

“Simple Heat”

Thermal Modeling of X-ray Heat Load

Rich Hilliard,
Tompkins Cortland Community College,
CHESS

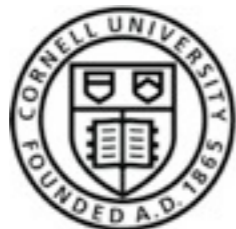
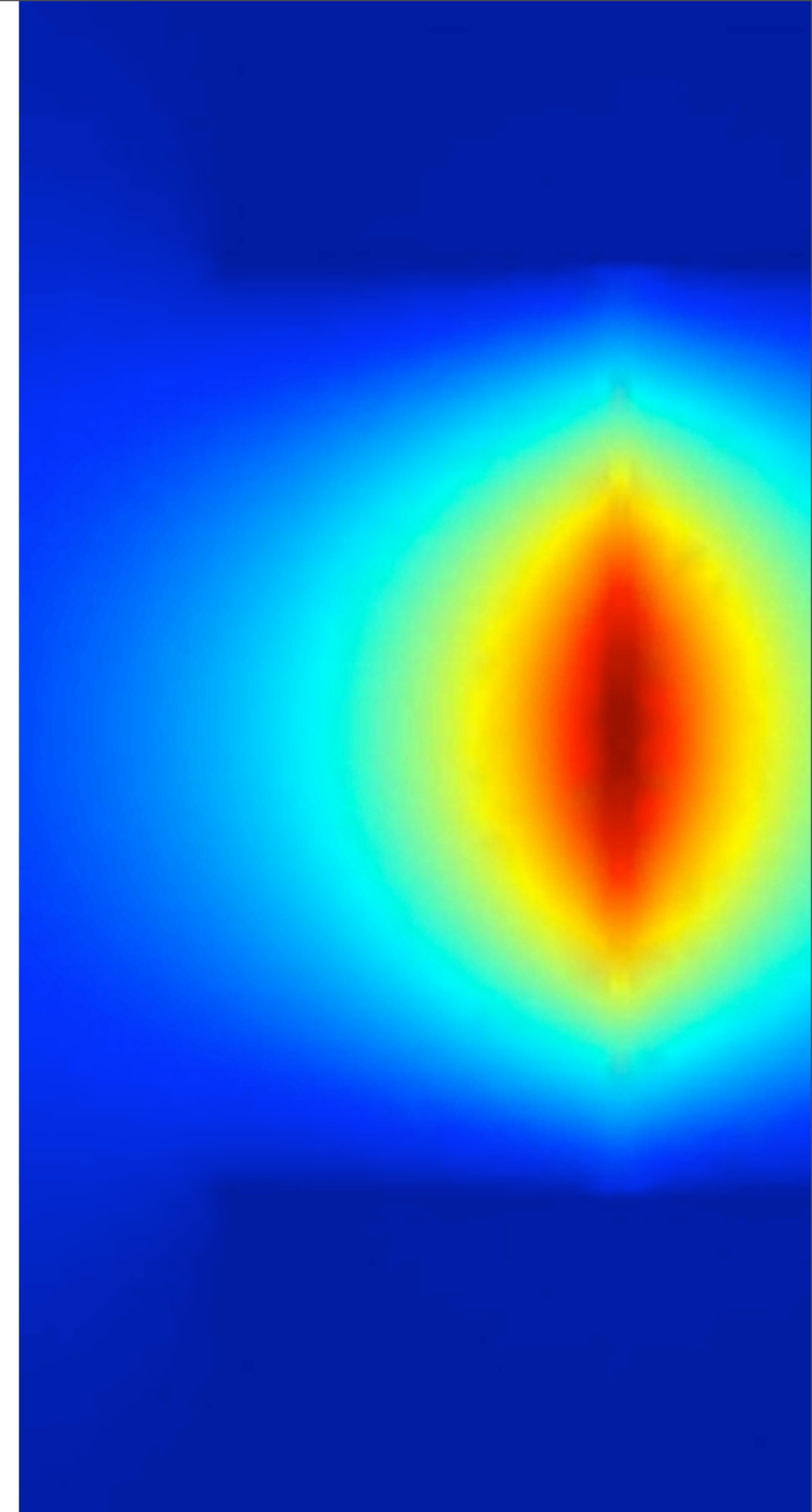


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Heat Loading

- Destroys samples
- Degrades equipment
- Disrupts experiment
- Laue Diffraction
- ERL: higher HL densities



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“Is HELIUM necessary?”

250 PSI

Interface: Optics & Cooling

- Skip the empirical
- Automate to save time

Water

v.

Liquid Nitrogen



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HeatBump
MATLAB



SimpleHeat
Python 3

Qt
PyQt
SIP

XOP 2.3 from ESRF

Manuel Sanchez del Rio and Roger J. Dejus



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Version 2.1.2

Mathematica output

Fixing the "both" dialog in adv
other optimizations/tests

Version 3.0

Importing and Exporting run data

Importing and Exporting source data

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Interpolation guard is now implemented. The previous work well, working on now. Created a new class and re function to deal with this error.

Version 1.2

A speed boost was added while filtering (instead of u search to find mu values, a binary search is now used in python from 300s to 5s

Version 2.0

Multiprocessing added. This update later included "ov half the cores are finished, a new dispatch occurs. I cut by a factor of N, now it is cut by 1.5N (N=number

There were a series of numerical errors, which includ +t, when multiple slices were implemented. There was power values when the slices were (100,10)mm,(110)mm, mmx11.

This was due to reference errors, and fixed by using The write_slice_to_table function was rehauled, in or changes as due to rectangle_grid.

There are still some index naming errors, these are o will be fixed in next release.

Inner loop optimization has been added. This cuts dow less indexing.

Memory errors are present, for a 102x102 matrix (100x source_flux array is about 396 MB. Broke my laptop. N

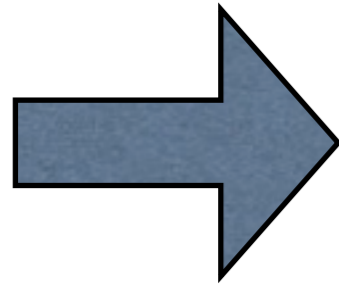
Version 2.1

There were several unnecessary deep copies of s_flux removed.

In the filter_flux function, s_flux gets edited and d recovered.

Attempted numpy handling, does not work on laptop. Wi use unofficial binaries.

Fixed a series of bugs, finally got good results. The smooth function, while the power is properly disconti the composition of two bugs, not changing the width a build?matrix, and a series of other computation error



i.d. / bending magnet	filter(s)	region
• [XOP]	radiation spectrum	heat load •
project	mirror	output

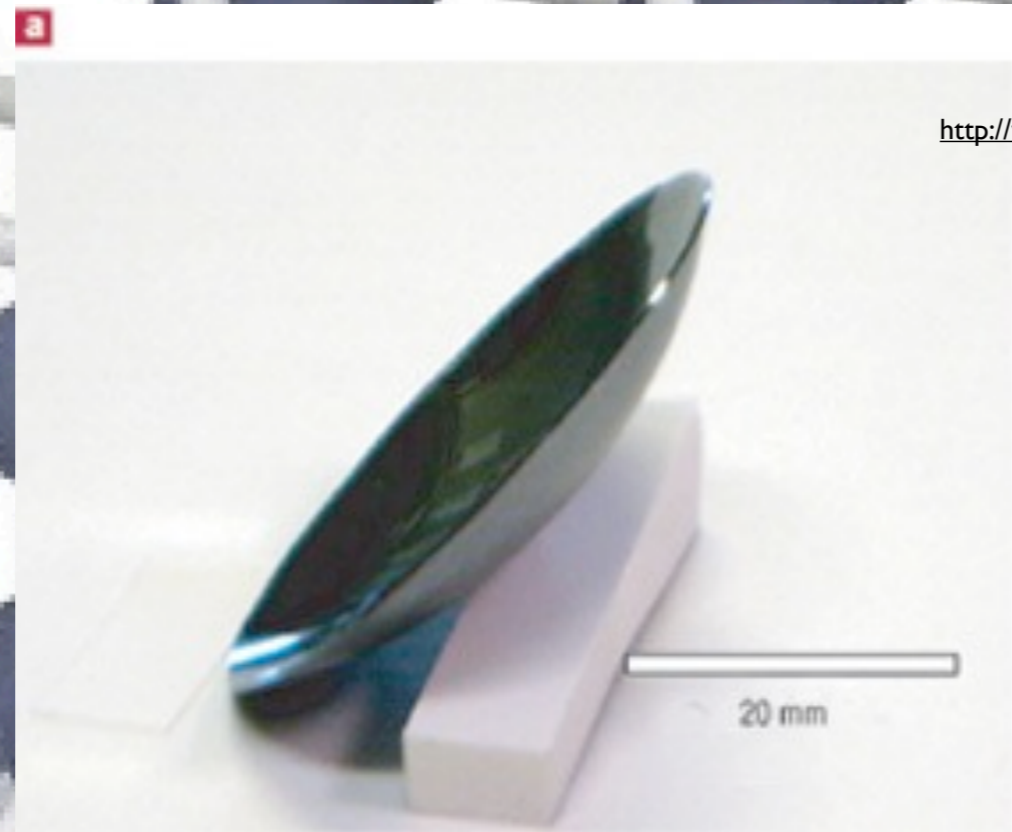


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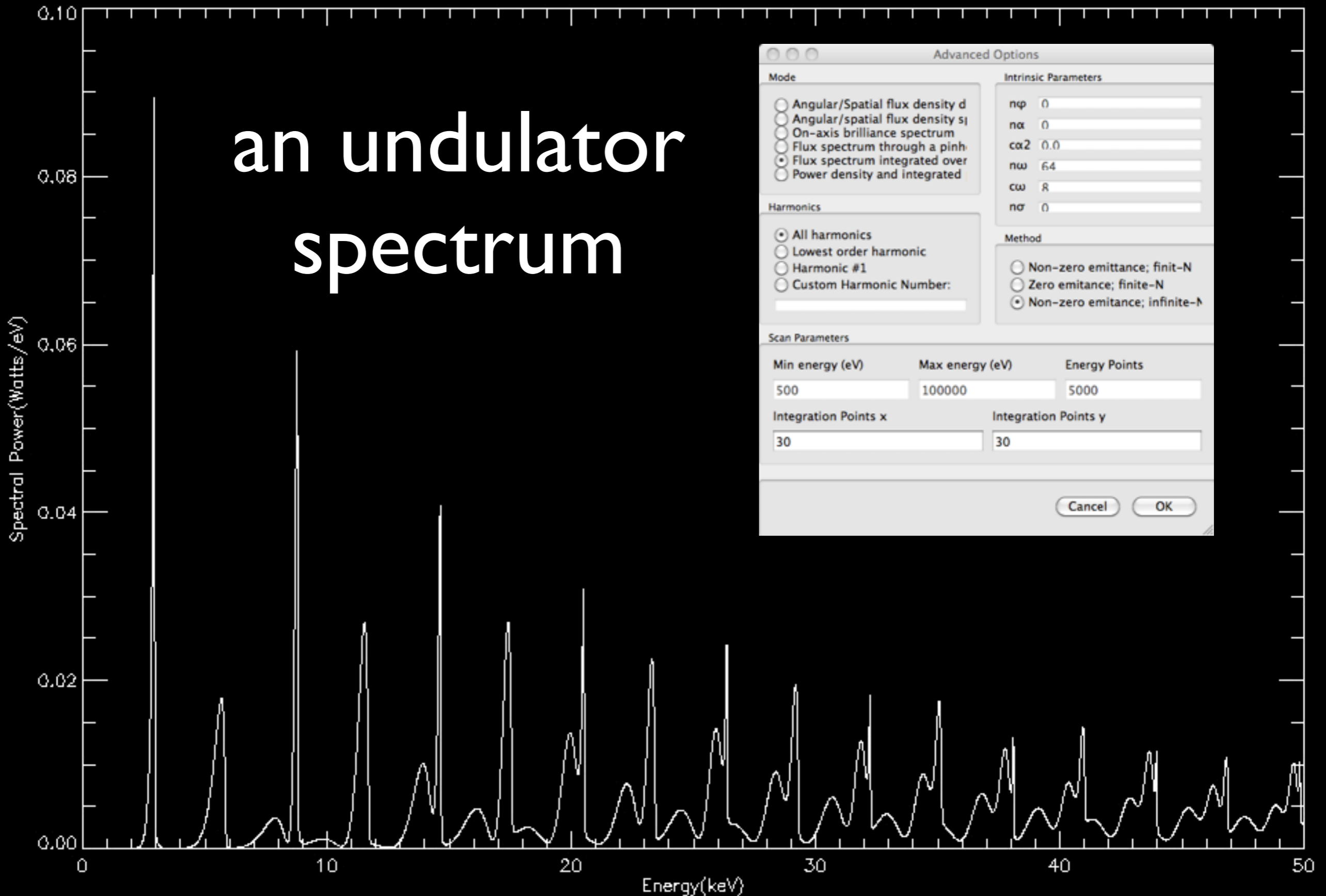
Ag
Al
Au
Be
Br
C
Co
Cu
Fe
Hg
Mn
Ni
Pb
Pt
Rb
Se
Si
Ta
Zn

Optics



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an undulator spectrum



0 saved sets. Current set has 2 columns.

X: Energy(keV) Y: Spectral Power

```

312 for p in range(0,len(flt)):
313     mat=flt[p][0]
314     matthick=float(flt[p][1])/10000 #here is the conversion from micron to centimeter
315     f=open("mu_data\\"+mat+".pkl","rb")
316     edata=pickle.load(f)
317     f.close()
318     elem_energy=[i[0] for i in edata]
319     elem_flux=[i[1] for i in edata]
320     for i in range(0,len(f_flux)):
321         fi=f_flux[i]
322         for j in range(0,len(f_flux[0])):
323             fij=fi[j]
324             #I=I0*e^(-mu*t)
325             mua=[-1*mu3(elem_energy,elem_flux,ea[m]) for m in range(0,len(ea))]
326             for m in range(0,len(ea)):
327                 fij[m]*=math.exp(mua[m]*(matthick))
328
329     if self.print_matrix_sums:
330         print_sum_matrix_by_layer(f_flux, 'filter_flux f_flux')
331         if len(self.thickness) > 1:
332             print_sum_matrix(f_flux, 'filter_flux f_flux')
333
334     return f_flux
335
336 def generate_energy_axis(self):
337     """returns x axis energy values. Xx is a testing element, any element can be used to generate the divisions."""
338
339     sdata=pickle.load(open("mu_data\\Xx.pkl","rb"))
340     pickle.dump(sdata,open("pickle\\energy_axis.pkl","wb"))
341     return [i[0] for i in sdata]
342
343 def run(self):
344     """function wrapper, formerly heat_load_matrix()"""
345     #never called directly, called by qt
346     #if path.exists("mathematica_output"):
347     #    rmtree("mathematica_output")
348

```

flux thru multiple filters



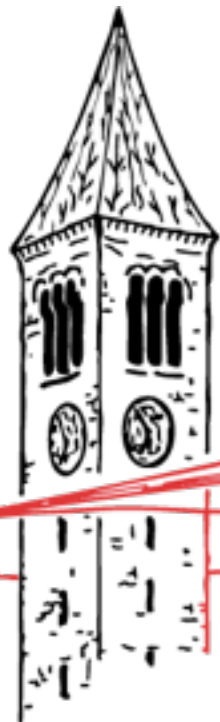
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Energy absorptions (deposition) by position

1.38E-02	5.00E-10	0.000275	3742457209.8274
1.42E-02	5.00E-10	0.000275	3730961075.1052
1.46E-02	5.00E-10	0.000275	3719047975.4146
1.5E-02	5.00E-10	0.000275	3706709400.6318
1.54E-02	5.00E-10	0.000275	3693936428.3188
1.58E-02	5.00E-10	0.000275	3680719671.1716
1.62E-02	5.00E-10	0.000275	3667049372.151
1.66E-02	5.00E-10	0.000275	3652915303.2702
1.7E-02	5.00E-10	0.000275	3638306721.682
1.74E-02	5.00E-10	0.000275	3623212425.9597
0.0178	5.00E-10	0.000275	3607620702.2968
0.0182	5.00E-10	0.000275	3591519200.0875
0.0186	5.00E-10	0.000275	3574895084.1892
1.9E-02	5.00E-10	0.000275	3557734896.0493
1.94E-02	5.00E-10	0.000275	3540024504.9856
0.0197999995	5.00E-10	0.000275	3521749165.7196
0.0199999995	5.00E-10	0.000275	3512419377.7762
0.02	5.00E-10	0.000275	3917773690.9992
0.0	3.00E-05	0.000275	3652915303.2702
5.00E-10	3.00E-05	0.000275	3923924010.5976
0.0002000005	3.00E-05	0.000275	3923875642.9012
6E-04	3.00E-05	0.000275	3923585659.5539
0.001	3.00E-05	0.000275	3923005490.3892
1.4E-03	3.00E-05	0.000275	3922134831.656
1.8E-03	3.00E-05	0.000275	3920973110.4305
0.0022	3.00E-05	0.000275	3919519708.0866
2.6E-03	3.00E-05	0.000275	3917773690.9992
0.003	3.00E-05	0.000275	3915734057.2794
0.0034	3.00E-05	0.000275	3913399566.3163
0.0038	3.00E-05	0.000275	3910768834.6291
0.0042	3.00E-05	0.000275	3907840312.9626
0.0046	3.00E-05	0.000275	3904612168.4708
0.005	3.00E-05	0.000275	3901082484.8228
0.0054	3.00E-05	0.000275	3897249139.509
5.8E-03	3.00E-05	0.000275	3893109790.1345
6.2E-03	3.00E-05	0.000275	3888661912.3773
6.6E-03	3.00E-05	0.000275	3883902771.6882
7E-03	3.00E-05	0.000275	3878829445.7088
7.4E-03	3.00E-05	0.000275	3873438809.1768
7.8E-03	3.00E-05	0.000275	3867727496.0524
0.0082	3.00E-05	0.000275	3861691939.3909
8.6E-03	3.00E-05	0.000275	3855328361.1577
9E-03	3.00E-05	0.000275	3848632722.8406

Brick Matrix

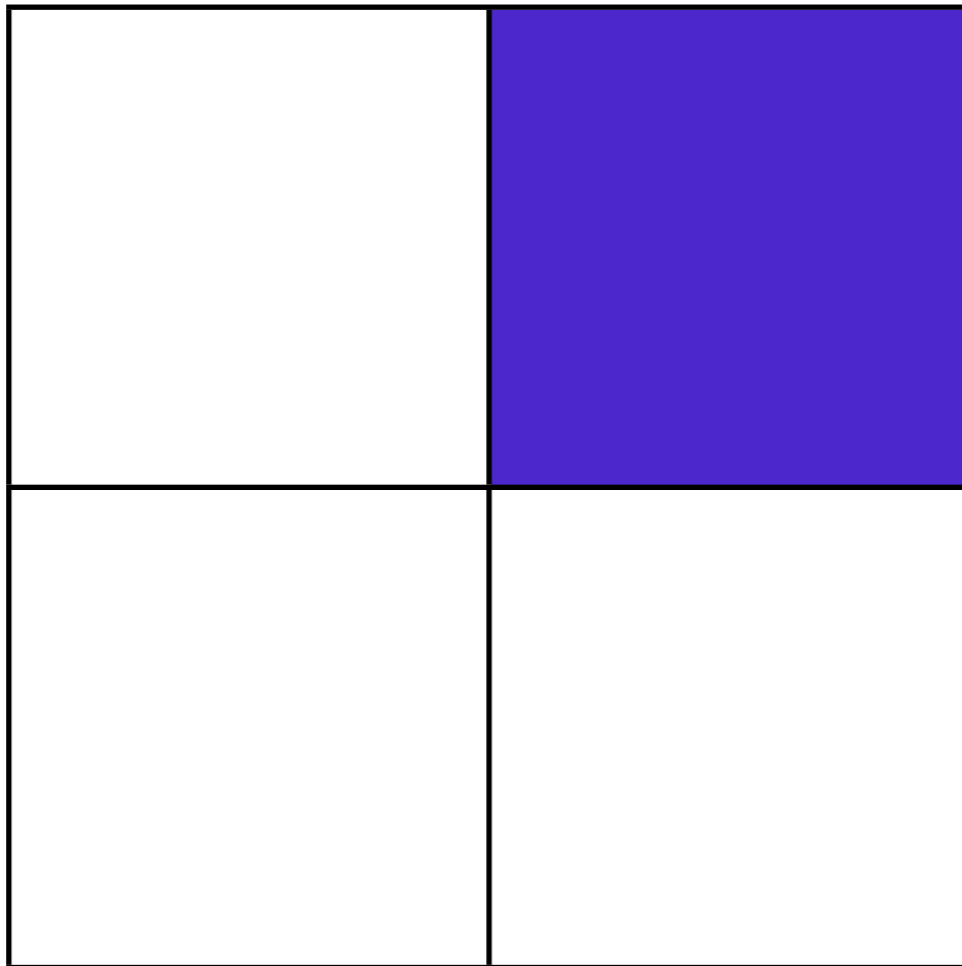


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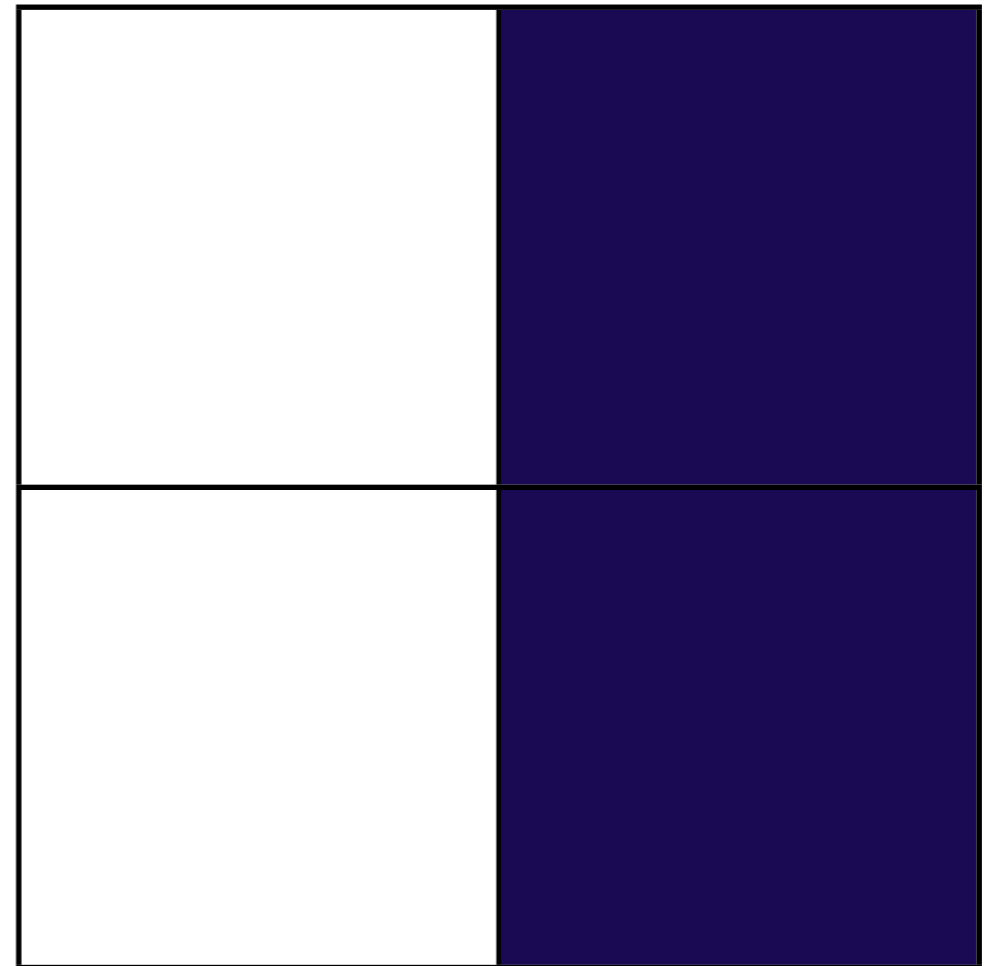
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Reflection / Projection

$$\theta = 90^\circ$$



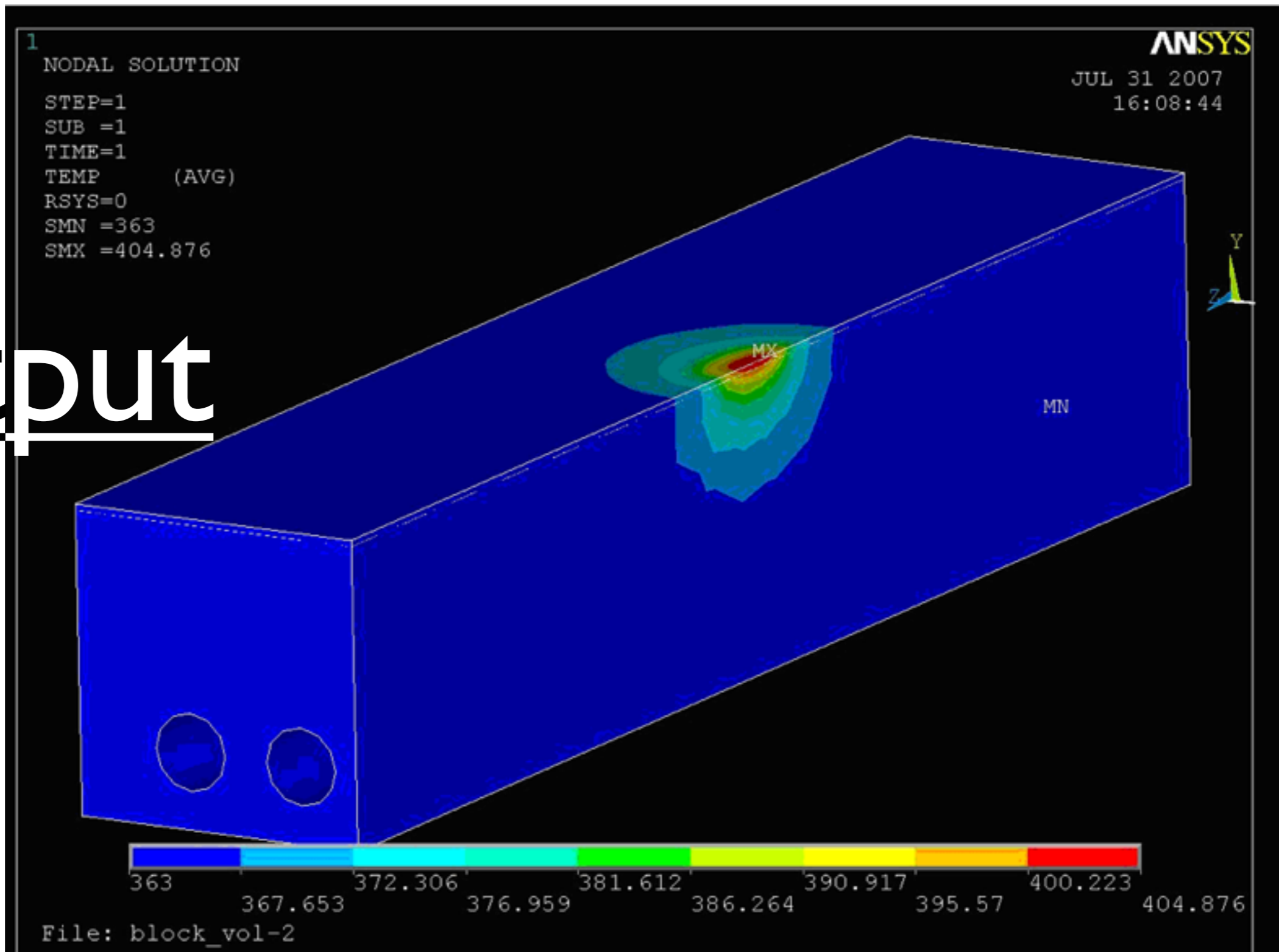
$$\theta \neq 90^\circ$$



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Output



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“Publishability”

- Integration of the existing code
(Debug, multiple platforms)
- Finish GUIs
- Output formatting features
- User procedure
- SPECTRA



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Acknowledgements:
Jim Savino, Aaron Lyndaker,
Ben Oswald, Ron Huang



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