Simple scaling laws for the yield of a double z pinch

- Hammer's double z-pinch design (J. Hammer et al., PoP, vol. 5, 2129 (1999) is the basis.
- For constant secondary temperature, the pulse length and yield scale as (J. Lindl, "Inertial Confinement Fusion" (Springer-Verlag, 1998)):

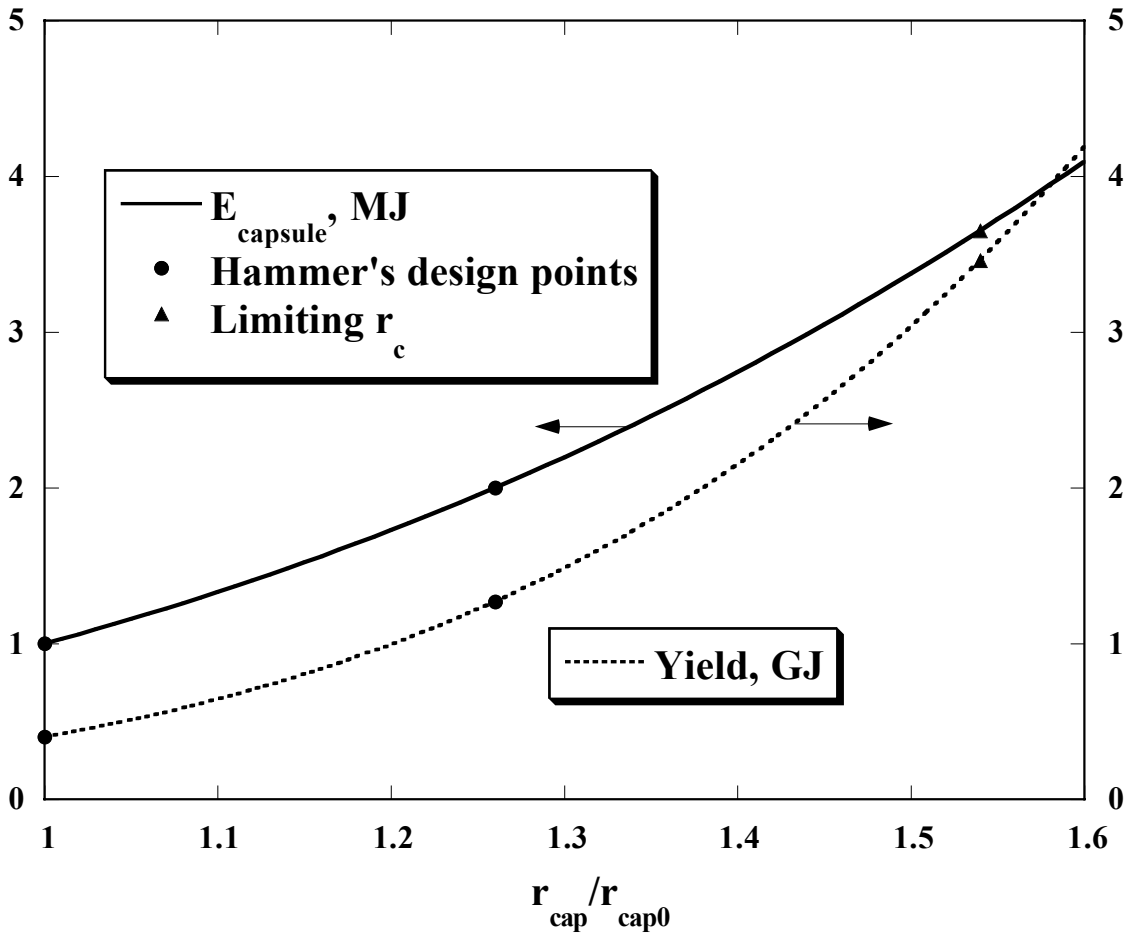
  Pulse length, $\tau_{x-ray} \sim r_{cap}$

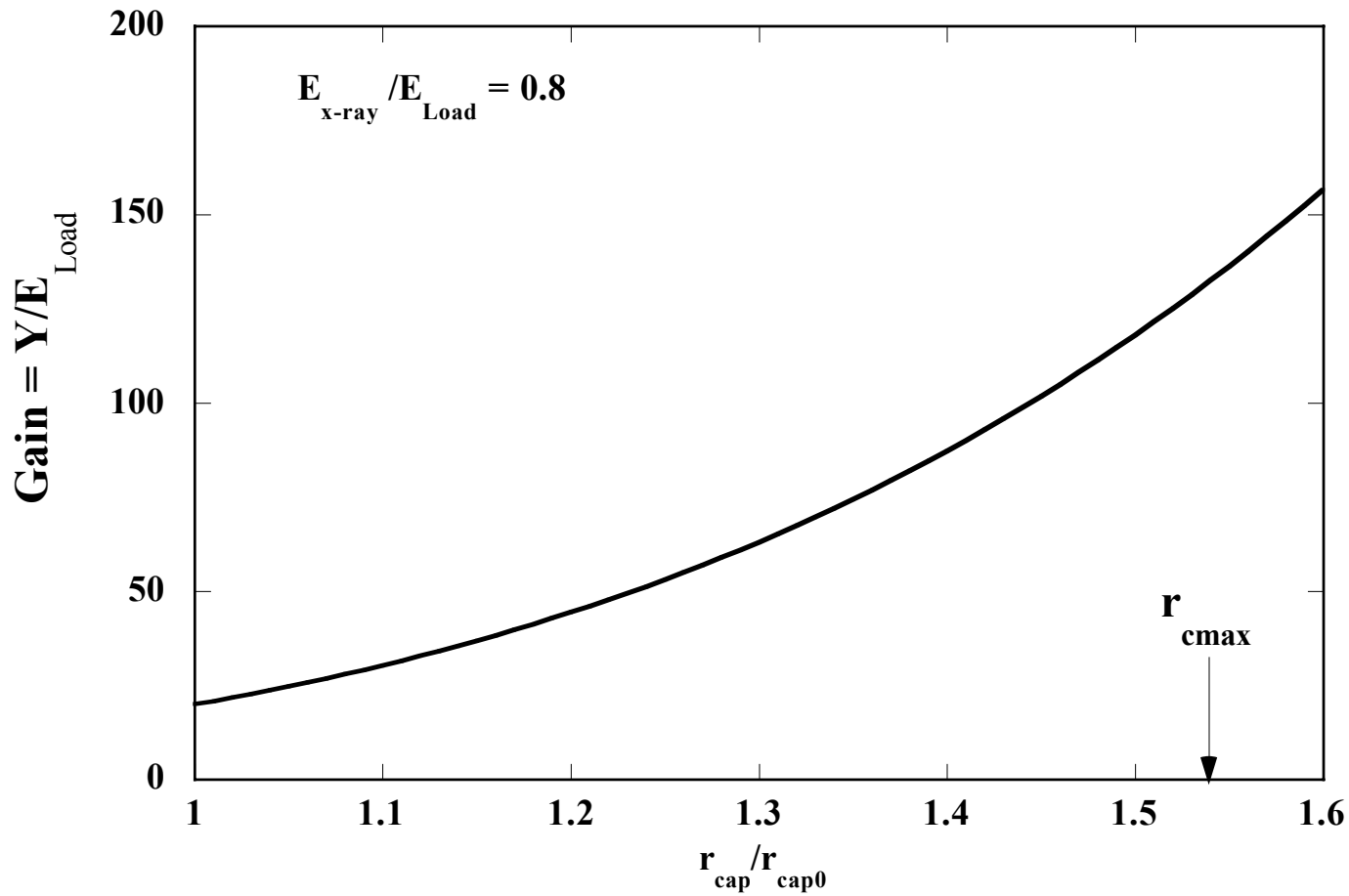
  So, Yield $\sim E_{cap}^{5/3} \sim r_{cap}^{5}$
- The capsule radius is a very important parameter!
- The maximum capsule radius is set by symmetry requirements:
  - The NIF point design has $r_w / r_{cap} \approx 2.5$.
- Hammer's design for yield = 0.4 GJ has r_{cap0} = 0.26 cm and r_w = 1 cm, or r_w / r_{cap} = 3.9, so the symmetry requirements are well met.
- Using the NIF point design, r_{cmax} = 0.4 cm, or r_{cmax}/r_{cap0} = 1.54

Simple scaling laws give yields up to 3.5 GJ for Hammer's double pinch design

- The required x-ray energy to maintain a constant secondary temperature scales as $E_{x\text{-}ray} \sim \tau^{0.62} \sim r_c^{0.62} \sim$ and $E_{x\text{-}ray} \sim I^2$
- So $I \sim r_c^{0.31}$

r_c/r_{cap0}	I
1	60 MA
1.26	64 MA
1.54	68 MA



Simple scaling shows the gain is high enough to produce an economical power plant

- The gain is:
  $G = Y/E_{load}$
- The gain scales as:
  $G \sim r_{cap}^{5}/E_{Load}$
  $E_{x\text{-}ray} \sim r_{cap}^{0.62}$
- So:
  $G \sim r_{cap}^{4.38}$