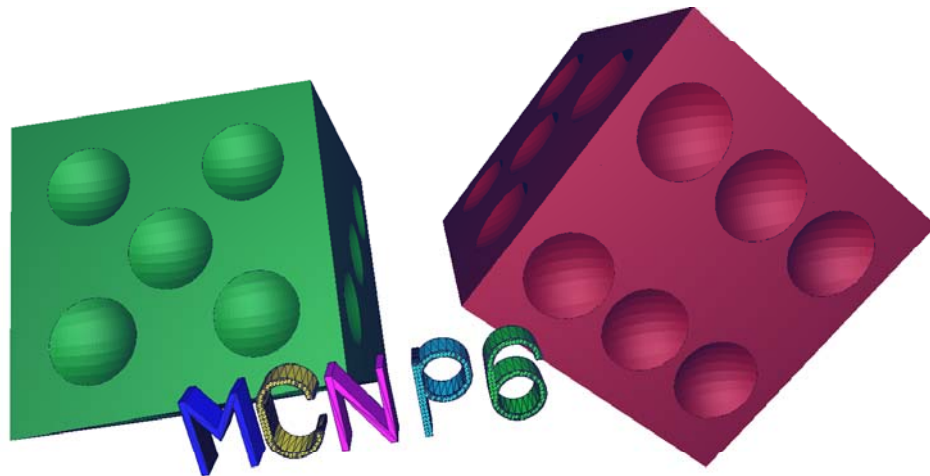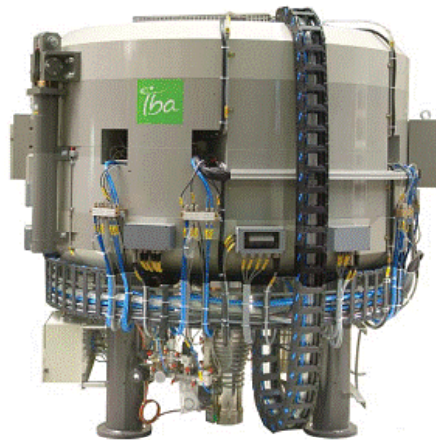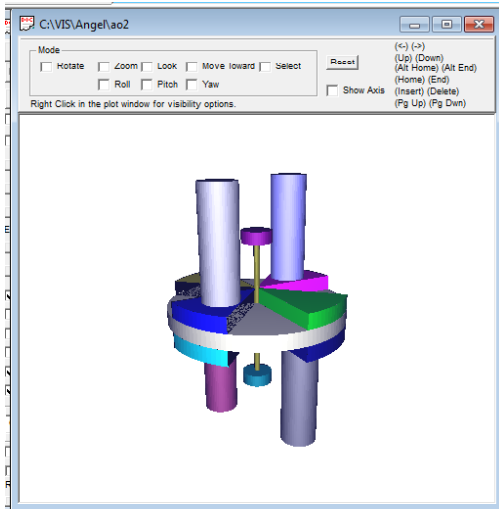# An MCNP6 Version of the Visual Editor

**Presented at the
American Nuclear Society
Radiation Physics & Shielding Division
meeting
Knoxville, Tennessee
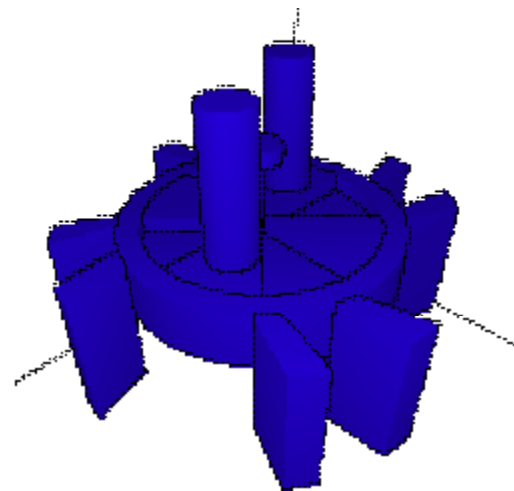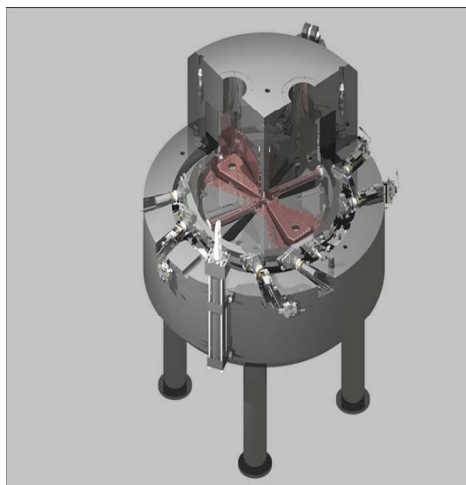September 14 – 18, 2014**

**Randy Schwarz
Visual Editor Consultants
www.mcnpvised.com**
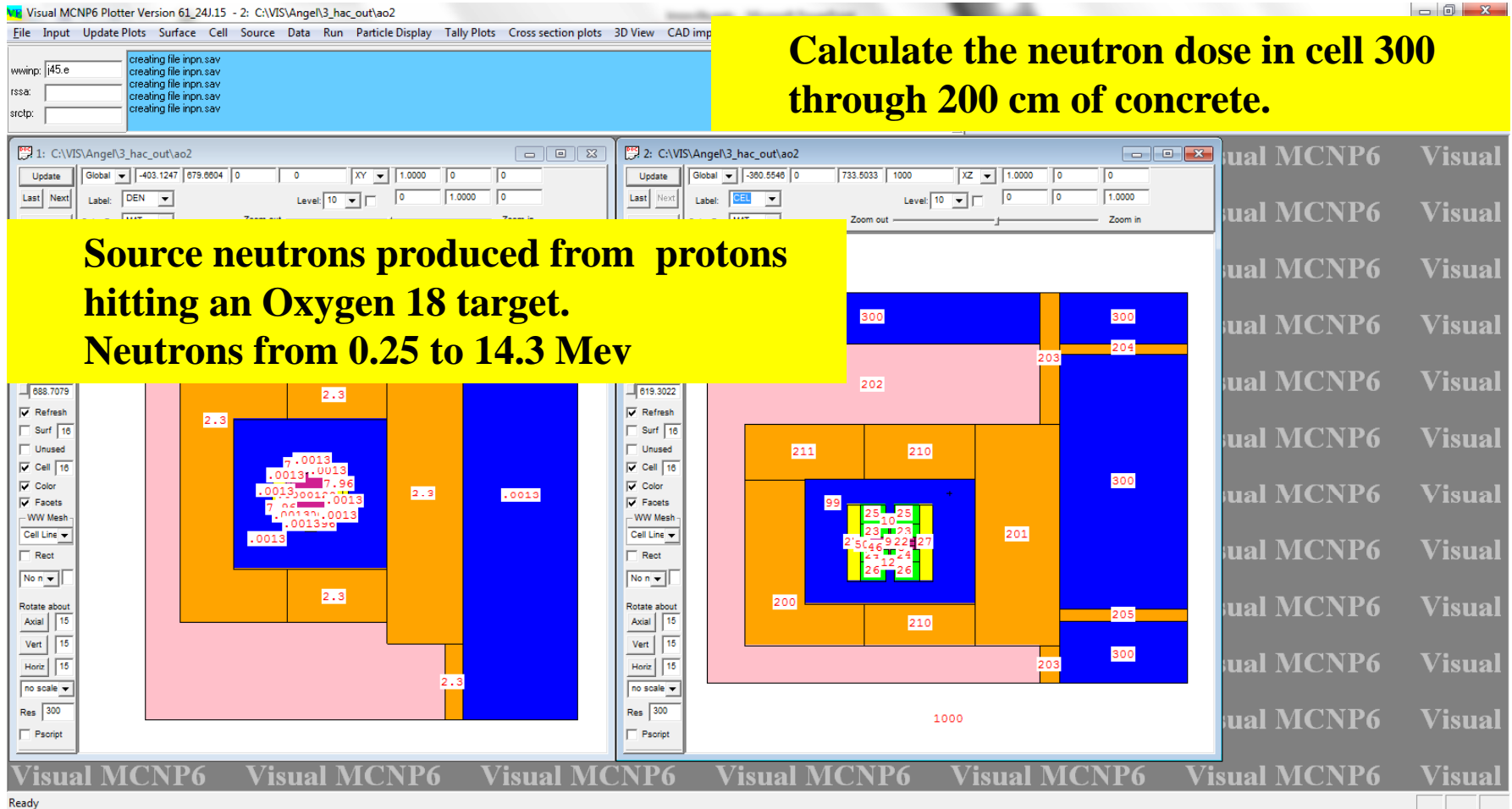
Case Study

Cyclotron IBA – Cyclone 18
Made in Belgium
Currently in use in Canada
18 Mev Protons
Used for productions of
radiopharmaceuticals
for PET Scans

Neutron Shielding Calculations
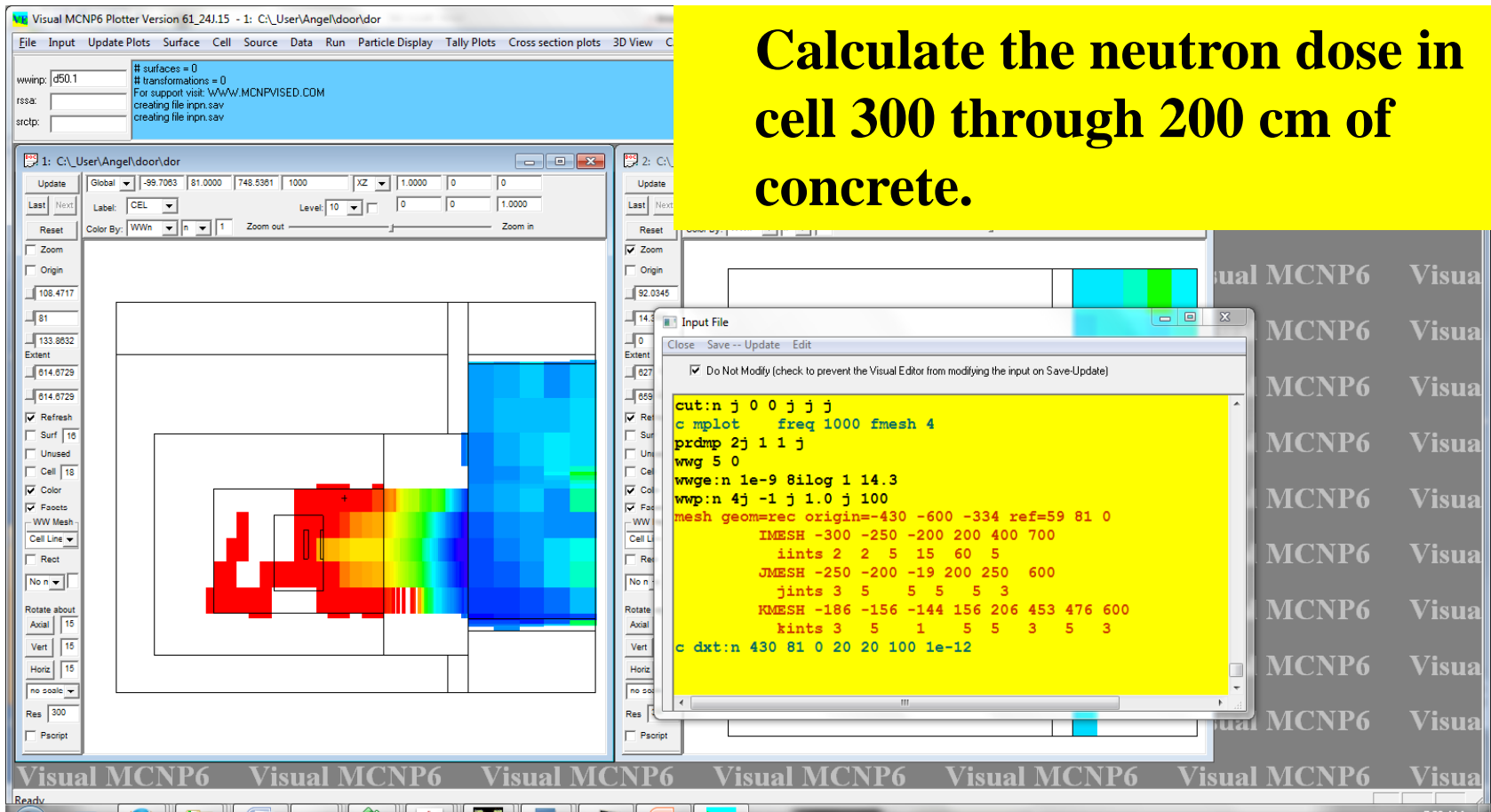

Calculate the neutron dose in cell 300 through 200 cm of concrete.

Source neutrons produced from protons hitting an Oxygen 18 target.
Neutrons from 0.25 to 14.3 Mev

Energy dependent WW Mesh

Calculate the neutron dose in cell 300 through 200 cm of concrete.

```
cut:n j 0 0 j j j
c mplot      freq 1000 fmesh 4
prdmp 2j 1 1 j
wwg 5 0
wwge:n 1e-9 8ilog 1 14.3
wwp:n 4j -1 j 1.0 j 100
mesh geom=rec origin=-430 -600 -334 ref=59 81 0
        IMESH -300 -250 -200 200 400 700
          iints 2   2   5  15   60   5
        JMESH -250 -200 -19 200 250   600
          jints 3   5     5   5   3
        KMESH -186 -156 -144 156 206 453 476 600
          kints 3   5    1    5   5   3   5   3
c dxt:n 430 81 0 20 20 100 1e-12
```

Bulk Neutron Dose - FMESH

Bulk Neutron Dose - TMESH

Contours created from reading the MCTAL file.

Converged f5 tally in 4 hours:
624856   1.3017E+02 0.0319 0.0097   4.3 4.1E+00
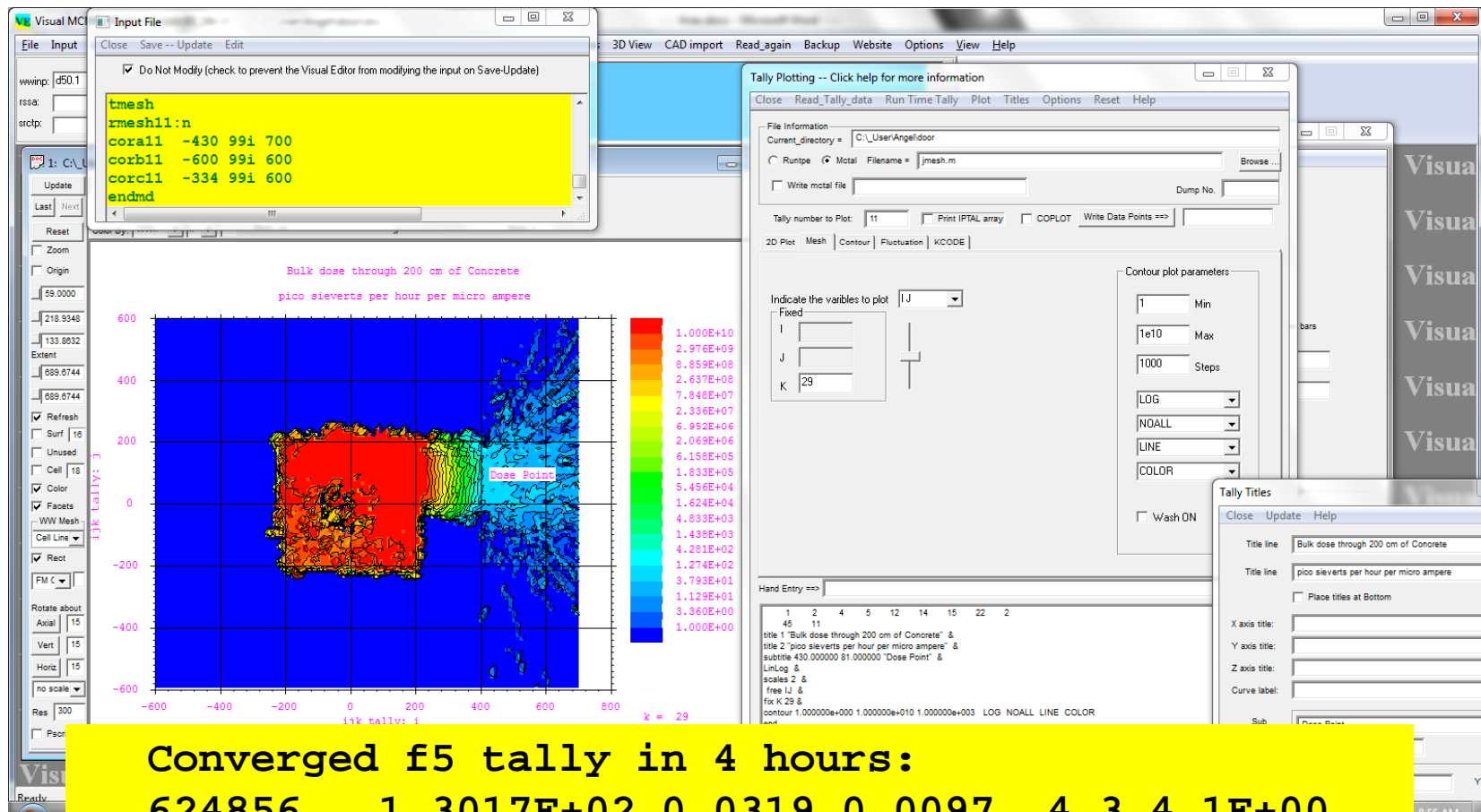
HVAC out shielding calculation
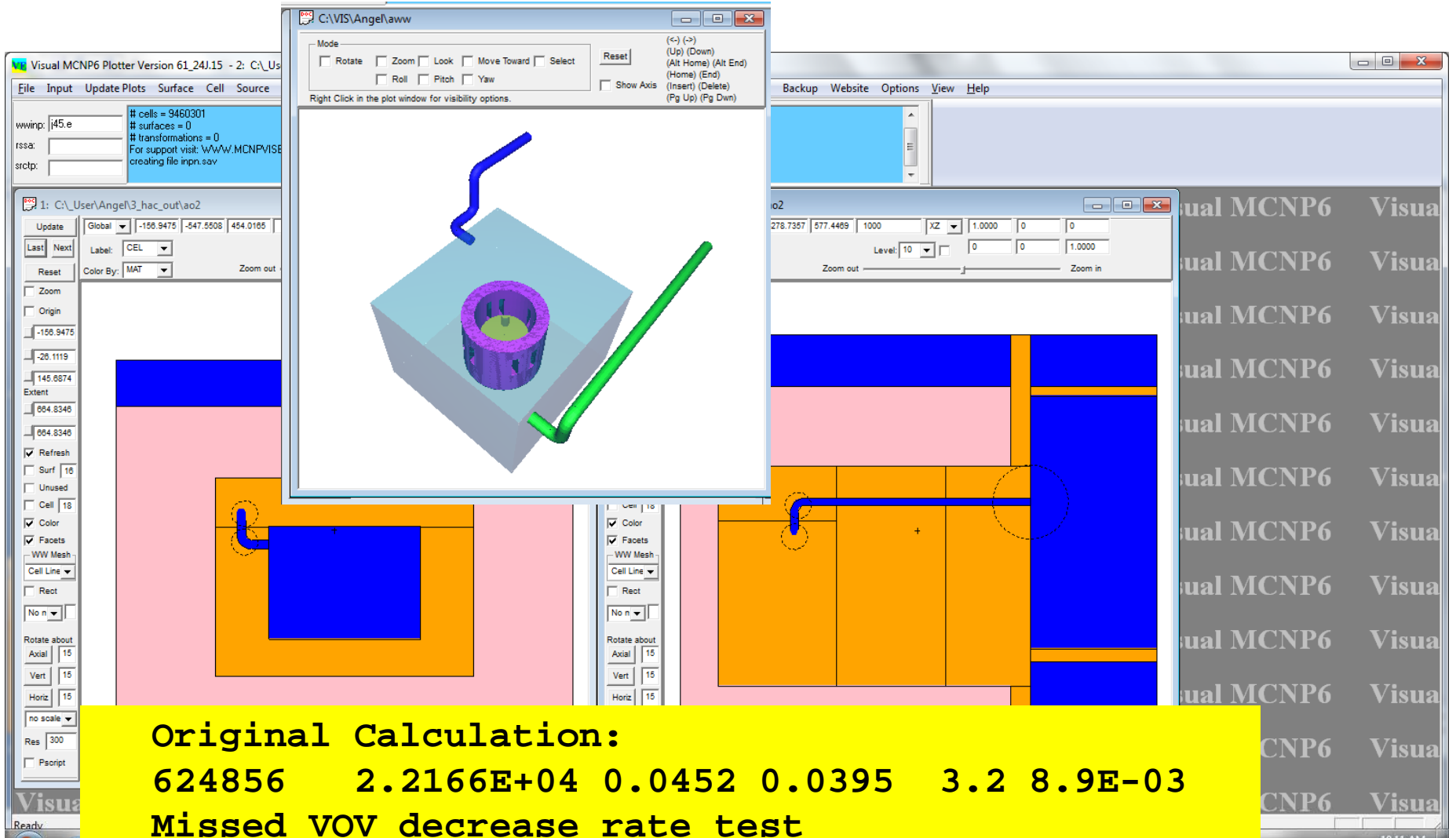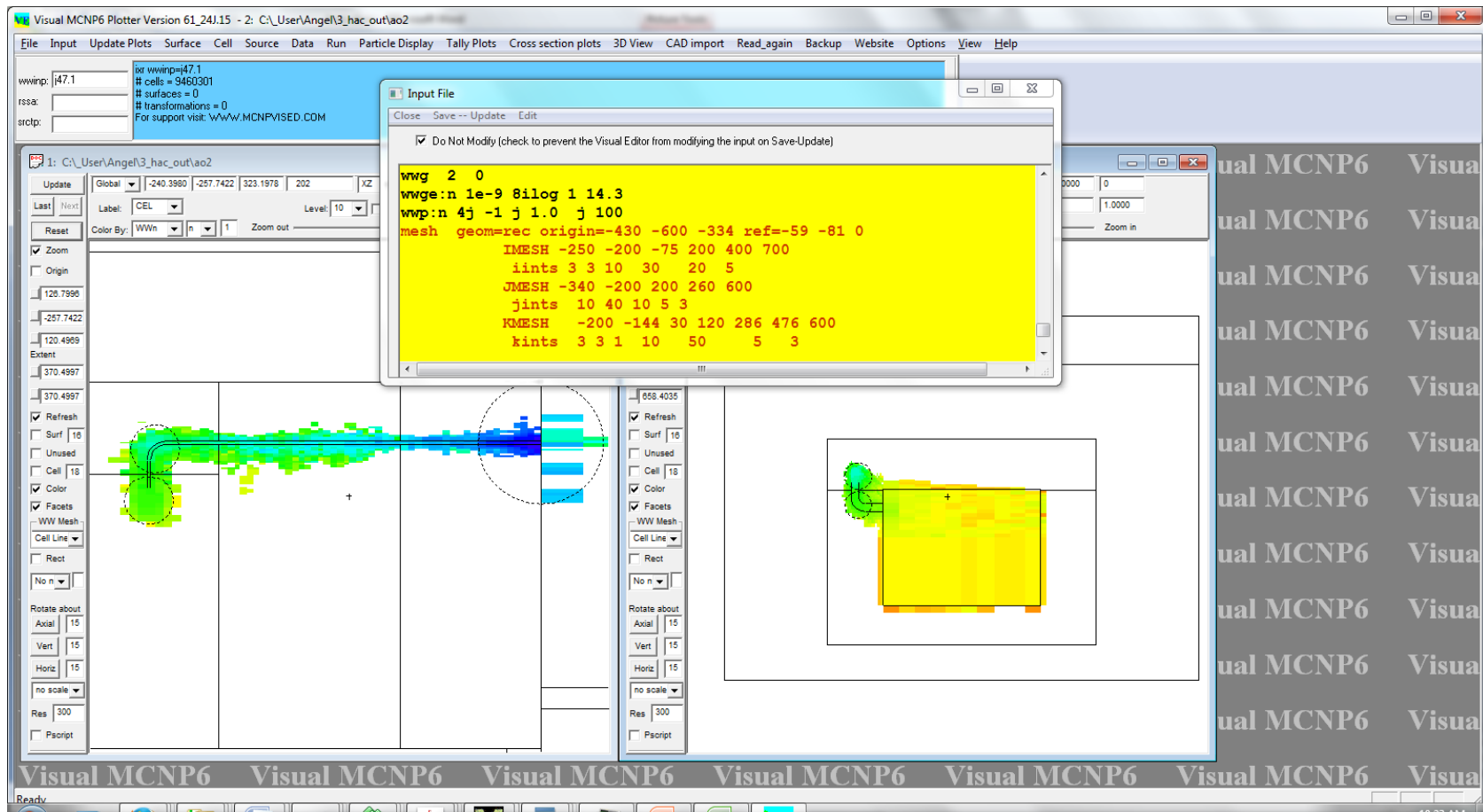

Original Calculation:
624856   2.2166E+04 0.0452 0.0395 3.2 8.9E-03
Missed VOV decrease rate test
55184 minutes / 38 days
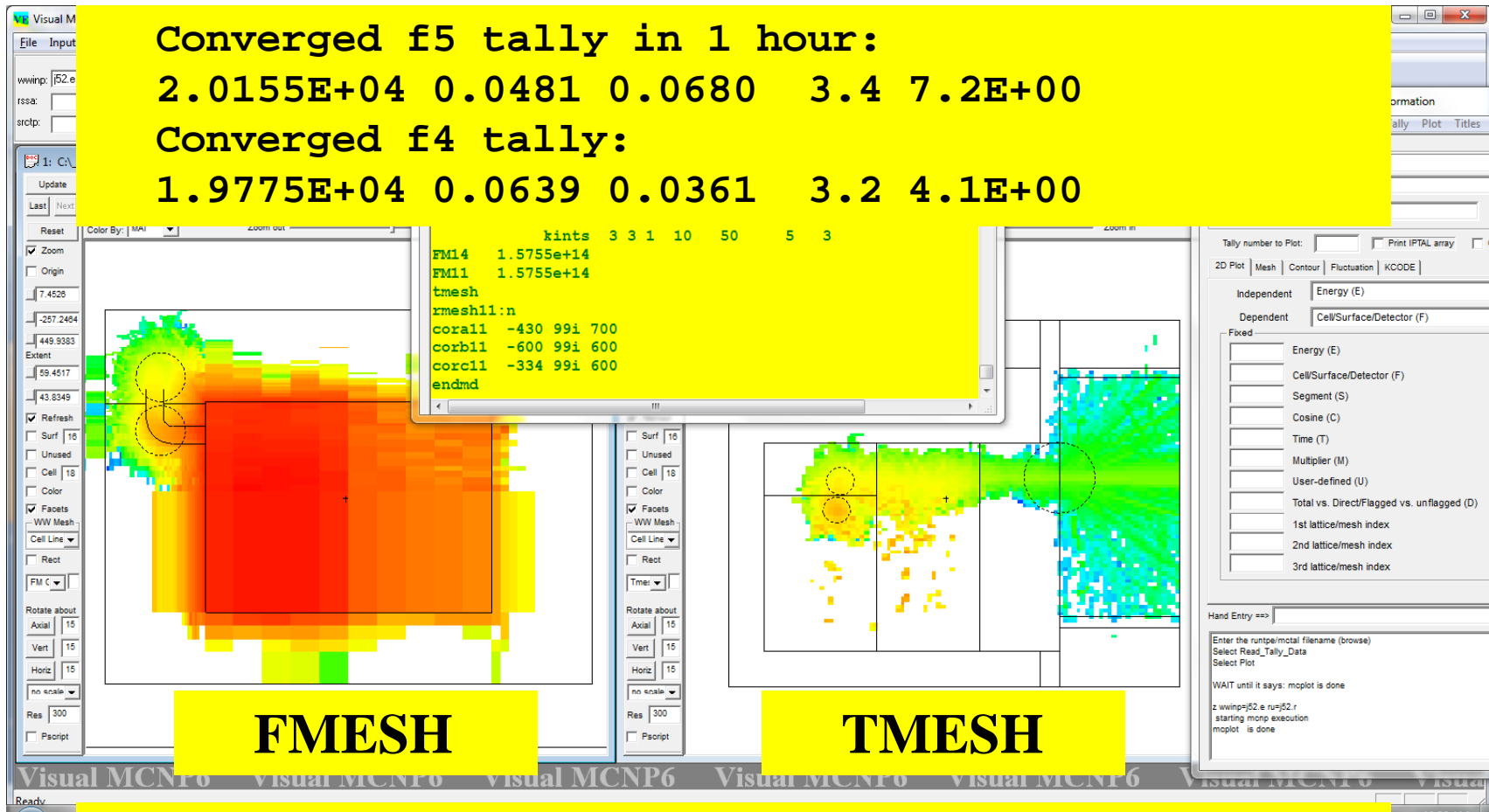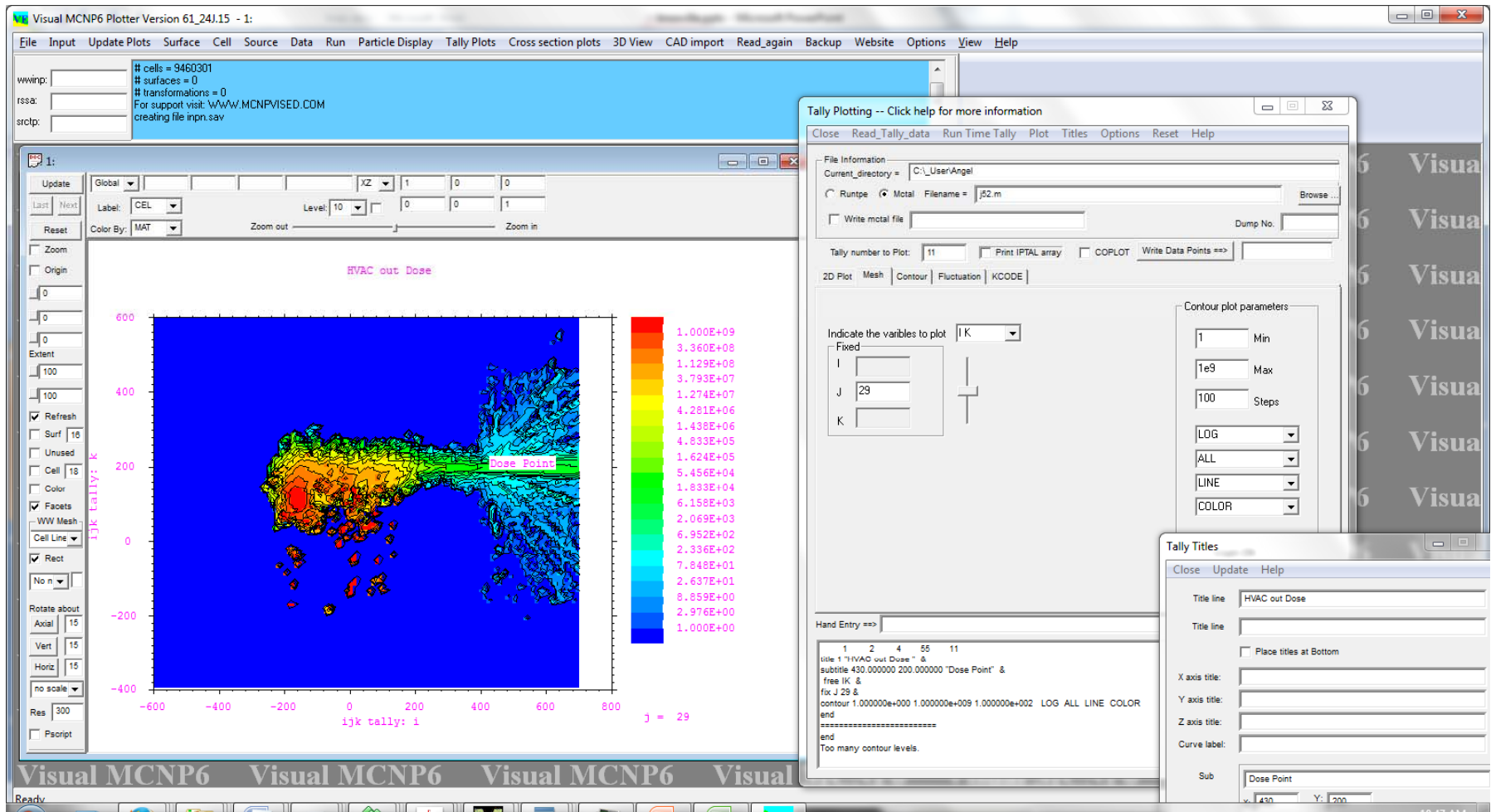
Energy dependent WW Mesh

Tally Mesh

Converged f5 tally in 1 hour:
2.0155E+04 0.0481 0.0680 3.4 7.2E+00
Converged f4 tally:
1.9775E+04 0.0639 0.0361 3.2 4.1E+00

```
                kints  3 3 1 10  50    5  3
FM14   1.5755e+14
FM11   1.5755e+14
tmesh
rmesh11:n
cora11  -430 99i 700
corb11  -600 99i 600
corc11  -334 99i 600
endmd
```

FMESH

TMESH

Original Calculation:
624856   2.2166E+04 0.0452 0.0395 3.2 8.9E-03
Missed VOV decrease rate test
55184 minutes / 38 days

HVAC out TMESH

HVAC in shielding calculation
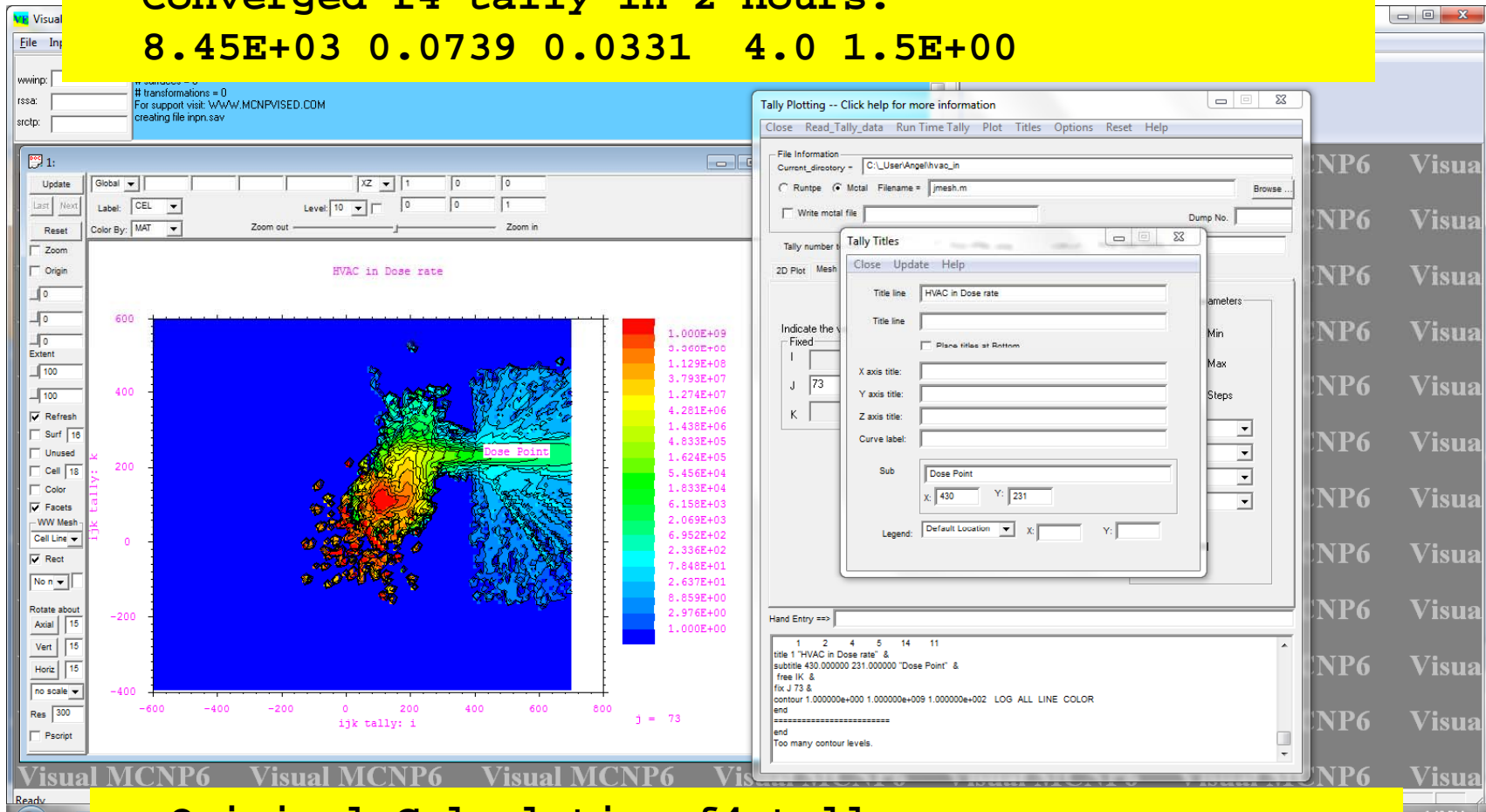
c   ++++ Variance Reduction   ++++++
DD   0.5 1e+5
DXT:n   105 260 108.67 12.5 35
        180 270 114 12.5 35
        196 270 223 12.5 50
        400 270 231.7 12.5 50
c   430 270 230.67 12 30
        100 1e-9
*tr1 -10 -80 25 45 90 0 45 45 0 0 0 0

Original Calculation f4 tally:
7.6176E+03 0.1008 0.1479 2.4 2.0E-04
Missed 4 tests
485007 minutes / 337 days / 0.92 years

HVAC in shielding calculation

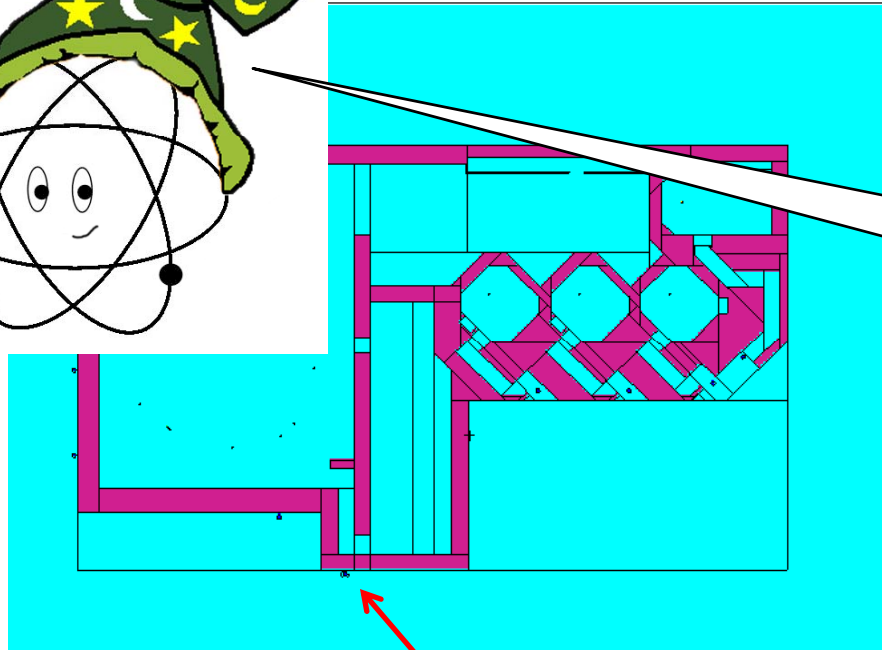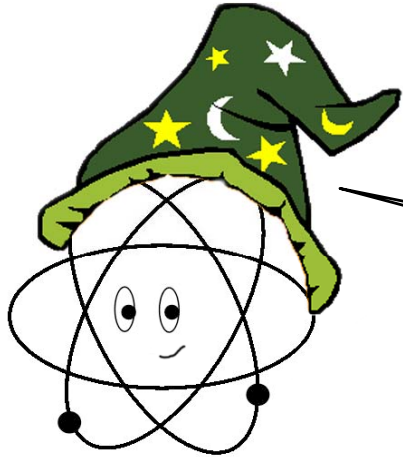**Converged f4 tally in 2 hours:**
8.45E+03 0.0739 0.0331 4.0 1.5E+00

Original Calculation f4 tally:
7.6176E+03 0.1008 0.1479 2.4 2.0E-04
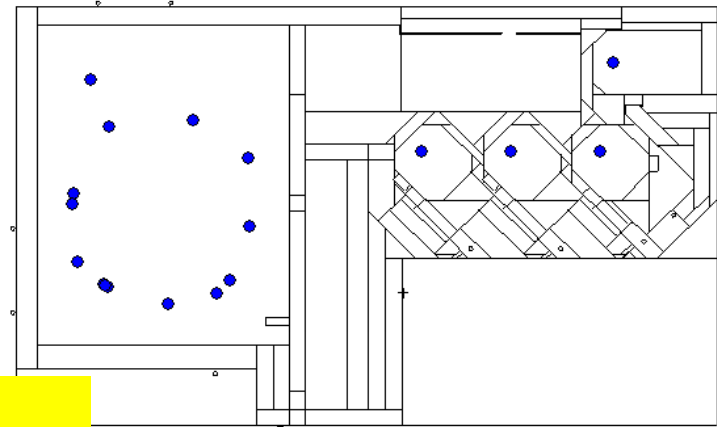**Missed 4 tests**
485007 minutes / 337 days / 0.92 years

The Rest of the Story.

Oyeon Kum – Paper Presented Monday afternoon.
Presented this problem to me to solve using Visual MCNP6.
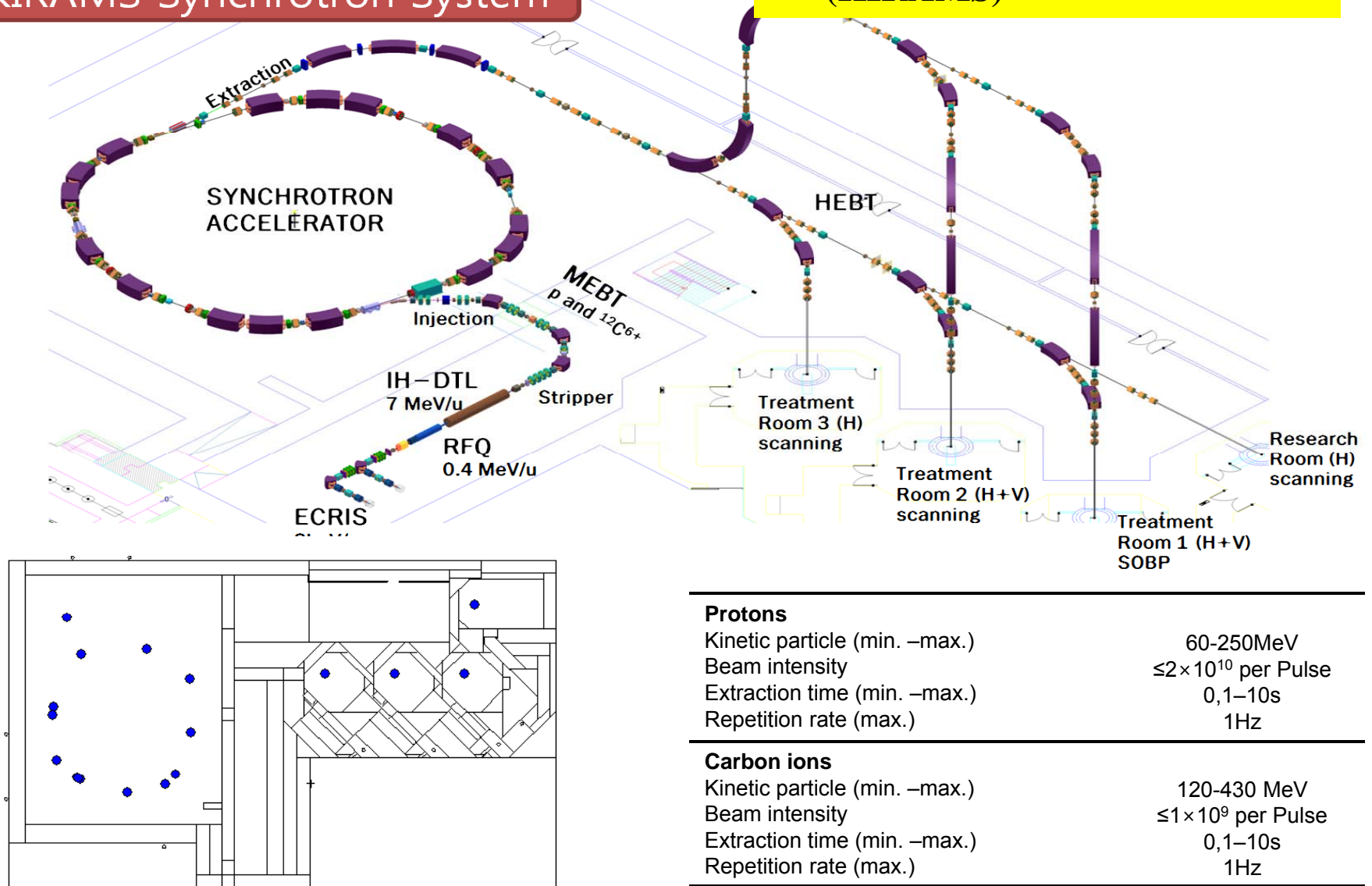
What would you do?

Dose Point

Carbon ion
Source Points

Original calculation
Neutrons produced from a carbon ions:
288 hours on 60 threads − 17280 Hours
= 720 days = 2 years
Does point not converged, RE= 0.21
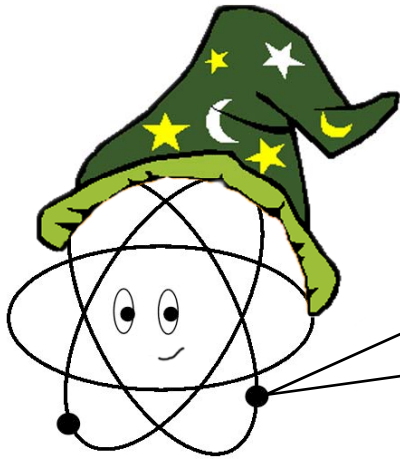
SYNCHROTRON SYSTEM

KIRAMS Synchrotron System

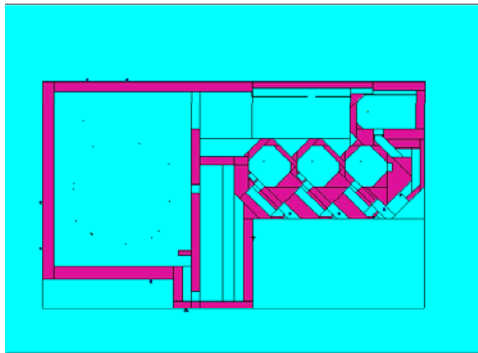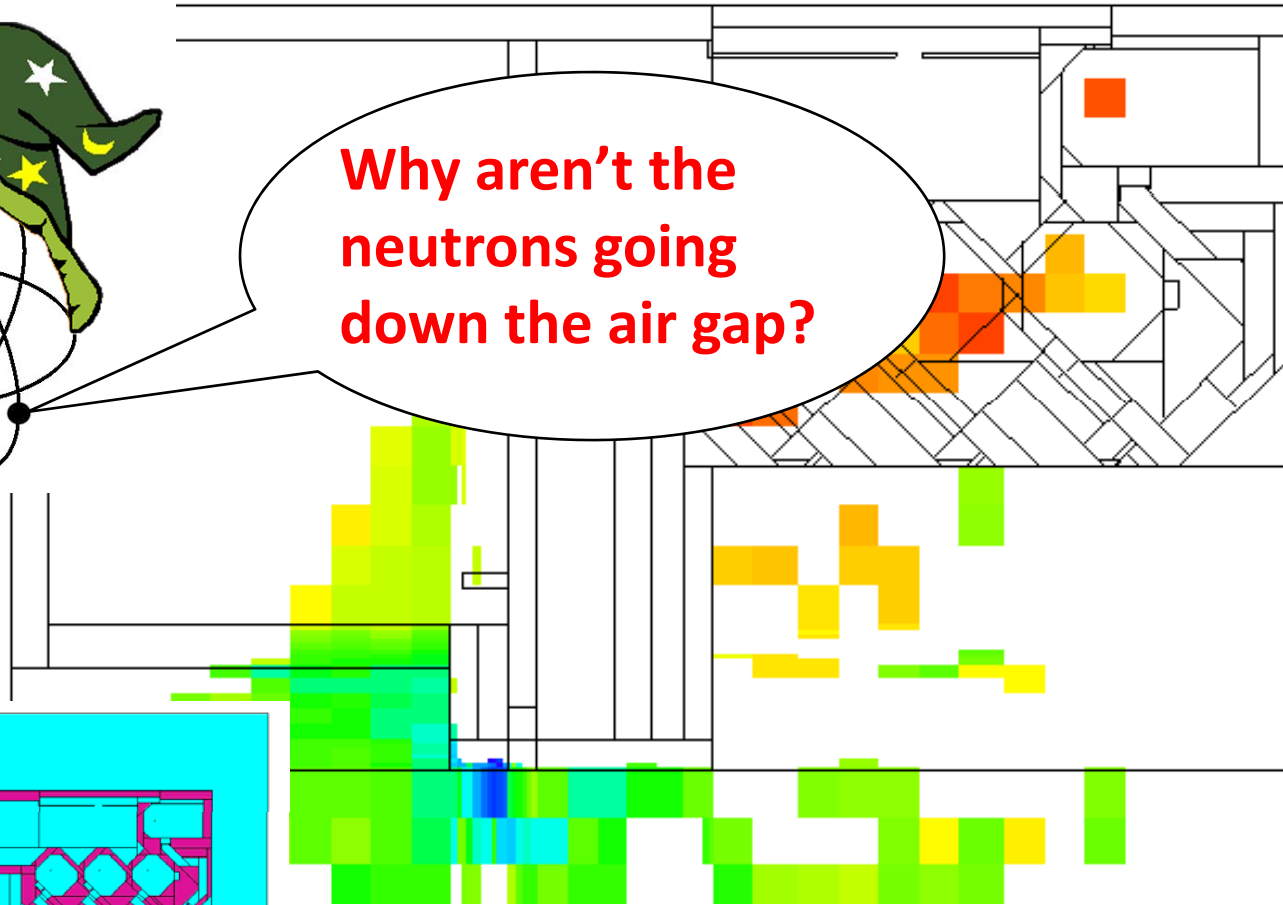| Protons	
Kinetic particle (min. –max.)	60-250MeV
Beam intensity	$\leq 2 \times 10^{10}$ per Pulse
Extraction time (min. –max.)	0,1–10s
Repetition rate (max.)	1Hz

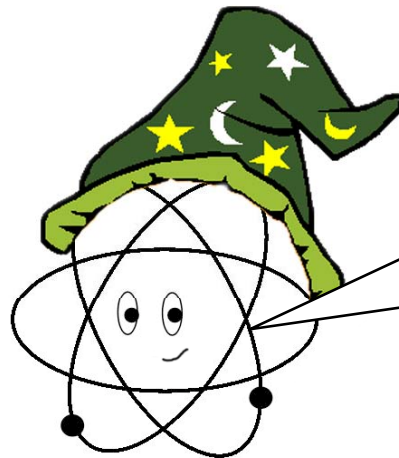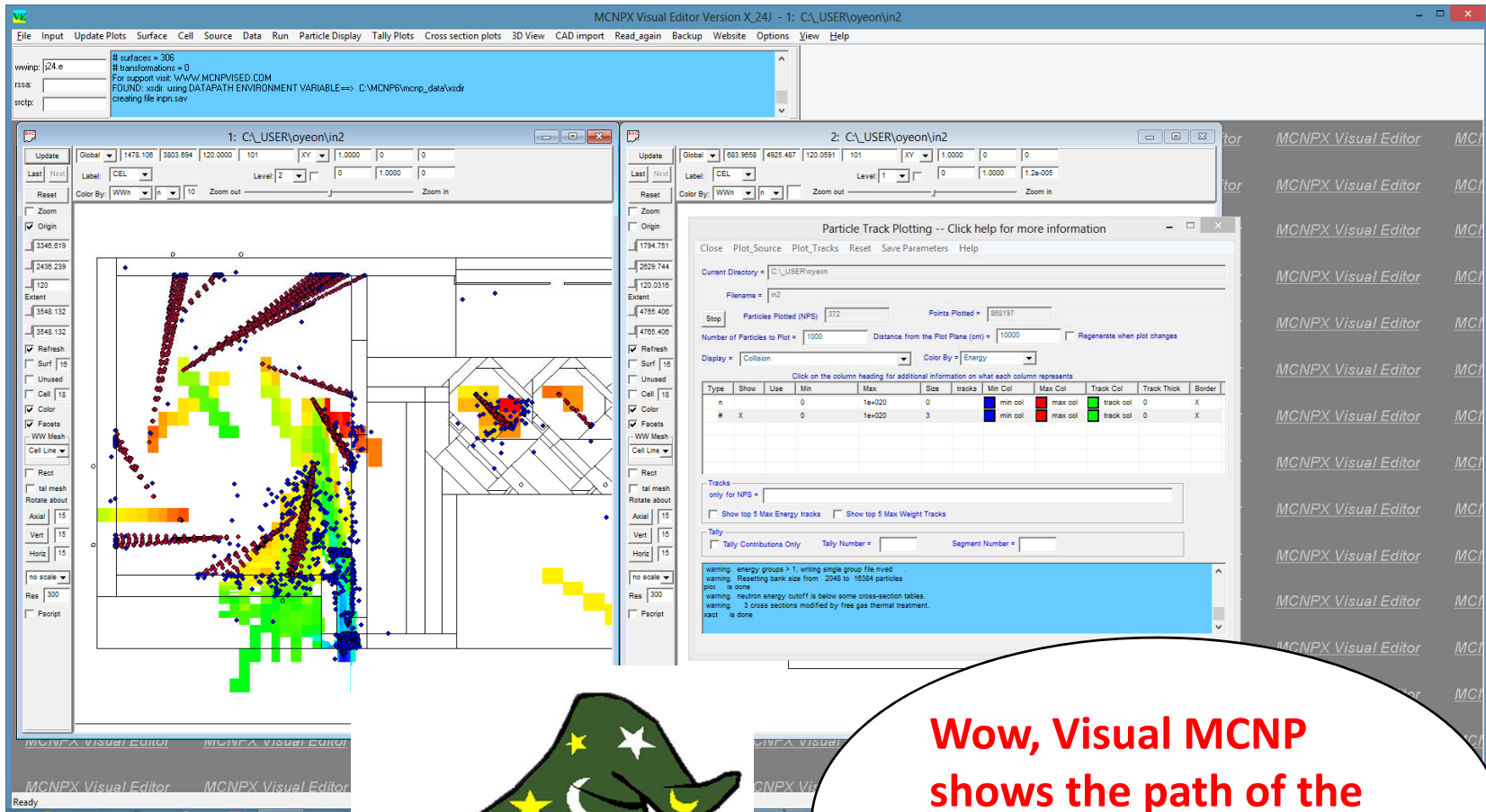| Carbon ions	
Kinetic particle (min. –max.)	120-430 MeV
Beam intensity	$\leq 1 \times 10^{9}$ per Pulse
Extraction time (min. –max.)	0,1–10s
Repetition rate (max.)	1Hz

Add a WW mesh

The Carbon Ions are directional.

Wow, Visual MCNP shows the path of the Carbon ions plotted on top of the WW mesh.
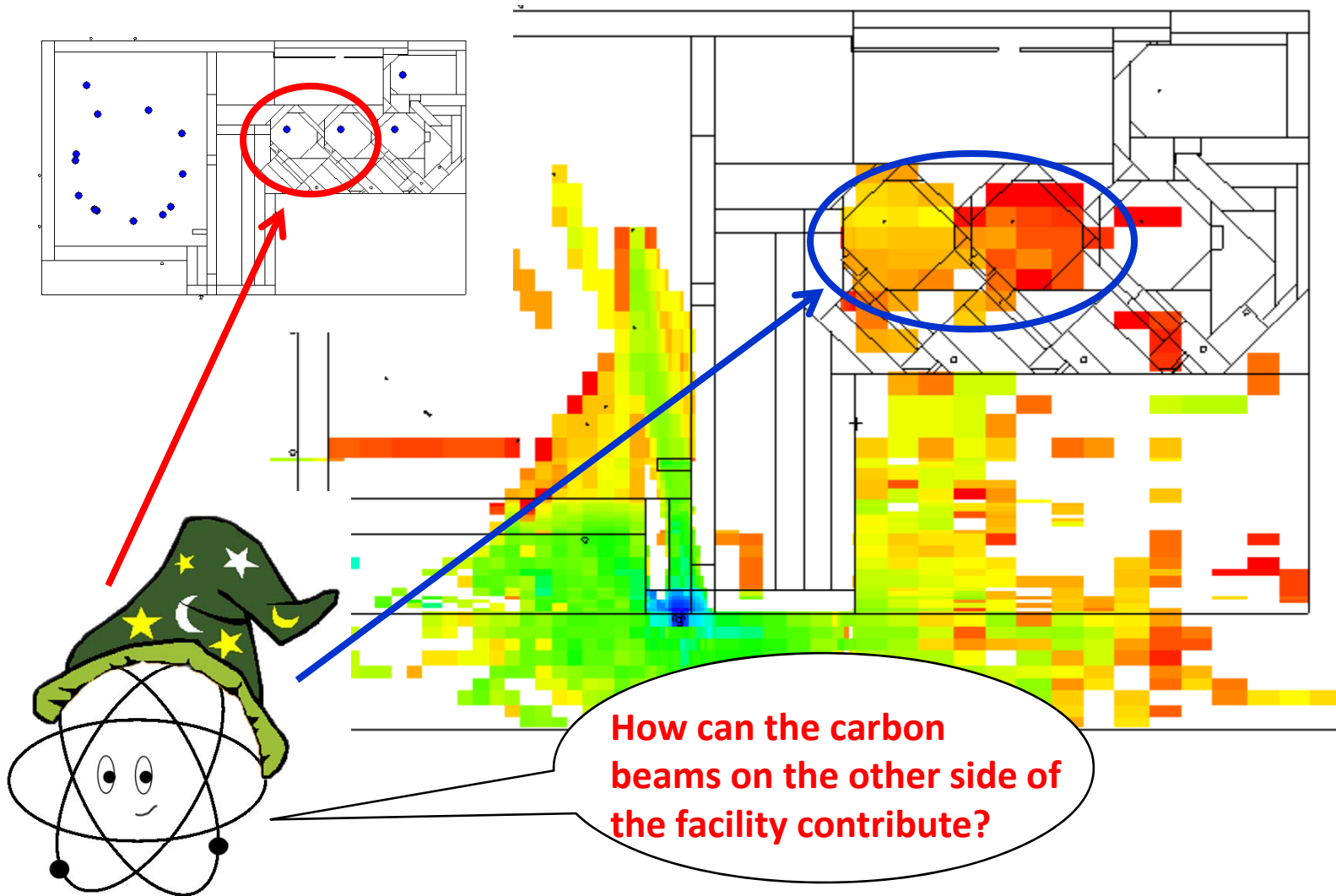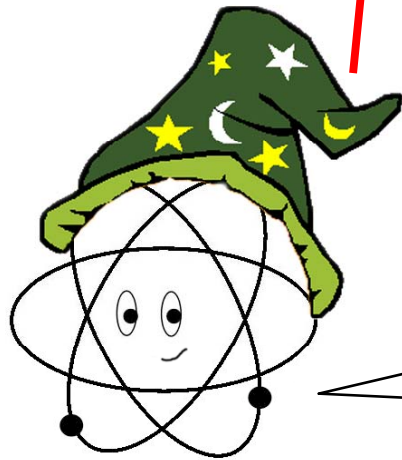
Optimize the WW Mesh
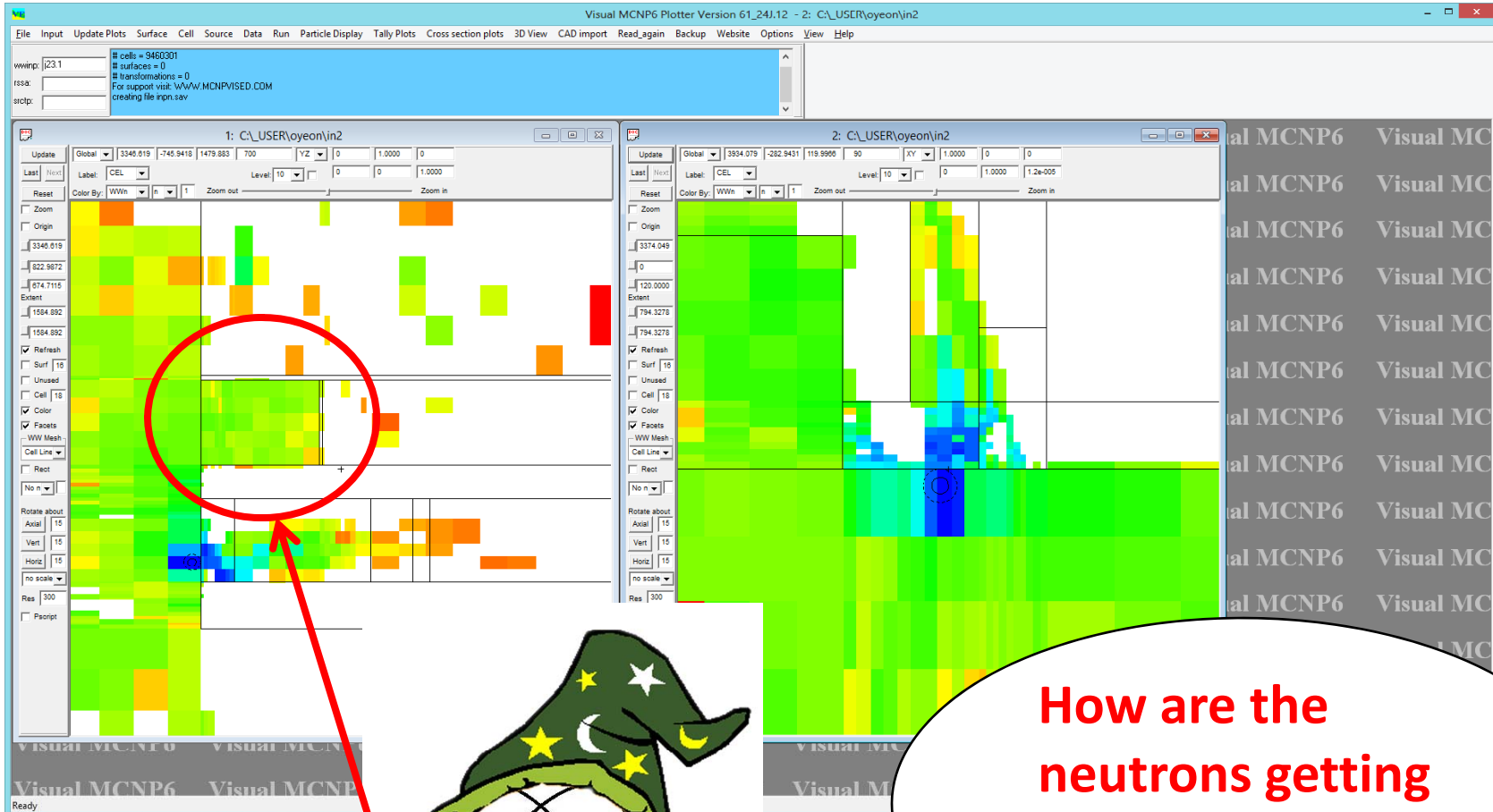
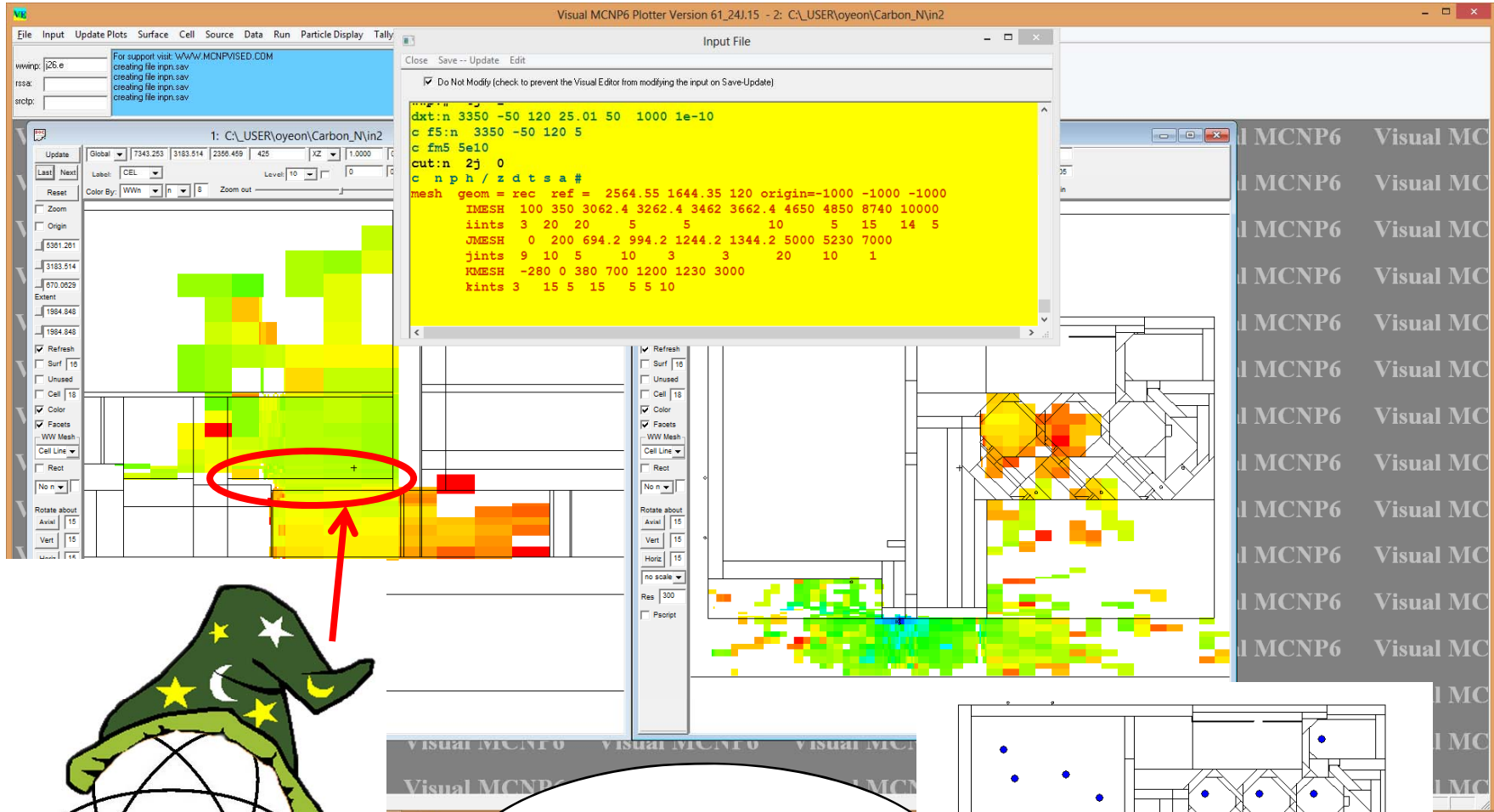
How are the neutrons getting through the ceiling?
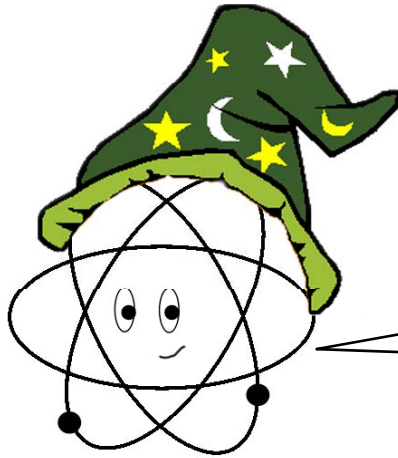
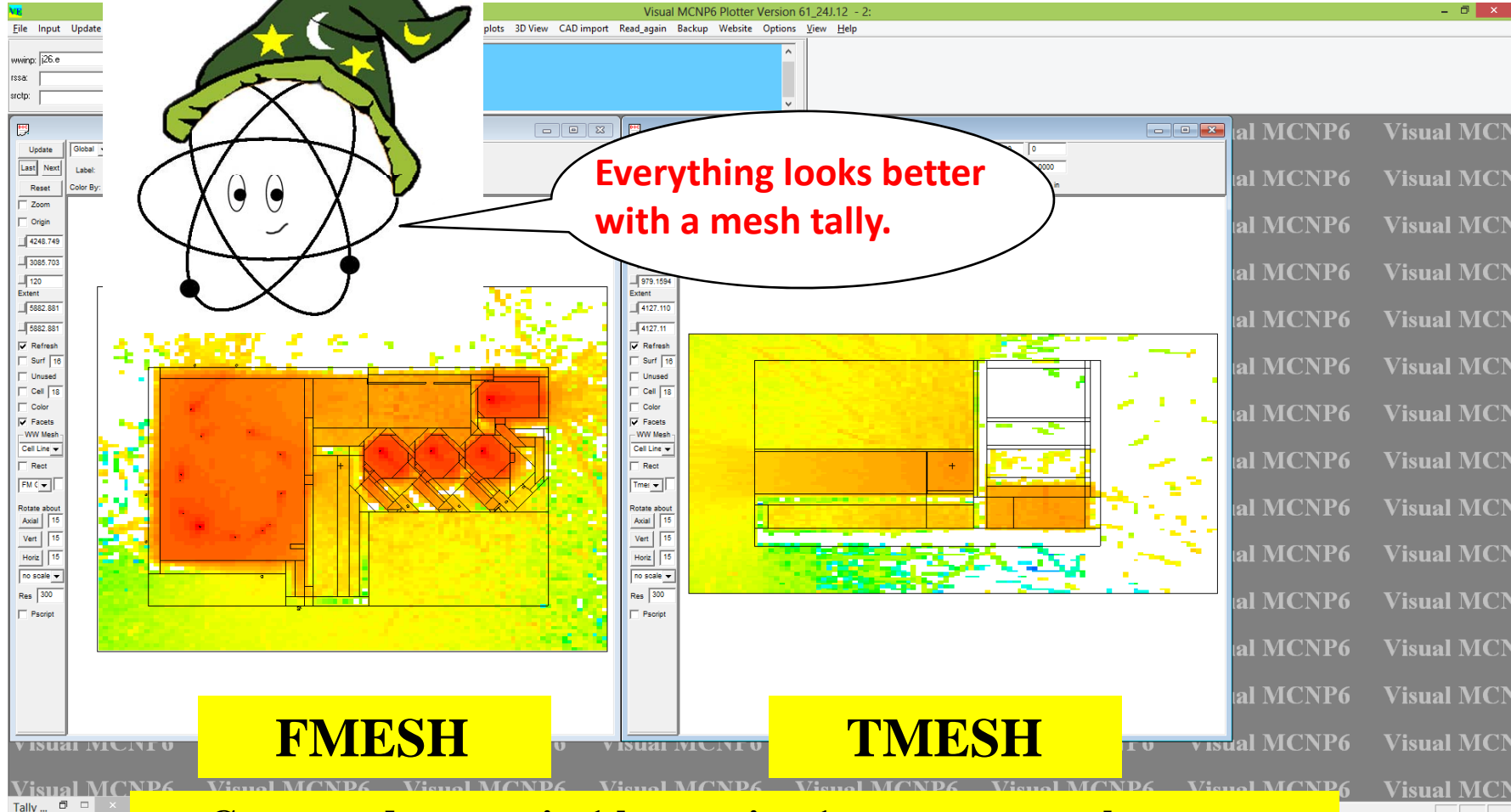# Optimize the WW Mesh

Multiple Source Contributions

The particles are going throw a thinner shield in the ceiling.

Results

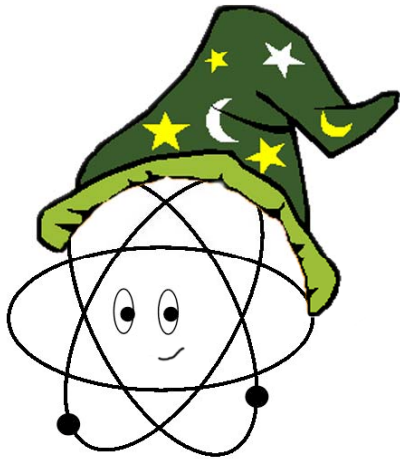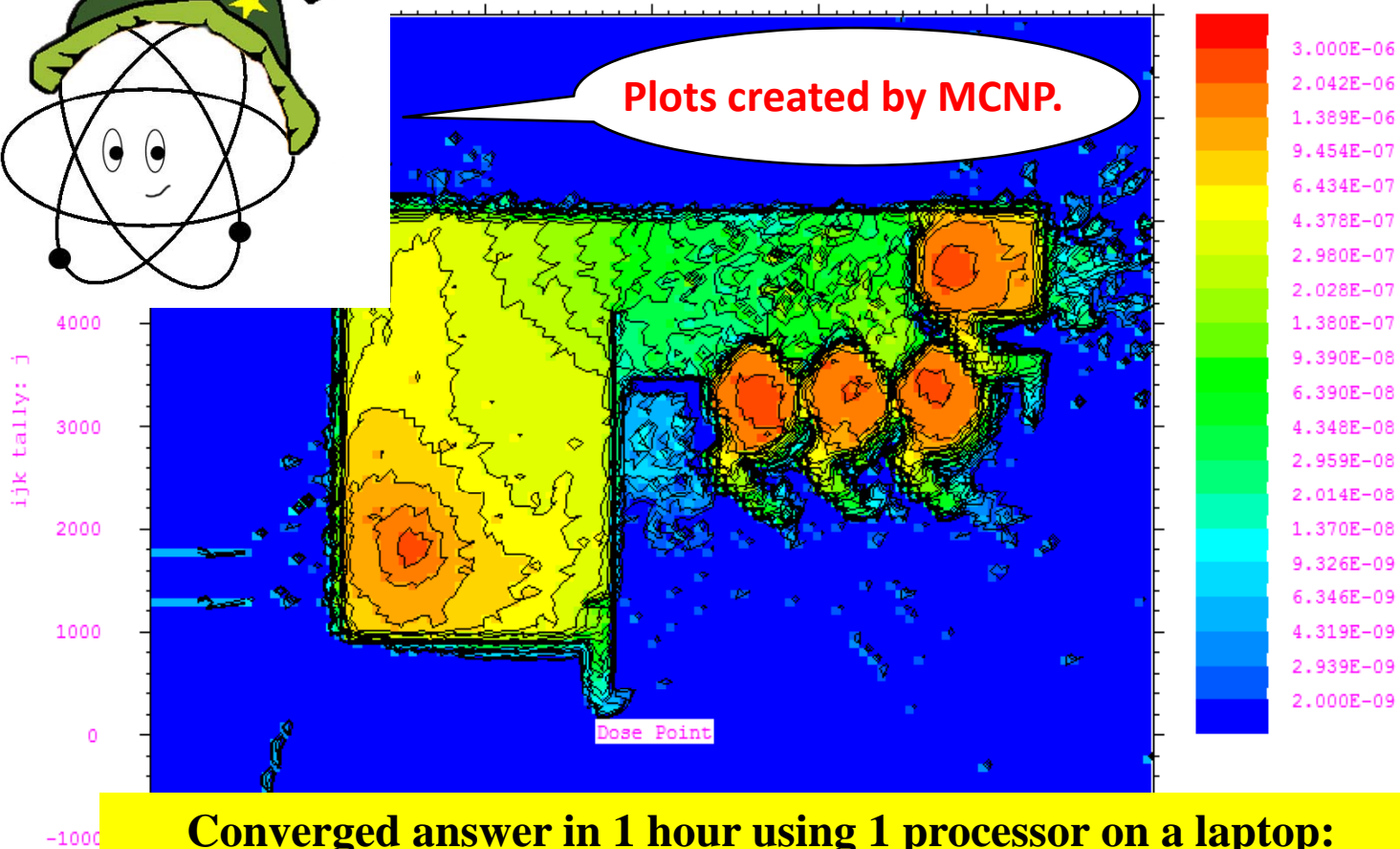**Everything looks better with a mesh tally.**
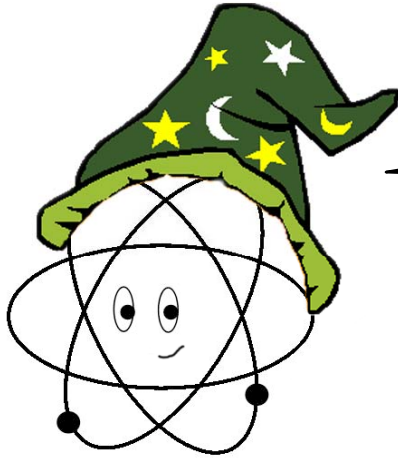
FMESH

TMESH

Converged answer in 1 hour using 1 processor on a laptop:
4.4262E-07 0.0614 0.0824 5.8 4.4E+00
Problem was presented on Monday, solved on Tuesday.

TMESH MCTAL Plots (XY)

Converged answer in 1 hour using 1 processor on a laptop:
4.4262E-07 0.0614 0.0824 5.8 4.4E+00
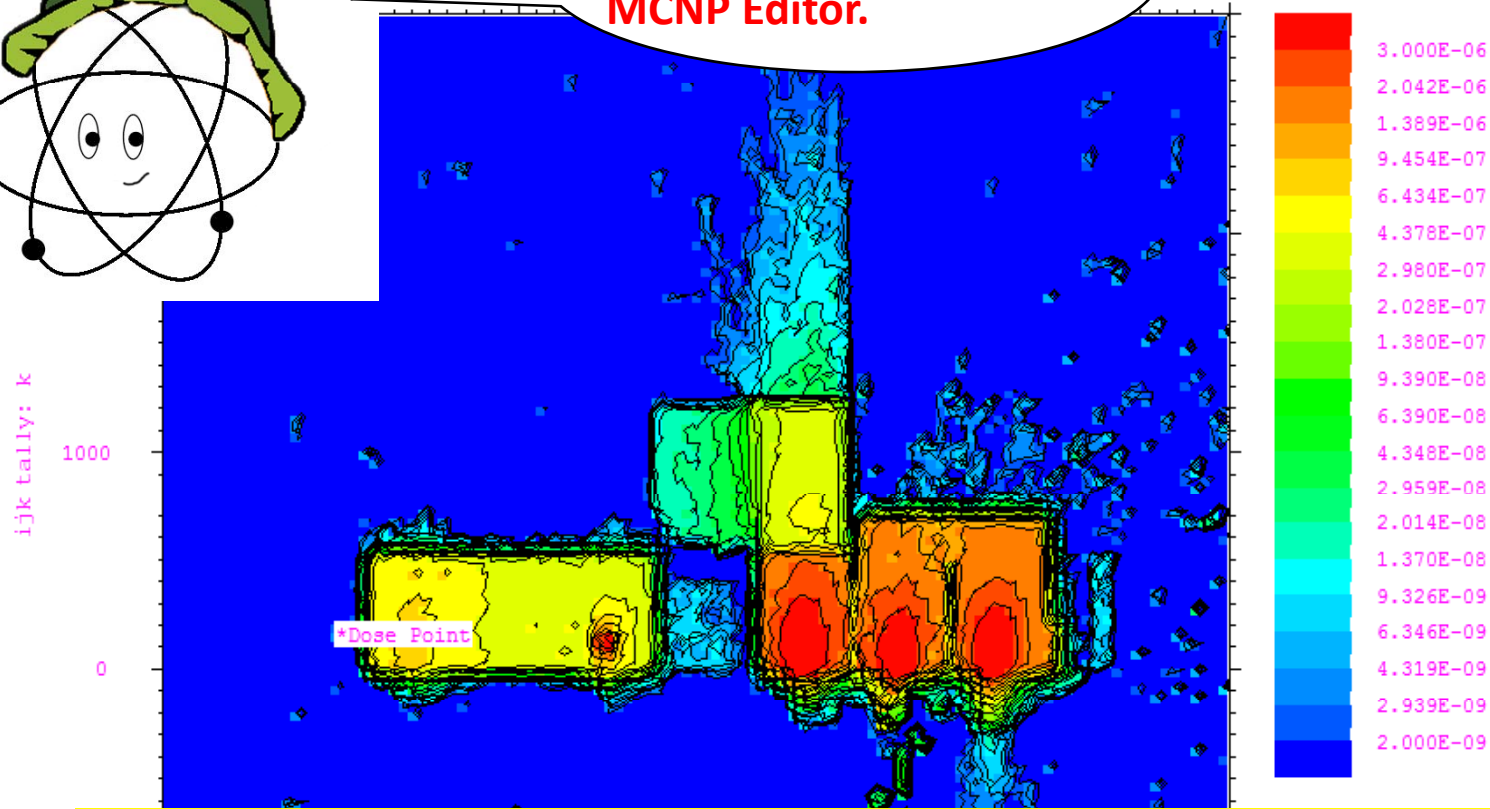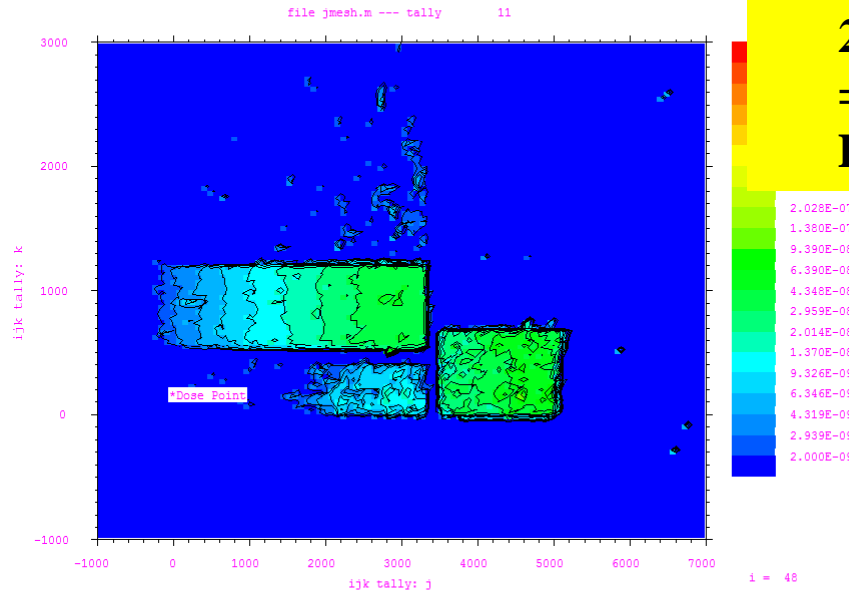Problem was presented on Monday, solved on Tuesday.

TMESH MCTAL Plots (XZ)

Converged answer in 1 hour using 1 processor on a laptop:
4.4262E-07 0.0614 0.0824 5.8 4.4E+00
Problem was presented on Monday, solved on Tuesday.

TMESH MCTAL Plots (YZ)

Original calculation:
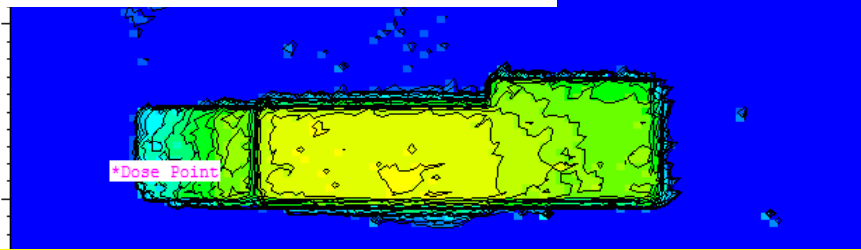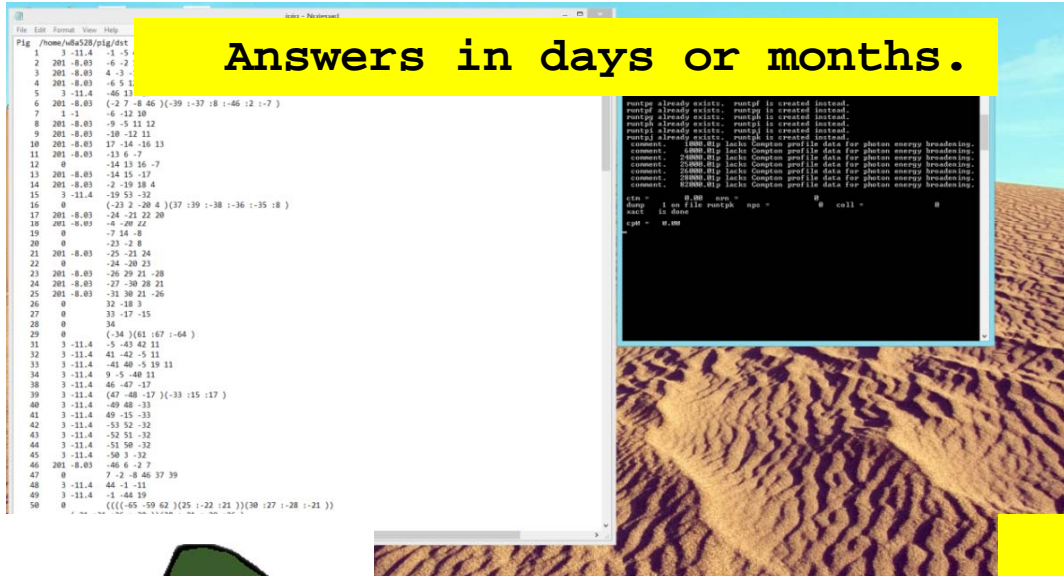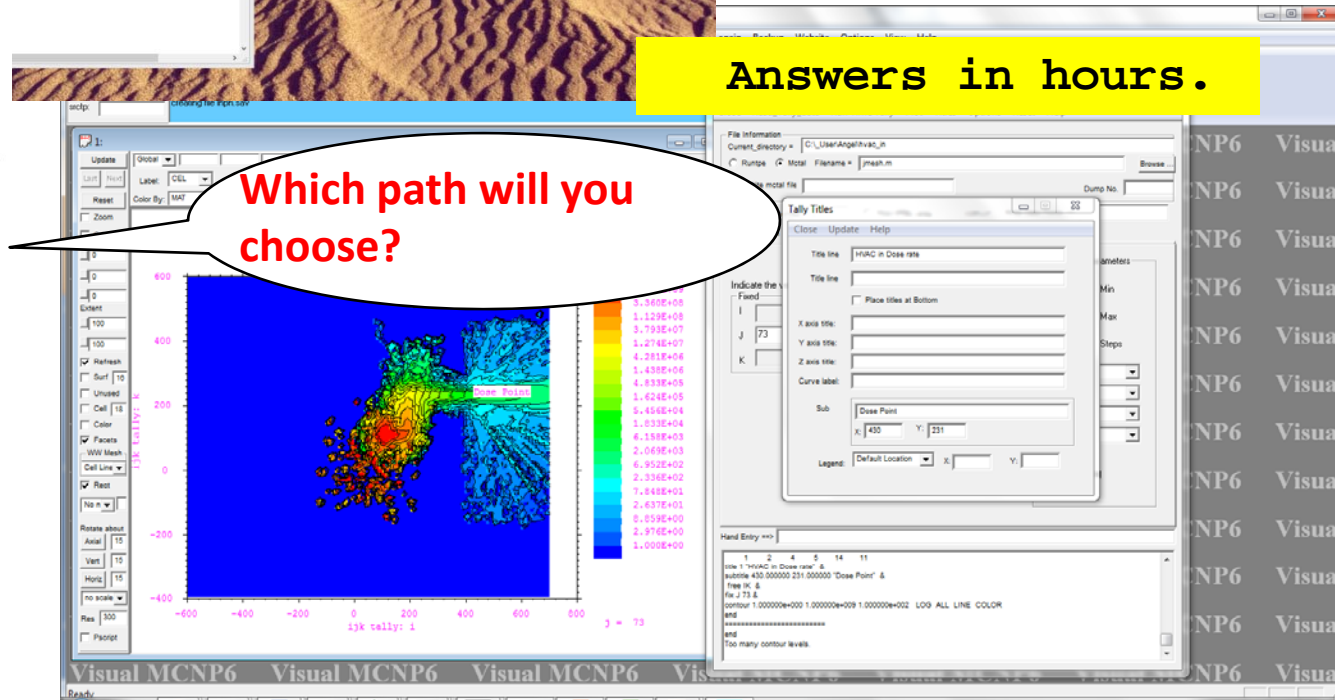288 hours on 60 threads = 17280 Hours
= 720 days = 2 years
Does point not converged, RE= 0.21

Converged answer in 1 hour using 1 processor on a laptop:
4.4262E-07 0.0614 0.0824 5.8 4.4E+00
Problem was presented on Monday, solved on Tuesday.

How will you do your calculations?