Output Spectra from NRL Direct Drive Targets

L. John Perkins
Lawrence Livermore National Laboratory

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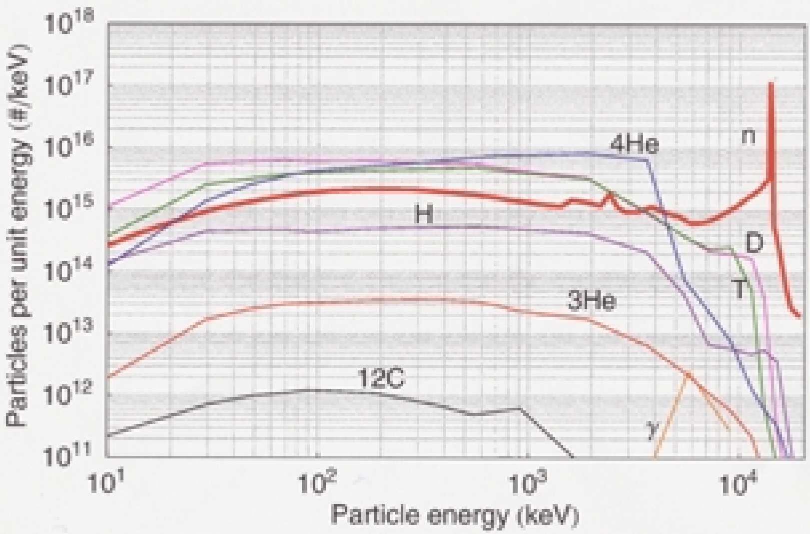
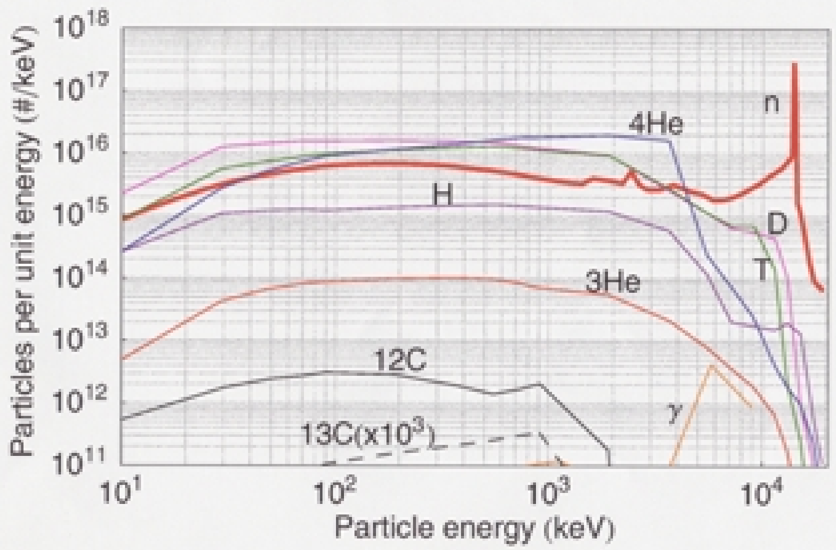
Output Energy Accounting @100ns

	Original NRL Target (MJ)	High Yield NRL Target (MJ)
X-rays	**2.10** *(1%)*	**6.07** *(2%)*
Neutrons	**109** *(71%)*	**279** *(70%)*
Gammas	**0.0089** *(0.006%)*	**0.0169** *(0.004%)*
Burn product fast ions:	**19.5** *(13%)*	**52.2** *(13%)*
Protons	*0.54*	*1.56*
Deuterons	*4.78*	*13.6*
Tritons	*4.32*	*12.5*
^{3}He	*0.0024*	*0.074*
^{4}He	*9.86*	*24.5*
^{12}C, ^{13}C, ^{x}Pt, Au	6.8×10^{-5}	2.0×10^{-4}
Debris ions kinetic energy:	**22.1** *(14%)*	**60.0** *(15%)*
Protons	*0.11*	*0.29*
Deuterons	*8.87*	23.5
Tritons	*11.1*	*30.2*
3He	*0.002*	0.072
4He	*1.33*	*4.03*
C	0.56	1.56
Gold	*0.15*	*0.35*
Residual thermal energy:	**0.012**	**0.045**
Residual burn products:	**0.33**	**1.51**
Laser energy absorbed:	**1.21**	**2.37**
Total out	**154MJ**	**401MJ**

Fast Burn Product Escape Spectra

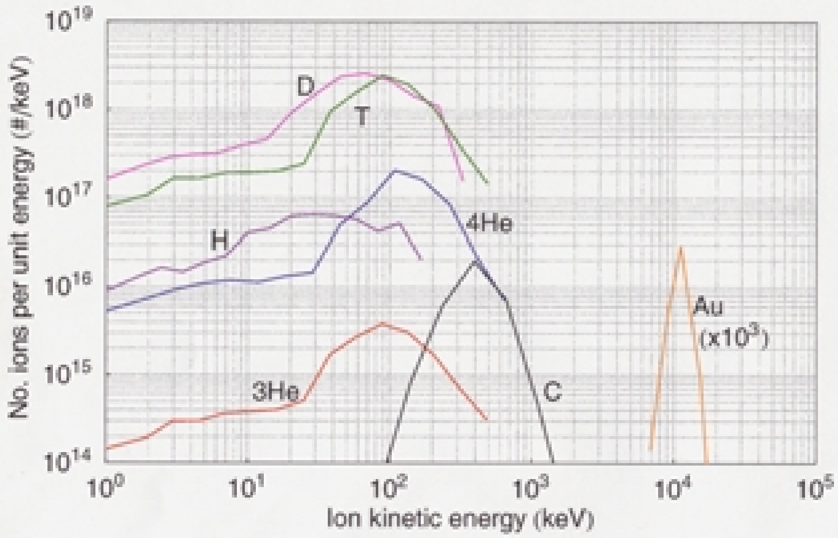


Original NRL Target
160MJ

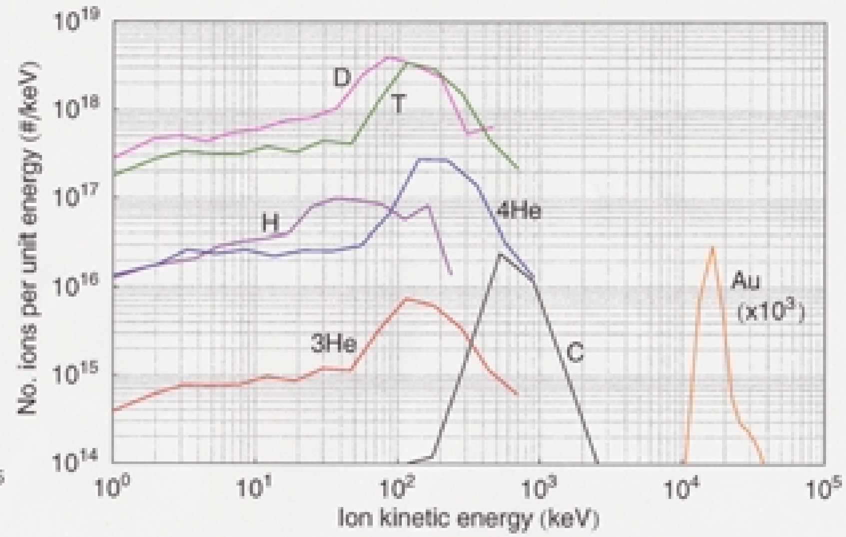


High Yield NRL Target
400MJ

Debris Kinetic Energy Spectra

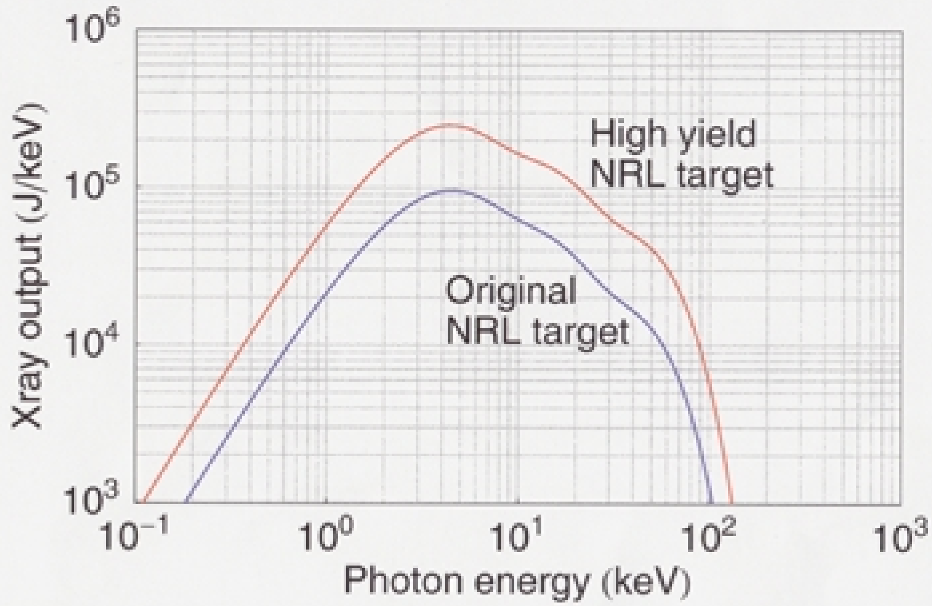


Original NRL Target
160MJ



High Yield NRL Target
400MJ

X-Ray Escape Spectra



Three-temperature black-body fits to the X-ray escape spectra

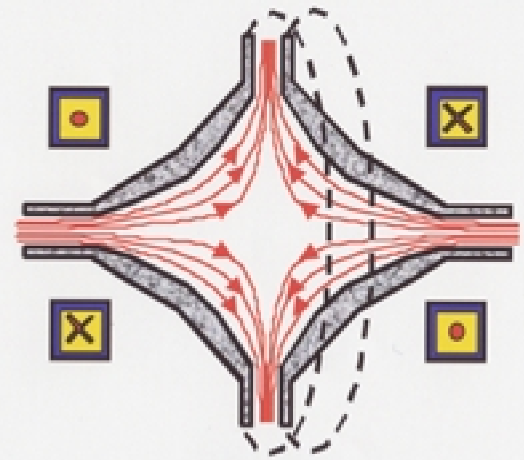
$$E(T(kev)) = \frac{c_1 T^3}{Exp[T/T_1]-1} + \frac{c_2 T^3}{Exp[T/T_2]-1} + \frac{c_3 T^3}{Exp[T/T_3]-1}, J/keV$$

	c1	T1	c2	T2	c3	T3
Original NRL Target	2.16×10^4	1.34	0.617×10^3	3.72	7.8	11.5
High Yield NRL Target	5.98×10^4	1.32	1.44×10^3	3.89	17.4	12.5

Chamber Magnetic Field Configurations

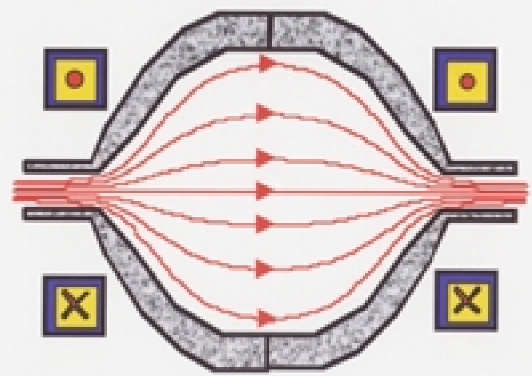
Why an In-situ Magnetic Field?

- Guides charged particle output into direct energy convertors (average duct power densities ~100's kW/cm^2, similar to welding arc jets; peak values higher)
- Buffers the target impulse time (X10-1000's); ⇒ confinement time of magnetic trap
- Protects chamber wall against KE debris (application to DT targets also?)



Spindle Cusp Configuration

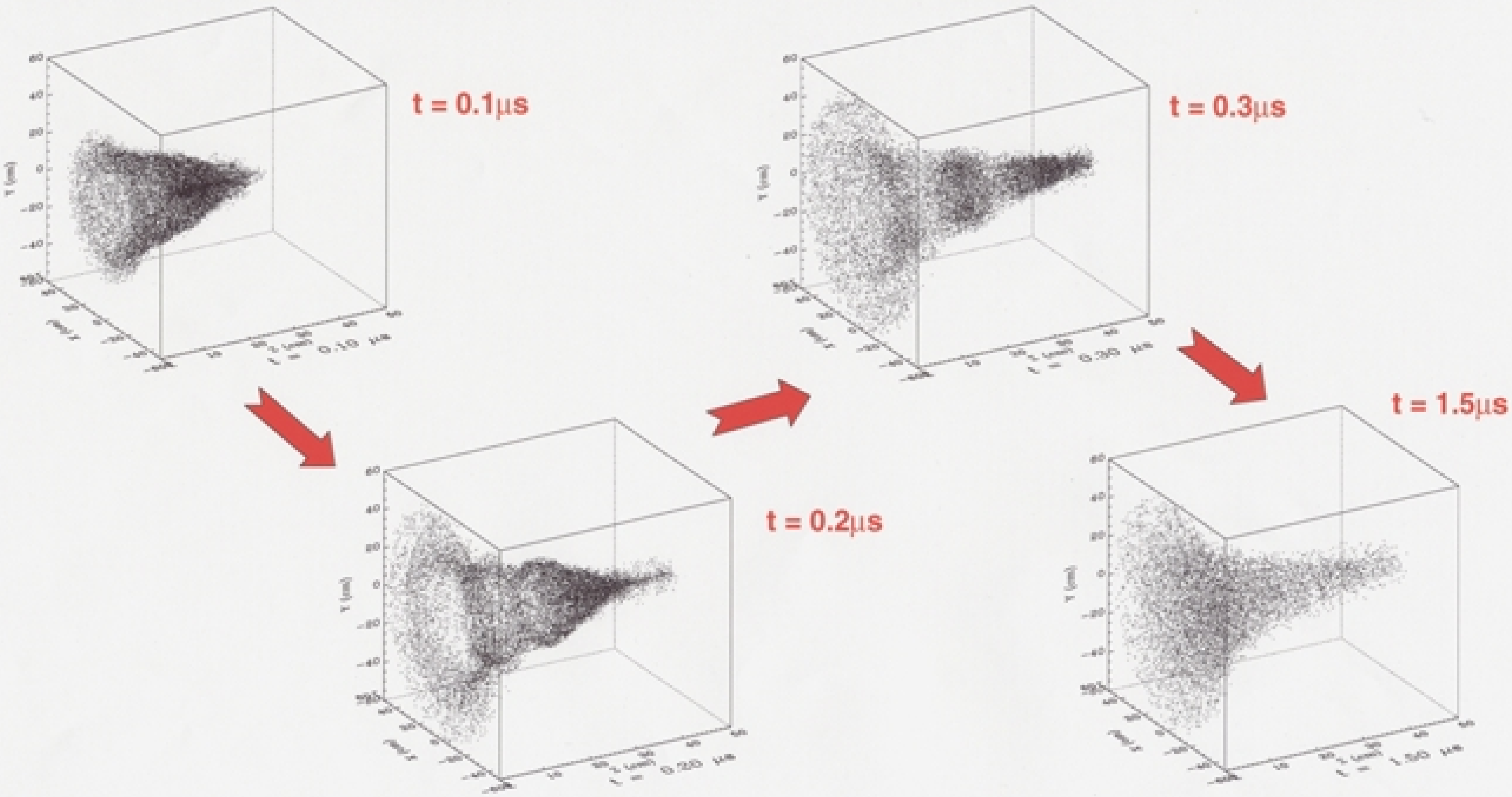
- Stable against MHD interchange instabilities
- But – lower confinement time than mirror
- But – has point and ring exit particle streams



Simple Mirror Configuration

- Simple geometry; only point exit particle streams
- Longer confinement times
- But – unstable to interchange (may be fixed through flow stabilization and attention to exit field geometry)

Pulsed Plasma Interaction with a Cusp Guide Field – Hybrid PIC Results



Initial conditions at t=0: Ion species=$^2H^+$, B(0)=5T, r(0)=0.1m, W(0)=20keV, T(0)=2keV, $n_{ion}(0)$=7e21m^{-3}, ⇒E(0)=0.1MJ

Energy conf. time ~1.5μs (~1/10 of expected, based on typ. cusp losses); ⇒Rayleigh Taylor instability?