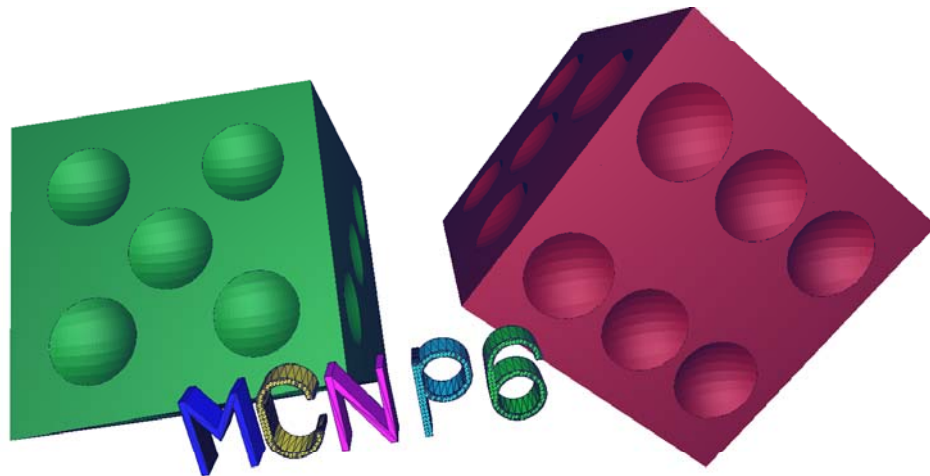


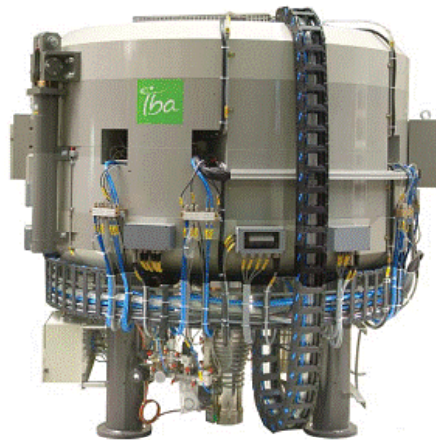
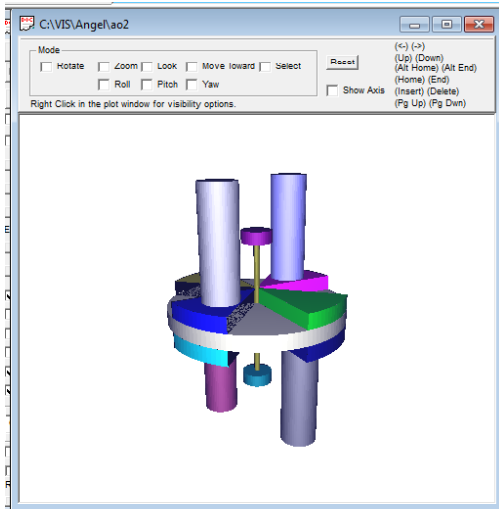
# An MCNP6 Version of the Visual Editor

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

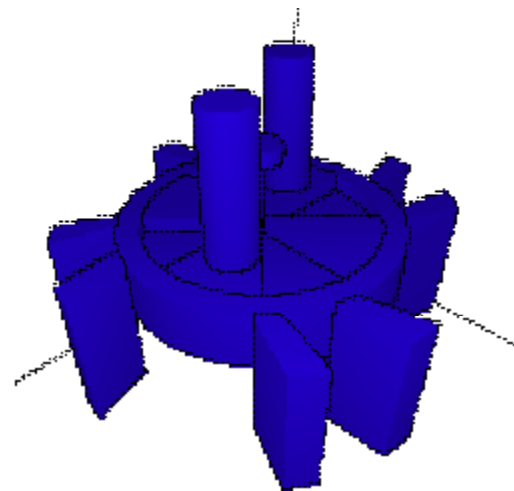
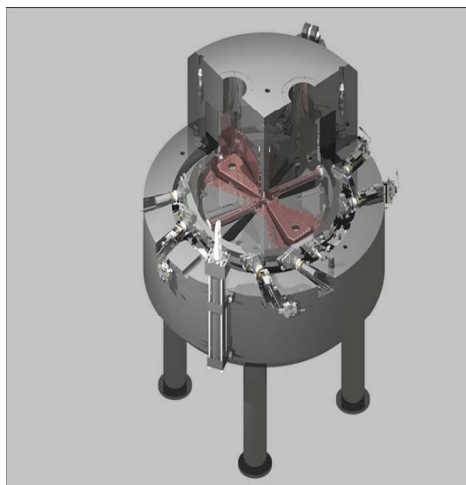
A 3D rendering of the text "MCNP6" in a multi-colored, blocky font. The letters are blue, green, purple, and yellow, with a slight shadow effect.

Randy Schwarz  
Visual Editor Consultants  
[www.mcnpvised.com](http://www.mcnpvised.com)

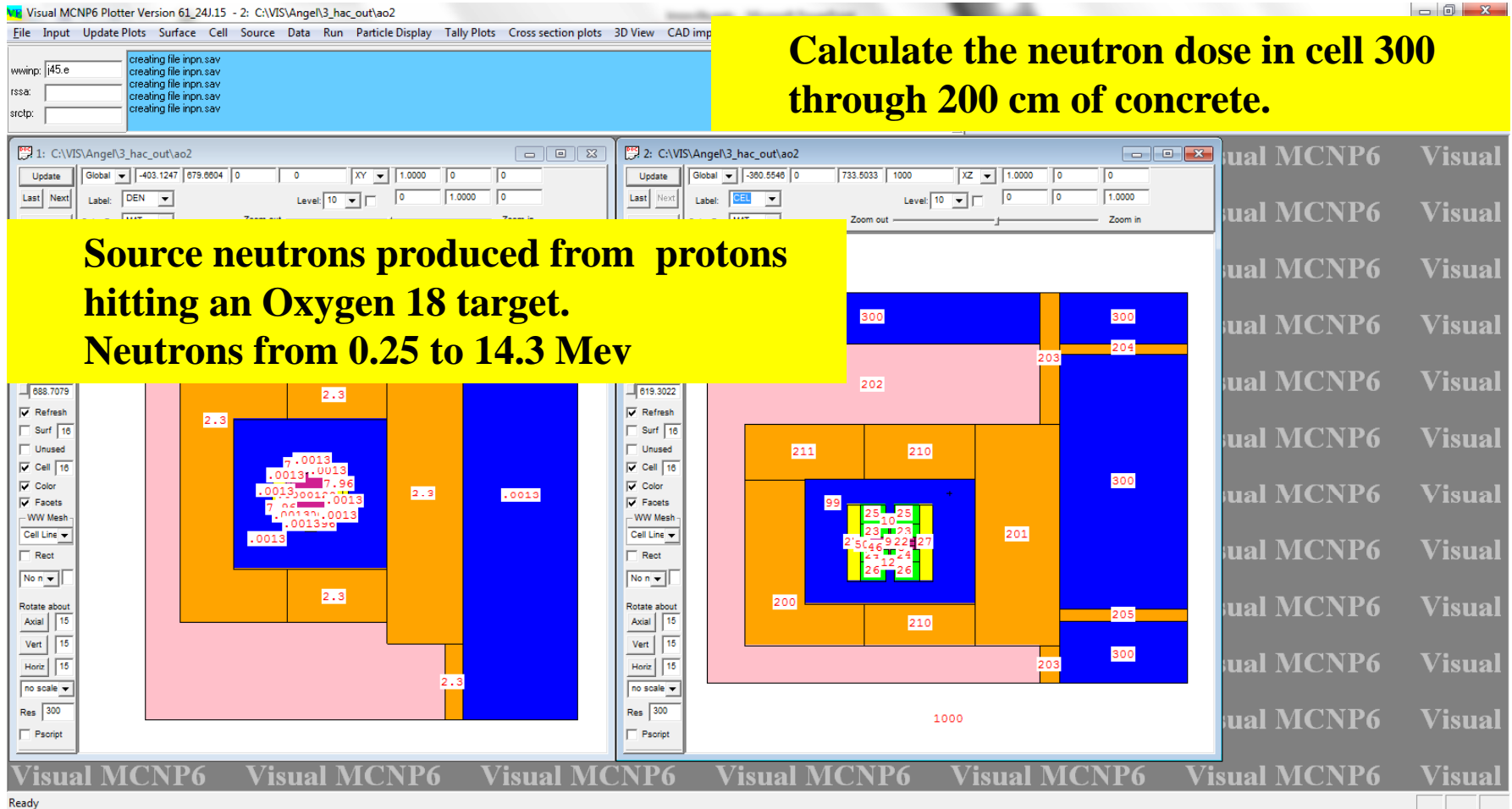
# Case Study



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

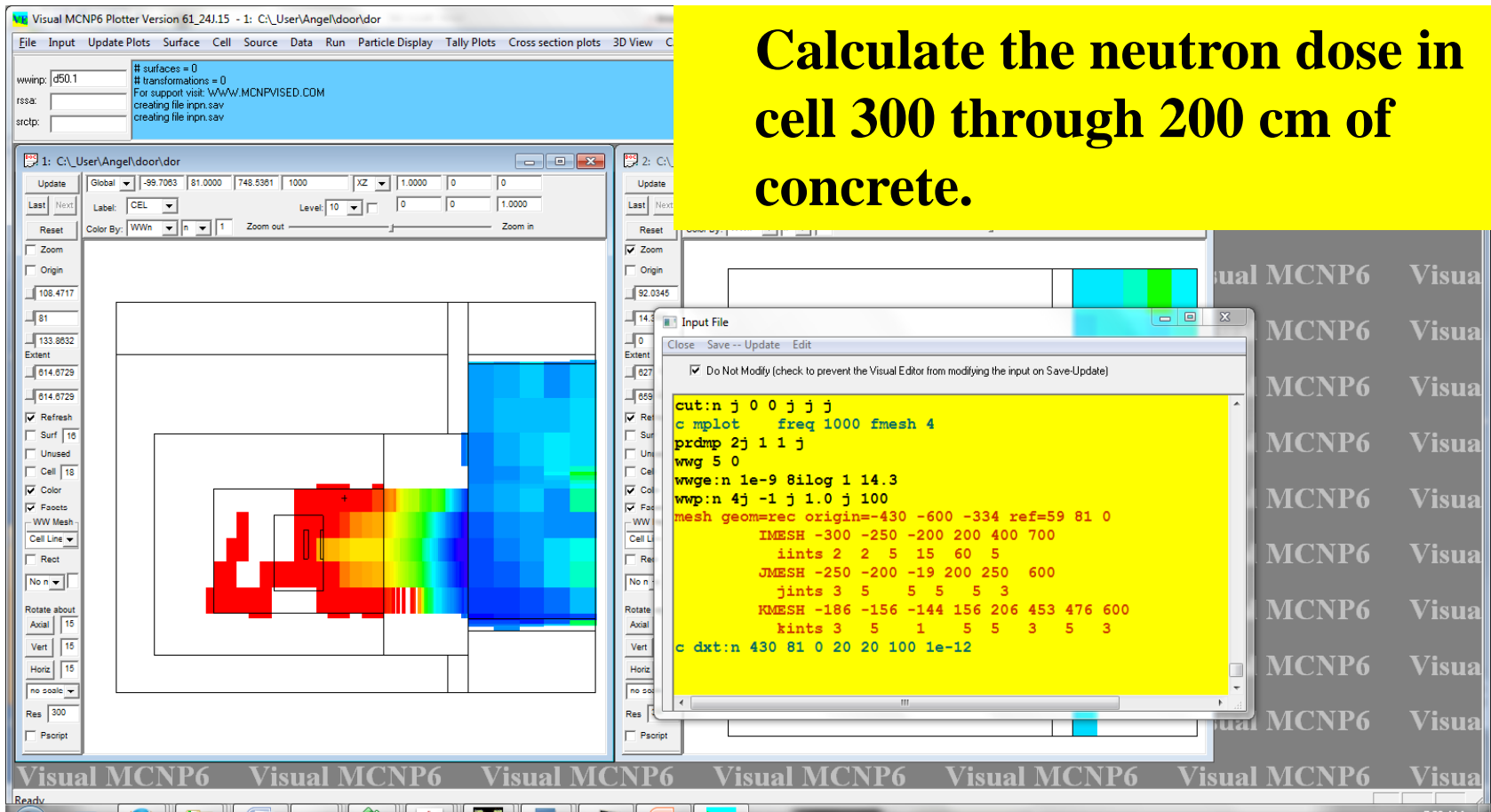


# Neutron Shielding Calculations



# Energy dependent WW Mesh

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



# Bulk Neutron Dose - FMESH

Visual MCNP

File Input

wwinp: d50.1  
rssa:  
srctp:

**Converged f5 tally in 4 hours:  
624856 1.3017E+02 0.0319 0.0097 4.3 4.1E+00**

1: C:\User\Angel\door\dor

2: C:\User\Angel\door\dor

Input File

```

KAMESH -186 -156 -144 156 206 453 4
kints 3 5 1 5 5 3 5
c dxt:n 430 81 0 20 20 100 1e-12
fmesh24:n geom=rec origin=-430 -600 -334
IMESH 700
iints 99
JMESH 600
jints 99
KMESH 600
kints 99
FM14 1.5755e+14
FM11 1.5755e+14
tmesh
imesh11:n
cora11 -430 99i 700
corb11 -600 99i 600
corc11 -334 99i 600
endmtd

```

File Information

Current\_directory = C:\User\Angel\door

Runtime Metal Filename = jmesh.r

Tally number to Plot: Print IPTAL array COPLOP Write Data Points ==>

2D Plot Mesh Contour Fluctuation KCODE

Independent Energy (E)

Dependent Cell/Surface/Detector (F)

Fixed

Energy (E)

Cell/Surface/Detector (F)

Segment (S)

Cosine (C)

Time (T)

Multiplier (M)

User-defined (U)

Total vs. Direct/Flagged vs. unflagged (D)

1st lattice/mesh index

2nd lattice/mesh index

3rd lattice/mesh index

Hand Entry ==>

Enter the runtime/metal filename (browse)

Select Read\_Tally\_Data

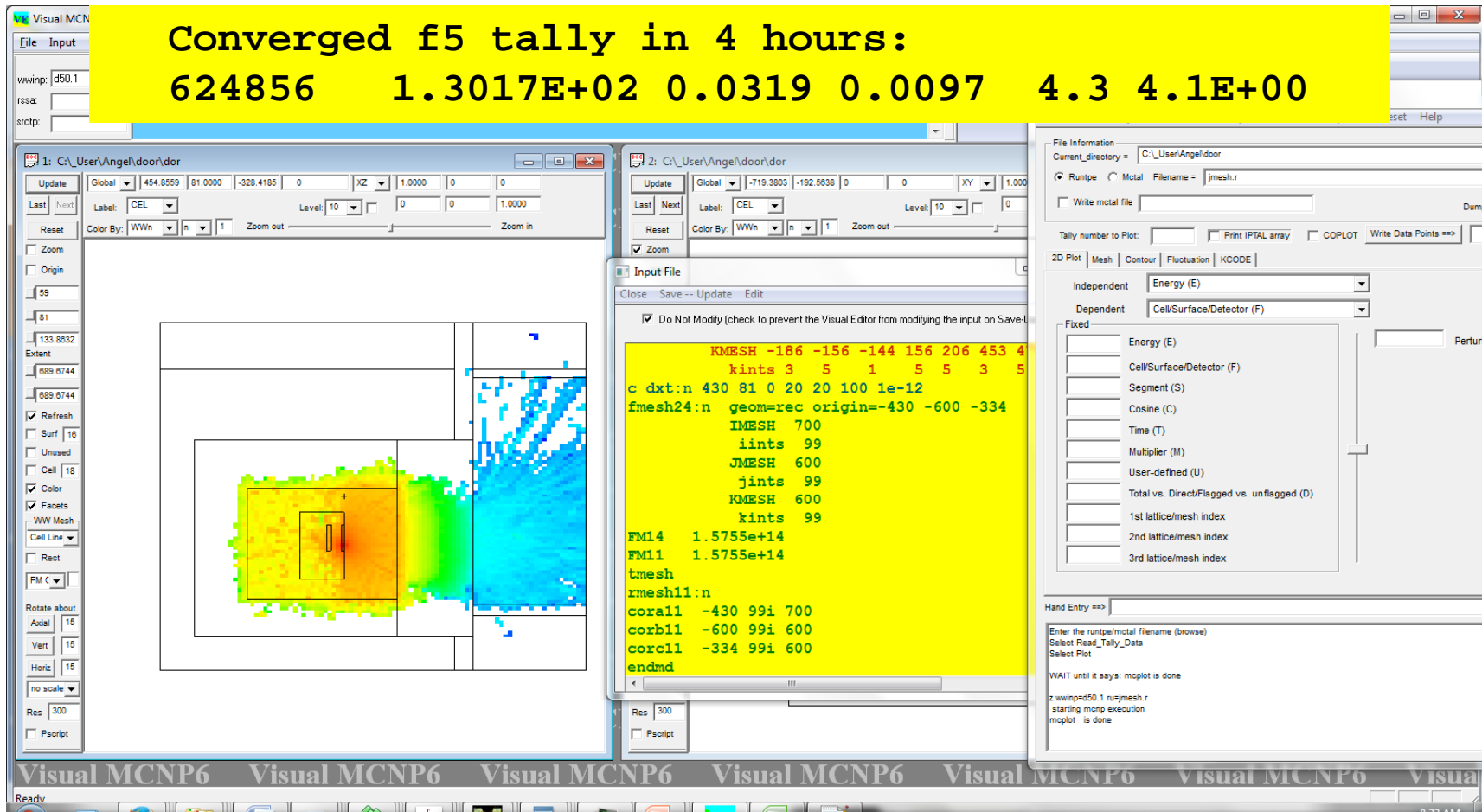
Select Plot

WAIT until it says: mplot is done

c wwinp=d50.1 run=jmesh.r  
starting momp execution  
mplot is done

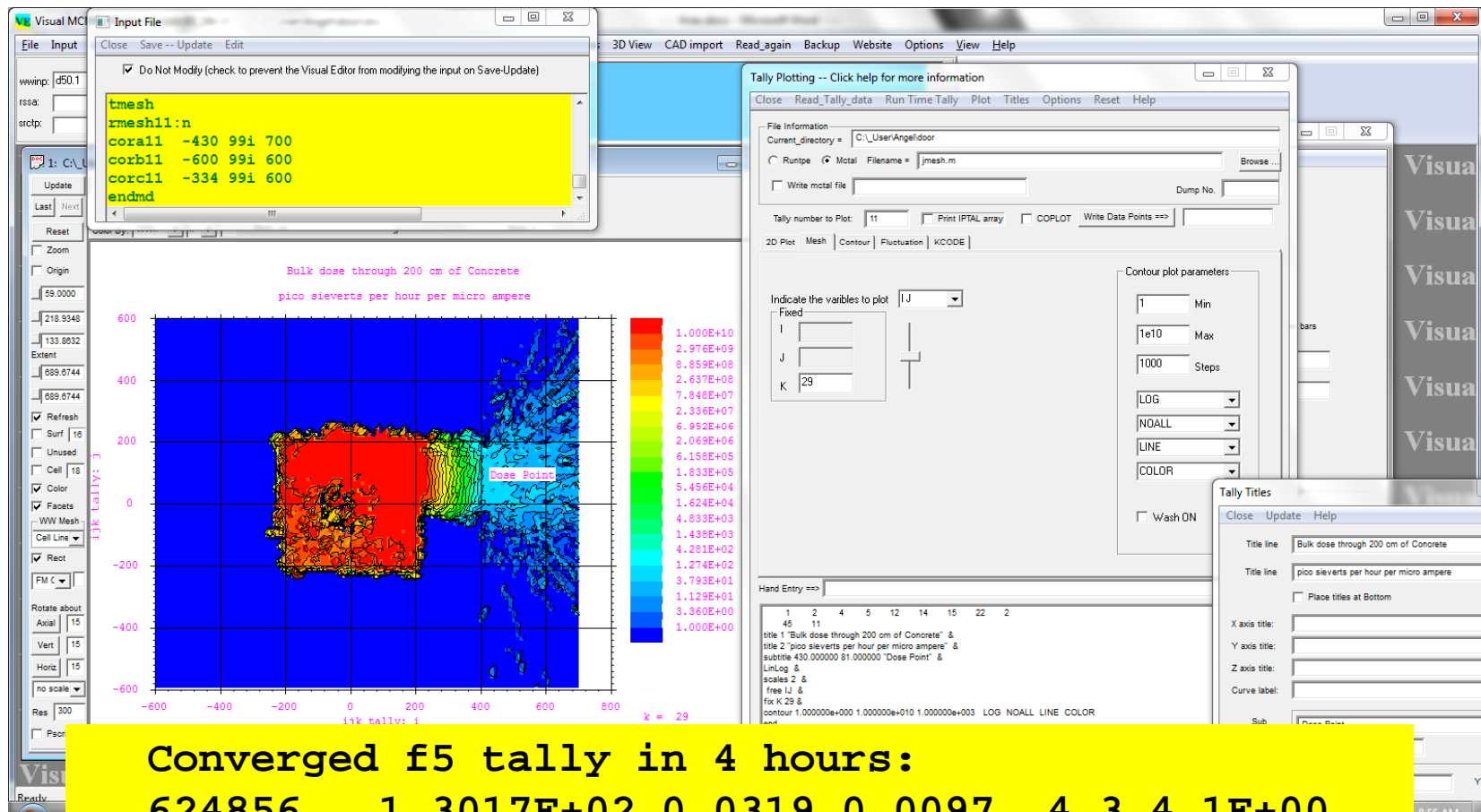
Visual MCNP6 Visual MCNP6 Visual MCNP6 Visual MCNP6 Visual MCNP6 Visual MCNP6 Visual

Ready

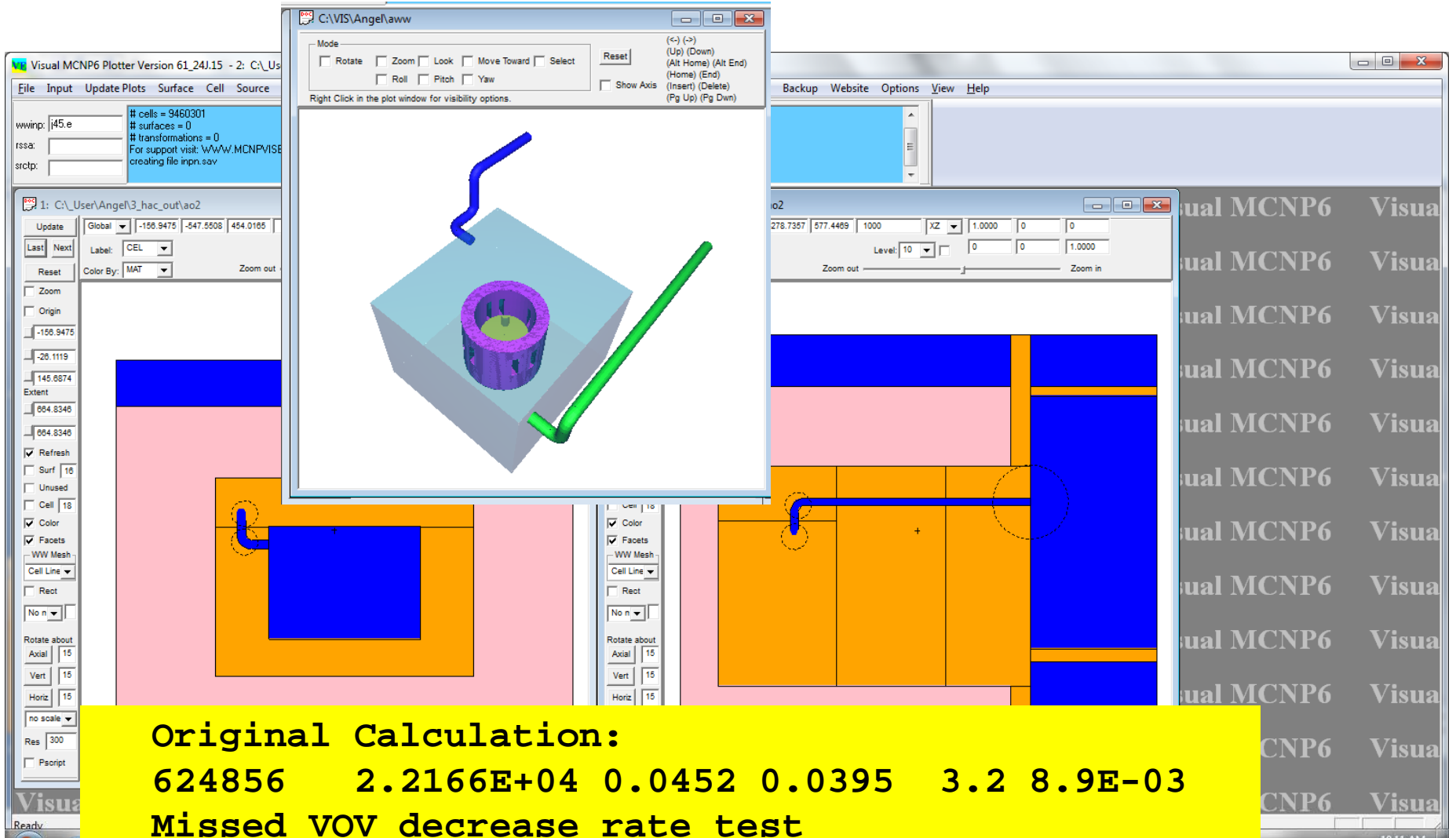


# Bulk Neutron Dose - TMESH

Contours created from reading the MCTAL file.



# HVAC out shielding calculation



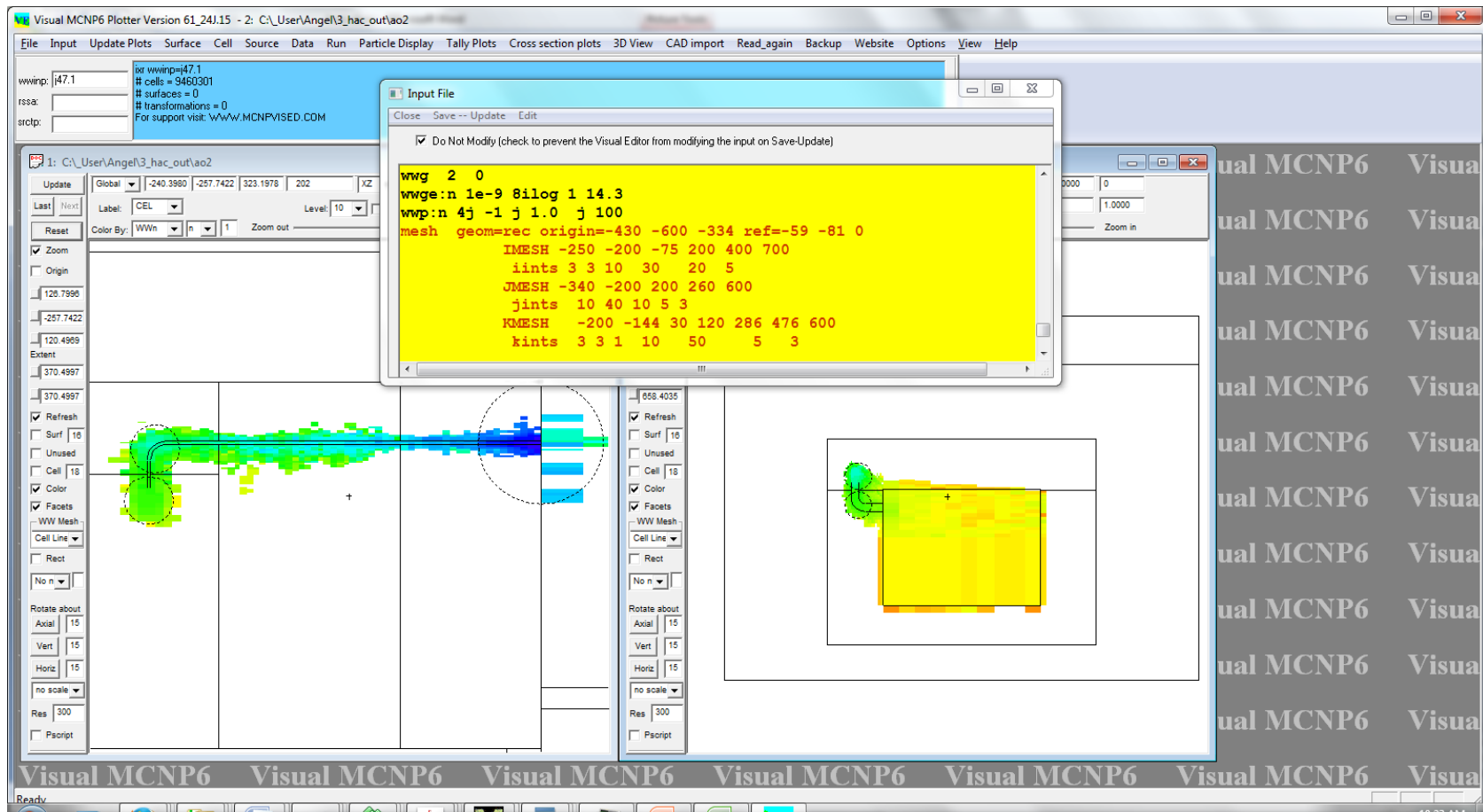
**Original Calculation:**

**624856    2.2166E+04   0.0452   0.0395   3.2   8.9E-03**

**Missed VOV decrease rate test**

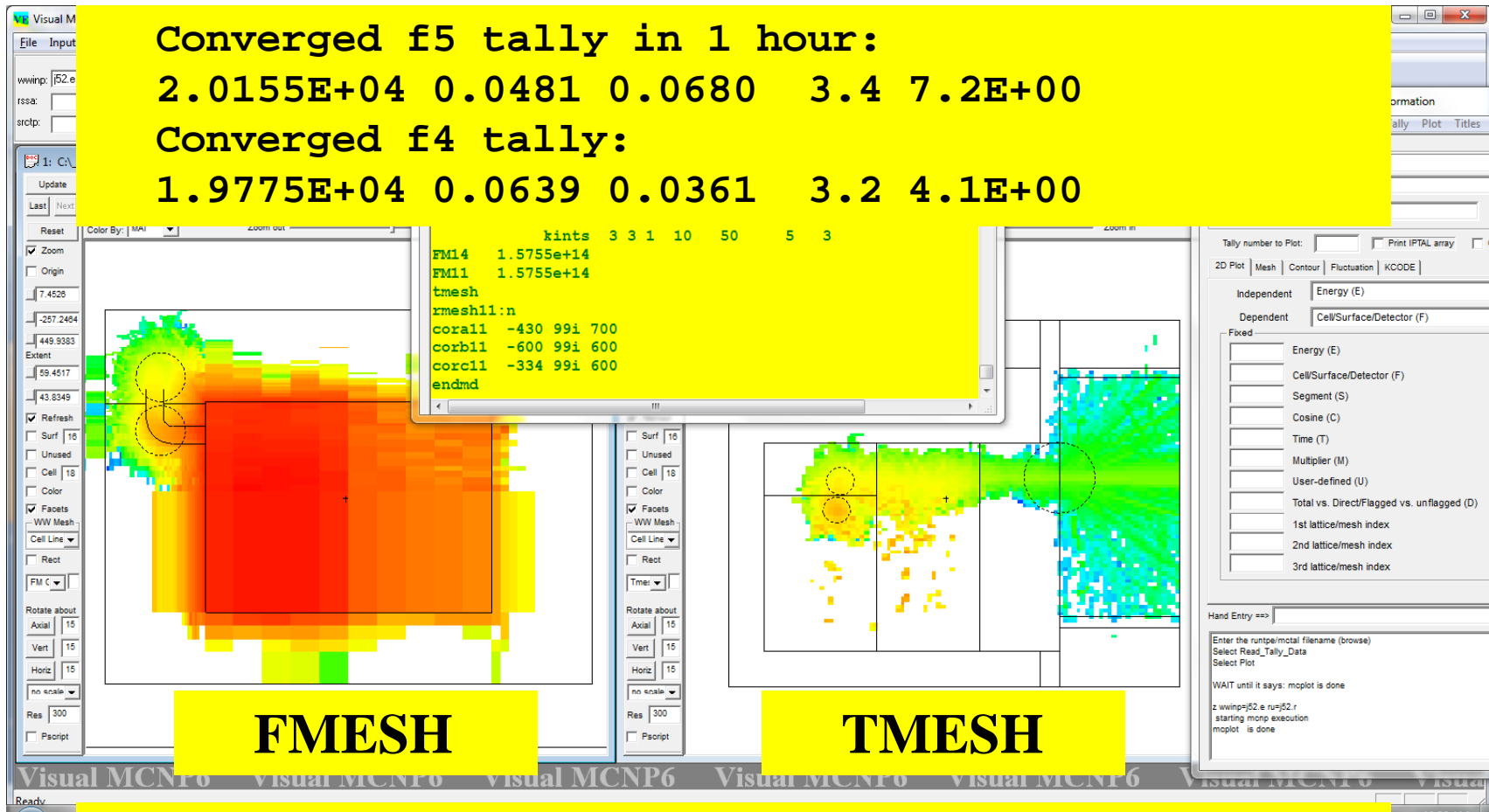
**55184 minutes / 38 days**

# Energy dependent WW Mesh





# Tally Mesh



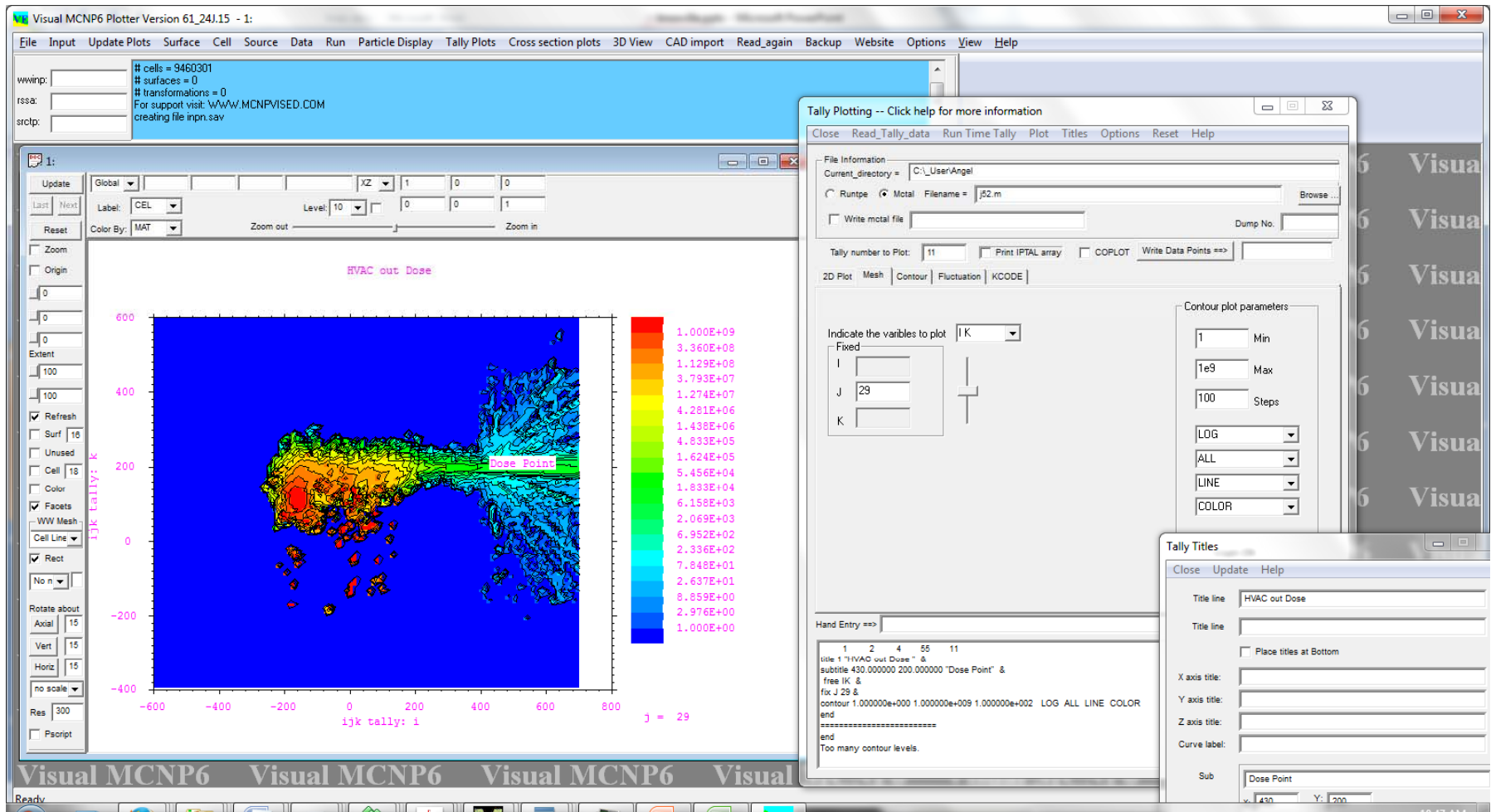
Original Calculation:

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

Visual MCNP6 Plotter Version 61.24J.15 - 2: C:\\_User\Angel\hvac\_in

File Input Update Plots Surface Cell Source Data Run Part

wwinp: k23.e # cells = 9460301  
 rssa: # surfaces = 0  
 srcfp: # transformations = 0  
 For support visit: WWW.MCNPVISED.COM

1: C:\\_User\Angel\hvac\_in.edi

Update Global 101.0324 -934.0861 453.0820 1000 YZ

Last Next Label: CEL Level: 10

Reset Color By: MAT Zoom out

Zoom

Origin

101.0324

-12.0502

131.3377

Extent

825.3821

825.3821

Refresh

Surf 10

Unused

Cell 18

Color

Facets

-WW Mesh-

Cell Line

Rect

No n

Rotate about

Axial 15

Vert 15

Horiz 15

no scale

Res 300

Pscrip

Visual

Ready

C:\VIS\Angel\aww

Mode

Rotate  Zoom  Look  Move Toward  Select  Show Axis

Reset

(<-) (->)  
 (Up) (Down)  
 (Alt Home) (Alt End)  
 (Home) (End)  
 (Insert) (Delete)  
 (Pg Up) (Pg Dwn)

Right Click in the plot window for visibility options.

Options View Help

Input File

Close Save -- Update Edit

Do Not Modify (check to prevent the Visual Editor from modifying the input on Save-Update)

```

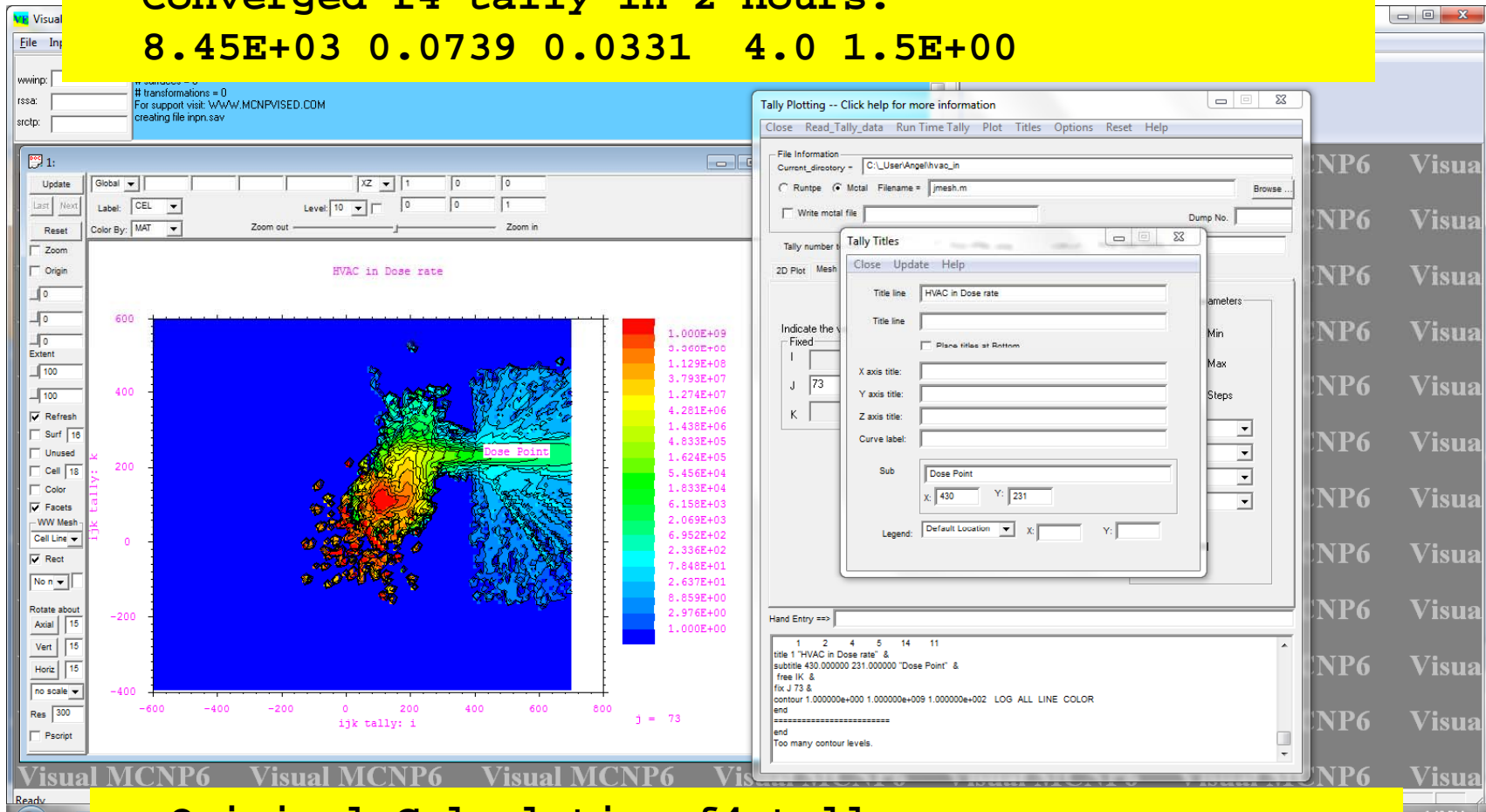
c +++ Variance Reduction +++++
DD 0.5 1e+5
DXT:n 105 260 108.67 12.5 35
      180 270 114 12.5 35
      196 270 223 12.5 50
      400 270 231.7 12.5 50
c 430 270 230.67 12 30
c 100 1e-9
*tr1 -10 -80 25 45 90 0 45 45 0 0 0 0
  
```

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



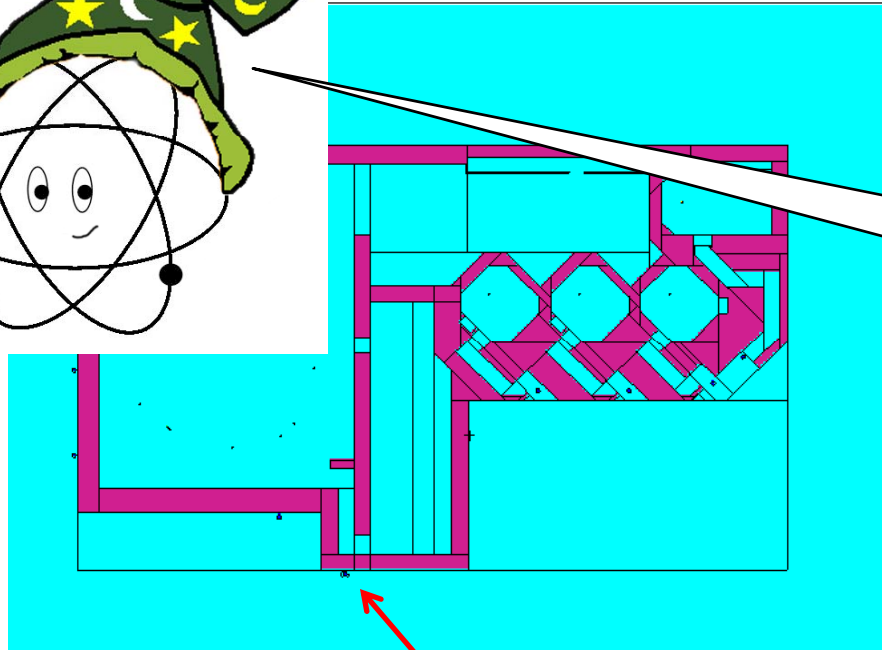
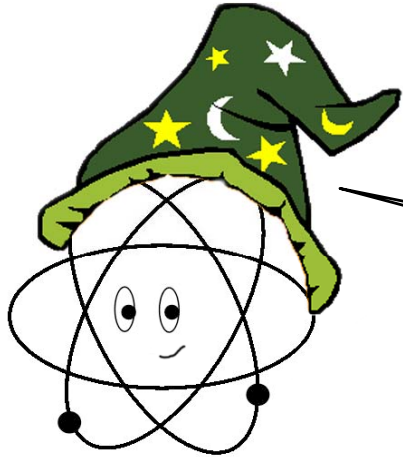
Original Calculation f4 tally:

7.6176E+03 0.1008 0.1479 2.4 2.0E-04

Missed 4 tests

485007 minutes / 337 days / 0.92 years

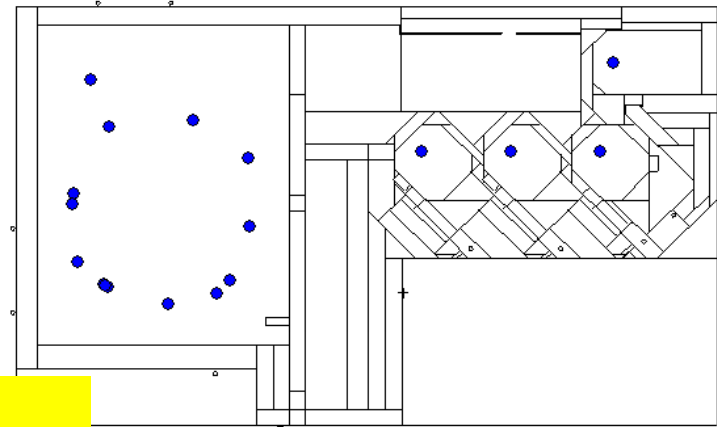
# The Rest of the Story.



**Dose Point**

Oyeon Kum – Paper Presented Monday afternoon.  
Presented this problem to me to solve using Visual MCNP6.

**What would you do?**



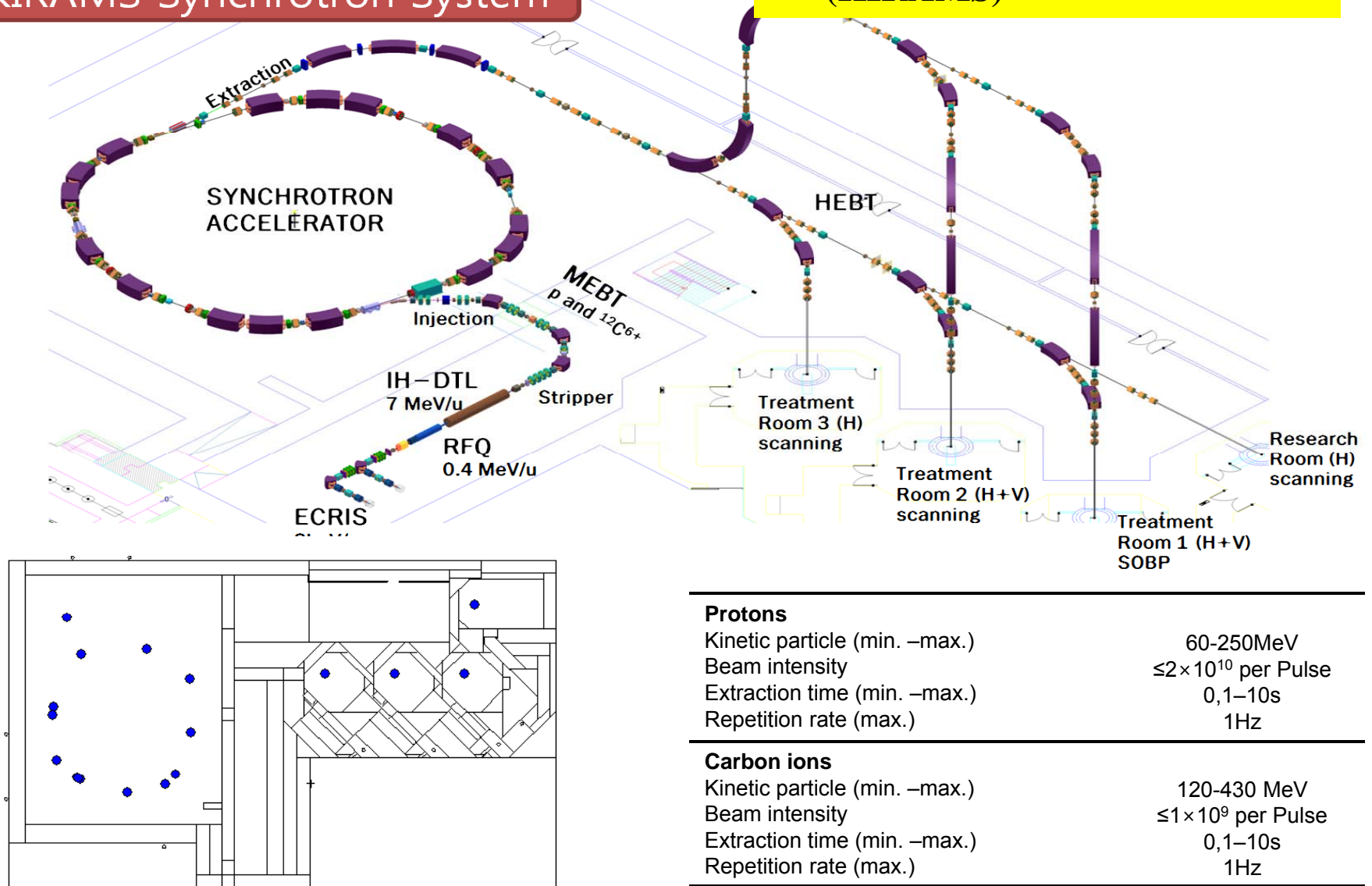
**Carbon ion Source Points**

**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

Slide provided by Oyeon Kum  
(KIRAMS)



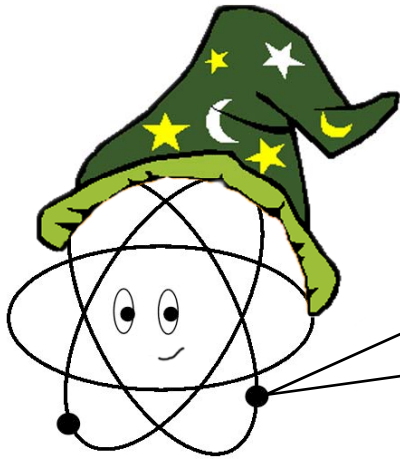
### Protons

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

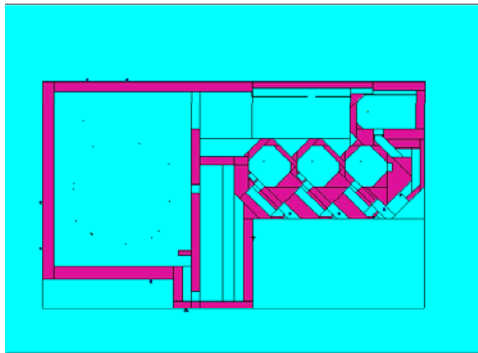
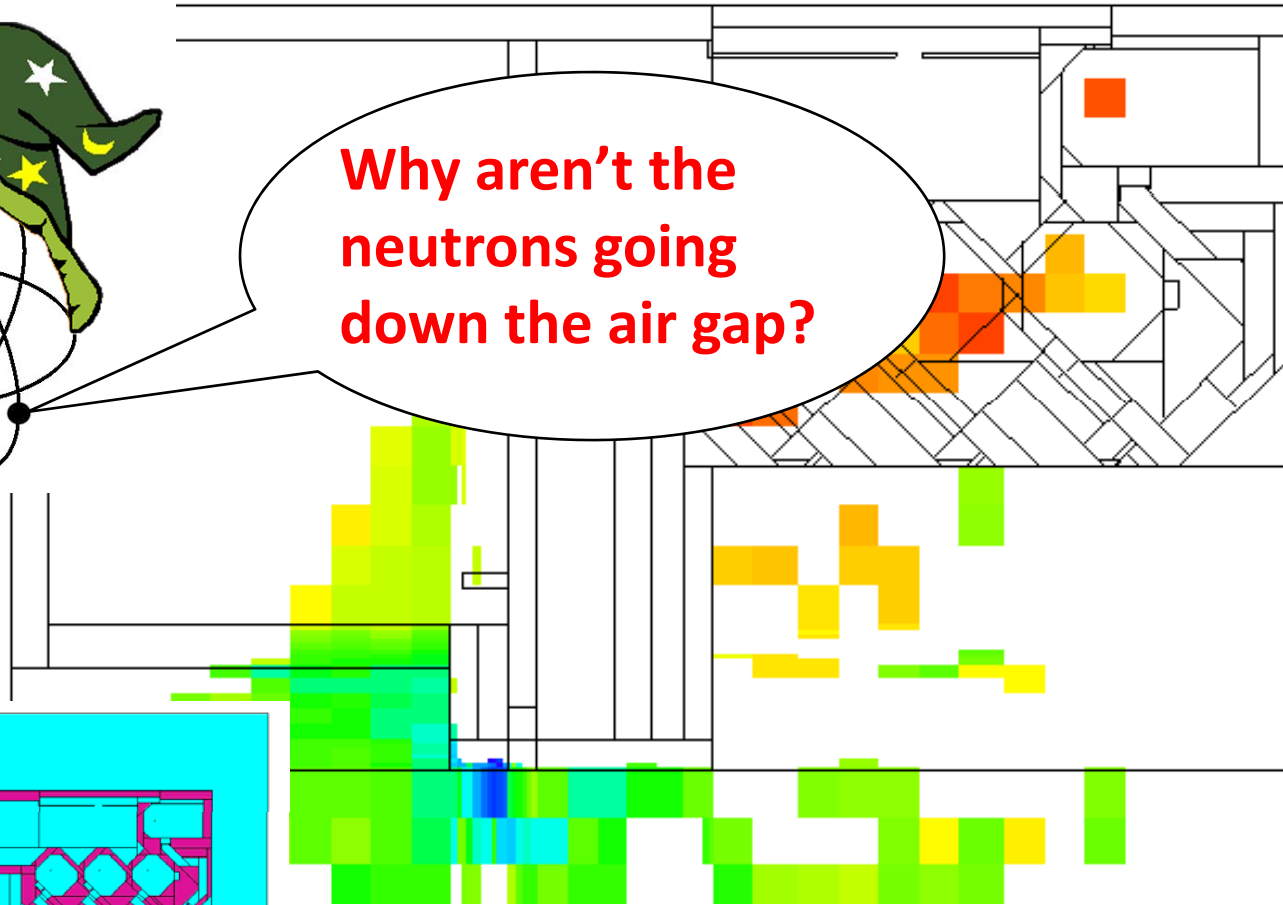
### Carbon ions

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

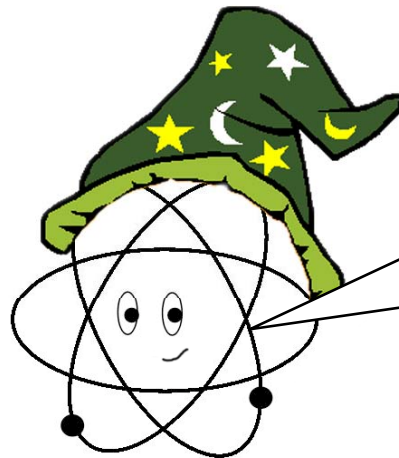
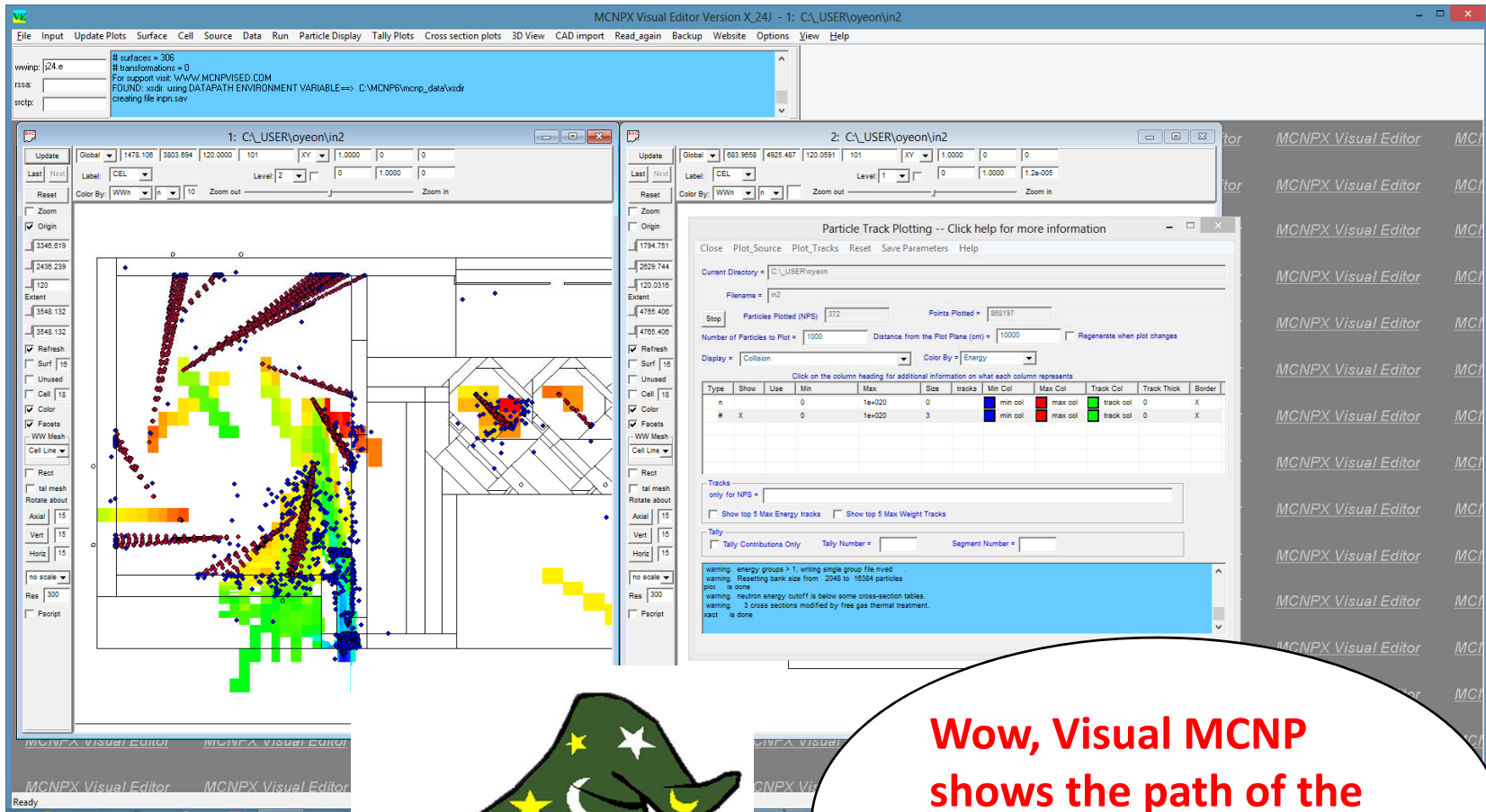
# Add a WW mesh



Why aren't the neutrons going down the air gap?



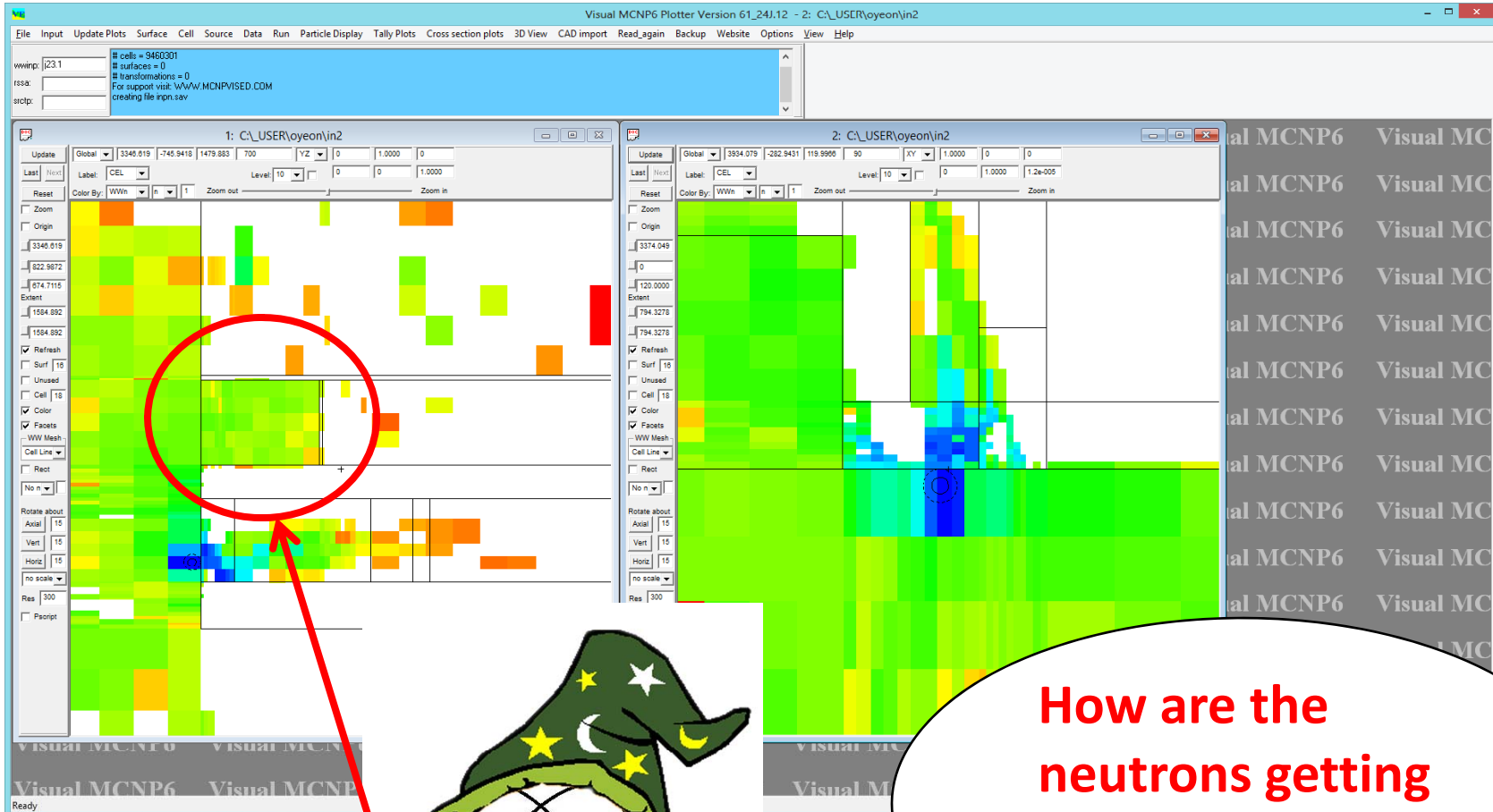
# The Carbon Ions are directional.



**Wow, Visual MCNP shows the path of the Carbon ions plotted on top of the WW mesh.**

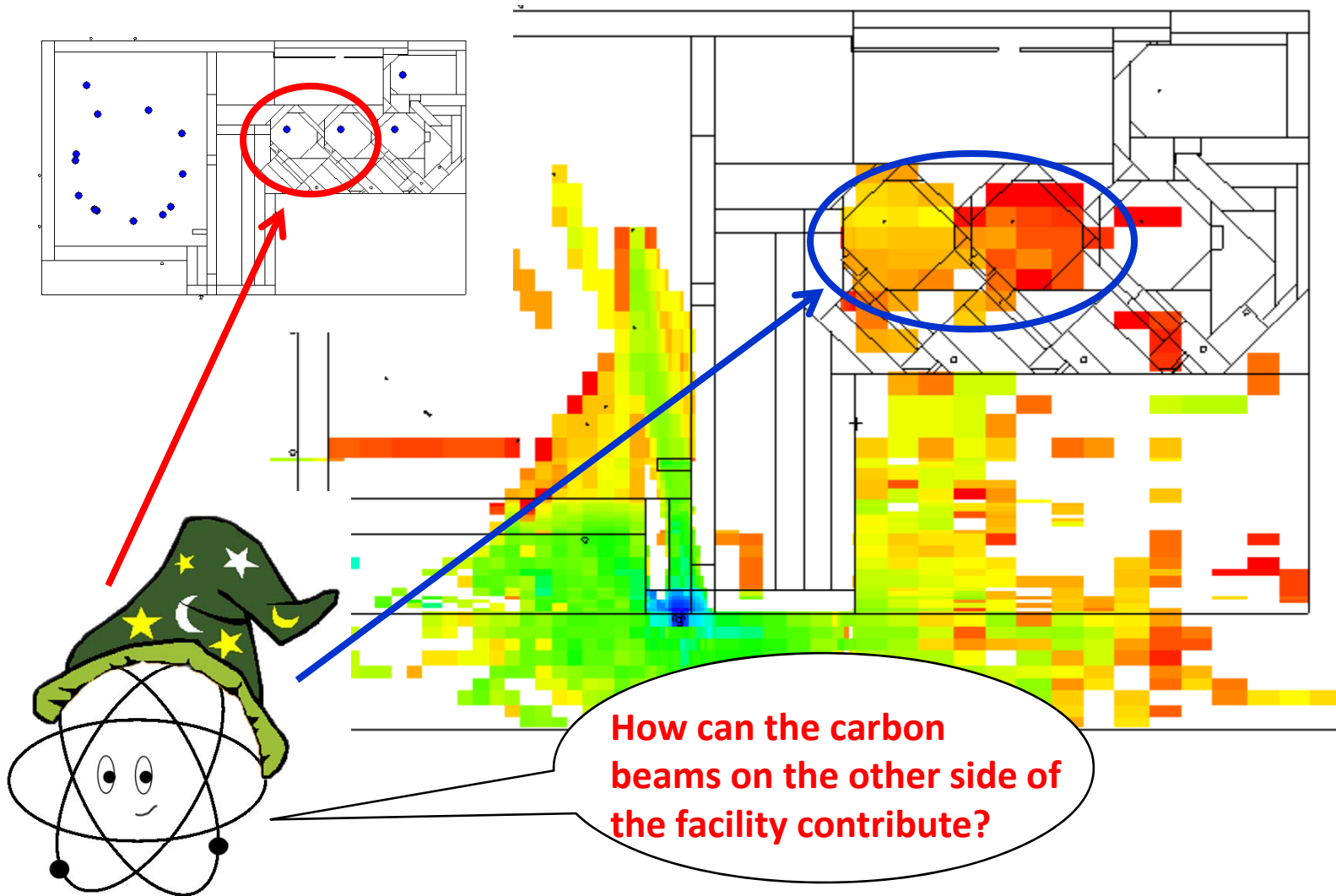


# Optimize the WW Mesh

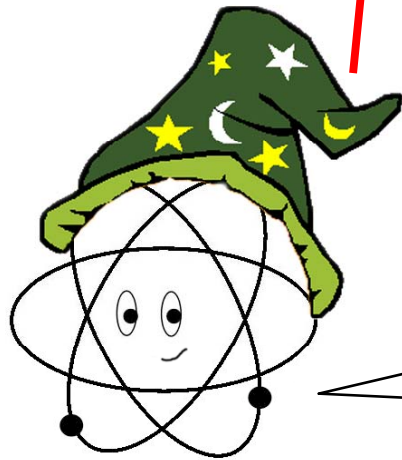
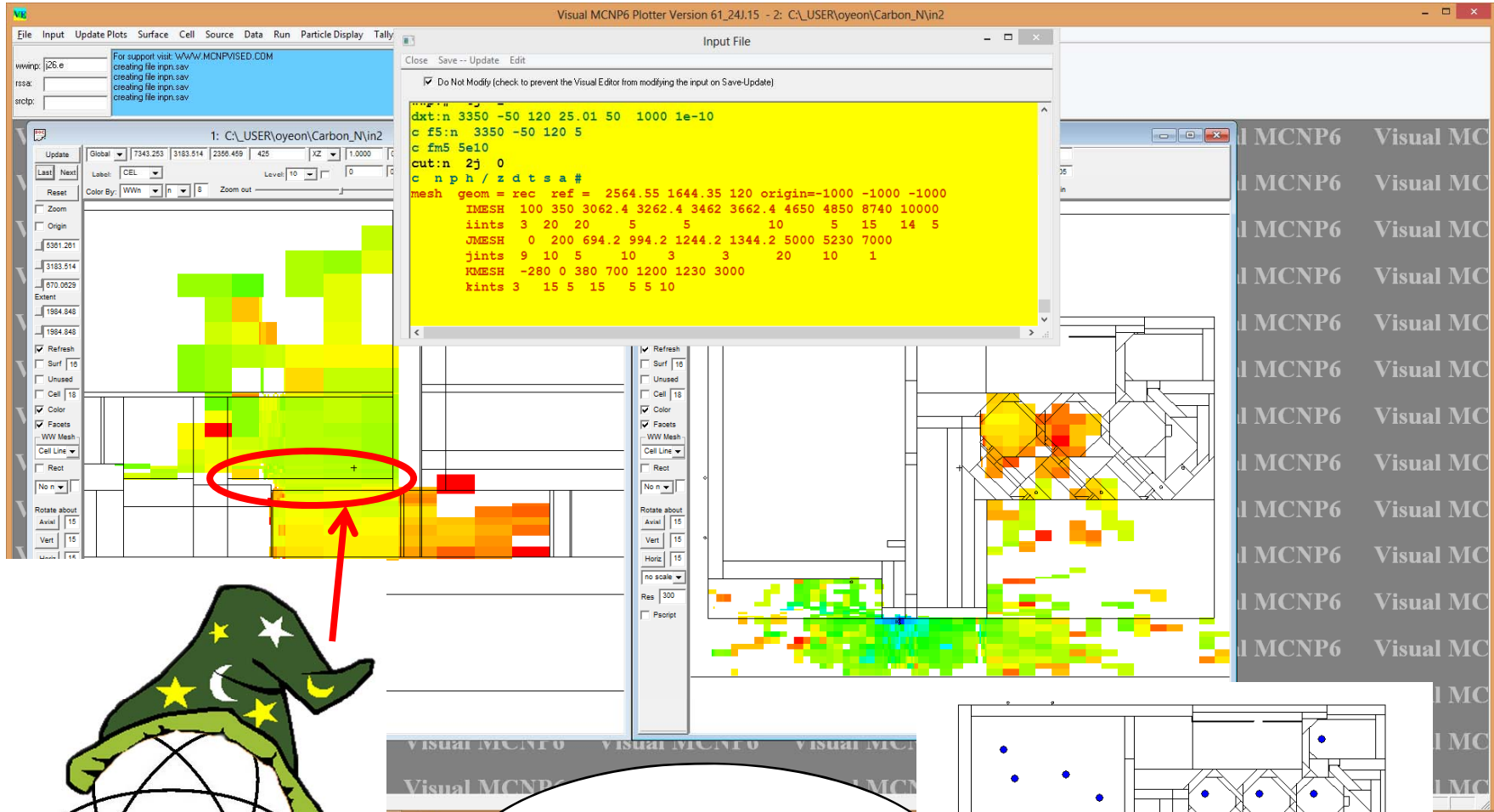


How are the neutrons getting through the ceiling?

# Optimize the WW Mesh

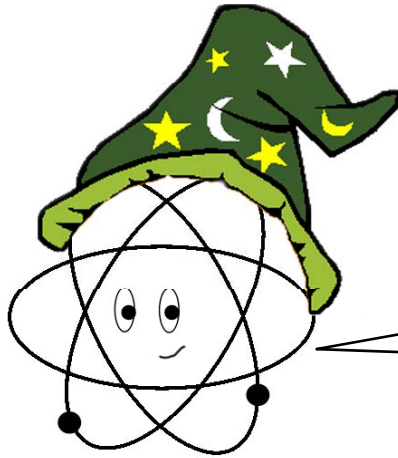


# Multiple Source Contributions

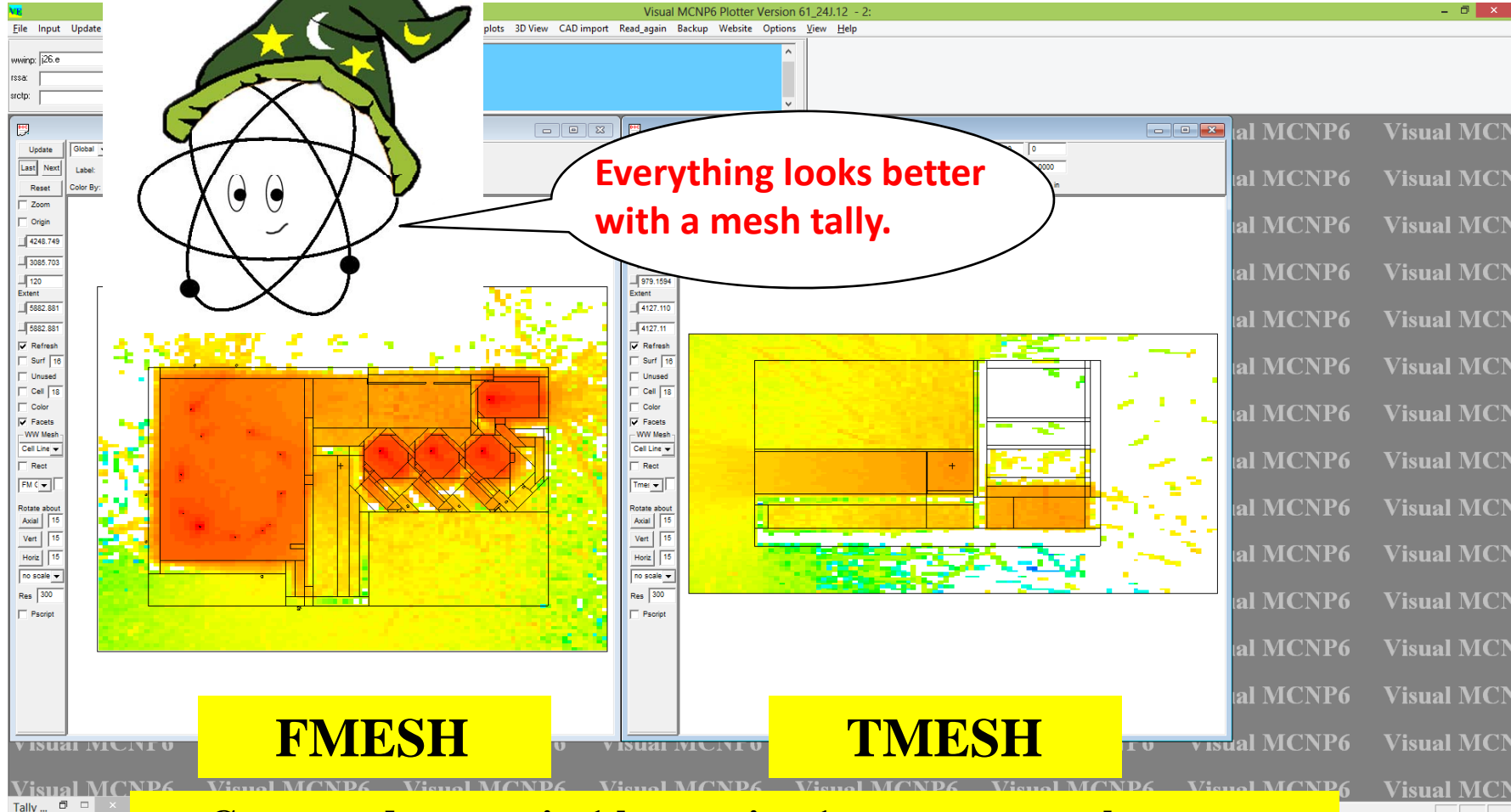


The particles are going through a thinner shield in the ceiling.

# Results



Everything looks better with a mesh tally.

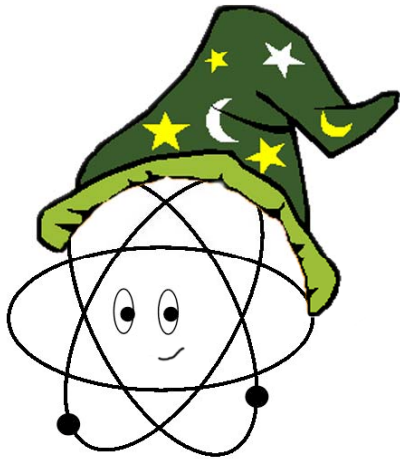


**FMESH**

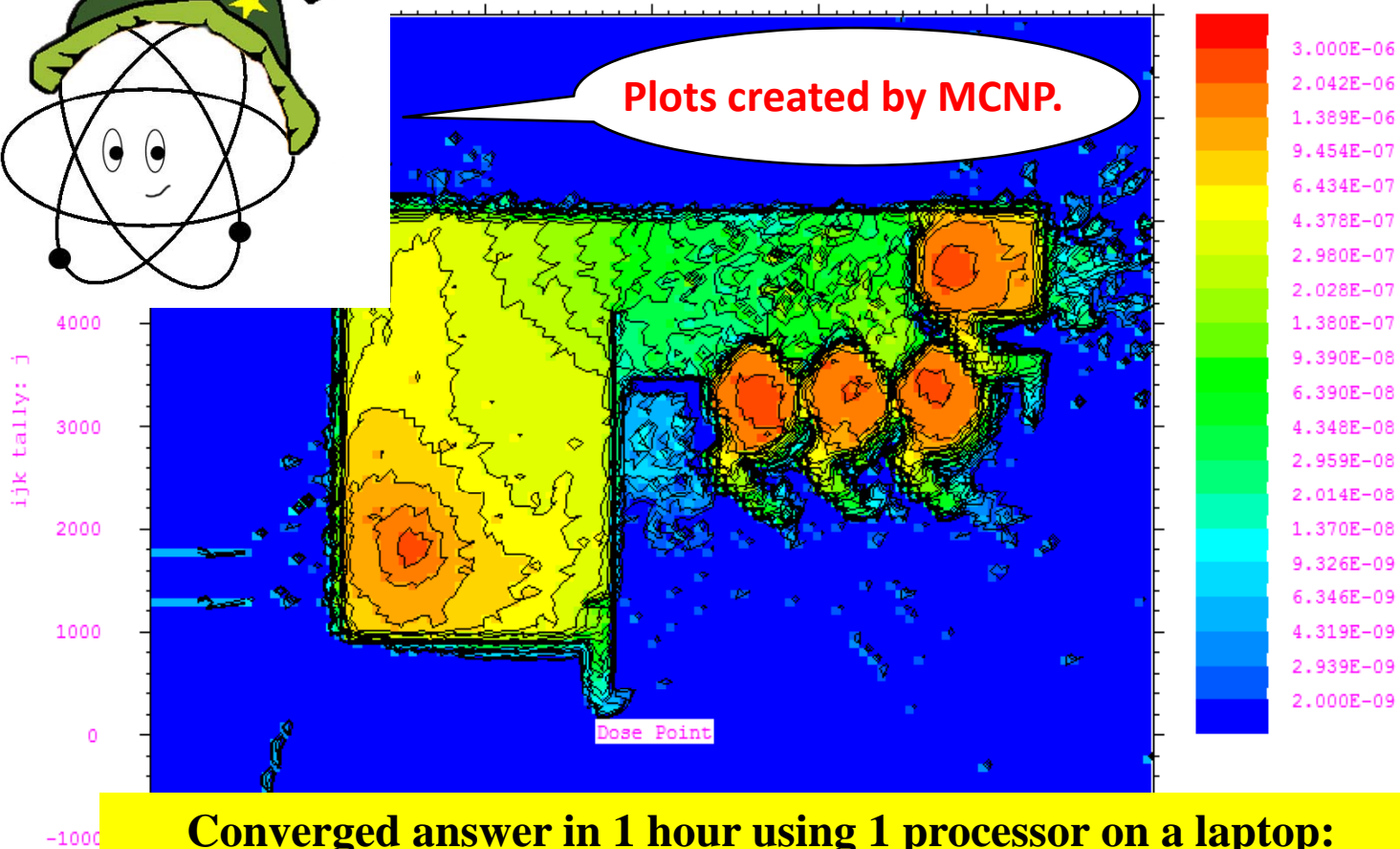
**TMESH**

**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)



file jmesh.m --- tally 11

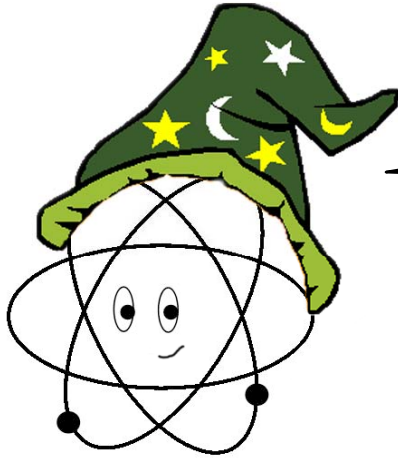


**Converged answer in 1 hour using 1 processor on a laptop:**

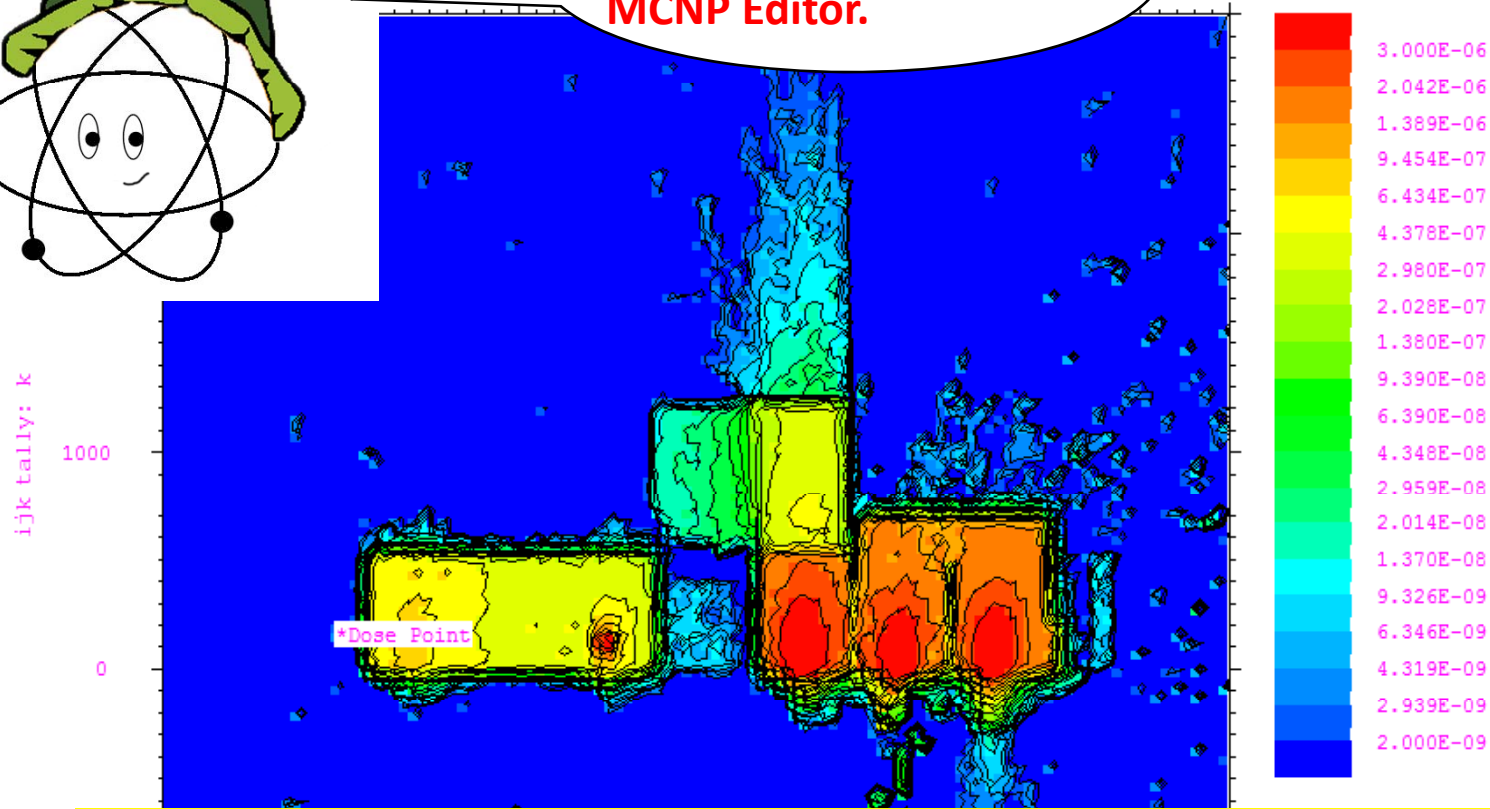
4.4262E-07 0.0614 0.0824 5.8 4.4E+00

Problem was presented on Monday, solved on Tuesday.

# TMESH MCTAL Plots (XZ)



Visualized with the Visual MCNP Editor.

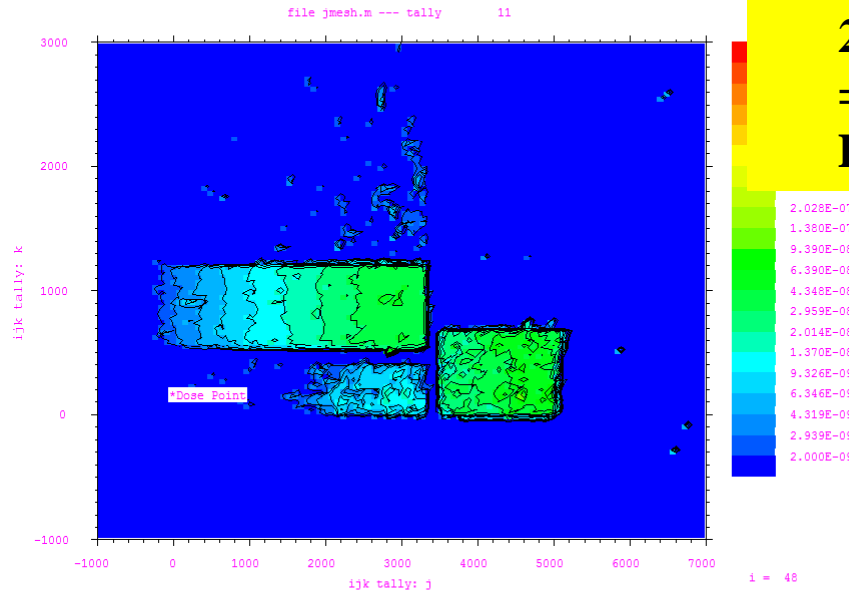


**Converged answer in 1 hour using 1 processor on a laptop:**

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**

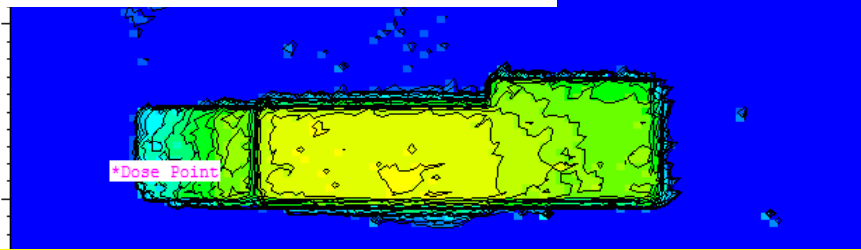
**Does point not converged, RE= 0.21**

11

ijk tall

1000

0



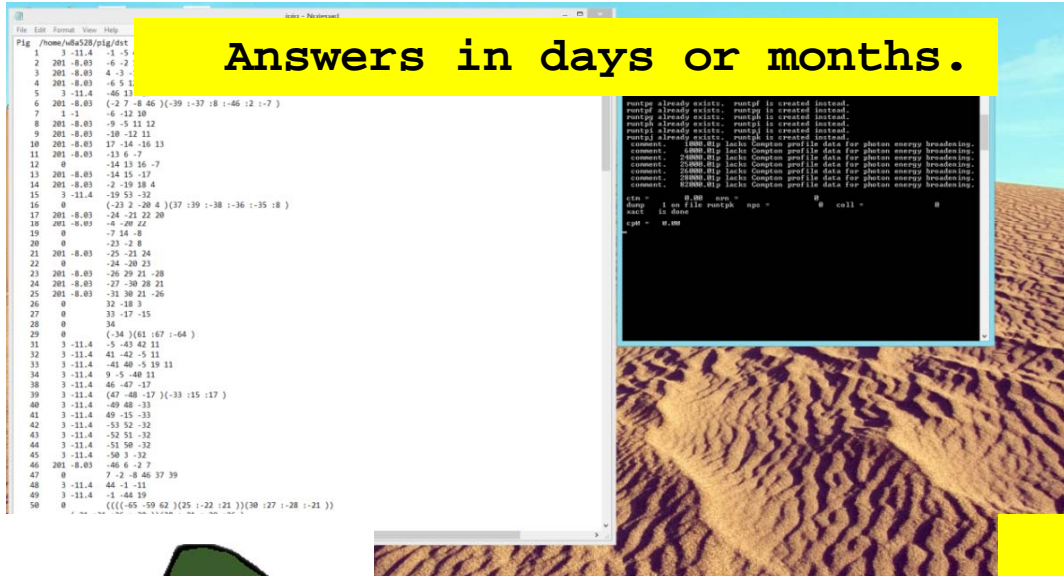
**Converged answer in 1 hour using 1 processor on a laptop:**

4.4262E-07 0.0614 0.0824 5.8 4.4E+00

**Problem was presented on Monday, solved on Tuesday.**

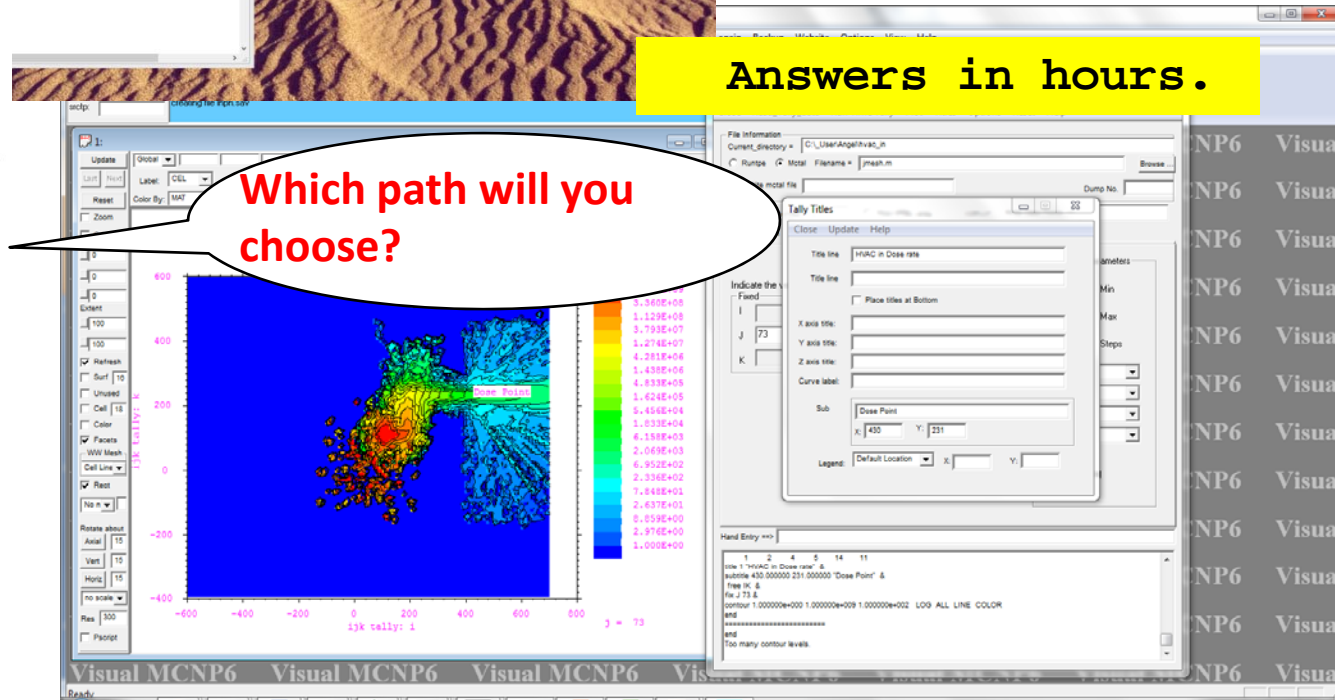
# How will you do your calculations?

**Answers in days or months.**



```
File Edit Format View Help
/home/uda528/pig/dst
1 3 -11.4 -1 -5
2 201 -8.03 -6 -2
3 201 -8.03 4 -3
4 201 -8.03 -6 5 1
5 3 -11.4 -6 13
6 201 -8.03 (-2 7 -8 46 )(139 137 18 146 12 17 )
7 1 -1 -6 -12 10
8 201 -8.03 -9 -5 11 12
9 201 -8.03 -10 -12 11
10 201 -8.03 17 -14 -16 13
11 201 -8.03 -13 6 -7
12 0 -14 13 16 -7
13 201 -8.03 -14 15 -17
14 201 -8.03 -2 -19 18 4
15 3 -11.4 -19 53 -32
16 0 (-23 2 -20 4 )(37 139 138 136 135 18 )
17 201 -8.03 -24 -21 22 20
18 201 -8.03 -6 -20 22
19 0 -7 14 -8
20 0 -23 -2 8
21 201 -8.03 -25 -21 24
22 0 -24 -20 23
23 201 -8.03 -26 29 21 -28
24 201 -8.03 -27 -30 28 21
25 201 -8.03 -31 30 21 -26
26 0 32 -18 3
27 0 33 -17 -15
28 0 34
29 0 (-34 (01 167 164 )
31 3 -11.4 -5 -43 42 11
32 3 -11.4 41 -42 -5 11
33 3 -11.4 -41 40 -5 19 11
34 3 -11.4 9 -5 -48 11
35 3 -11.4 46 -47 -17
36 3 -11.4 (47 -48 -17 )(133 115 117 )
37 3 -11.4 -49 48 -33
38 3 -11.4 49 -15 -33
39 3 -11.4 -53 52 -32
40 3 -11.4 -52 51 -32
41 3 -11.4 -51 50 -32
42 3 -11.4 -50 3 32
43 201 -8.03 -40 6 -2 7
44 0 7 -2 -8 46 37 39
45 3 -11.4 44 -1 -11
46 3 -11.4 -1 -44 19
47 0
48 0 ((((-65 -59 62 )(25 122 121 ))(38 127 128 121 ))
49 0
50 0
```

**Answers in hours.**



Which path will you choose?

Visual MCNP6

