Fidelity of RHEPP and Z Experiments to Study Wall Response

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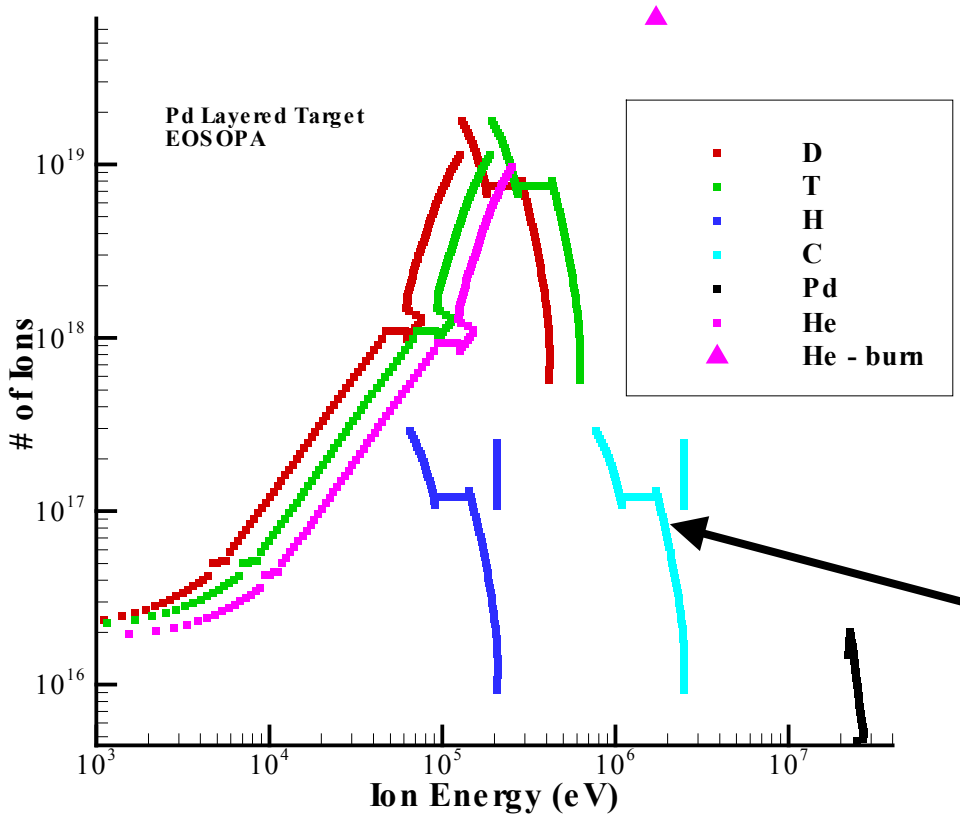
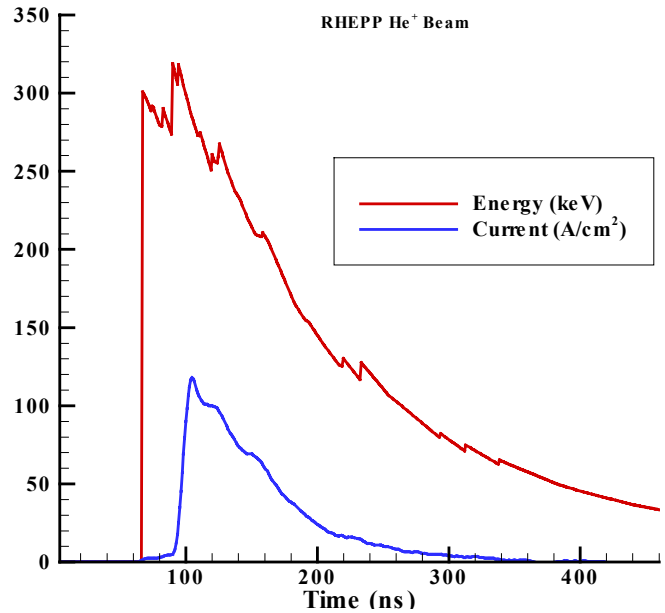
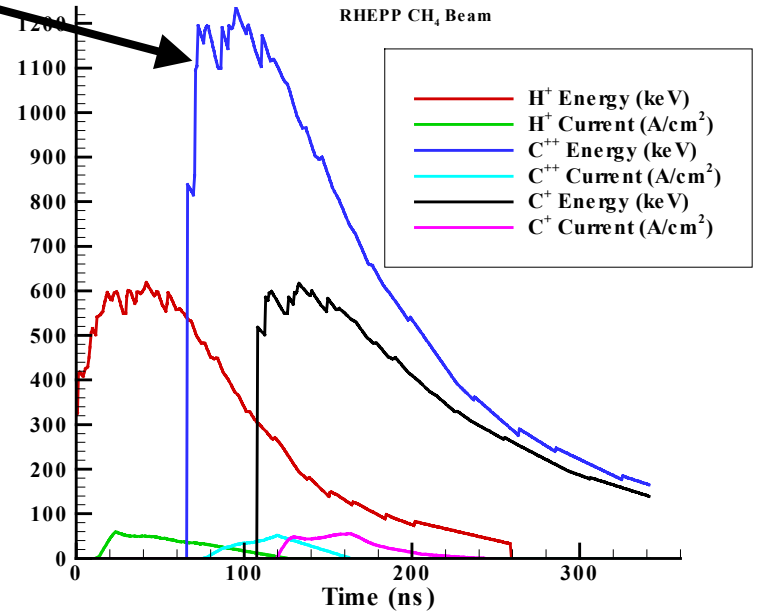
Z and RHEPP Can Replicate the Conditions in the Walls of IFE Target Chambers

- X-rays and ions (debris and fusion products) from target micro-explosions are great threats to the survival of gas-protected dry-wall target chambers.
- Z and RHEPP at Sandia National Laboratories can provide x-rays and ions that, though not exactly the same as predicted target output, are of relevant spectra and intensities.
- The question assessed in this talk is "How important are the differences between IFE target output and what is available on Z and RHEPP?".

Ion Spectra: RHEPP versus NRL Direct-Drive Targets



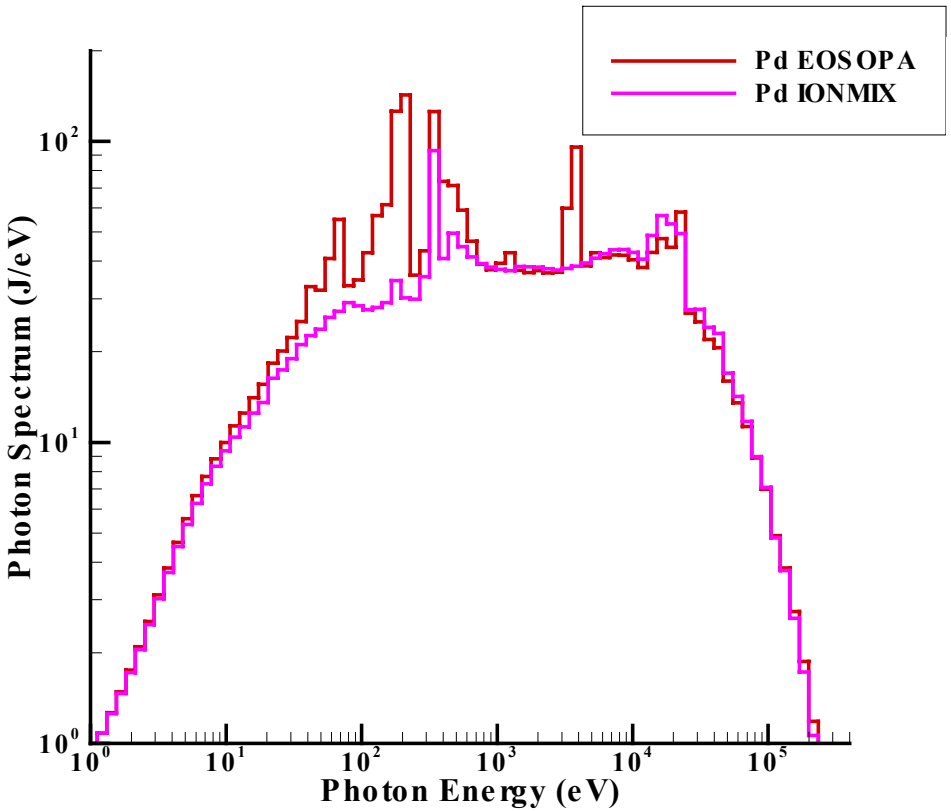




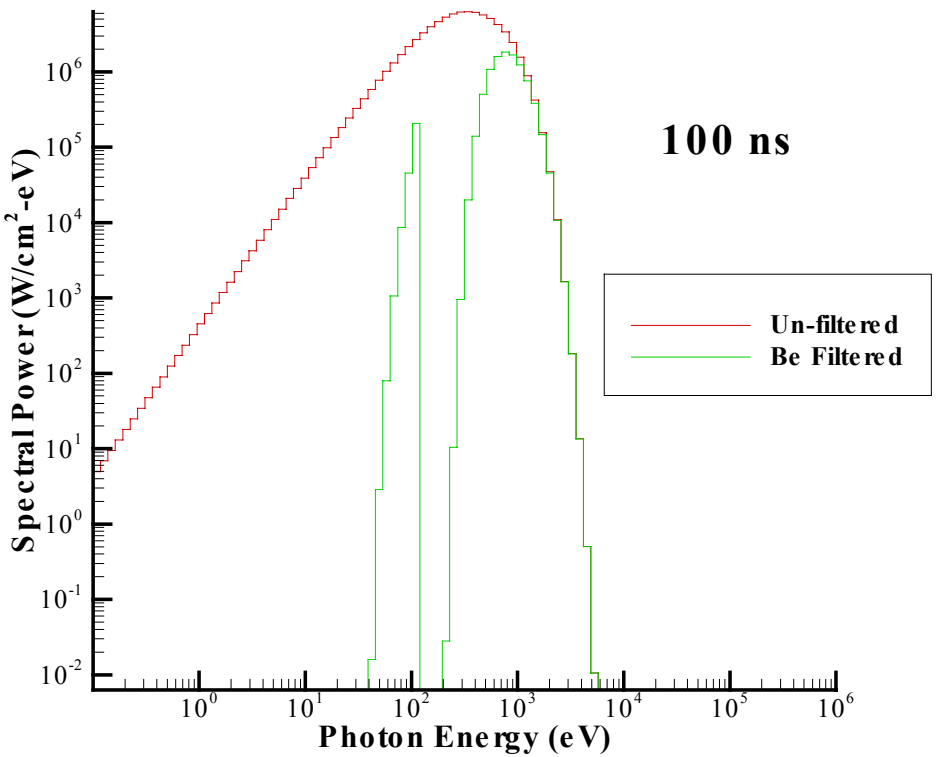
The IFE chamber experiences ion pulses 100's of ns in duration, which is what RHEPP produces.

Filtering of Z W-Wire-Array X-Rays Can Move Spectrum Closer to Direct-Drive Threat Spectrum

350 MJ Direct-Drive Target



Filtered and Un-Filtered Z



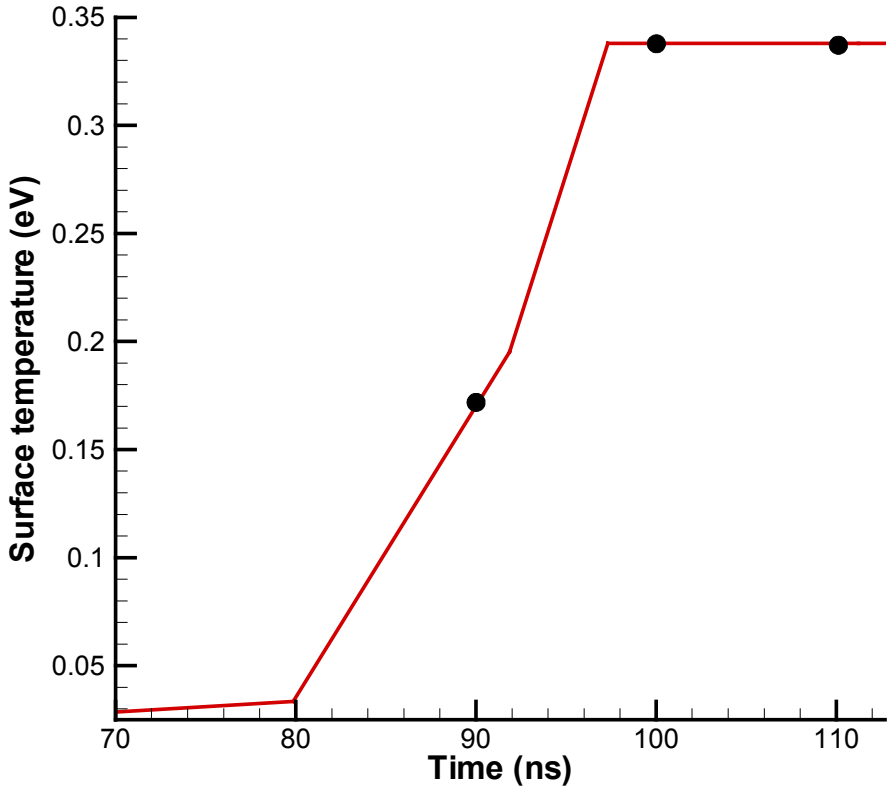
Direct-Drive IFE targets radiate most of their x-rays over ~ 10 ns, which is similar for Z.

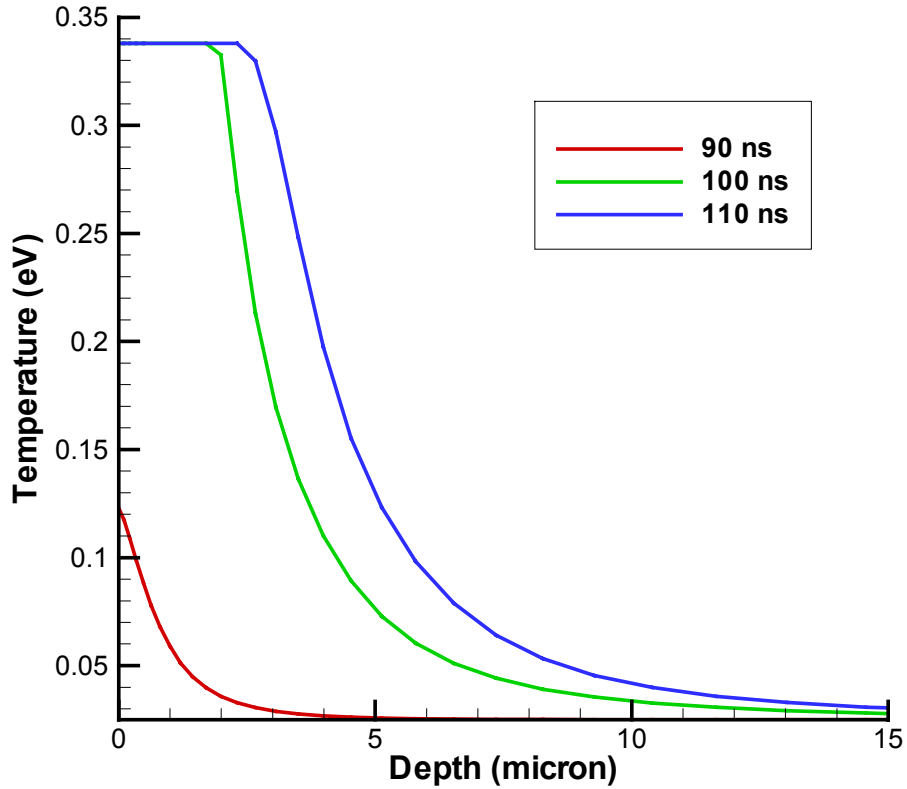
Z X-Rays Heat Graphite to Sublimation in About 20 ns to a Depth of About 5 μm

X-rays
- ~50 J/cm²
- Unfiltered
- W Z-pinch

Graphite
- Conductivity: (W/m-eV)
- μm Sublimated

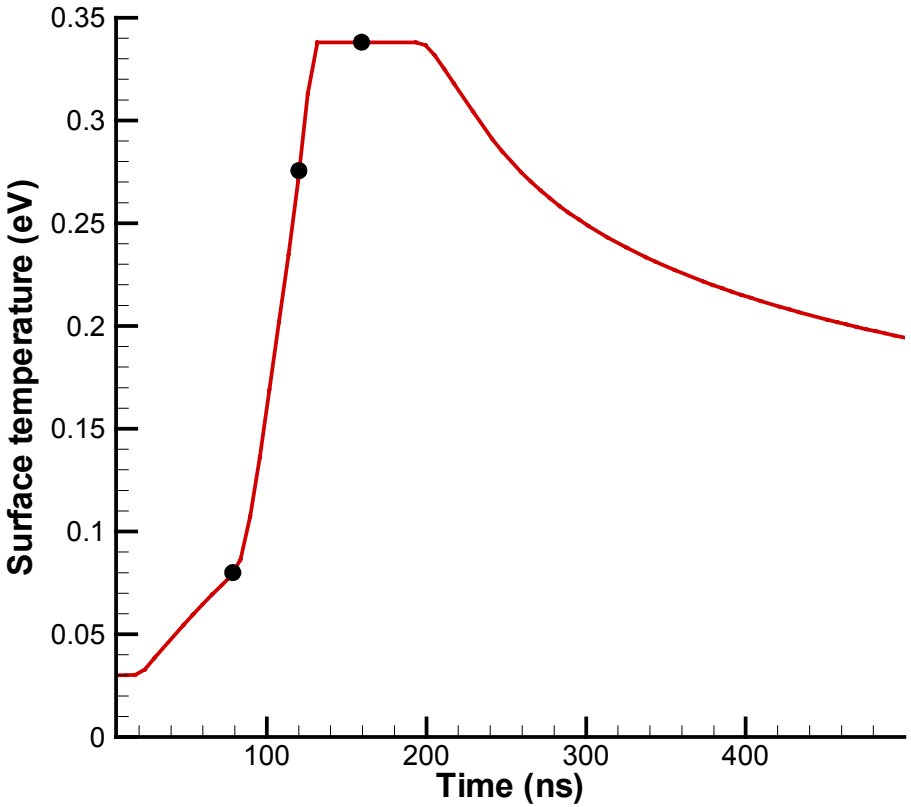
BUCKY Simulation
- 1-D
- Condensate w/o hydro
- Spectrum from VISRAD

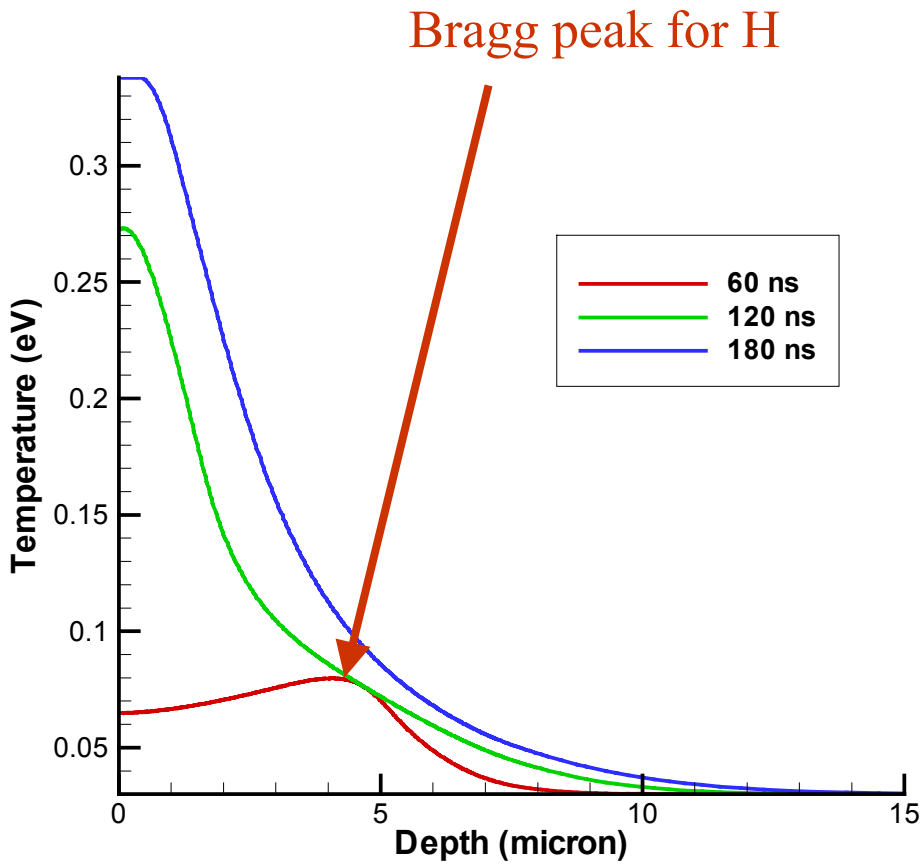




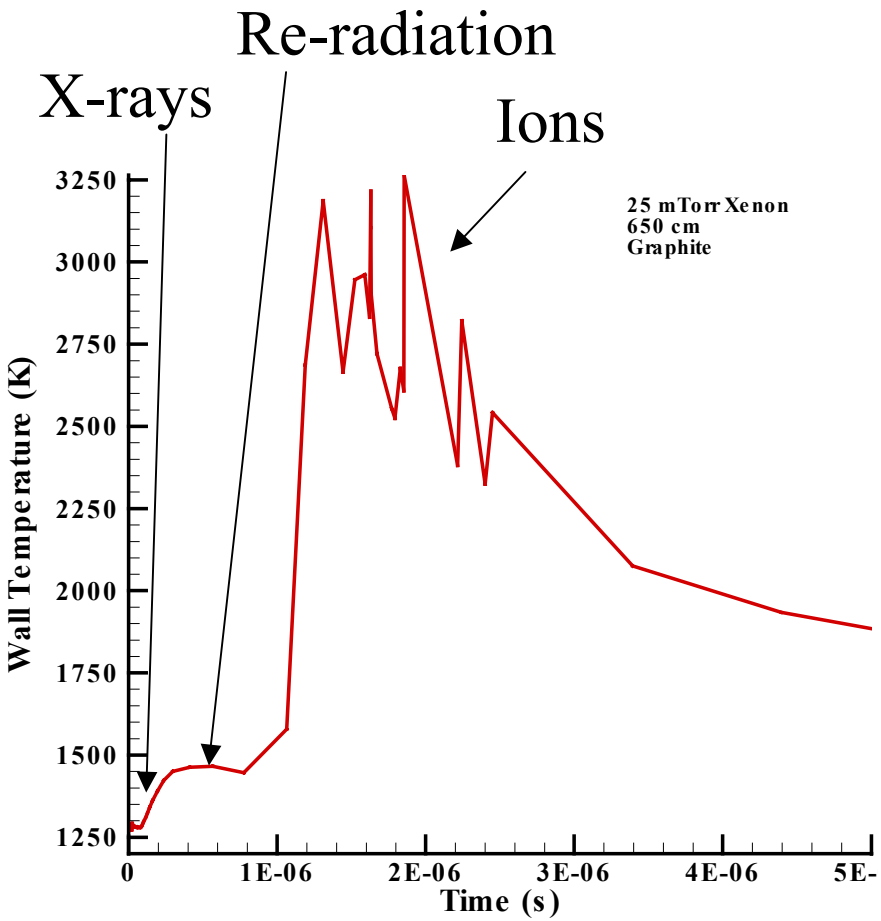
RHEPP CH_4 Beam Heats Graphite to Sublimation in About 200 ns and to a Depth of Several μm

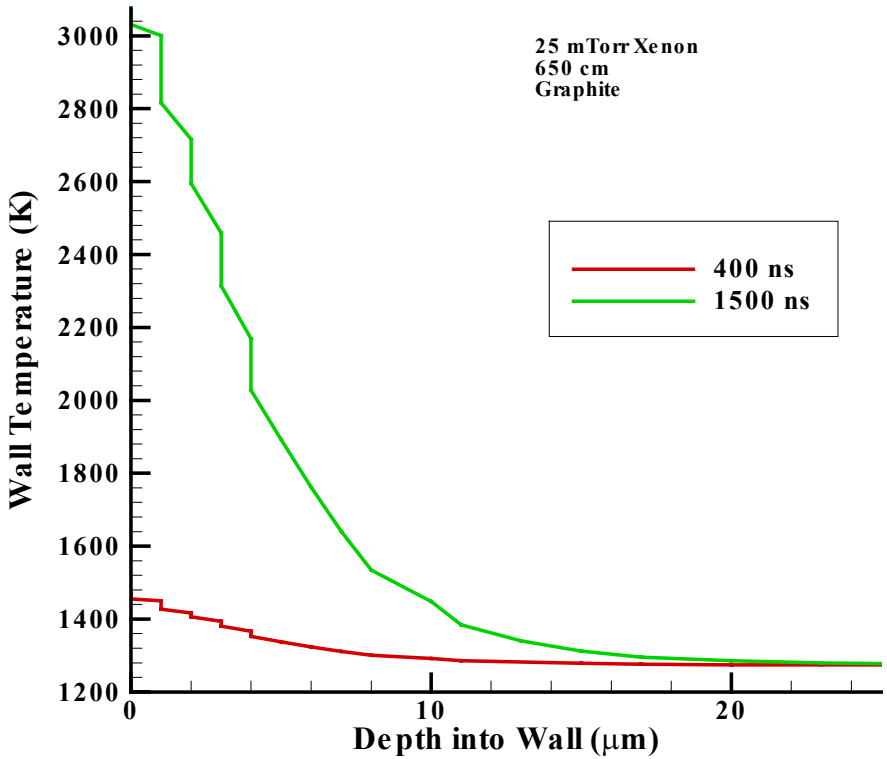
CH_4 beam: ~6 J/cm^2



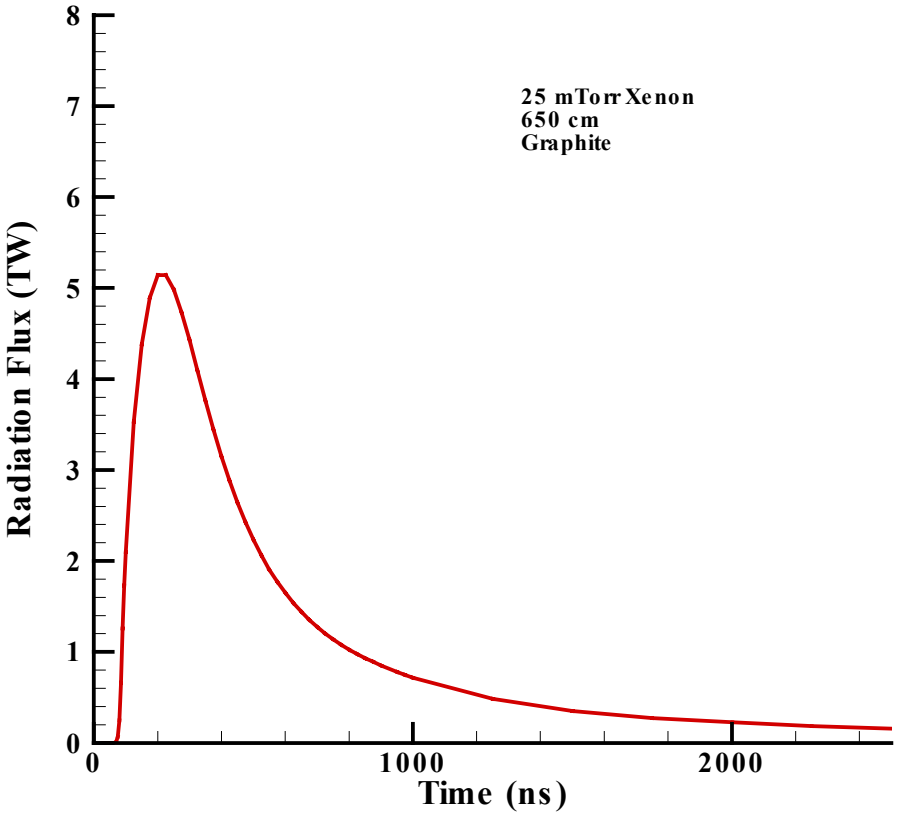


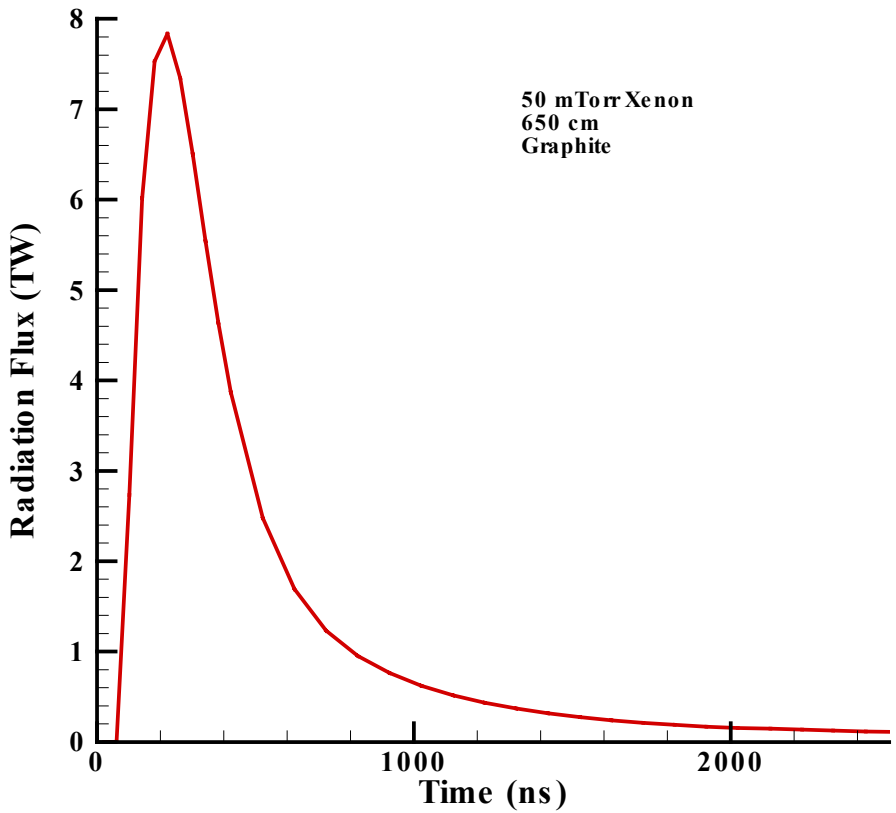
A Graphite Wall 650 cm in Radius and Protected by 25 mTorr of Xe is Heated Over About 200 ns and to a Depth of 5 μm.





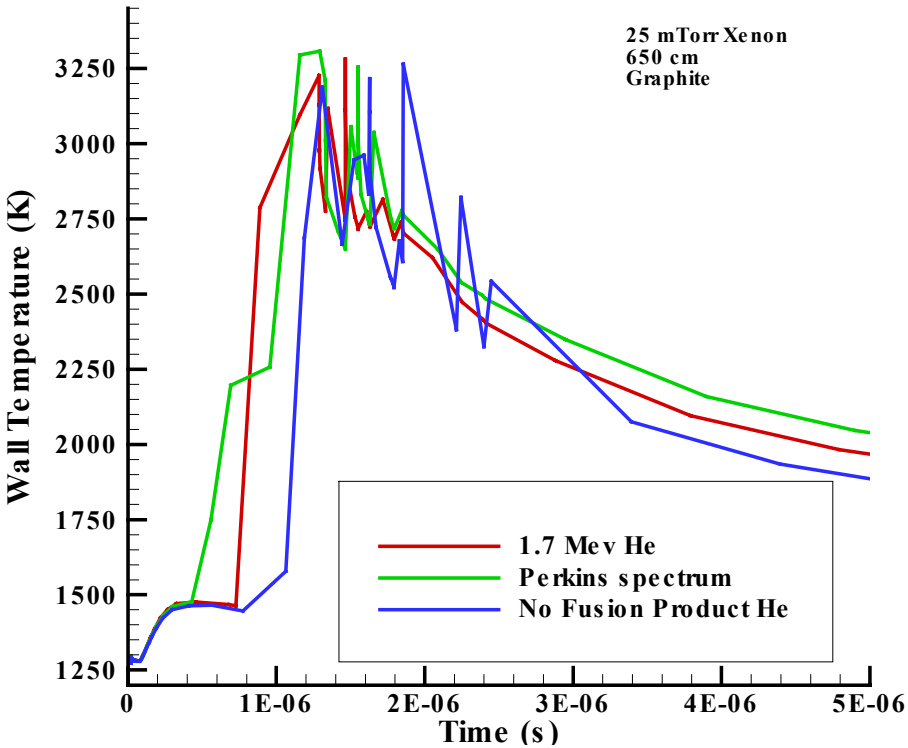
A Graphite Wall 650 cm in Radius and Protected by 50 mTorr of Xe Sees Considerably More Re-Radiated Energy Than a Wall Protected by 25 mTorr.

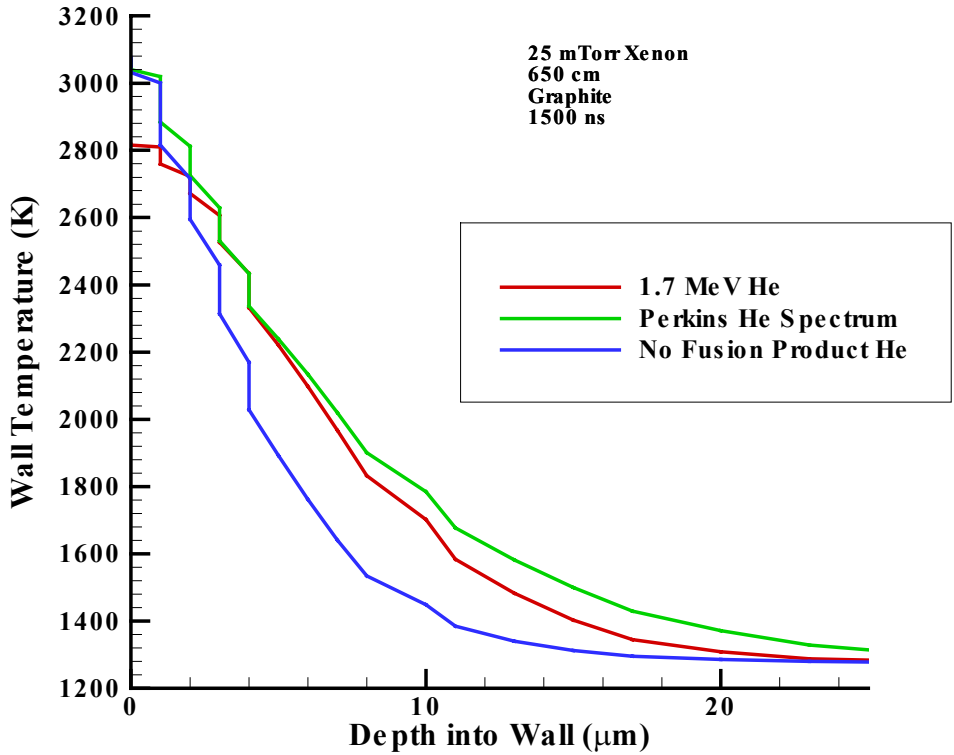




- This issue is not studied by current RHEPP or Z experiments.
- As Xe density increases this effect becomes more important.
- How can this be studied?: gas-bag experiments on Z, RHEPP or NIF.

Fusion Product Helium Is a Very Large Fraction of Debris Ion Target Output, But it is Difficult to Duplicate in Detail: How Important are the Details?





Peak surface temperatures in an IFE chamber wall are similar with and without fusion product He; details of temperature rise is different.

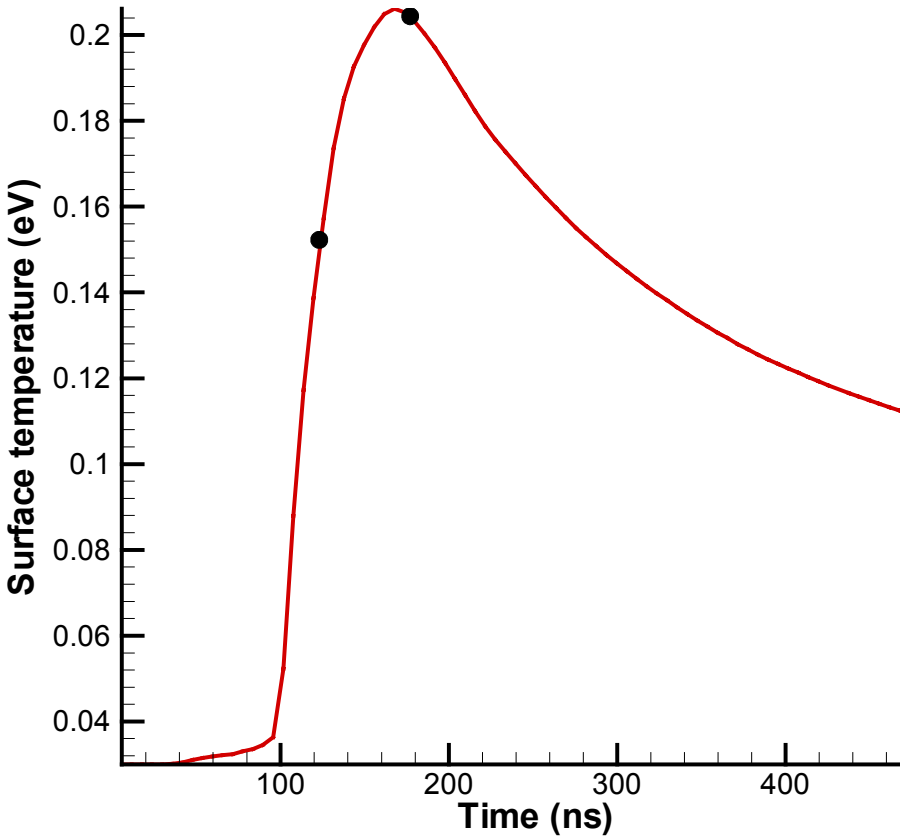
Details of fusion product helium ions do play an important role to temperature profiles in wall.

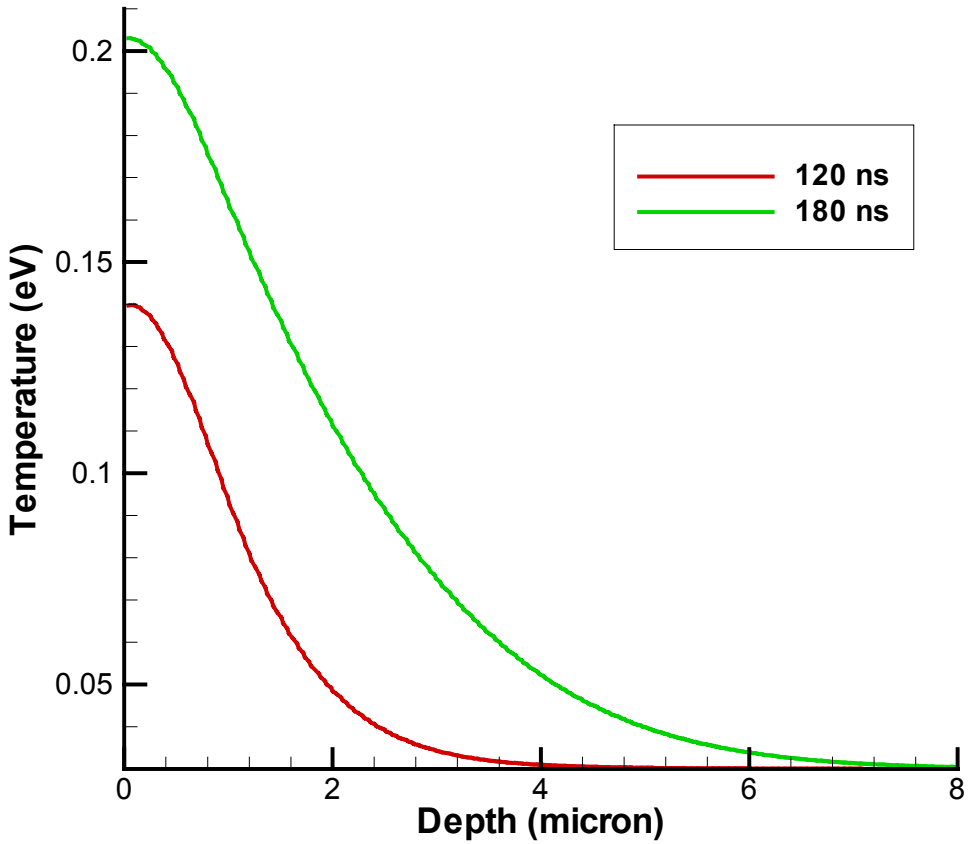
Z and RHEPP Can Replicate the Conditions in the Walls of IFE Target Chambers

- Though there are some differences between IFE target spectra and RHEPP and Z, the experiments study the most important issues.
- The surface temperature histories and the temperature profiles are similar.
- Important issues to keep an eye on: > MeV He, re-radiated energy, > 5 keV photons.

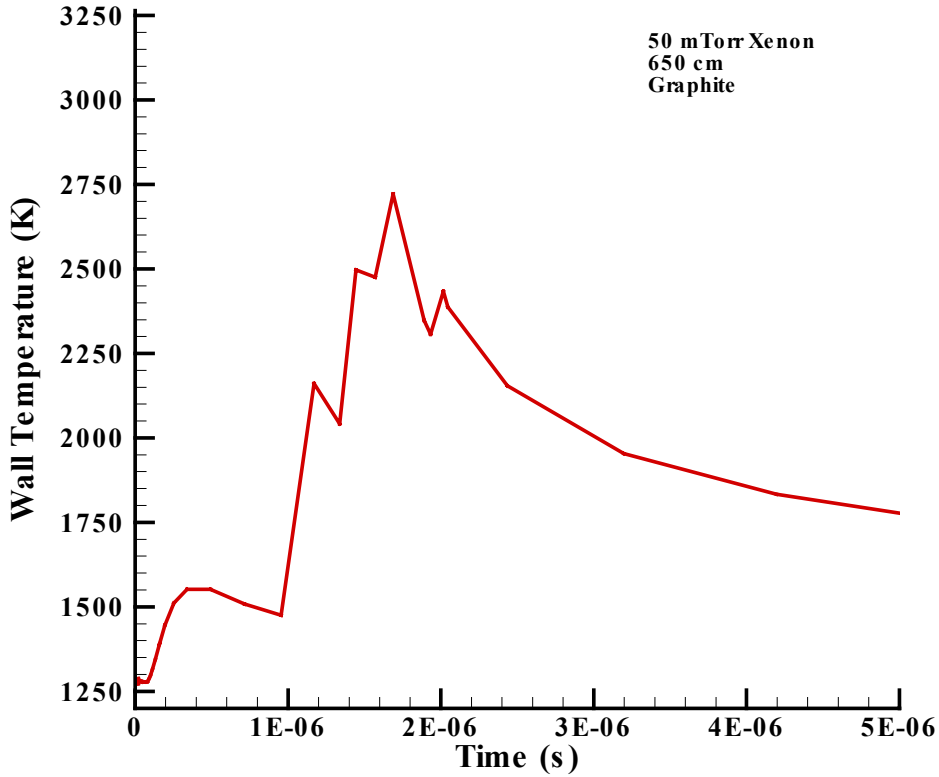
RHEPP He Beam Heats Graphite to Sublimation in About 100 ns and to a Depth of Several μm

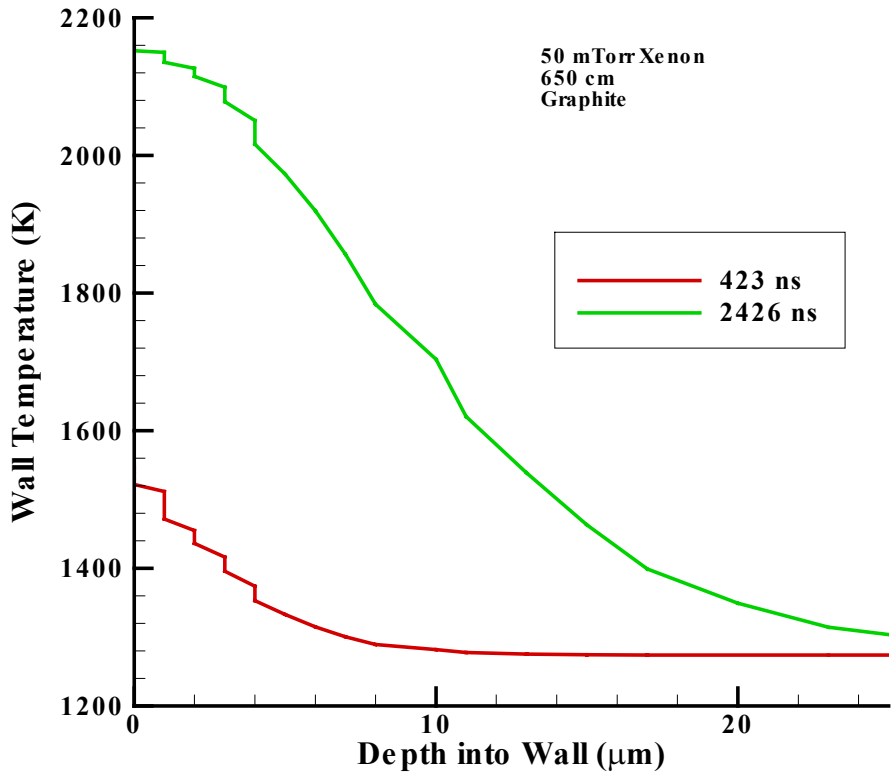
Back-Up #1 He beam: ~2 J/cm^2



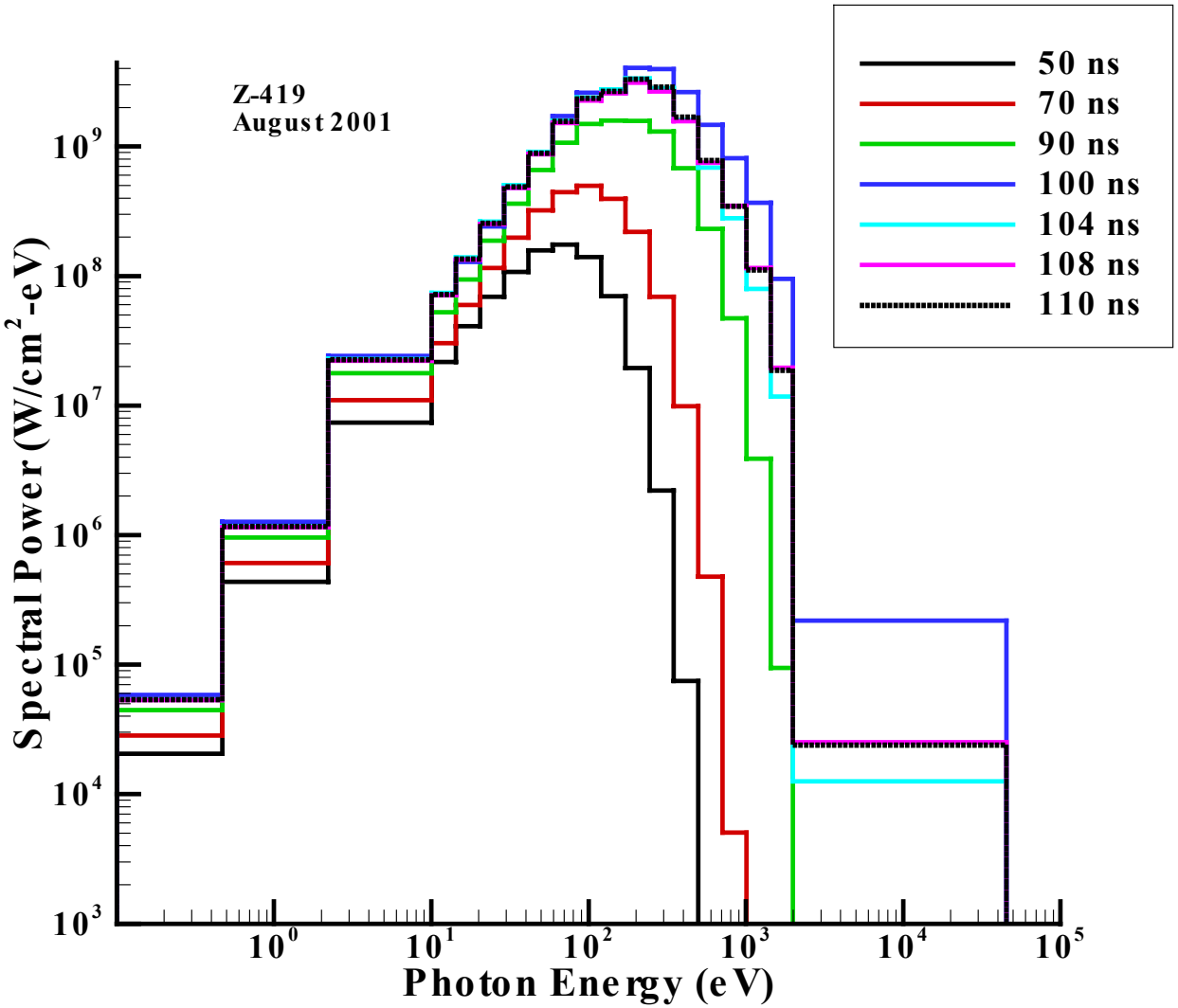


Back-Up #2


50 mTorr Xenon
650 cm
Graphite
Wall Temperature (K)
3250
3000
2750
2500
2250
2000
1750
1500
1250
0
1E-06
2E-06
3E-06
4E-06
5E-06
Time (s)


50 mTorr Xenon
650 cm
Graphite
423 ns
2426 ns
Wall Temperature (K)
2200
2000
1800
1600
1400
1200
0
10
20
Depth into Wall (μm)

Back-Up #3


Z-419
August 2001
50 ns
70 ns
90 ns
100 ns
104 ns
108 ns
110 ns
Spectral Power (W/cm^2-eV)
10^9
10^8
10^7
10^6
10^5
10^4
10^3
10^0
10^1
10^2
10^3
10^4
10^5
Photon Energy (eV)

Details of Fusion Product Helium Ions Do Not Play an Important Role in Energy Radiated From Gas to Wall

Back-Up #4