

Intro

What is EMP?

And potential EMP derived from mathematical models of High altitude Nuclear burst induced EMP.

Presented and prepared by

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AKA DrForbin

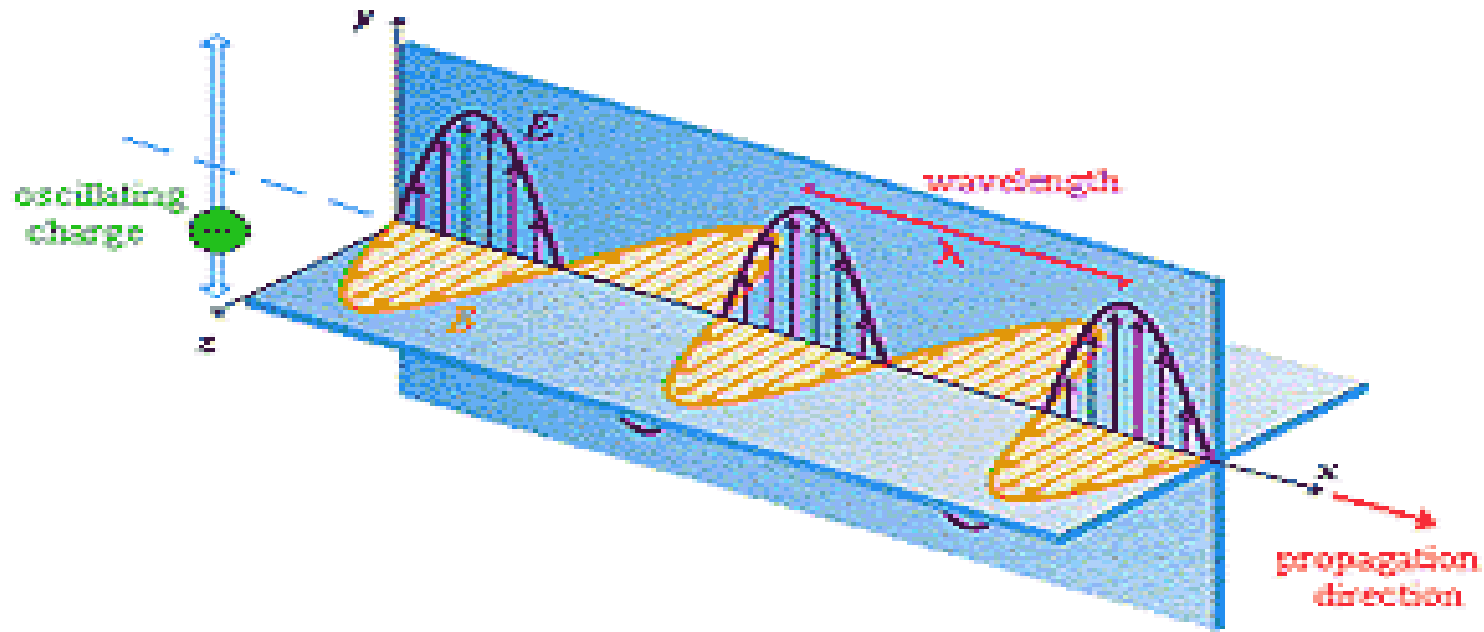
Definition

- Emp is an Electro Magnetic Pulse of short duration caused by an atomic fission or thermonuclear weapon.
- Emp can also be caused by solar flares
- In the case of solar flares the process is quite similar to emp generated by a blast except the origin of the charged particles are the sun.
- E1 pulse;
- Maxima rise time approx 5ns (.5 shakes)
- Pulse width approx 40ns (4 shakes)

Photons

- Electric and magnetic field alternating at right angles to each other.
- The alternating magnetic field induces an alternating electric field. Alternating electric field induces an alternating magnetic field.
- By using some quite advanced math James Clark Maxwell was able to show the wave propagated at a rate of $299,792,458\text{m/s}$
- An ether was not require as a media of propagation.
- See Michelson–Morley experiment.

A little Physics (the Photon)



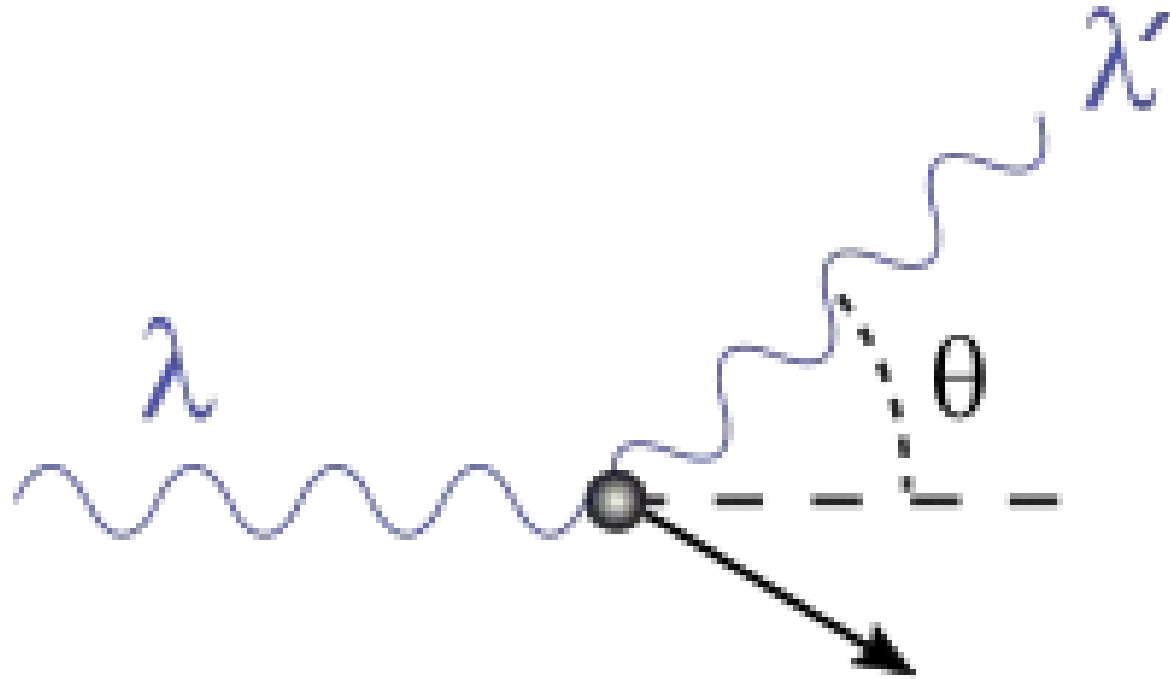
Energy of a Photon

- $E = hf = hc/\lambda$. $h = 6.626 \times 10^{-34} \text{ Js}$
- h is plank's constant.
- From Physicist Max Plank.

Compton scattering

- From experiment by Arthur Holly Compton
- Was meant to prove particle nature of the photon.
- Photon strikes a particle imparting a portion of its energy to the particle causing it to scatter.
- The particle moves in one direction with a portion of the photon's energy and the photon moves off in another with a decreased energy.
- Of course energy is conserved

Compton scattering



So how does it work?

- Blast occurs producing Gamma rays (High energy form of Photons)
- Electrons are blown off of atoms due to the Compton effect.
- The electrons then spiral down the magnetic flux lines of the earth
- The acceleration of the electrons cause the electrons to emit photons
- The fields (electric and magnetic) radiate out and intersect the target and create the EMP.
- Please refer to slides below showing process and absorption region.

Blast production of EMP

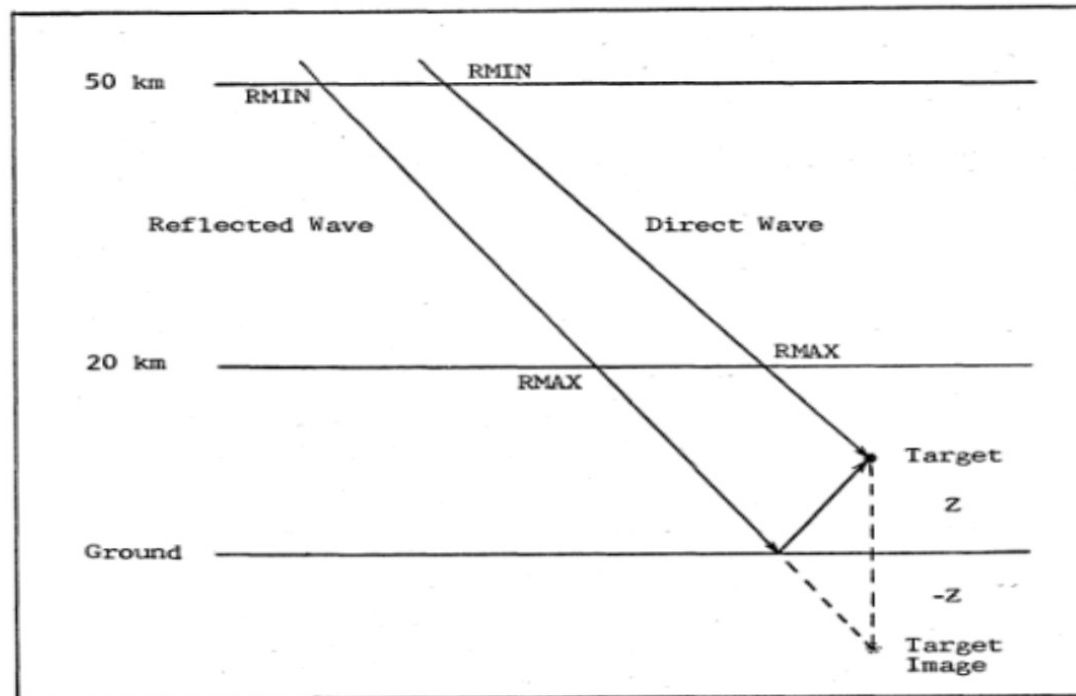


Fig. 3. Target Geometry

Another view with magnetic flux lines

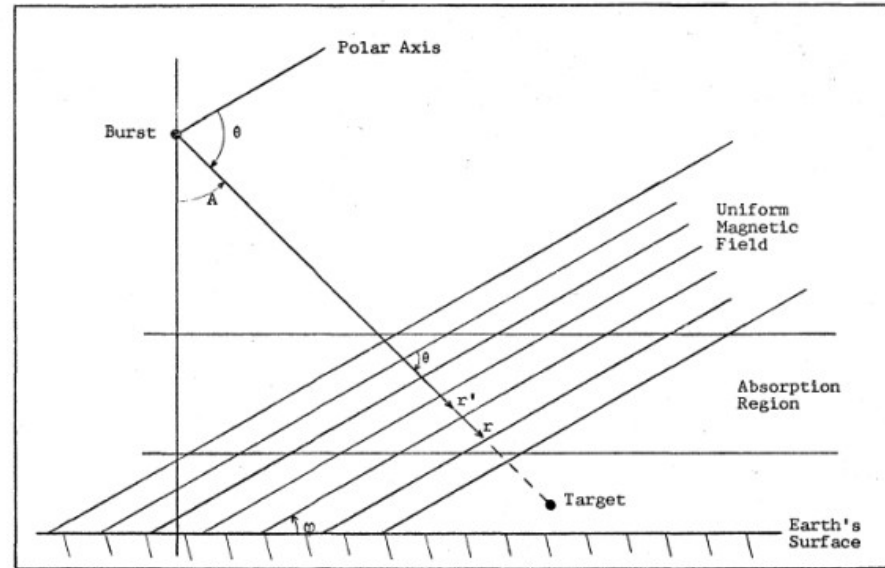
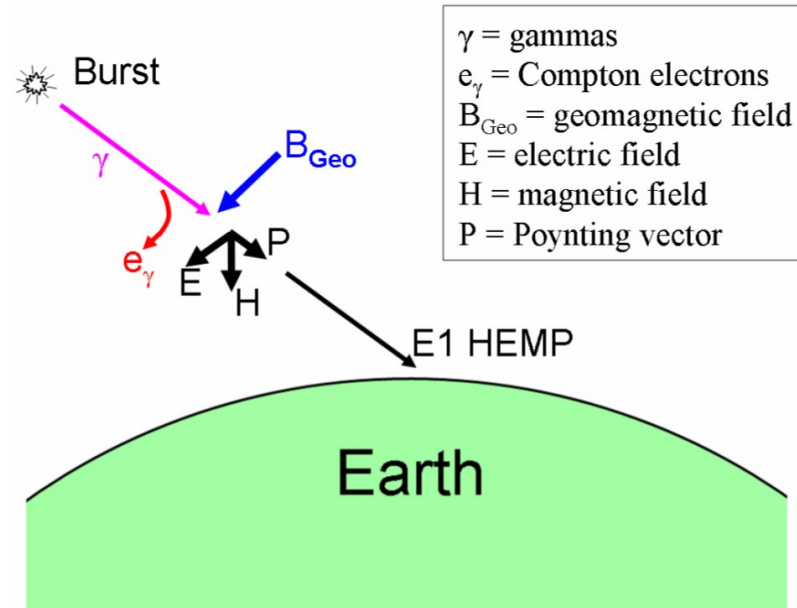


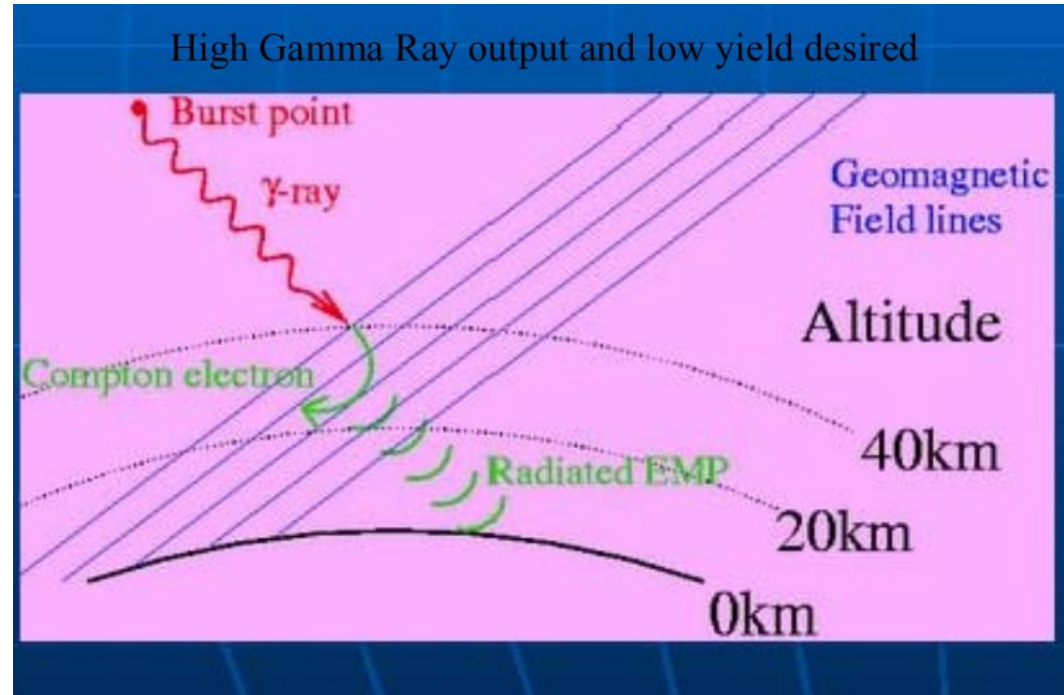
Fig. 1. Geometry of the Burst

More Slides

E1 EMP diagram good



More slides



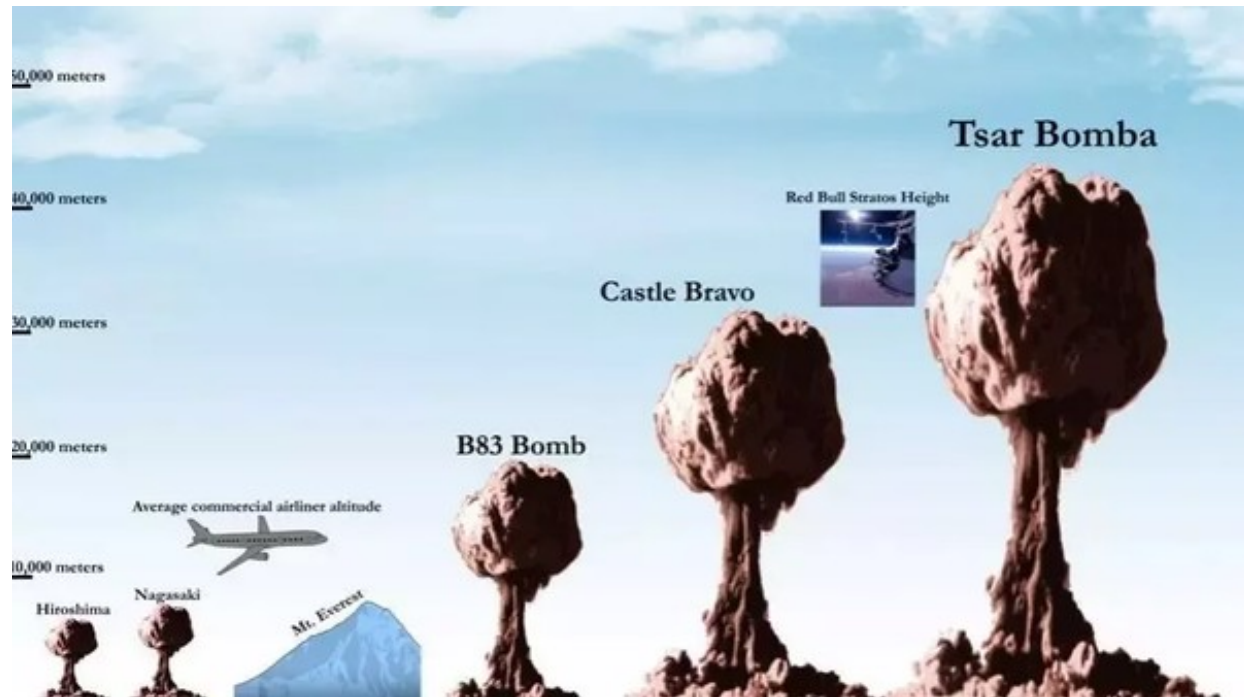
Notes on Blast Yield

- All models use what is called Prompt gamma Yield.

This is not the Yield of the device as a totality, but represents as a general statement about .1% of the total energy of the device being converted to gamma rays. So to create 100Ktons energy of Gamma radiation yield would require a bomb of $100,000 / .001 = 100\text{Mton}$.

Approx twice the size (57 Mton) of the tested Tsar Bomb. The Tsar design was suppose to have been able to produce 100Mton but was scaled back. As it stands it was the largest single man made explosion in history. The energy released was equivalent to over 1500x the combined energy released in Hiroshima and Nagasaki and 10 times ALL the bombs dropped during World War II.







FOFT FUNCTION

FUNCTION FOFT(T)

C
C F(T) IS THE POMRANNING MODEL FOR TIME DEPENDENCE
C OF NUCLEAR WEAPON YIELD IN RETARDED TIME

INTEGER OUX

COMMON OUX,AP,BP,RNP,TOP

TSHAKE=1.E8*T

DENOM=(BP+AP*EXP((AP+BP)*(TSHAKE-TOP)))*RNP

FOFT=(AP+BP)*EXP(AP*(TSHAKE-TOP))/DENOM

RETURN

END

AP	BP	RNP	TOP
1/shakes	1/shakes	shakes	shakes (units)
2.2	.25	5.62603	2.23 Grouse (left chart)
1.7	2.8	1.6	1.2 Sunny (right chart)

Meaning of variables

4 variables are defined for the time value function

Alpha, Beta, RNP, TOP Independent variable in time except RNP

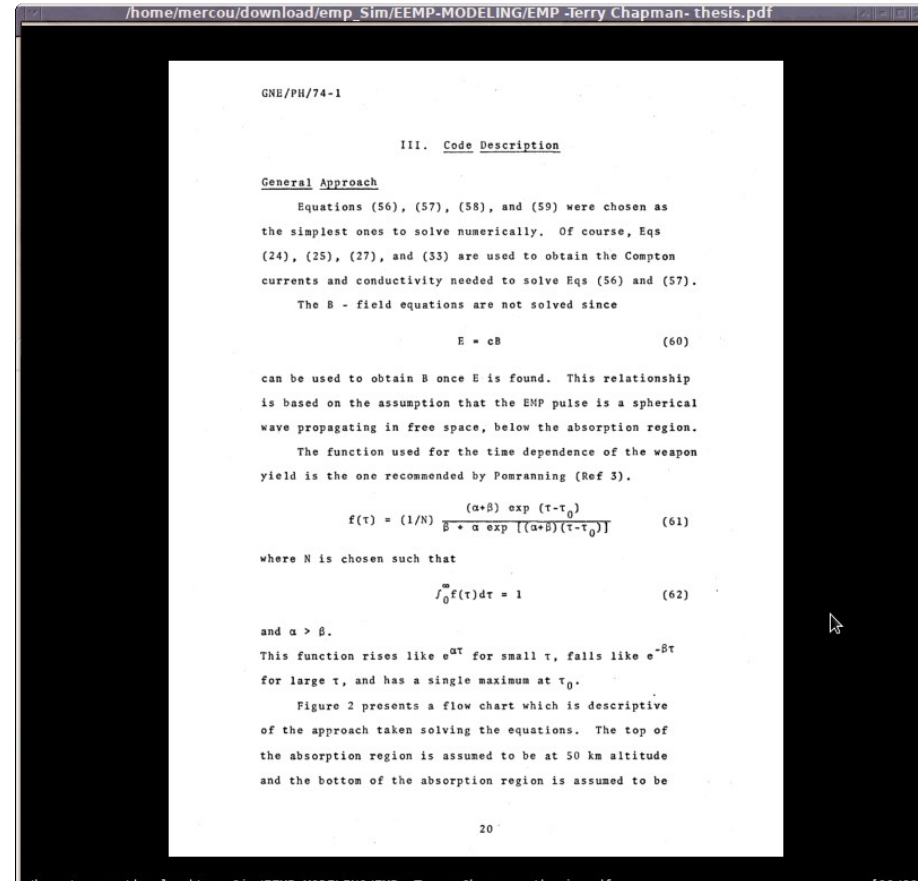
Alpha-Defines the left side of the slope.

TOP- Defines the top of the pulse

Beta- Defines the right side of the slope

RNP- Scaling factor to equate integral to 1 in integration interval

FOFT from Chapman



FOFT from Seiler

$$f(t) = \frac{(a + s) \exp a (t - t_0)}{s + a \exp [(a + s)(t - t_0)]}$$

From Pomraning (Early air fireball model)

/home/mercou/Desktop/758430.pdf

2. REPRESENTATION OF THE DEVICE OUTPUT

We assume a point source of radiation of yield Y and a time dependence, $f(t)$, given by

$$f(t) = \frac{1}{N} \frac{(\alpha + \beta) e^{\alpha(t-t_0)}}{\beta + \alpha e^{(\alpha + \beta)(t-t_0)}}, \quad \alpha > \beta. \quad (1)$$

Here N is a normalization constant such that

$$\int_0^{\infty} dt f(t) = 1. \quad (2)$$

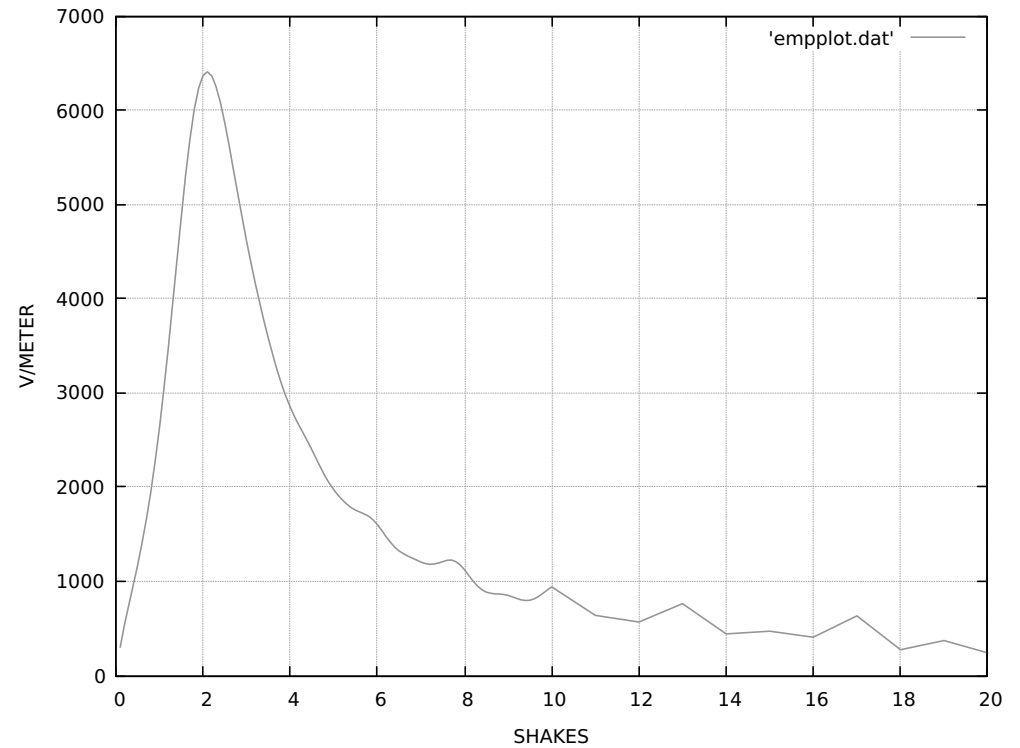
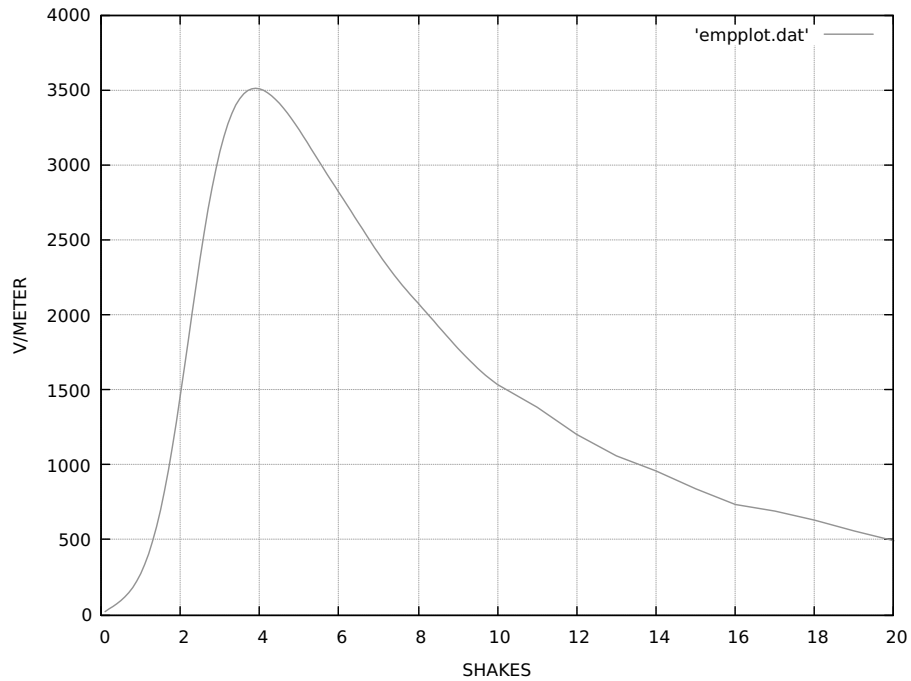
This function has the properties:

- a) Rises like $e^{\alpha t}$ for small t ;
- b) Falls like $e^{-\beta t}$ for large t ;
- c) Has a single maximum at $t = t_0$;
- d) $f(t_0) = 1/N$.

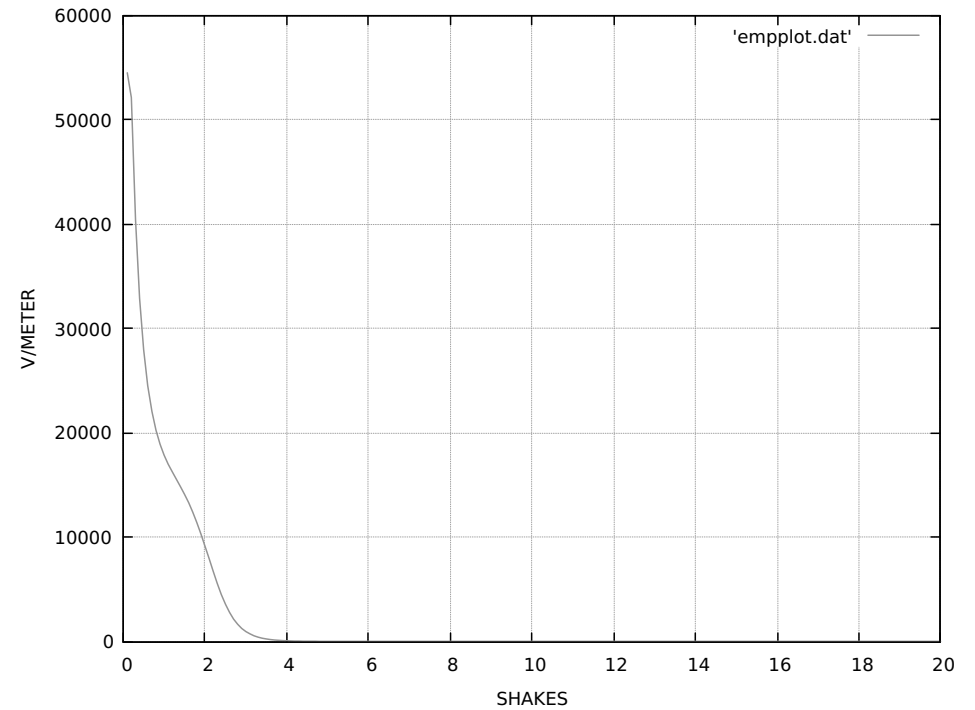
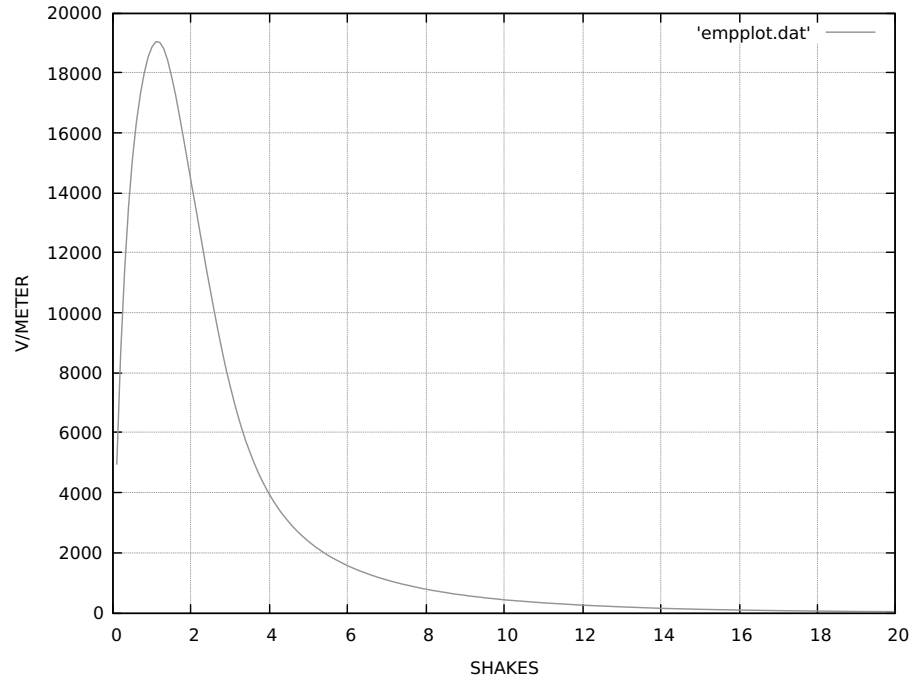
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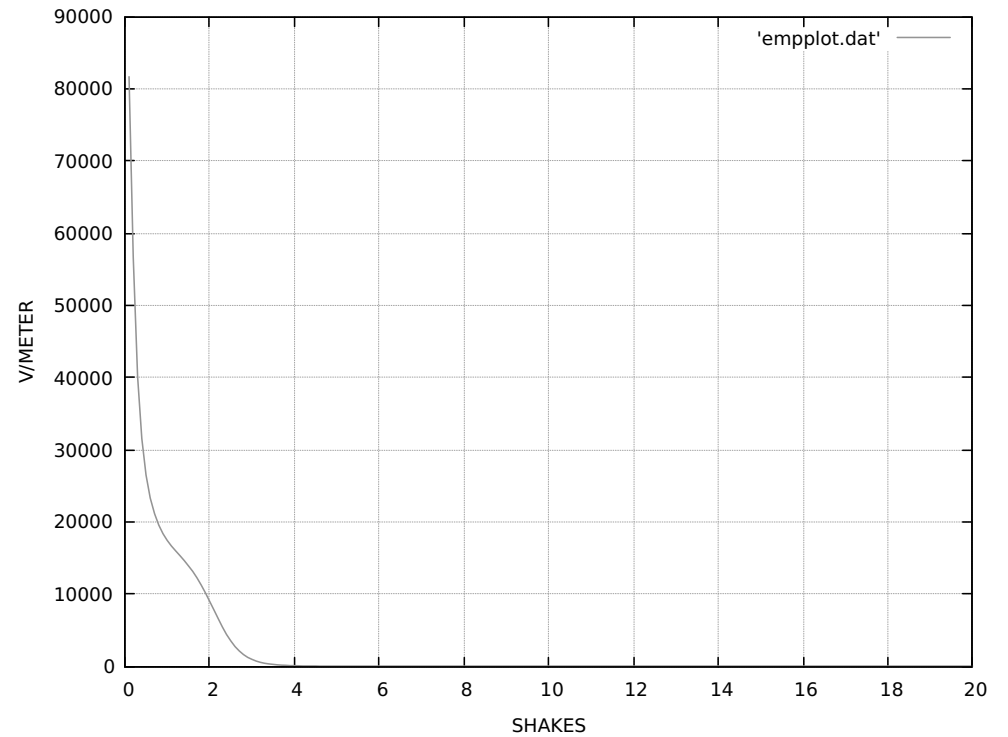
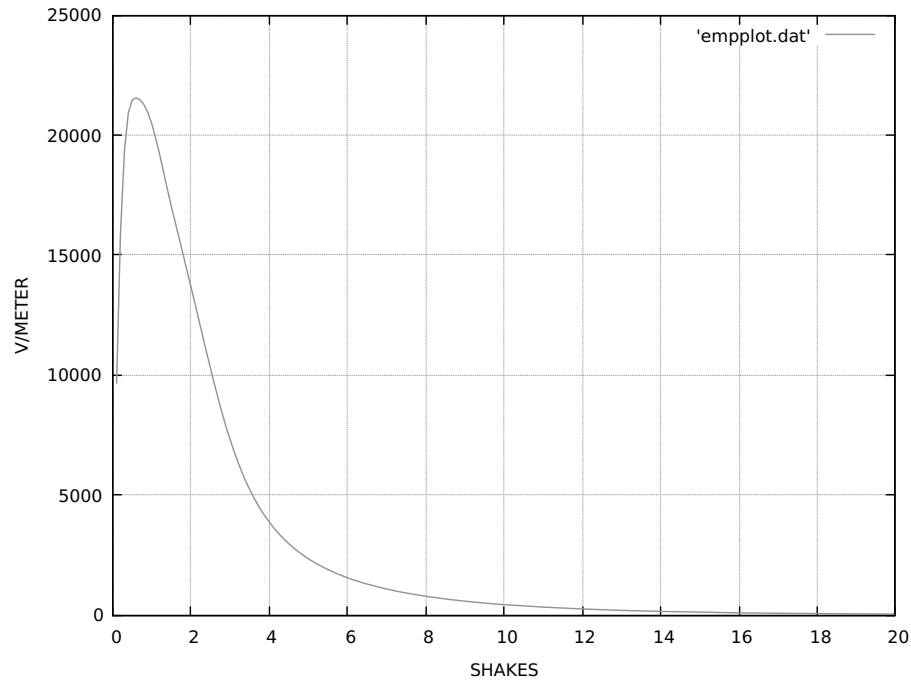
.001Ktons Yield



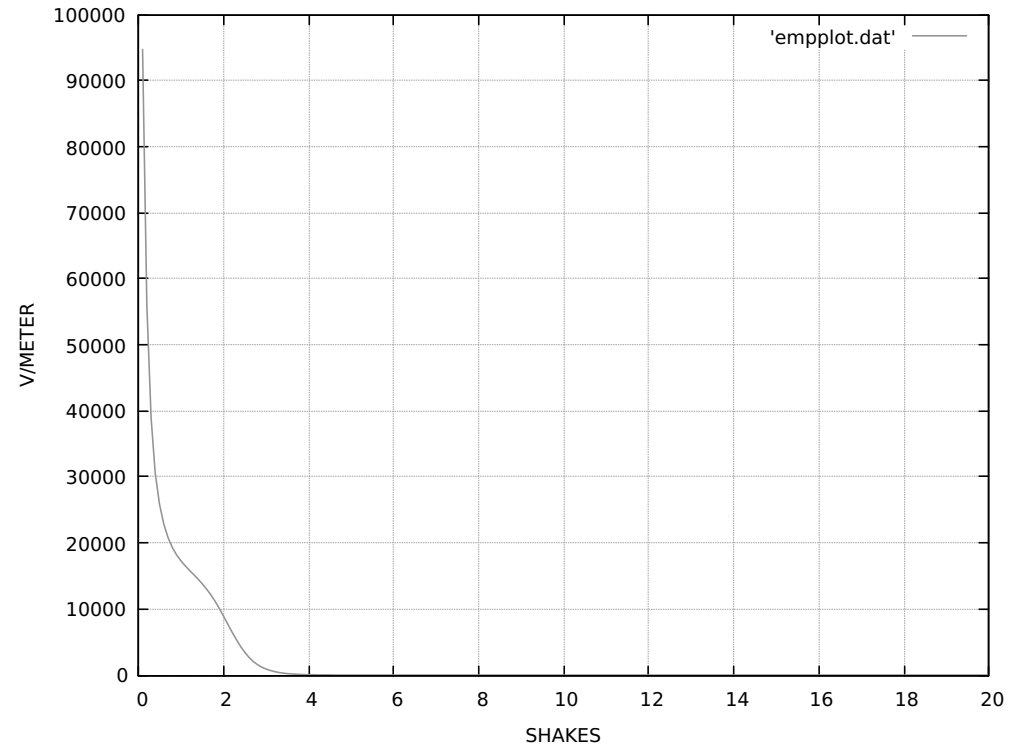
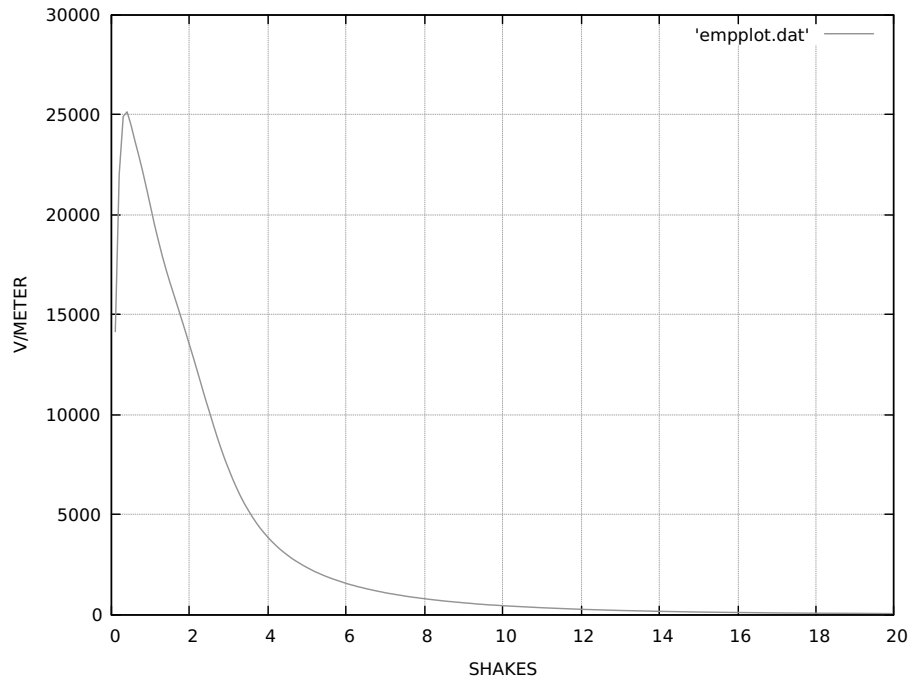
.25Ktons Yield



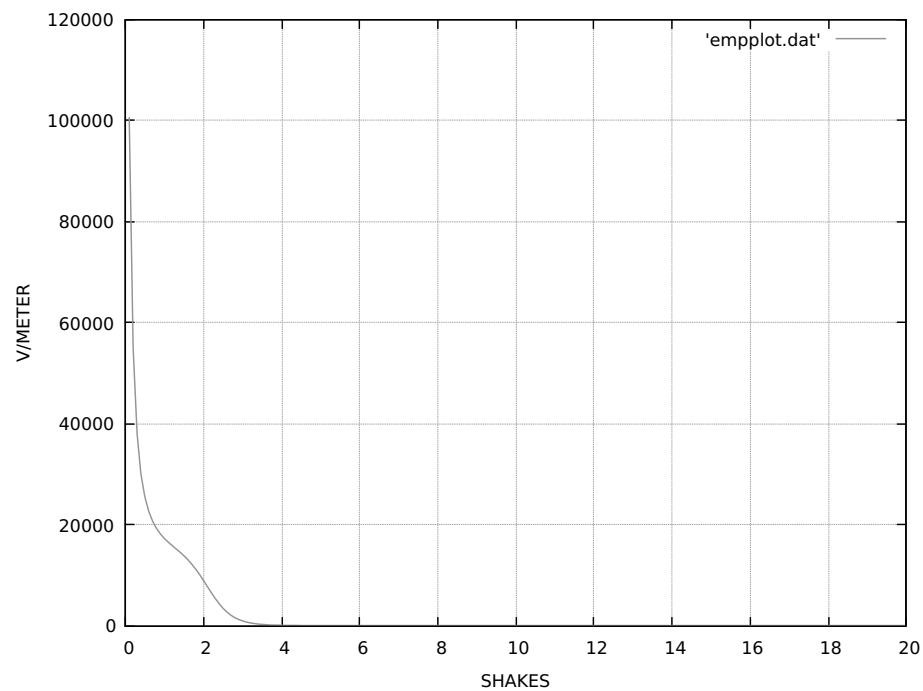
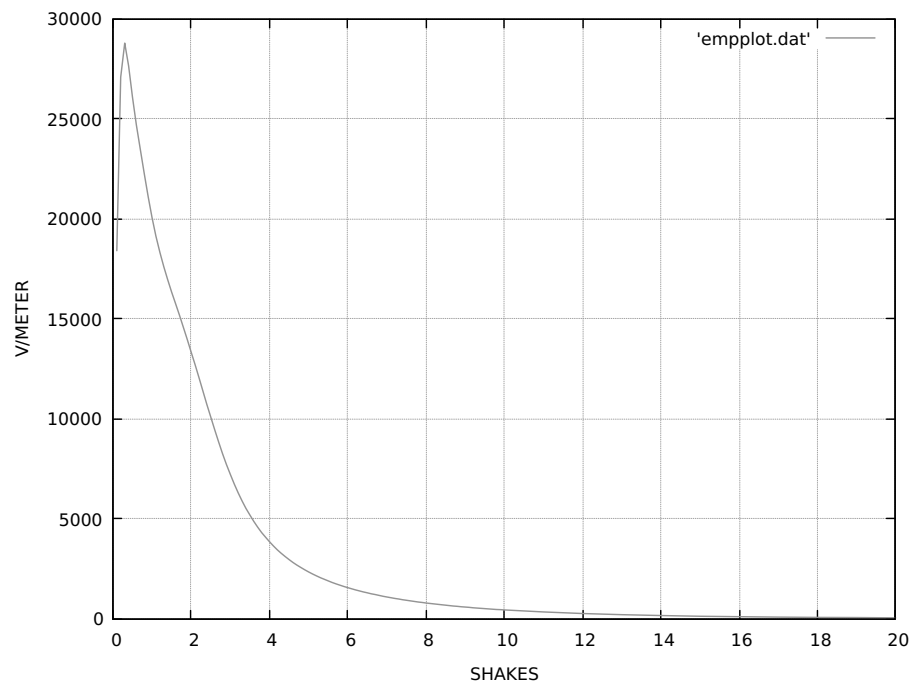
.50Ktons Yield



.75Ktons Yield



1 Ktons Yield

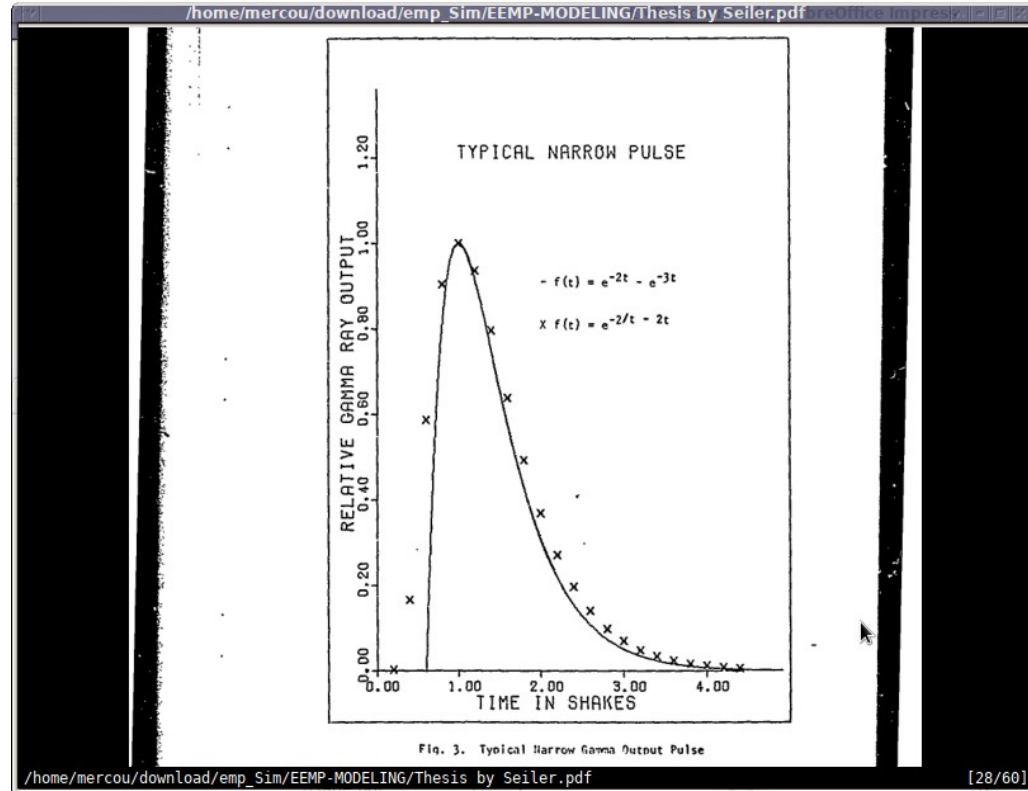


My derived constants

The following section will show my derived constants.

- Methodology
- Derived constants
- Run for .001,.25,.50,.75,1 Ktons
- Comparison

Seiler pulse gamma yield $f(t)$



The objective is to reproduce pulse as exemplified by Seiler (see previous slide) using the FOFT pulse equation shown previously. The restraints and requirements are a peak at 5ns or .5 shakes $a > b$ and the definite integral from 0 to ∞ equals 1. The equation must also mimic the general shape of the pulse. Rolloff time is 40ns (4 shakes).

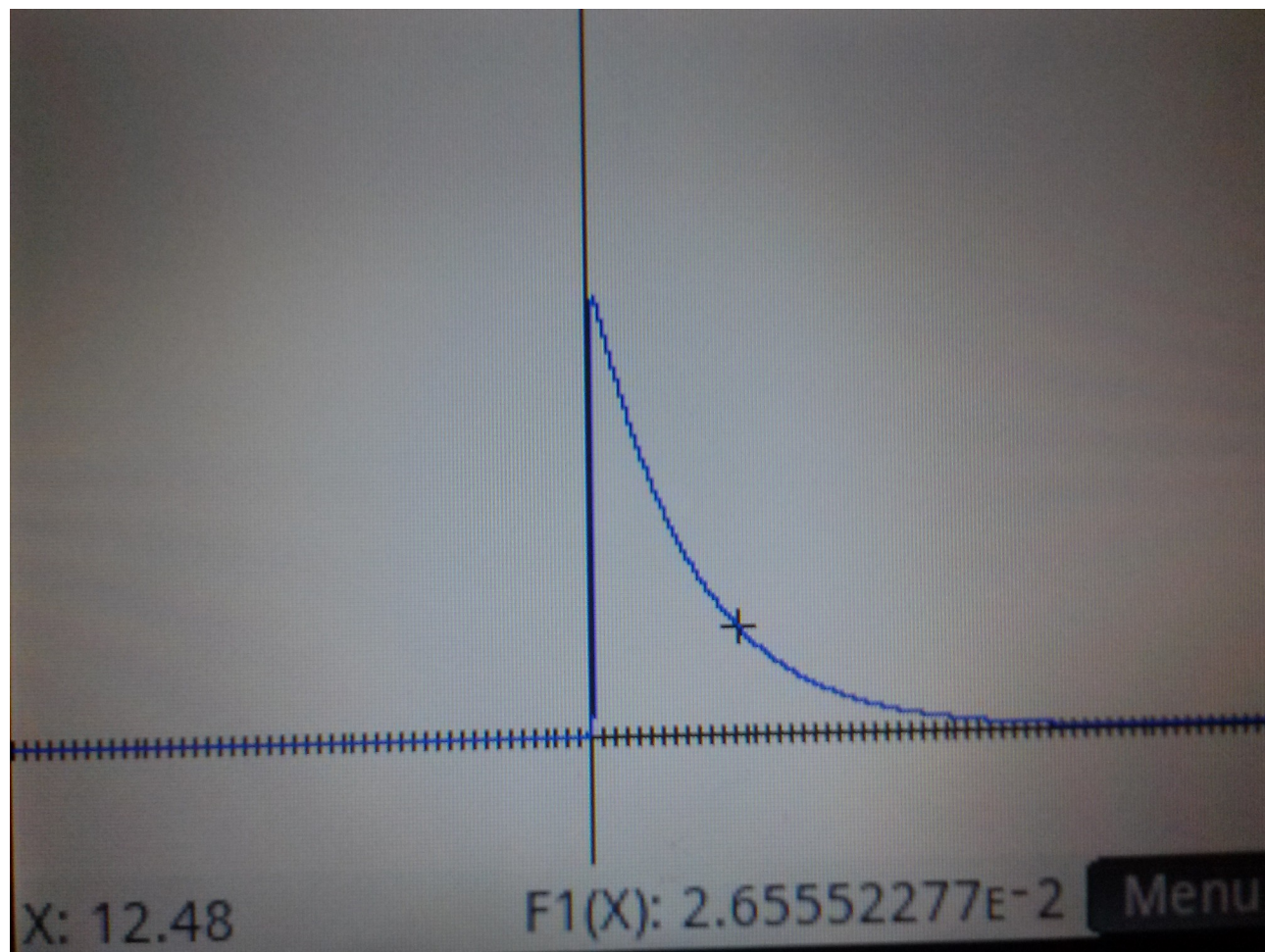
Derived constants

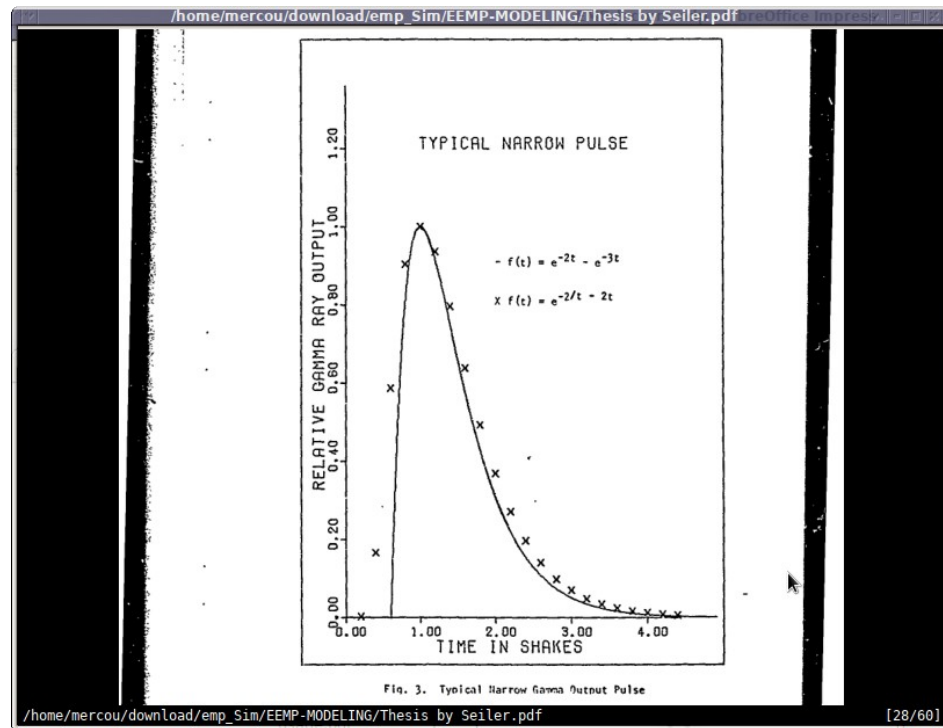
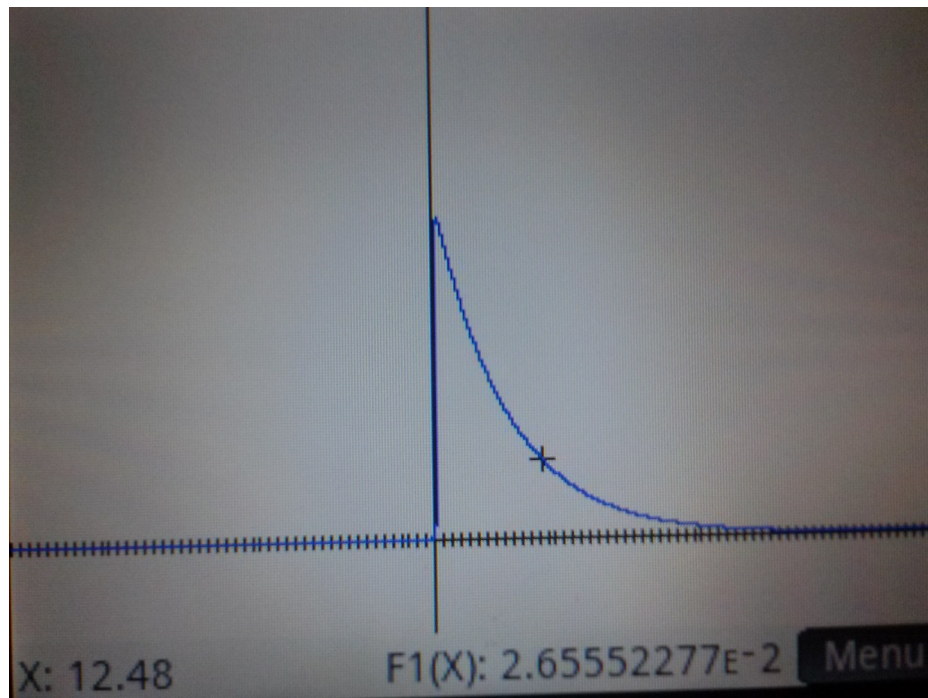
AP	BP	RNP	TOP
19	.12	9	.5

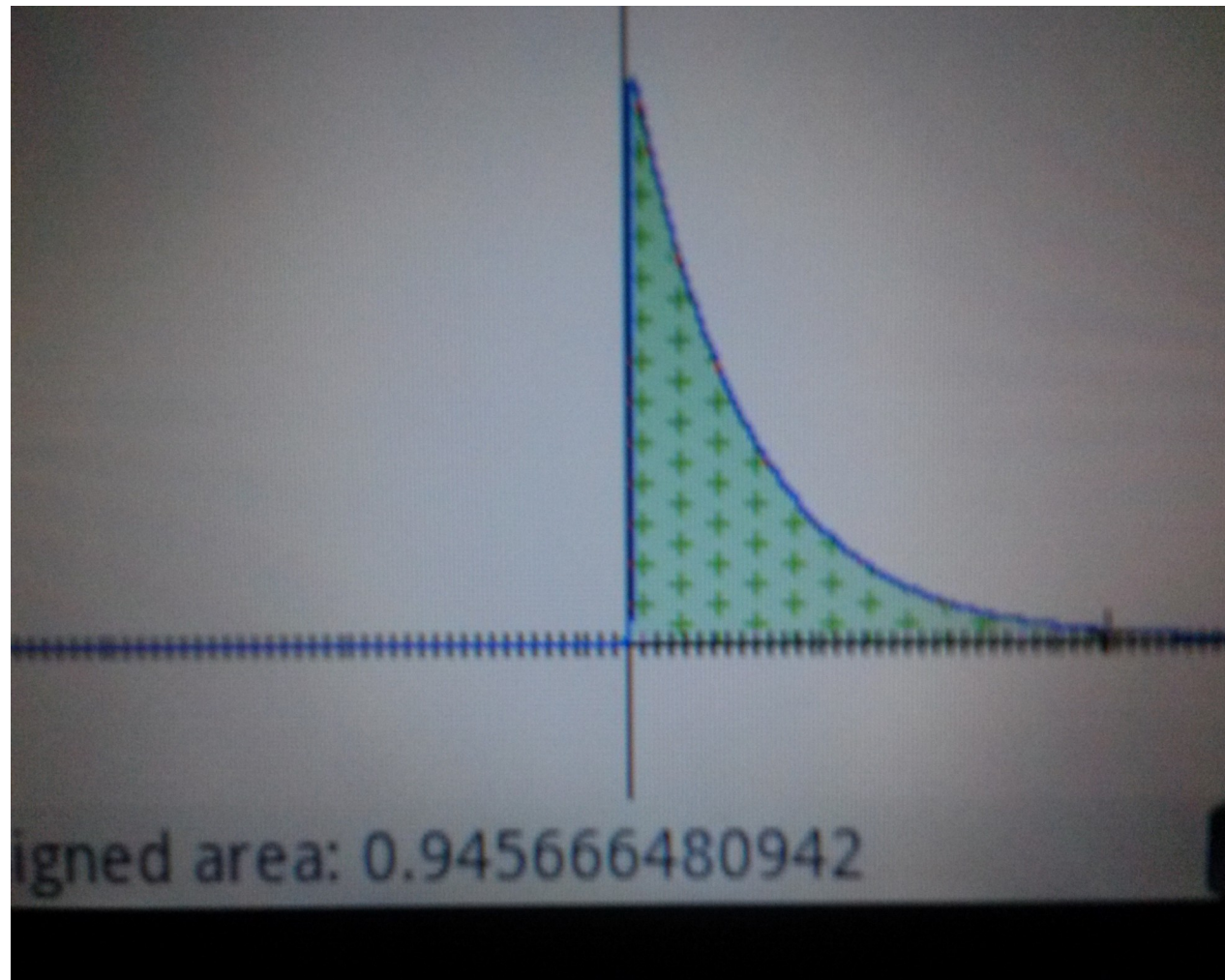
Using these constants mimics Seiler pulse closely and fulfills the requirement of integration equaling 1.

Peak gamma yield is also achieved at .5 shakes into run.

See following slides to illustrate.





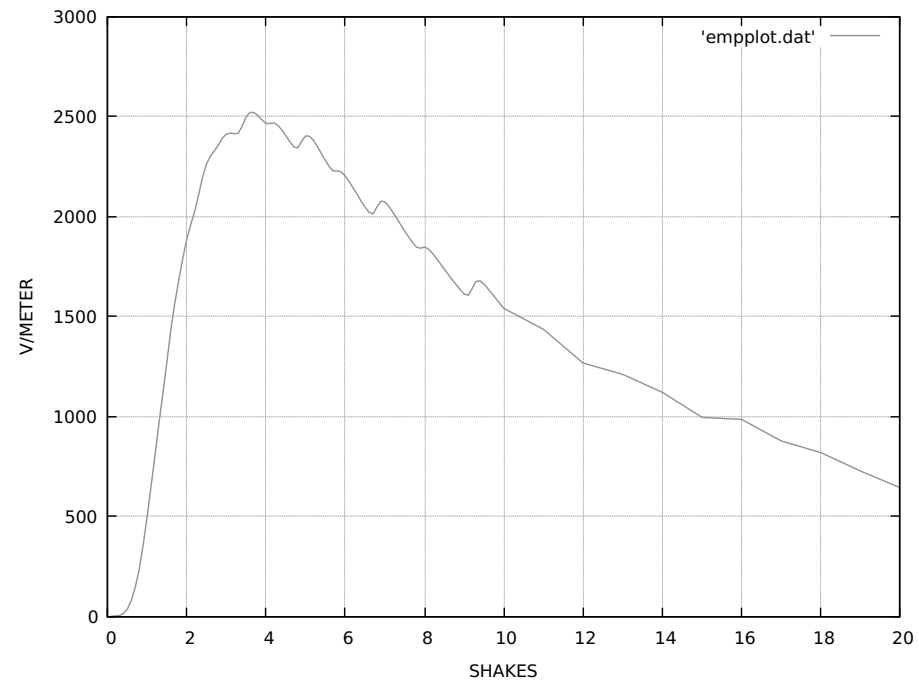


Once previous constants were employed an additional problem arose, namely at certain points in the calculation a NaN (NOT a NUMBER) error was encountered. After debugging it was ascertained that the problem was too small of word size. The original code was run on a CDC 6600 supercomputer which had a word size of 60bits. I therefore reasoned that the default wordsize on an intel arch was too small. Changing some variables (see source) to DOUBLE PRECISION solved the problem.

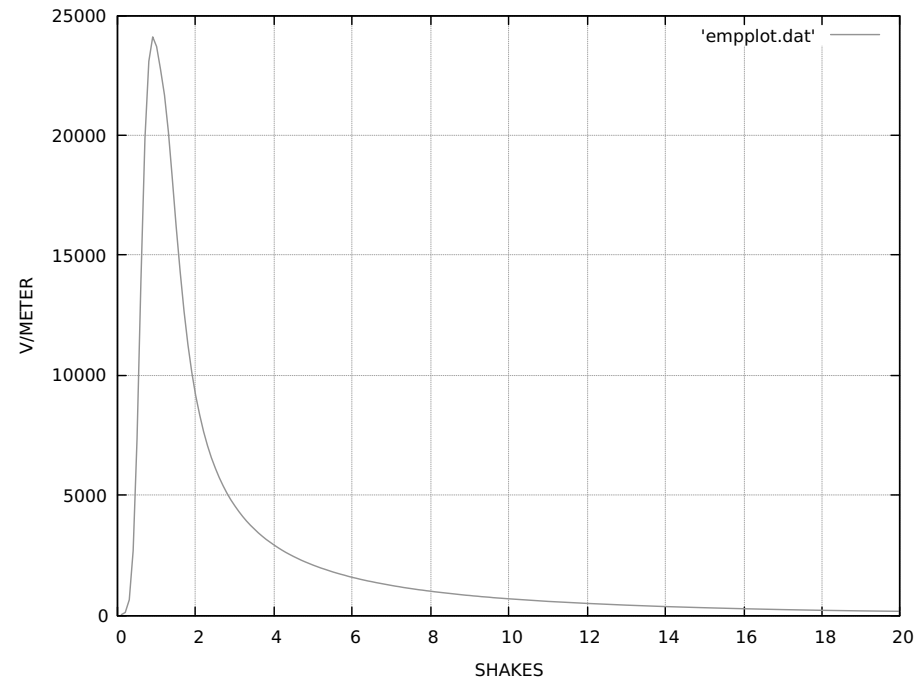




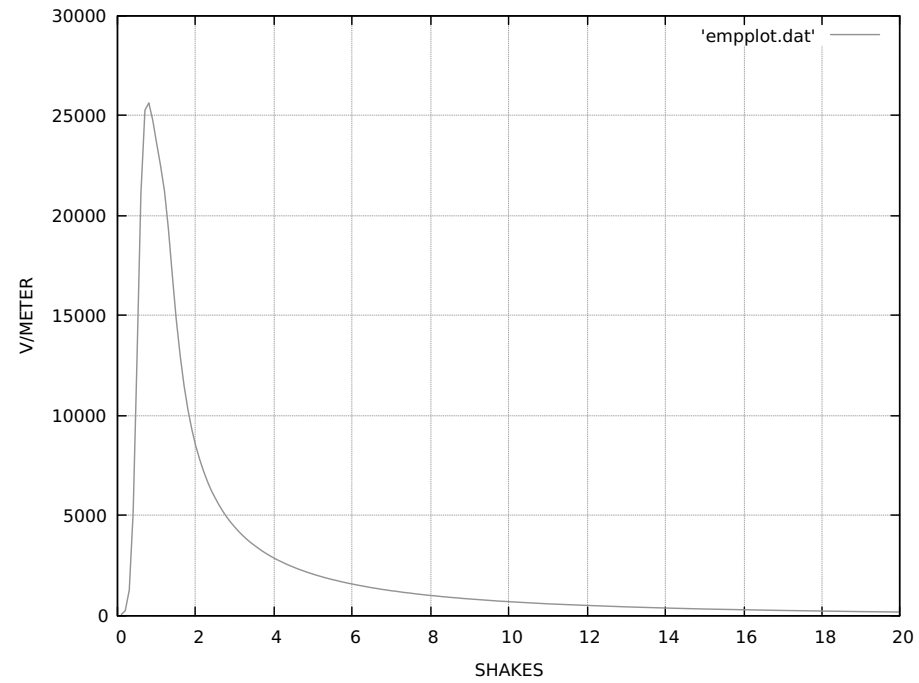
.001 Ktons



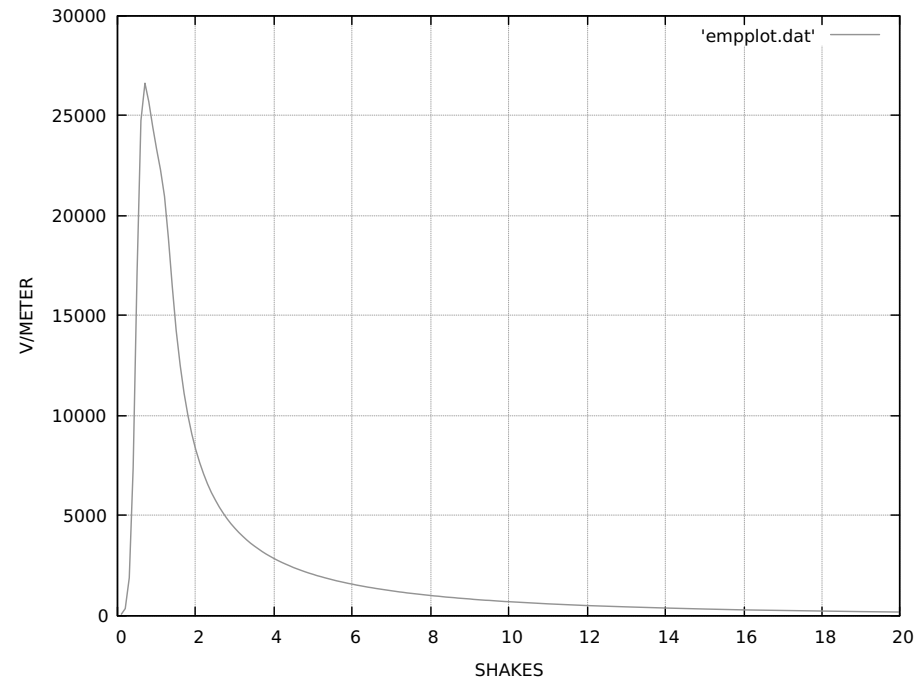
.25Ktons



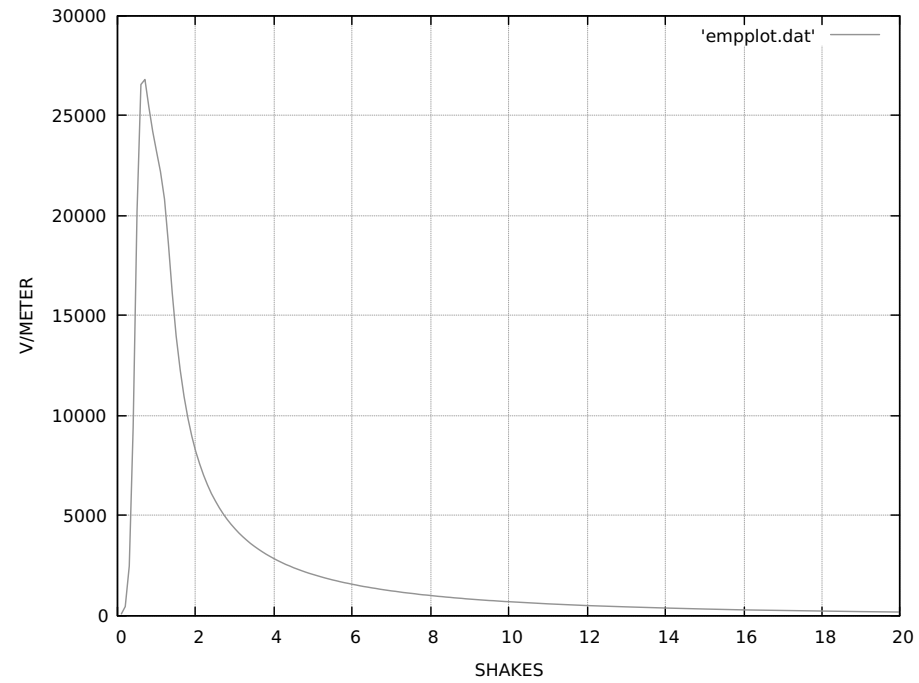
.50Ktons



.75Ktons



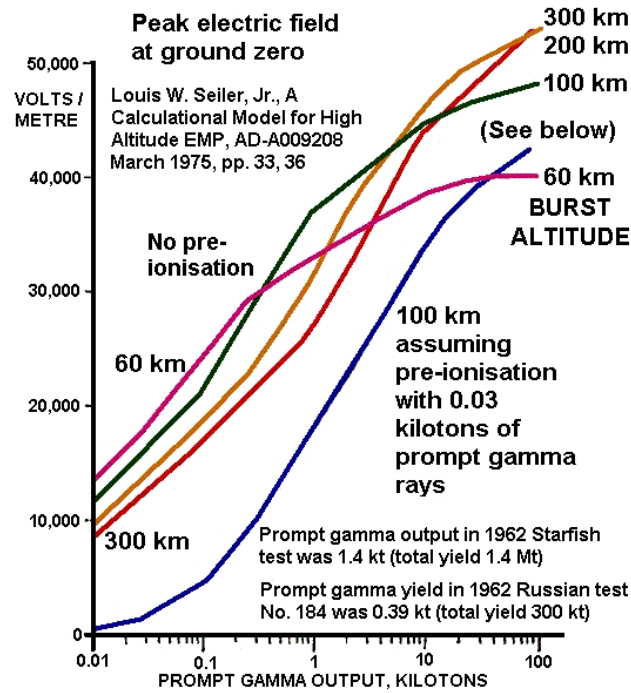
1Ktons



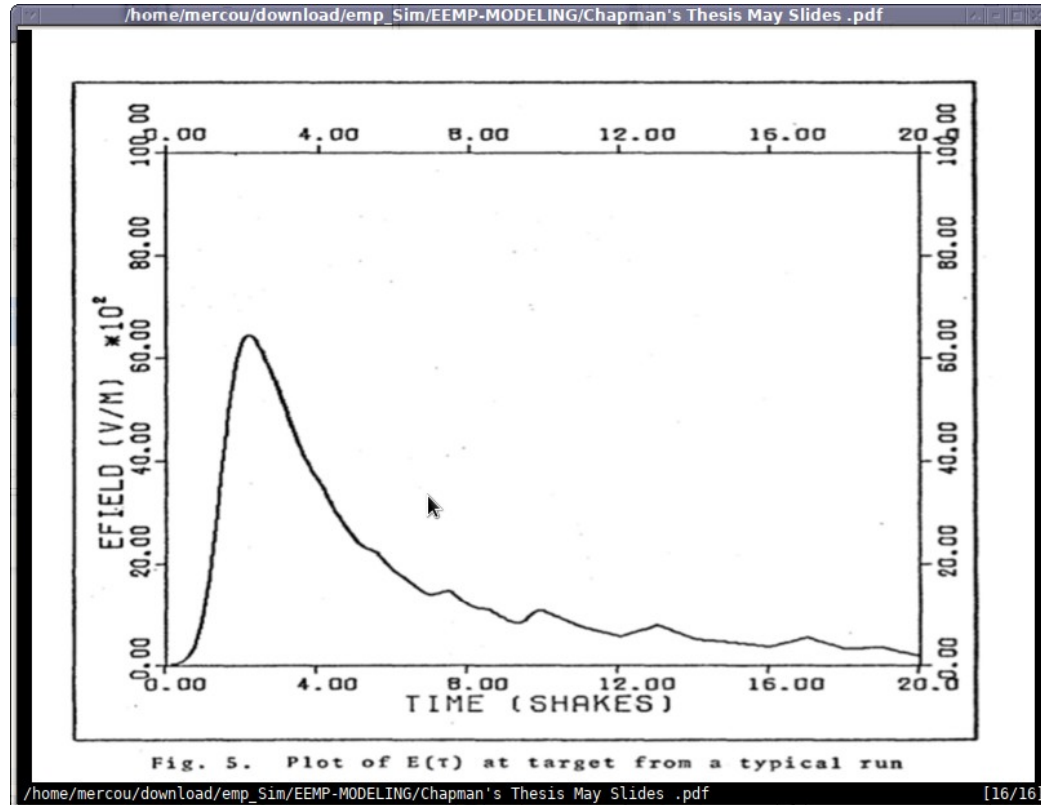
Notes

- The accuracy of the previous mathematical runs has not been verified.
- Please refer to cleaned up and amended fortran source code
- <https://github.com/drforbin/EEMP-MODELING>
- EEMP (Enhanced EMP Modeling)

Seiler emp as $F(x)$ of prompt gamma yield



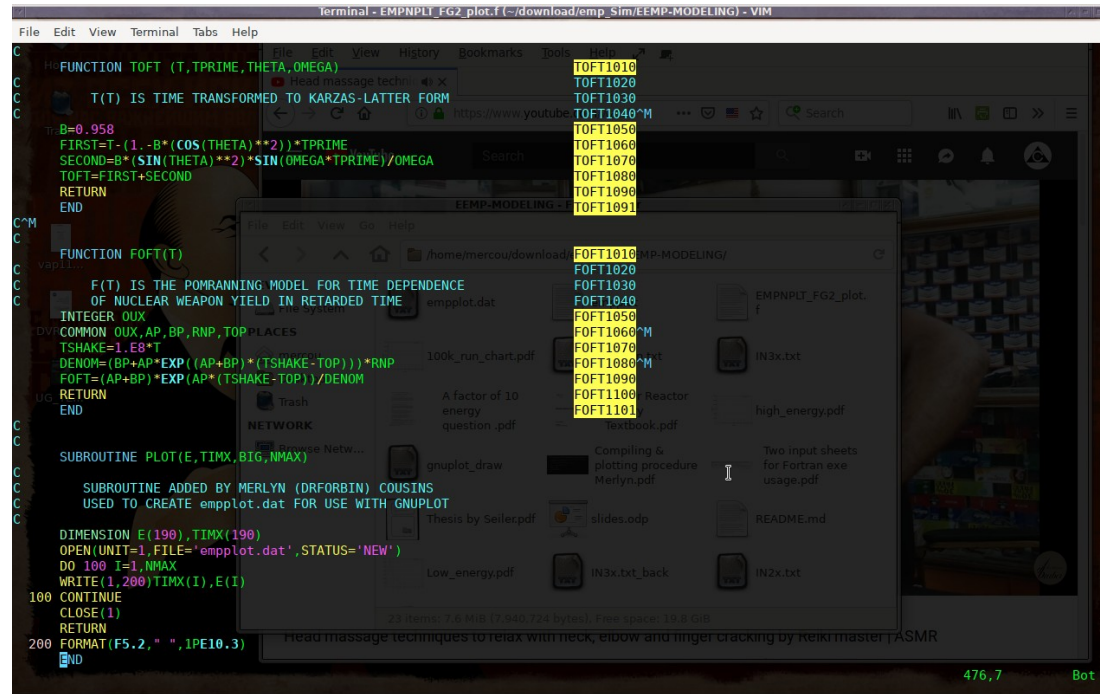
Chapman .001 Ktons yield



Changes added functions

Following slide shows function added for plotting purposes.
Function writes txt file which can be ran through gnuplot to produce a plot.

Added CALL for plotting



The screenshot shows a terminal window with a Fortran program. The code defines a function TOFT for time transformation and a subroutine PLOT for plotting. A file explorer window is open over the code, showing a directory with various files. The terminal output at the bottom shows the program's execution status.

```
terminal - EMPNPLT_FG2_plot.f (~/.download/emp_sim/EEMP-MODELING) - VIM
File Edit View Terminal Tabs Help

FUNCTION TOFT (T,TPRIME,THETA,OMEGA)
  T(T) IS TIME TRANSFORMED TO KARZAS-LATTER FORM
  B=0.958
  FIRST=T-(1.-B*(COS(THETA)**2))*TPRIME
  SECOND=B*(SIN(THETA)**2)*SIN(OMEGA*TPRIME)/OMEGA
  TOFT=FIRST+SECOND
  RETURN
END

FUNCTION FOFT(T)
  F(T) IS THE POMRANNING MODEL FOR TIME DEPENDENCE
  OF NUCLEAR WEAPON YIELD IN RETARDED TIME
  INTEGER OUX
  COMMON OUX,AP,BP,RNP,TOP,PLACES
  TSHAKE=1.E8*T
  DENOM=(BP+AP*EXP((AP+BP)*(TSHAKE-TOP)))*RNP
  FOFT=(AP+BP)*EXP(AP*(TSHAKE-TOP))/DENOM
  RETURN
END

SUBROUTINE PLOT(E,TIMX,BIG,NMAX)
  SUBROUTINE ADDED BY MERLYN (DRFORBIN) COUSINS
  USED TO CREATE empplot.dat FOR USE WITH GNUPLOT

  DIMENSION E(190),TIMX(190)
  OPEN(UNIT=1,FILE='empplot.dat',STATUS='NEW')
  DO 100 I=1,NMAX
    WRITE(1,200)TIMX(I),E(I)
  100 CONTINUE
  CLOSE(1)
  RETURN
  FORMAT(F5.2," ",1PE10.3)
END
```

File Explorer: /home/mercou/download/EEMP-MODELING/

- empplot.dat
- 100k_run_chart.pdf
- A factor of 10 energy question.pdf
- gnuplot_draw
- Thesis by Seiler.pdf
- Low_energy.pdf
- EMPNPLT_FG2_plot.f
- IN3x.txt
- high_energy.pdf
- Reactor
- Textbook.pdf
- Compiling & plotting procedure Merlyn.pdf
- slides.odp
- IN3x.txt_back
- IN2x.txt
- README.md

23 items: 7.6 MiB (7,940,724 bytes). Free space: 10.8 GiB

Head massage techniques to relax with neck, elbow and finger cracking by keiki master TASM

476,7 Bot

Conclusion

Based on all available data (to the presenter) the grouse constants appear to produce figures which more closely track emp as $f(x)$ of gamma yield. Please consider the max is slightly over 50Kv/m for a gamma yield of 100Ktons (seiler chart). Using grouse's constants the 1Kton emp is ~28Kv/m, ~34Kv/m for seiler chart, and well over 100Kv/m using sunny's constants. My constants produce a result near 27Kv/m

Grouse's constants track the only available data more closely than does the sunny constants.

My constants are the more conservative but are the only constants which fully reproduce the Seiler gamma pulse faithfully using the Pommranning equation.

cont

More work has to be done to nail down exactly how these four constants interact in order that more reliable conclusions can be reached. As it stands the findings are riddled with inconsistencies.

But given both Grouse's, My numbers and Seiler's produce ~ a 30Kv/m EMP using a prompt gamma yield of 1Kton, which would translate into about a total weapon yield of $1000/.001=1\text{Mton}$ it still would pose a serious treat to unshielded electronic devices.

cont

In closing consider the fact that the U.S. among other nations has given up any pretense of civil defense as well as any major ground based ICBM systems opting for submarine based systems. It begs the question if expending money to harden infrastructure is really necessary or prudent. This is a question for political discussion. As this paper is meant to be technical in nature this aspect is rendered out of scope but is brought up as food for thought.

HAVE FUN with the Apocalypse