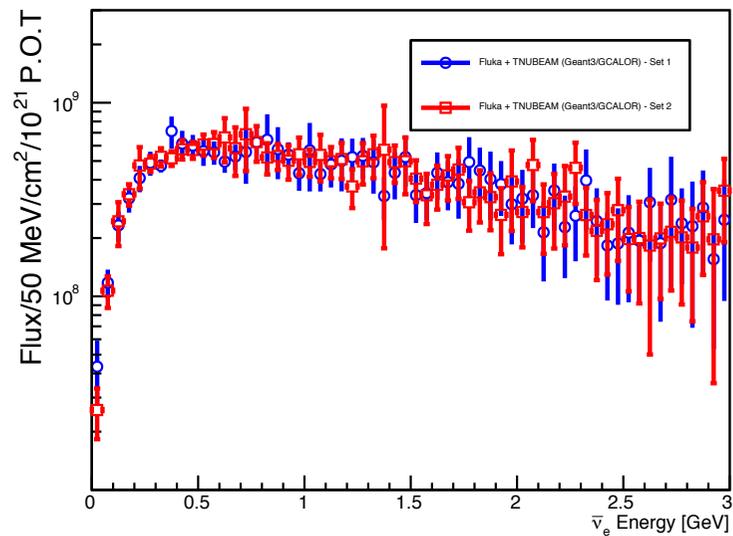
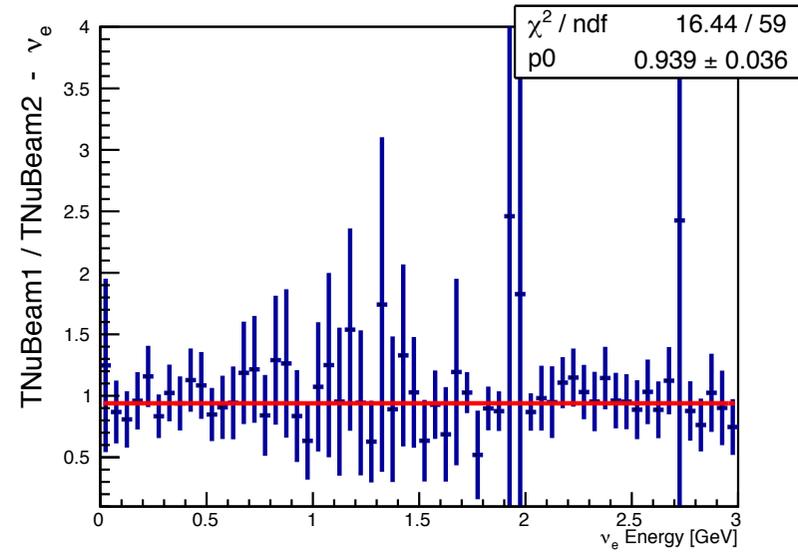
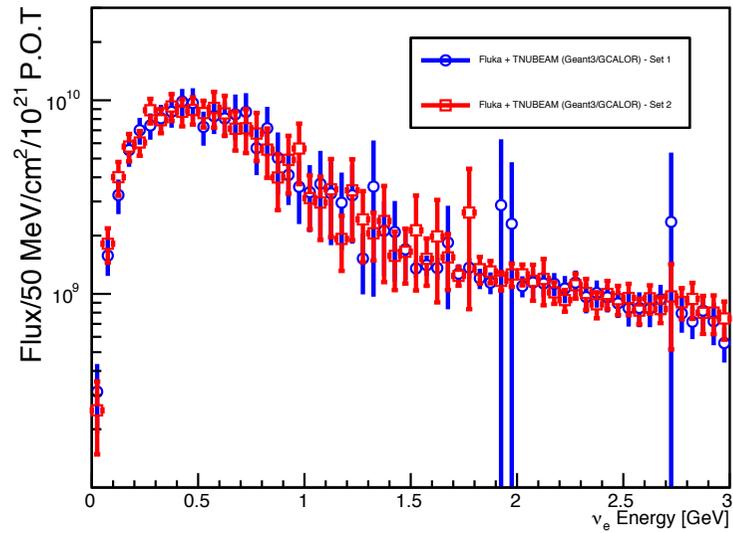


Strange fluctuation in some bins \rightarrow identified as negative flux!?

ν flux comparison - TNUbeam vs TNUbeam



ν flux comparison - TNUbeam vs TNUbeam



χ^2 fit too low → error calculation and/or random generator problem?

In progress...

- Comparison TNUbeam/JNUBEAM improved, but problems remaining
- Negative flux in JNUBEAM? Check TNUbeam too...
- Check error calculation/ random generator in TNUbeam
- Compare TNUBeam vs JNUBEAM by process
- Improvement of TNUBeam structure and user interface still under development
- Comparison of MC predictions with latest NA61 (LT 2010) results → done (see separate file)