HAPL 350MJ-Class Baseline Target Design 10/10/05

1. Target Build and Materials

Region	Rel at. fracts	Density(g/cm3)
DT gas	1:1	2e-4 (17.3K)
DT fuel	1:1	0.2564 (17.3K)
CHDT Abl	1:1:5.9795:5.9795	0.3312 (wicked DT in 100mg/cc foam ; 18.5K)
CH shell	1:1	1.070
Au/Pd shell	1:1	15.66

Region	r_inner(cm)	del-r(cm)
DT gas	0.	0.178
DT fuel	0.178	0.0334
CHDT Abl	0.2114	0.0176 (note below)
CH shell	0.229	5.e-4
Au/Pd shell	0.2295	800.e-8
(r0=	0.229508)	

Outer mixed 50:50 Ag/Pd gold overcoat (800A) for imprint reduction and IR reflection. CH shell increased to 5microns for adequate robustness.

Temp of gas plus DT fuel taken as 17.3K with temperature of outer portion at 18.5K (=crude accommodation of heat pulse during injection)

Ablator is relatively thinner than previous to minimize fraction of unburnt ablator left at ignition, thus minimizing high energy CHDT debris ions. This is at the expense of a larger rho-R at ignition and extra tamping; zoomed gains can increase from ~150 to ~165 with thicker ablators that have ~30-40% left at ign; latter will have a higher energy content debris flux

2. Pulse Shape:

Time(ns)	Power (TW over 4Pi)
0	0
0.1	100.0 (picket)
0.45	100.0
0.55	0.
2.04	0.
2.14	7.5 (foot)
12.77	7.5
12.87	26.3 (2^{nd} shock)
15.59	26.3
15.69	169.0 (3^{rd} shock)
17.06	169.0
17.16	425.0 (main shock; first zoom point)
19.61	425.0
19.71	350.0 (second zoom point)
22.26	350.0
22.36	0

Pulse shape here modeled as simple five-shock system: picket, foot, 3rd shock, 4th shock and main shock. Pedestals were used for ease of locating shock convergence (see next) with rise/fall times of 0.1ns (assumed capability of DPPSL; KrF ok??). Can increase rise/fall times to ~200-300ps providing timing centroids and integrated energies are maintained (a slight timing retune would be req'd)

Shocks 2-4 timed to coalesce at inside edge of fuel at time of breakout of picket shock. 5th (main) shock timed to reach fuel/ablator interface at time when rarefaction shock from 1-4 coalescence reaches there.

3. Laser Intensity Profile and Zooming

Modeled with 29 rays equally spaced across each of 60 beams with f/infinity focusing (initially parallel rays) with a quadratic (cosine^2) intensity distribution:
I(r)=Io(1-(r/r0)^2)
Initial spot size is initial target diameter 2*r0. Wavelength=0.248micron

Two zooms are used where spot size, 2*r_focus is reduced to critical radius at that time as follows:

Time (ns)	r_focus(cm)
0.	r0
17.16	rCrit=0.8039 r0
19.71	rCrit=0.6505 r0

Zoom power reduction at these points relative to unzoomed case are 0.85 and 0.7 respectively and is already accounted for in above pulse shape table.
NB: Unzomed absorption fraction is ~91%; zoomed absorption fraction is ~98%
Unzoomed gain ~120; zoomed gain ~150

4. Integral Performance

Yield	364.7MJ (369.8MJ unzoomed)
Edrive (incident energy)	2.459 MJ (3.0481MJ unzoomed)
Gain	148.3 (121 unzoomed)

IFAR at 2/3r0	30.5
Conv ratio	33.4
Peak shell velocity	3.02e7cm/s
Max rho-R at ign	2.784 g/cm2 (in-going rho-R)

Robustness:
KE margin at ign 0.389

Average peak laser intensity over period of peak drive power 0.929e15W/cm2
Final peak laser intensity at min radius 1.52e15W/cm2
Peak laser power 425TW

5. Output Energy Accounting

5.1 Summary Table

Escape spectra at 100ns after drive pulse initiation

	Thermal Debris (J)	**Burn and Nuclear Products (J)**	**Total (J)**
X-rays	–	–	4.937e6
Gammas	–	1.680e4	1.680e4
Neutrons	–	2.743e8	2.743e8
Protons	6.255e5	1.137e6	1.763e6
Deuterons	1.166e7	1.006e7	2.1724e7
Tritons	1.733e7	9.166e6	2.650e7
^{3}He	3.171e4	4.607e4	7.777e4
^{4}He	3.556e6	2.673e7	3.028e7
^{12}C	6.879e6	8.834e2	6.880e6
^{13}C	8.366e4	1.141e1	8.367e4
Pd	1.844e5	<1	1.844e5
Au	3.607e5	<1	3.607e5
Pt	<1	<1	<1
	4.071e7	**3.214e8**	**3.671e8**
	(nuclear energy produced=3.647e8(=sum of thermonuclear energy plus exo- and endo-thermic in-flight reactions); laser energy absorb.=2.426e6; residual thermal energy=3.494e4J)		

5.2 X-Ray Escape Spectrum

3-T black body fit to escape spectra after 100ns:

$$E(T(\text{keV})) = \frac{c_1 T^3}{\text{Exp}[T/T_1]-1} + \frac{c_2 T^3}{\text{Exp}[T/T_2]-1} + \frac{c_3 T^3}{\text{Exp}[T/T_3]-1} \quad , \quad \text{J/keV}$$

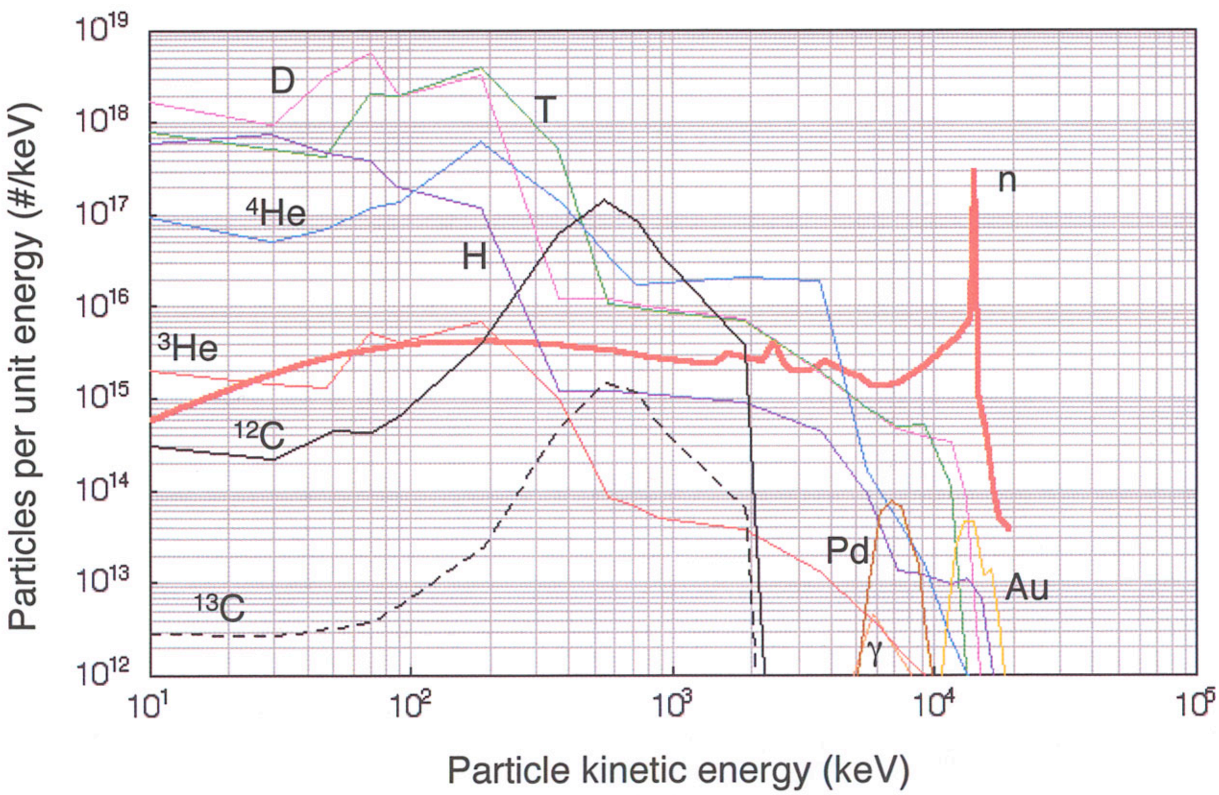
where c1=1.24e5, T1=1.08, c2=9.90e2, T2=4.30, c3=4.85, T3=1.51e1

Total integrated energy = 4.937e6J

5.3 Composite Particle Spectra

Charged particle, neutron and gamma escape spectra after 100ns.
Charged particles are summation of thermal debris kinetic energy plus burn and nuclear products
(See Appendix A for tabulated data).

Spectra normalization:
For neutron and gamma spectra here, normalization is number of particles per group divided by the difference of the group boundaries energies
For charged particles, normalization is number of particles per group divided by the difference of the mid group minus the next lower mid bin energy. This is due to the way that Lasnex performs the dE/dx slowing-down from mid bin energy to mid bin energy.
See Appendix A for further details



6. Laser/Target Specifications (working draft , in-progess)

Energy on target, typical (MJ)	~2.5-3.5MJ dependent on wavelength (2-4w)
Pulse lengths, typical (ns)	Total~25, time at peak power ~5 (see target specific pulse shape specs)
Power, typical (W)	<5e14(peak), ~1e14(picket), Contrast ratio<=60(see target shape specs)
Intensity, typical (W/cm^2)	~1e15 (over av. peak power) (see target specific specs)
Pulse shape shock precision: time/power	± 0.05ns (± 0.3ns -> -7% in gain); ± 3% (± 10% ->-7% in gain)
No of ports	60**
Beam intensity profile and focus	Quadratic (=cosine-squared); focus at target diameter at t=0 (see specific target specs for zooming)**
Beam-beam power bal	8% in 0.5ns
Quad-quad power bal	4% in 0.5ns (indep quads)
Individual beam non-uniformity	3% in 0.5ns (all modes)
Bandwidth/smoothing/RMS imprint	1THz(3w) / 2D SSD / 50nm
Polarization smoothing	2x50urad (needed?)
Overall uniformity; low modes (beam-beam variation; pointing, power-bal.....)	dI/I=1.5% (for CR=30,del-$r_h/r_h \leq 1/3$)
Overall uniformity; high modes l=10-120 (from individual beam structures)	<0.5% RMS for t_{smooth}=0.5ns (indiv beam uniform. ~3%)
Laser alignment /target tracking	± 20um rel to target center
Capsule outer CH surface finish	<50nm *
Inner ice layer uniformity/ roughness	± 5um (± 2um -> -7% in gain); <0.5um for l ≥ 10 (NIF direct drive specs as a placeholder)*

Sources: J.Perkins HAPL w/shop presentations UCLA (June 2004), PPPL (Oct 2004); D.Eimeral "Configuring the NIF for Direct Drive" UCRL-ID-120758 LLNL (1995); R.McCrory "NIF Direct-Drive Ignition Plan" plus briefing VGs (April 1999); LLE Reviews **98** p67, **79** p121, **84** 181. S.Skupsky(LLE) pvte comm. (May 2005)

* NIF indirect drive specs: 12nm (CH), 33nm (Be/Cu), 0.5um (inner ice l>10)

** Placeholder specs. See also "Port Placement and Illumination Uniformity", Malcolm McGeoch, HAPL meeting, June 20th 2005, Livermore, CA

Appendix A. Output Energy Spectra – Tabular Output

Appendix A. Tabular Output Particle Spectra After 100ns

Table outputs are of the form {{e_l(keV), e_u(keV), e_mid(kev),N(paticles/keV)}, {....}}

Note that energy normalization (particles/keV) for neuton and gamma spectra is no. particles per group divided by the difference of the group boundary energies. Thus total energy under each spectrum of partile type i is:
E(i)= Sum_j [e_mid(i,j)*(e_u(i,j)-e_l(i,j))*N(i,j)*1.6022e-16] Joules

For charged particles, normalization is no, particles per group divided by the difference of the mid group energy minus the next lower mid group energy . This is due to the way that Lasnex perform its dE/dx slowing down from mid-bin to mid bin. Thus total energy under each charged particle spectrum i is
E(i)= Sum_j [e_mid(i,j)*(e_mid(i,j)-e_mid(i,j-1))*N(i,j)*1.6022e-16] Joules

i =1 = gammas (abosol iso # = 0)
i = 2= neutrons (abosol iso # = 1)
i = 3 = deuterons (abosol iso # = 3)
i = 4 = tritons (abosol iso # = 4)
i = 5 = 4He (abosol iso # = 6)
i = 6 = protons (abosol iso # = 2)
i = 7 = 3He (abosol iso # = 5)
i = 8 = 12C (abosol iso # = 13)
i = 9 =13C (abosol iso # = 14)
i = 10=Pd (abosol iso # = 15)
i =11= 197Au (abosol iso # = 16)
i = 12 =nTot=Pt (abosol iso # = 17)

Gammas

{{197.8, 826.4, 512.1, 3.974×10^{10}}, {826.4, 1424., 1125., 7.564×10^{10}}, {1424., 2566., 1995., 2.215×10^{10}}, {2566., 4110., 3338., 2.888×10^{10}}, {4110., 7406., 5758., 4.56×10^{12}}, {7406., 10550., 8978., 6.399×10^{11}}}

Neutrons

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{{1.307×10^-6, 0.00002091, 0.00001111, 1.051×10^6},
 {0.00002091, 0.0001307, 0.00007579, 3.792×10^7},
 {0.0001307, 0.0003345, 0.0002326, 9.974×10^7},
 {0.0003345, 0.001176, 0.0007553, 2.012×10^8}, {0.001176, 0.002091, 0.001633, 3.222×10^8},
 {0.002091, 0.005658, 0.003874, 5.213×10^8}, {0.005658, 0.01307, 0.009363, 8.344×10^8},
 {0.01307, 0.02075, 0.01691, 1.158×10^9}, {0.02075, 0.05123, 0.03599, 1.774×10^9},
 {0.05123, 0.1025, 0.07684, 3.806×10^9}, {0.1025, 0.2091, 0.1558, 2.178×10^10},
 {0.2091, 0.3811, 0.2951, 6.407×10^11}, {0.3811, 0.5658, 0.4734, 5.26×10^12},
 {0.5658, 0.7156, 0.6407, 9.479×10^12}, {0.7156, 1.059, 0.887, 1.58×10^13},
 {1.059, 1.307, 1.183, 2.553×10^13}, {1.307, 1.882, 1.594, 4.164×10^13},
 {1.882, 2.94, 2.411, 8.079×10^13}, {2.94, 3.345, 3.143, 1.237×10^14},
 {3.345, 4.234, 3.79, 1.633×10^14}, {4.234, 5.763, 4.998, 2.442×10^14},
 {5.763, 7.527, 6.645, 3.602×10^14}, {7.527, 10.25, 8.886, 5.193×10^14},
 {10.25, 15.11, 12.68, 7.954×10^14}, {15.11, 20.91, 18.01, 1.169×10^15},
 {20.91, 26.46, 23.69, 1.553×10^15}, {26.46, 32.67, 29.57, 1.957×10^15},
 {32.67, 39.53, 36.1, 2.318×10^15}, {39.53, 70.02, 54.78, 3.051×10^15},
 {70.02, 98.91, 84.46, 3.828×10^15}, {98.91, 130.7, 114.8, 4.146×10^15},
 {130.7, 182., 156.3, 4.24×10^15}, {182., 207.5, 194.7, 4.248×10^15},
 {207.5, 241.7, 224.6, 4.198×10^15}, {241.7, 271., 256.3, 4.131×10^15},
 {271., 294., 282.5, 4.116×10^15}, {294., 334.5, 314.3, 4.005×10^15},
 {334.5, 377.7, 356.1, 3.863×10^15}, {377.7, 512.3, 445., 3.634×10^15},
 {512.3, 632.5, 572.4, 3.383×10^15}, {632.5, 752.7, 692.6, 3.152×10^15},
 {752.7, 883.4, 818., 2.877×10^15}, {883.4, 1025., 953.9, 2.737×10^15},
 {1025., 1176., 1100., 2.581×10^15}, {1176., 1338., 1257., 2.471×10^15},
 {1338., 1511., 1424., 2.406×10^15}, {1511., 1694., 1602., 3.122×10^15},
 {1694., 2091., 1892., 2.879×10^15}, {2091., 2305., 2198., 2.56×10^15},
 {2305., 2530., 2418., 4.076×10^15}, {2530., 2741., 2636., 2.451×10^15},
 {2741., 3011., 2876., 2.049×10^15}, {3011., 3534., 3272., 2.039×10^15},
 {3534., 4069., 3801., 2.556×10^15}, {4069., 4396., 4232., 2.22×10^15},
 {4396., 4704., 4550., 2.004×10^15}, {4704., 4991., 4848., 1.873×10^15},
 {4991., 5353., 5172., 1.785×10^15}, {5353., 5658., 5505., 1.56×10^15},
 {5658., 6043., 5850., 1.379×10^15}, {6043., 6367., 6205., 1.379×10^15},
 {6367., 6737., 6552., 1.396×10^15}, {6737., 7156., 6946., 1.457×10^15},
 {7156., 7548., 7352., 1.561×10^15}, {7548., 7910., 7729., 1.688×10^15},
 {7910., 8322., 8116., 1.841×10^15}, {8322., 8787., 8554., 2.035×10^15},
 {8787., 9177., 8982., 2.256×10^15}, {9177., 9665., 9421., 2.474×10^15},
 {9665., 10120., 9892., 2.773×10^15}, {10120., 10590., 10350., 3.13×10^15},
 {10590., 11010., 10800., 3.514×10^15}, {11010., 11550., 11280., 3.903×10^15},
 {11550., 11990., 11770., 4.303×10^15}, {11990., 12500., 12250., 4.768×10^15},
 {12500., 13070., 12780., 5.547×10^15}, {13070., 13540., 13310., 6.581×10^15},
 {13540., 13860., 13700., 7.319×10^15}, {13860., 14130., 14000., 2.902×10^17},
 {14130., 14410., 14270., 6.789×10^16}, {14410., 14680., 14550., 1.199×10^15},
 {14680., 15190., 14930., 8.741×10^14}, {15190., 15750., 15470., 4.756×10^14},
 {15750., 16330., 16040., 2.254×10^14}, {16330., 16920., 16630., 1.057×10^14},
 {16920., 18130., 17530., 5.005×10^13}, {18130., 20000., 19070., 3.736×10^13}}
```

2 H

{{1. $\times 10^{-7}$, 20., 10., 1.687 $\times 10^{18}$}, {20., 38.39, 29.19, 9.609 $\times 10^{17}$},
{38.39, 56.77, 47.58, 3.249 $\times 10^{18}$}, {56.77, 83.94, 70.35, 5.721 $\times 10^{18}$},
{83.94, 95.64, 89.79, 1.942 $\times 10^{18}$}, {95.64, 271.4, 183.5, 3.311 $\times 10^{18}$},
{271.4, 457.3, 364.4, 1.258 $\times 10^{16}$}, {457.3, 676.2, 566.8, 1.23 $\times 10^{16}$},
{676.2, 770.4, 723.3, 1.076 $\times 10^{16}$}, {770.4, 1000., 885.2, 9.771 $\times 10^{15}$},
{1000., 2800., 1900., 7.419 $\times 10^{15}$}, {2800., 4472., 3636., 1.901 $\times 10^{15}$},
{4472., 6503., 5488., 8.068 $\times 10^{14}$}, {6503., 7843., 7173., 4.579 $\times 10^{14}$},
{7843., 10390., 9114., 3.943 $\times 10^{14}$}, {10390., 12520., 11450., 3.31 $\times 10^{14}$},
{12520., 13750., 13140., 7.839 $\times 10^{13}$}, {13750., 16590., 15170., 4.135 $\times 10^{11}$},
{16590., 18210., 17400., 4.598 $\times 10^{10}$}, {18210., 20000., 19110., 1.188 $\times 10^{9}$}}

3 H

{{1. $\times 10^{-7}$, 20., 10., 8.031 $\times 10^{17}$}, {20., 38.39, 29.19, 5.205 $\times 10^{17}$},
{38.39, 56.77, 47.58, 4.377 $\times 10^{17}$}, {56.77, 83.94, 70.35, 2.081 $\times 10^{18}$},
{83.94, 95.64, 89.79, 1.978 $\times 10^{18}$}, {95.64, 271.4, 183.5, 3.973 $\times 10^{18}$},
{271.4, 457.3, 364.4, 5.019 $\times 10^{17}$}, {457.3, 676.2, 566.8, 1.045 $\times 10^{16}$},
{676.2, 770.4, 723.3, 9.588 $\times 10^{15}$}, {770.4, 1000., 885.2, 8.781 $\times 10^{15}$},
{1000., 2800., 1900., 7.082 $\times 10^{15}$}, {2800., 4472., 3636., 2.032 $\times 10^{15}$},
{4472., 6503., 5488., 8.049 $\times 10^{14}$}, {6503., 7843., 7173., 5.01 $\times 10^{14}$},
{7843., 10390., 9114., 5.241 $\times 10^{14}$}, {10390., 12520., 11450., 1.054 $\times 10^{14}$},
{12520., 13750., 13140., 1.14 $\times 10^{12}$}, {13750., 16590., 15170., 1.296 $\times 10^{11}$},
{16590., 18210., 17400., 3.037 $\times 10^{9}$}, {18210., 20000., 19110., 2.544 $\times 10^{8}$}}

4 He

{{1. $\times 10^{-7}$, 20., 10., 9.41 $\times 10^{16}$}, {20., 38.39, 29.19, 5.106 $\times 10^{16}$},
{38.39, 56.77, 47.58, 7.153 $\times 10^{16}$}, {56.77, 83.94, 70.35, 1.182 $\times 10^{17}$},
{83.94, 95.64, 89.79, 1.367 $\times 10^{17}$}, {95.64, 271.4, 183.5, 6.238 $\times 10^{17}$},
{271.4, 457.3, 364.4, 1.47 $\times 10^{17}$}, {457.3, 676.2, 566.8, 3.536 $\times 10^{16}$},
{676.2, 770.4, 723.3, 1.732 $\times 10^{16}$}, {770.4, 1000., 885.2, 1.827 $\times 10^{16}$},
{1000., 2800., 1900., 2.073 $\times 10^{16}$}, {2800., 4472., 3636., 1.852 $\times 10^{16}$},
{4472., 6503., 5488., 1.572 $\times 10^{14}$}, {6503., 7843., 7173., 4.647 $\times 10^{13}$},
{7843., 10390., 9114., 1.546 $\times 10^{13}$}, {10390., 12520., 11450., 2.323 $\times 10^{12}$},
{12520., 13750., 13140., 1.056 $\times 10^{12}$}, {13750., 16590., 15170., 5.632 $\times 10^{11}$},
{16590., 18210., 17400., 1.461 $\times 10^{11}$}, {18210., 20000., 19110., 2.575 $\times 10^{10}$}}

1 H

{{1. $\times 10^{-7}$, 20., 10., 5.994 $\times 10^{17}$}, {20., 38.39, 29.19, 7.535 $\times 10^{17}$},
{38.39, 56.77, 47.58, 4.658 $\times 10^{17}$}, {56.77, 83.94, 70.35, 3.948 $\times 10^{17}$},
{83.94, 95.64, 89.79, 2.019 $\times 10^{17}$}, {95.64, 271.4, 183.5, 1.197 $\times 10^{17}$},
{271.4, 457.3, 364.4, 1.217 $\times 10^{15}$}, {457.3, 676.2, 566.8, 1.214 $\times 10^{15}$},
{676.2, 770.4, 723.3, 1.143 $\times 10^{15}$}, {770.4, 1000., 885.2, 1.11 $\times 10^{15}$},
{1000., 2800., 1900., 9.161 $\times 10^{14}$}, {2800., 4472., 3636., 4.47 $\times 10^{14}$},
{4472., 6503., 5488., 8.743 $\times 10^{13}$}, {6503., 7843., 7173., 1.31 $\times 10^{13}$},
{7843., 10390., 9114., 1.209 $\times 10^{13}$}, {10390., 12520., 11450., 9.56 $\times 10^{12}$},
{12520., 13750., 13140., 1.085 $\times 10^{13}$}, {13750., 16590., 15170., 6.436 $\times 10^{12}$},
{16590., 18210., 17400., 3.512 $\times 10^{11}$}, {18210., 20000., 19110., 5.327 $\times 10^{10}$}}

3 He

{{1. × 10^{-7}, 20., 10., 2.064 × 10^{15}}, {20., 38.39, 29.19, 1.464 × 10^{15}},
{38.39, 56.77, 47.58, 1.321 × 10^{15}}, {56.77, 83.94, 70.35, 5.314 × 10^{15}},
{83.94, 95.64, 89.79, 4.232 × 10^{15}}, {95.64, 271.4, 183.5, 7.09 × 10^{15}},
{271.4, 457.3, 364.4, 9.886 × 10^{14}}, {457.3, 676.2, 566.8, 8.457 × 10^{13}},
{676.2, 770.4, 723.3, 6.651 × 10^{13}}, {770.4, 1000., 885.2, 4.982 × 10^{13}},
{1000., 2800., 1900., 3.766 × 10^{13}}, {2800., 4472., 3636., 1.324 × 10^{13}},
{4472., 6503., 5488., 4.467 × 10^{12}}, {6503., 7843., 7173., 1.958 × 10^{12}},
{7843., 10390., 9114., 1.014 × 10^{12}}, {10390., 12520., 11450., 3.714 × 10^{11}},
{12520., 13750., 13140., 1.058 × 10^{11}}, {13750., 16590., 15170., 1.073 × 10^{10}},
{16590., 18210., 17400., 5.062 × 10^{7}}, {18210., 20000., 19110., 3.583 × 10^{6}}}

12 C

{{0., 20., 10., 3.114 × 10^{14}},
{20., 40., 30., 2.233 × 10^{14}}, {40., 60., 50., 4.527 × 10^{14}},
{60., 80., 70., 4.255 × 10^{14}}, {80., 100., 90., 6.448 × 10^{14}},
{100., 280., 190., 4.397 × 10^{15}}, {280., 460., 370., 6.552 × 10^{16}},
{460., 640., 550., 1.476 × 10^{17}}, {640., 820., 730., 8.714 × 10^{16}},
{820., 1000., 910., 3.48 × 10^{16}}, {1000., 2800., 1900., 3.578 × 10^{15}},
{2800., 4600., 3700., 2.036}, {4600., 6400., 5500., 2.036},
{6400., 8200., 7300., 2.036}, {8200., 10000., 9100., 2.036}}

13 C

{{0., 20., 10., 2.83 × 10^{12}}, {20., 40., 30., 2.632 × 10^{12}}, {40., 60., 50., 3.247 × 10^{12}},
{60., 80., 70., 3.682 × 10^{12}}, {80., 100., 90., 5.735 × 10^{12}}, {100., 280., 190., 2.513 × 10^{13}},
{280., 460., 370., 4.807 × 10^{14}}, {460., 640., 550., 1.458 × 10^{15}},
{640., 820., 730., 1.156 × 10^{15}}, {820., 1000., 910., 4.635 × 10^{14}},
{1000., 2800., 1900., 6.249 × 10^{13}}, {2800., 4600., 3700., 2.014},
{4600., 6400., 5500., 2.014}, {6400., 8200., 7300., 2.014}, {8200., 10000., 9100., 2.014}}

Pd

{{0., 20., 10., 2.404 × 10^{9}}, {20., 40., 30., 4.574 × 10^{11}},
{40., 60., 50., 9.879 × 10^{12}}, {60., 80., 70., 6.219 × 10^{13}}, {80., 100., 90., 7.623 × 10^{13}},
{100., 280., 190., 6.765 × 10^{13}}, {280., 460., 370., 2.687 × 10^{13}},
{460., 640., 550., 1.472 × 10^{13}}, {640., 820., 730., 2.805 × 10^{12}},
{820., 1000., 910., 6.769 × 10^{11}}, {1000., 2800., 1900., 1.564 × 10^{11}},
{2800., 4600., 3700., 7.196 × 10^{9}}, {4600., 6400., 5500., 5.079 × 10^{8}},
{6400., 8200., 7300., 7.477 × 10^{7}}, {8200., 10000., 9100., 3.284 × 10^{7}}}

Au

{{0., 20., 10., 1.776 × 10^{8}}, {20., 40., 30., 2.657 × 10^{10}},
{40., 60., 50., 1.653 × 10^{12}}, {60., 80., 70., 2.146 × 10^{13}}, {80., 100., 90., 4.7 × 10^{13}},
{100., 280., 190., 4.524 × 10^{13}}, {280., 460., 370., 1.245 × 10^{13}},
{460., 640., 550., 1.422 × 10^{13}}, {640., 820., 730., 4.036 × 10^{12}},
{820., 1000., 910., 7.621 × 10^{11}}, {1000., 2800., 1900., 1.258 × 10^{11}},
{2800., 4600., 3700., 2.71 × 10^{9}}, {4600., 6400., 5500., 9.473 × 10^{7}},
{6400., 8200., 7300., 1.423 × 10^{6}}, {8200., 10000., 9100., 864500.}}