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Compact Wire Array Sources (126678)

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Purpose, Goals and Approach

- Assess novel compact wire arrays to enable a new class of pulsed power hohlraum radiation source
- Planar and compact cylindrical wire array scaling and dynamics are studied at 3-6 MA on Saturn

Significance of Results

Successful development of an advanced compact x-ray source would enable a new research direction in pulsed power Planckian radiation sources and ICF

Key Accomplishments

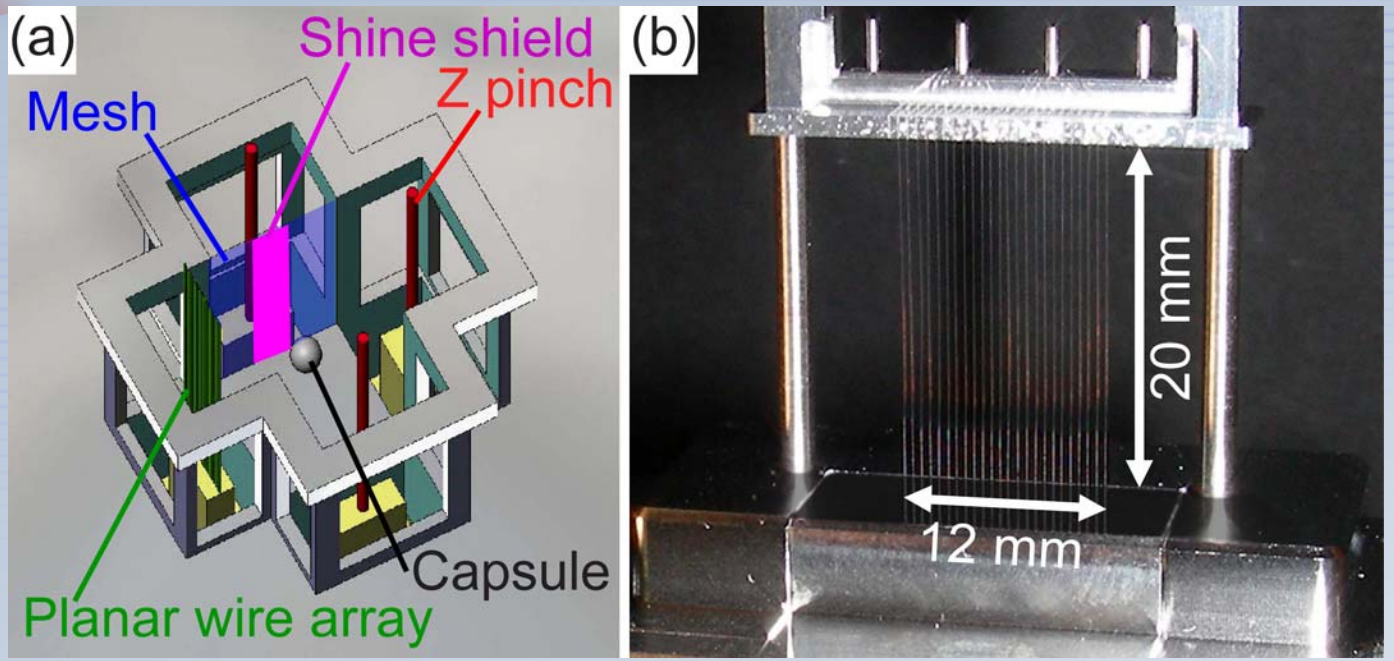
- Planar wire array scaling established at current levels relevant for Z machine concept
- Initial compact cylindrical load data
- Dynamics of general interest to z-pinch physics are studied

What's Next

- Publication of results in peer-reviewed journals (FY09)
- Numerical design of Z experiment based on Saturn data (FY09-10)
- University collaboration on experiments, theory and modeling (FY09-10)

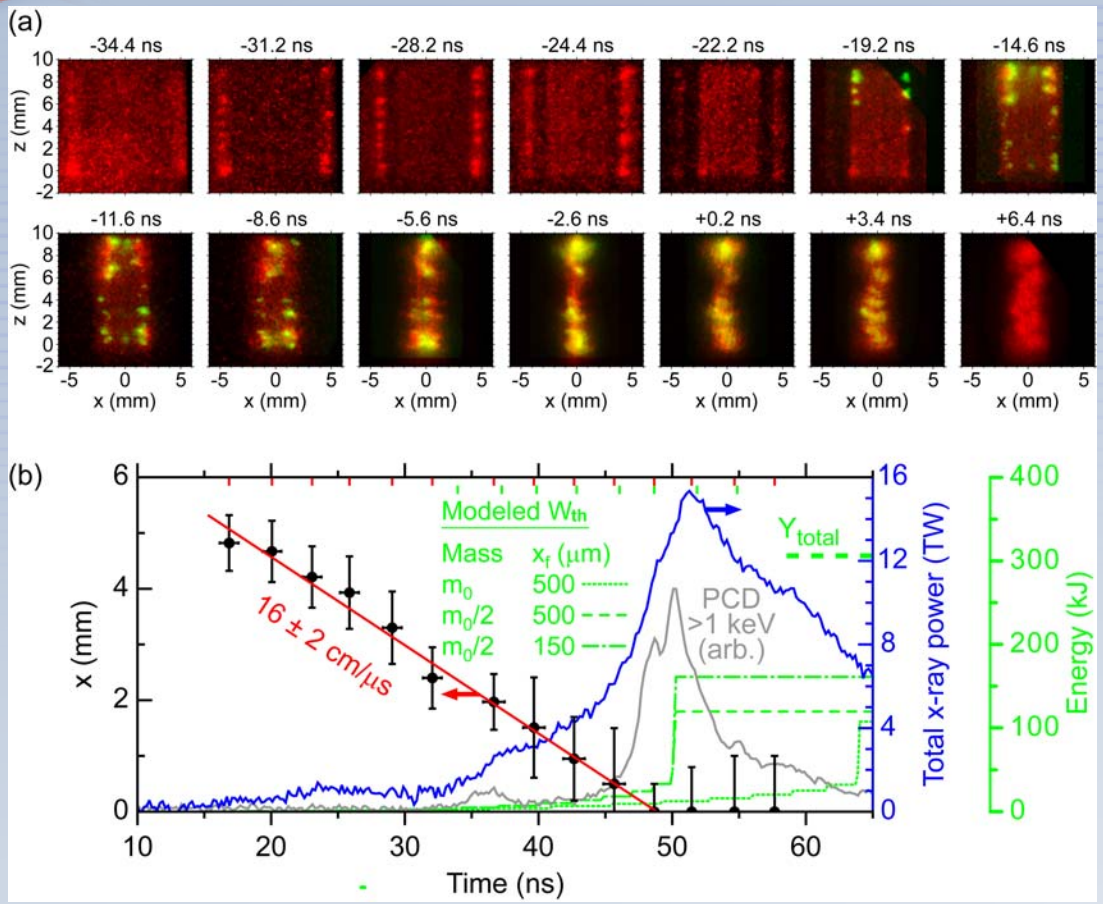
Sandia National Laboratories

Saturn is a unique bridge to study novel, high-risk university ideas at multi-MA



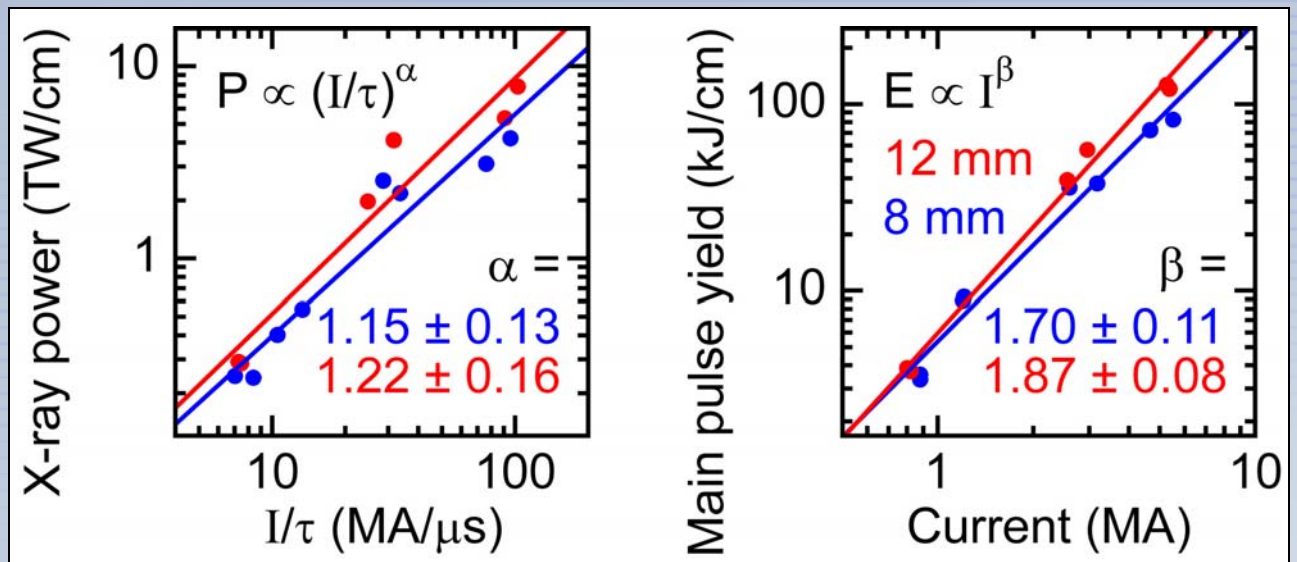
- Vacuum hohlraum driven by multiple z-pinch sources could enable new directions in radiation sources and ICF
- Studying one advanced wire array source on Saturn is directly relevant to multi-pinch concept on Z
  - Establish x-ray power scaling with current, width, implosion time

Investigation of implosion dynamics of general interest to z-pinch physics



- Magnetic Rayleigh-Taylor instability, snowplow stabilization, trailing mass, current convergence, resistive heating, opacity

Planar wire array scaling is empirically established in 1-6 MA data set

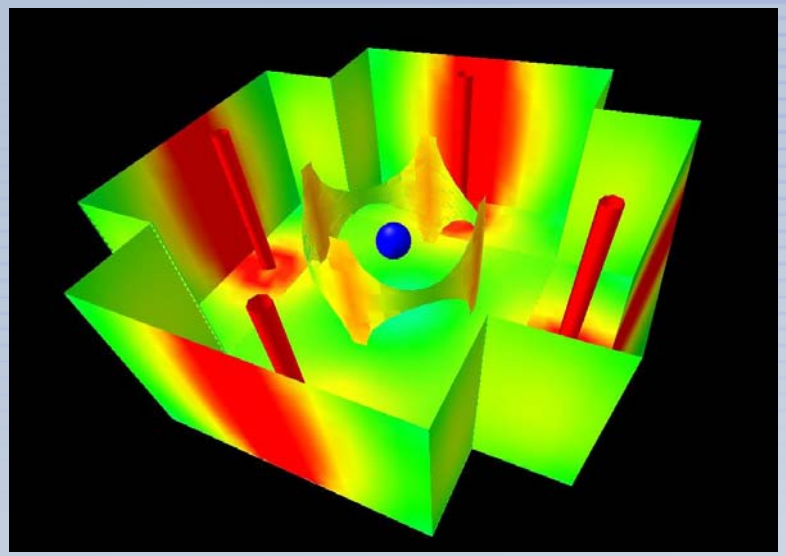


	Planar wire arrays	Cylindrical arrays (Z)
$P \propto$	$I^{1.28\pm0.13} W^{0.96\pm0.24} \tau^{-0.64\pm0.12}$	$I^{1.45\pm0.10} R^{0.71\pm0.21} \tau^{-1.34\pm0.17}$
$E_{main\ pulse} \propto$	$I^{1.68\pm0.12} W^{0.64\pm0.21} \tau^{0.07\pm0.10}$	$I^{1.94\pm0.12} R^{0.58\pm0.25} \tau^{0.33\pm0.20}$

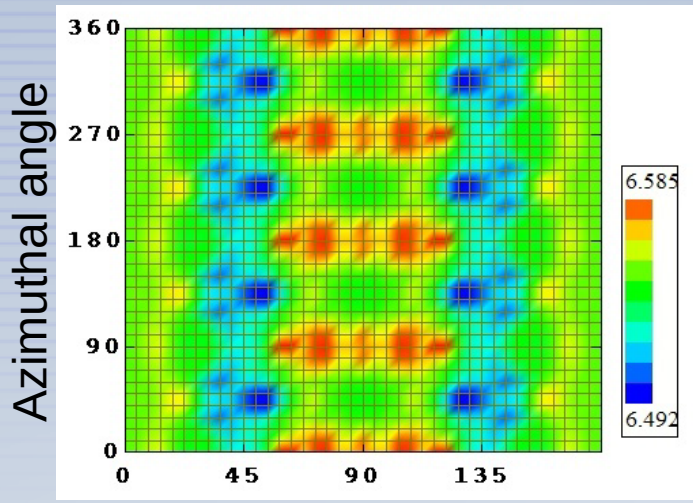
- Similar scaling behavior to cylindrical wire arrays on Z
- Initial scaling study for Ø3 mm cylindrical arrays on Saturn indicates less favorable behavior

LDRD data supports design-driven assessment of concept on Z

Hohlraum driven by 4 x 12 TW planar array z-pinches



< 1.5% asymmetry in flux to capsule



- Viewfactor calculations (R.A. Vesey) of multi-pinch vacuum hohlraums on Z can be benchmarked to Saturn
- Numerical assessment will determine whether Z experiments are attractive

Compact wire array next steps…

- Journal publications based on Saturn LDRD data will support vital university collaborations (UNR, Ecole Poly.)
  - PRL on planar array scaling and dynamics (FY09)
  - PoP on K-shell x-ray production in Al planar arrays (FY09-10)
  - PoP on opacity and power scaling in high mass loads (FY09-10)
- Numerical design study of planar-array-driven hohlraums will determine if programmatic Z shots along this new research direction are warranted (FY09-10)
- Saturn follow-on experiments (LDRD, FY09-10)
- University experiments in novel compact sources (UNR)