# Beamline Simulations

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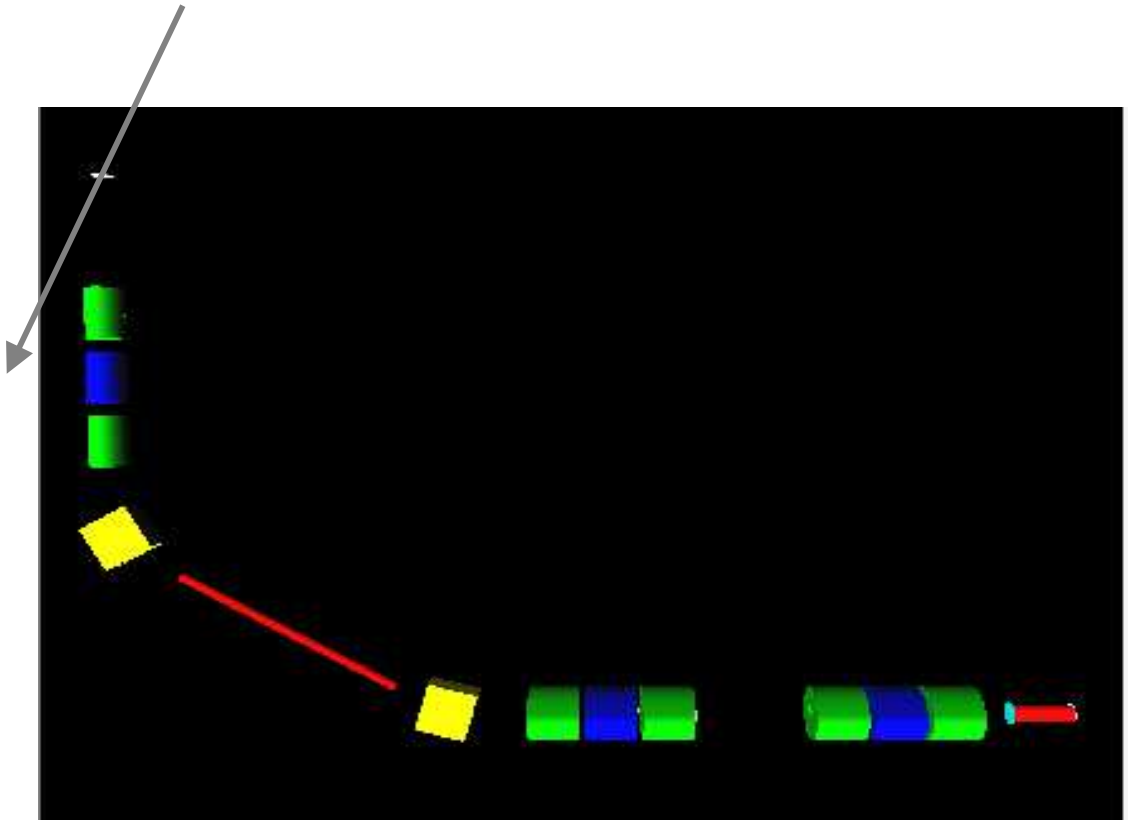
# Beamline Activities

- Developing g4beamline, a “Swiss Army Knife” for Geant4
- Beamline studies for MICE (with K.Tilley and P.Drumm from RAL)
  - Basic tracking and rates
    - MAY03 Design
    - JAN04 Design
    - MAR04 Design
  - Target production calculations, overall normalization
  - Singles rate studies in upstream counters
  - Upstream TOF performance, mu/pi separation
  - Upstream TOF thickness effects on beam rates
  - Study of downstream counter size requirements
- Supporting other users of g4beamline

# MICE Beamline



(3-D view approximately a plan view)

# MICE Target Particle Production

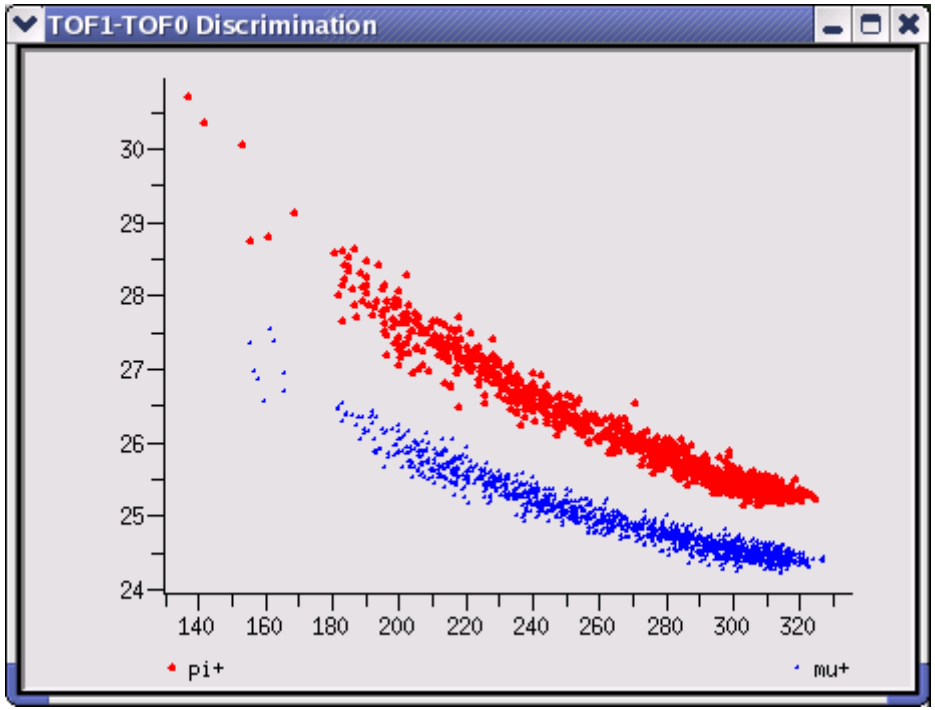
**Particles into acceptance per millisecond of good target.**

| Particle | LAHET | MARS | Geant4 |
|---|---|---|---|
| pi- | | 3.2E5 | 2.8E5 |
| e- | | 4.6E3 | 1.5E4 |
| e+ | | 0 | 1.6E4 |
| gamma | | 7.0E5 | 5.6E5 |
| pi+ | 7.8E5 | 1.1E6 | 9.7E5 |
| n | | 7.2E6 | 4.1E6 |
| p | 3.7E5 | 6.2E6 | 3.6E6 |

# MICE Good-mu+ Rates (MAR04)

| **Description** | **LAHET** | **MARS** | **Geant4** |
|---|---|---|---|
| Protons on model Target | $1 \cdot 10^7$ | $1 \cdot 10^7$ | $1 \cdot 10^7$ |
| $\pi^+$ Into Acceptance | 7.20 | 9.30 | 8.81 |
| $\pi^+$ Per millisecond into Acceptance | $1.22 \cdot 10^6$ | $1.58 \cdot 10^6$ | $1.50 \cdot 10^6$ |
| $\pi^+$ Generated into Acceptance and Tracked | $1 \cdot 10^7$ | | |
| good $\mu^+$ (no $LH_2$, no RF) | 1277 | | |
| good $\mu^+$ per millisecond | 156 | 202 | 191 |

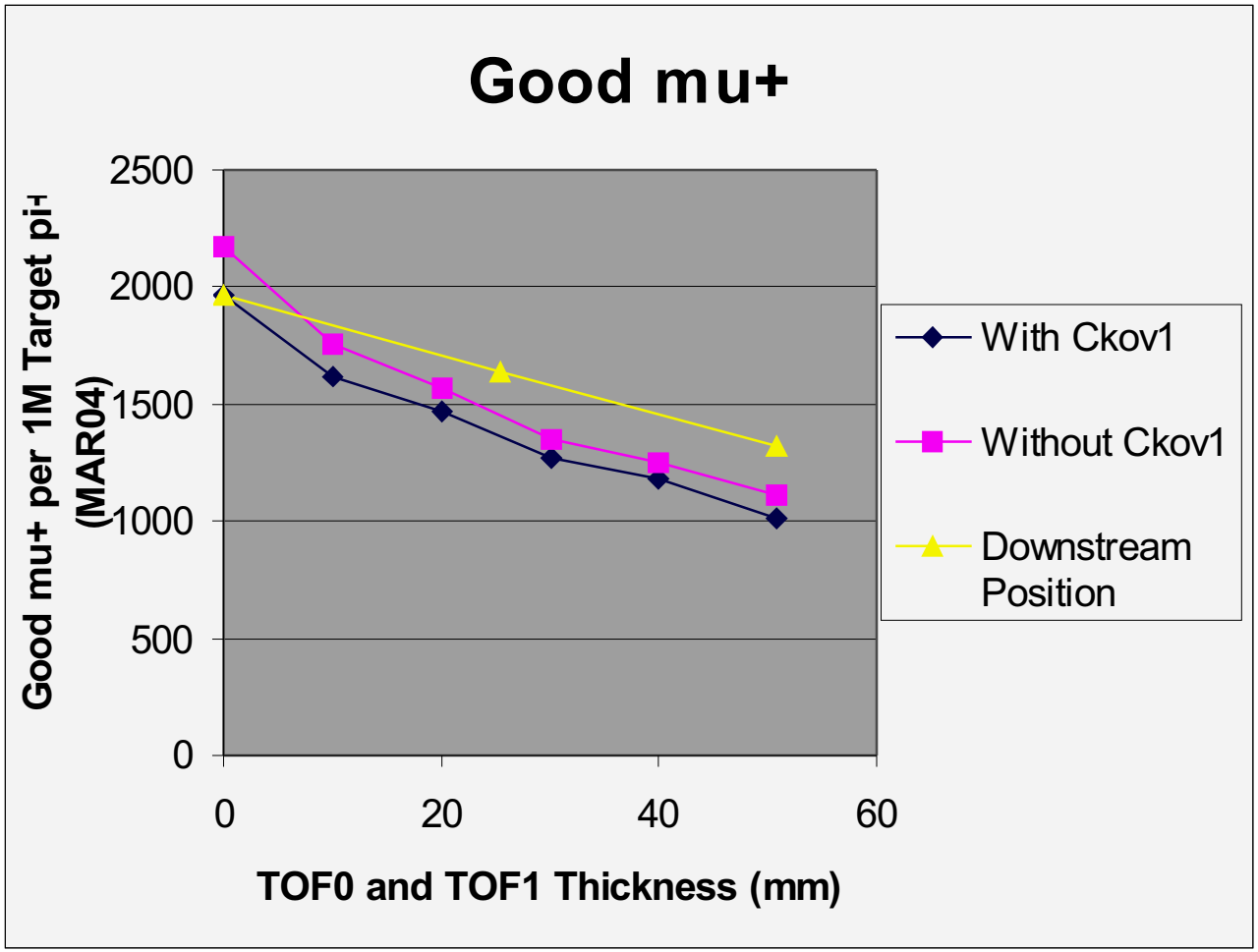
# JAN04 Beamline TOF1-TOF0 Performance




Includes:

- TOF resolution of 50 ps
- Momentum measured in Tracker1, with resolution 2-25 MeV/c depending on $P_{\perp}$
- JAN04 beamline (MAR04 has 30% longer distance)
- Events generated to fill the Q4 aperture, with pi/mu=1 (really ~0.02 at TOF1, ~0.002 for good-$\mu^+$)

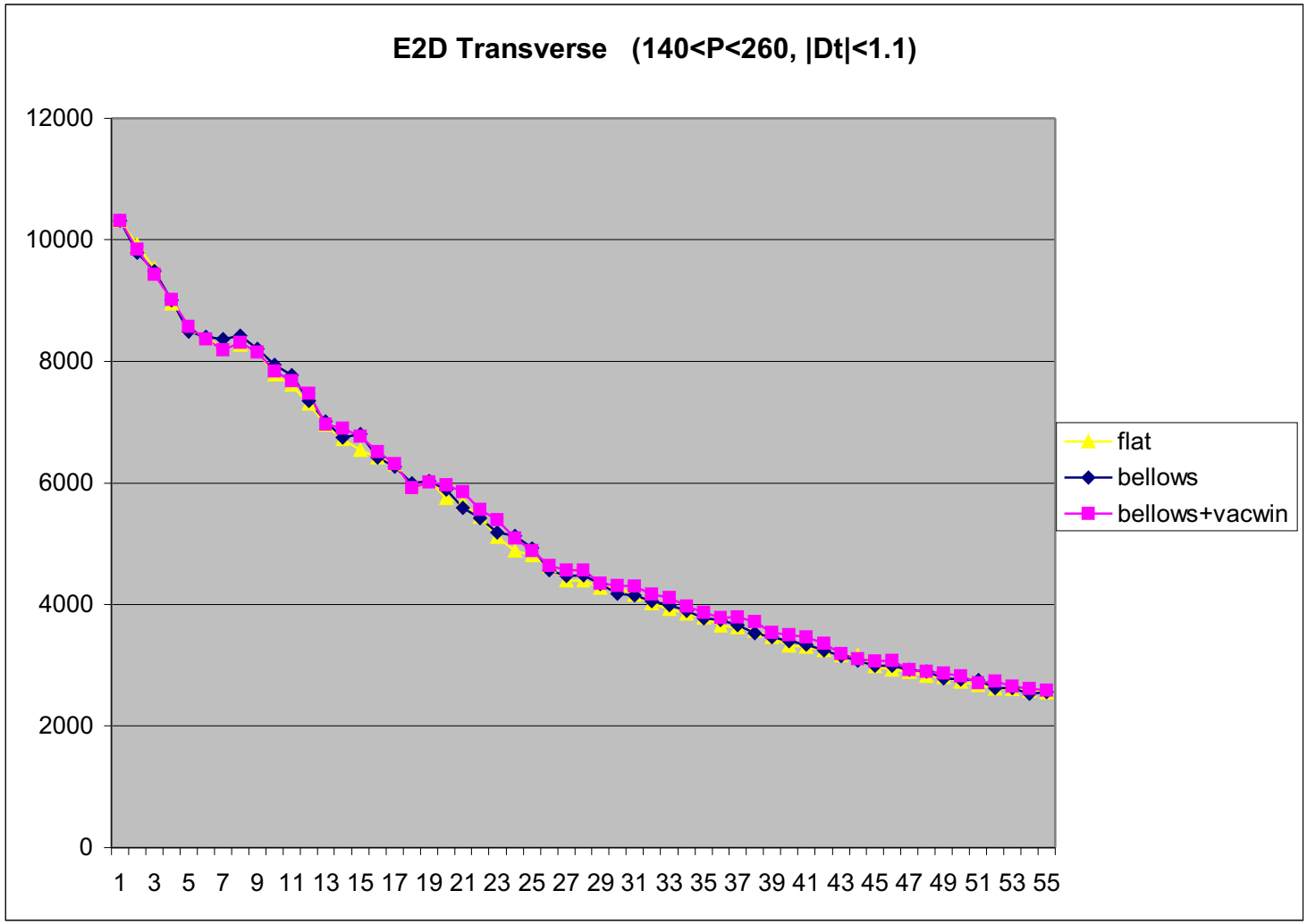
# Effect of TOF0 and TOF1 Thickness on Good-Mu+ Rate



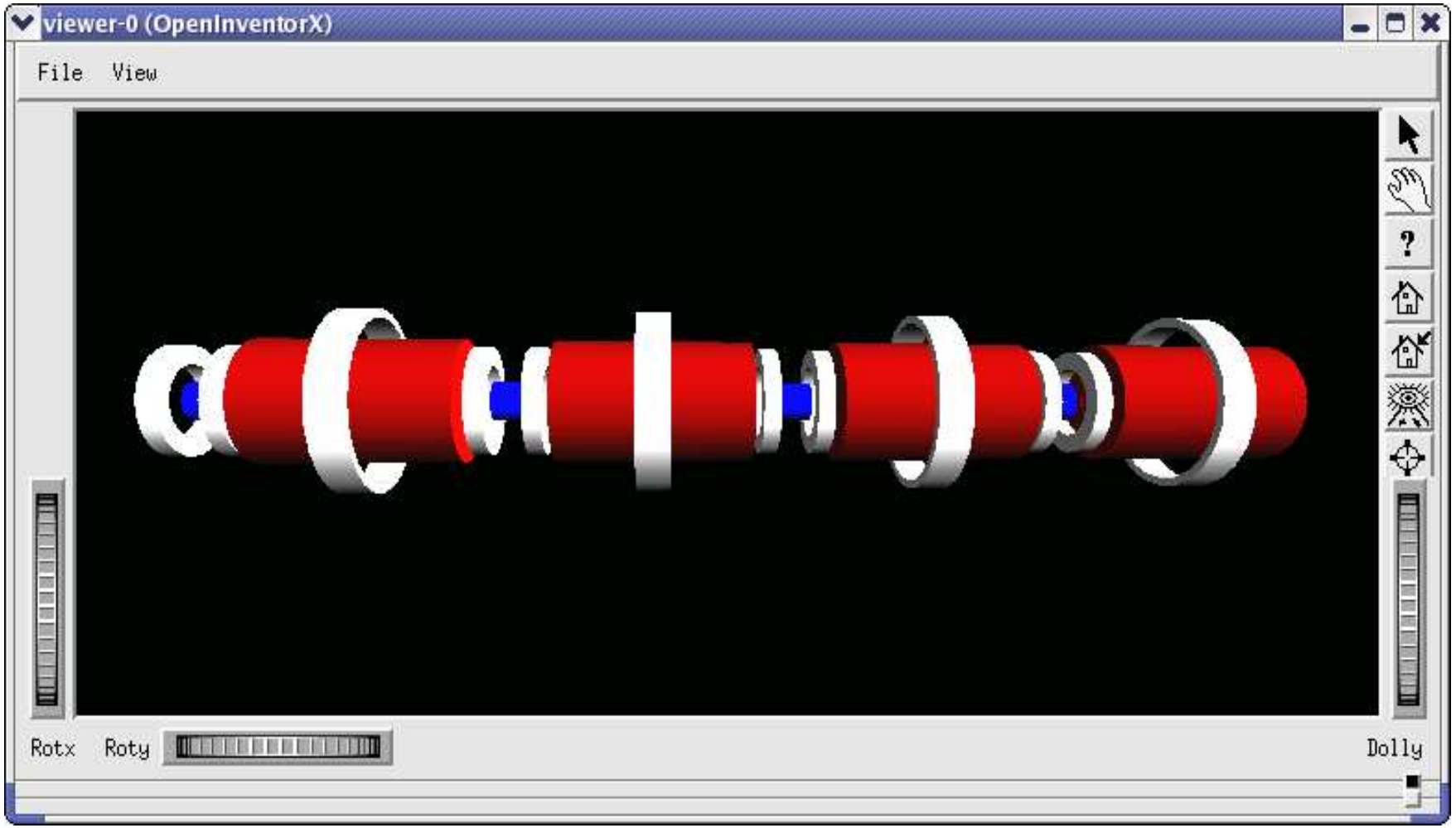

Downstream Position has TOF0 just downstream of Q6, and TOF1 just downstream of Q9, with an iron shield between it and the Tracker1 Solenoids, as for TOF2.

# Other Investigations using g4beamline

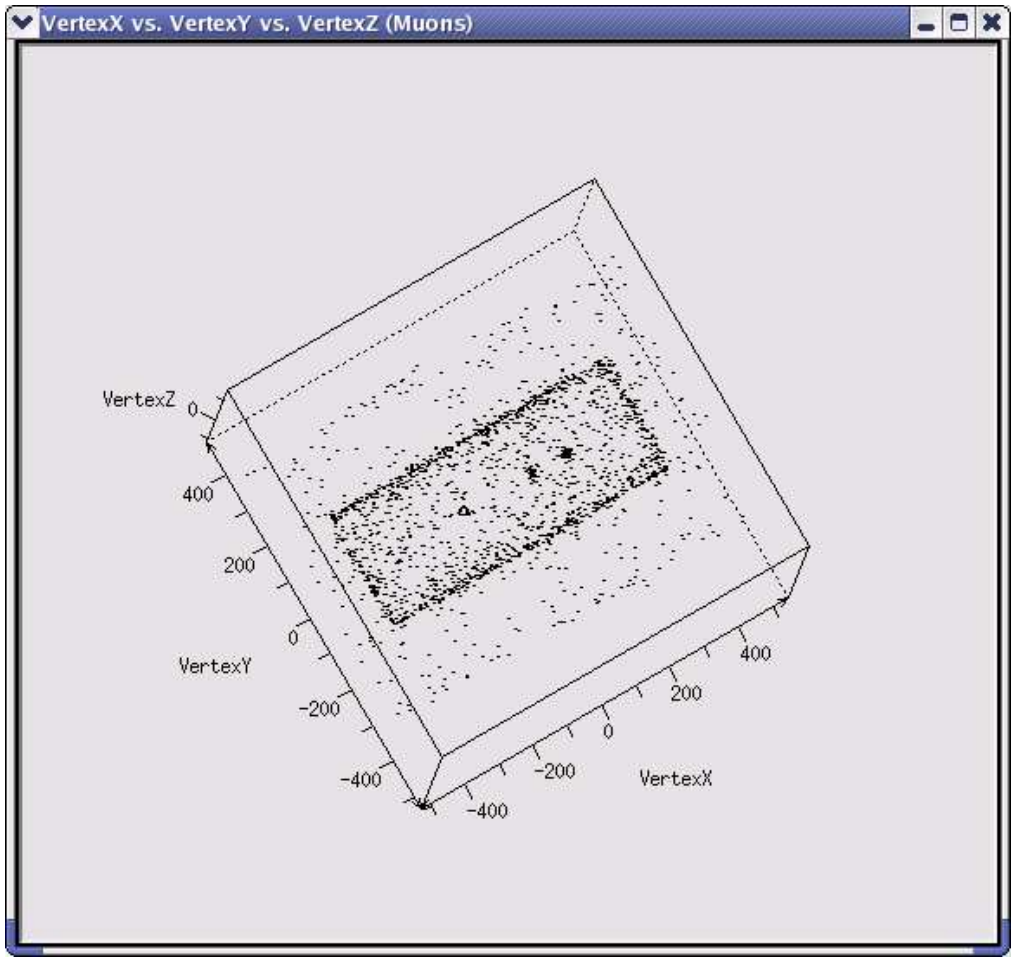
# Study2 Cooling Channel Performance (g4beamline)



# 4 cells from Study 2



# Cosmic-Ray muon Tomography of a Shipping Container




Four 20 cm internal objects:
$H_2O$ (invisible)
Al
Fe
Pb

Simple 2-track vertex using 4 surrounding counters.

The clusters at the walls are an artifact of the view (they are spread out in 3-d).

26-second exposure to Cosmic Rays