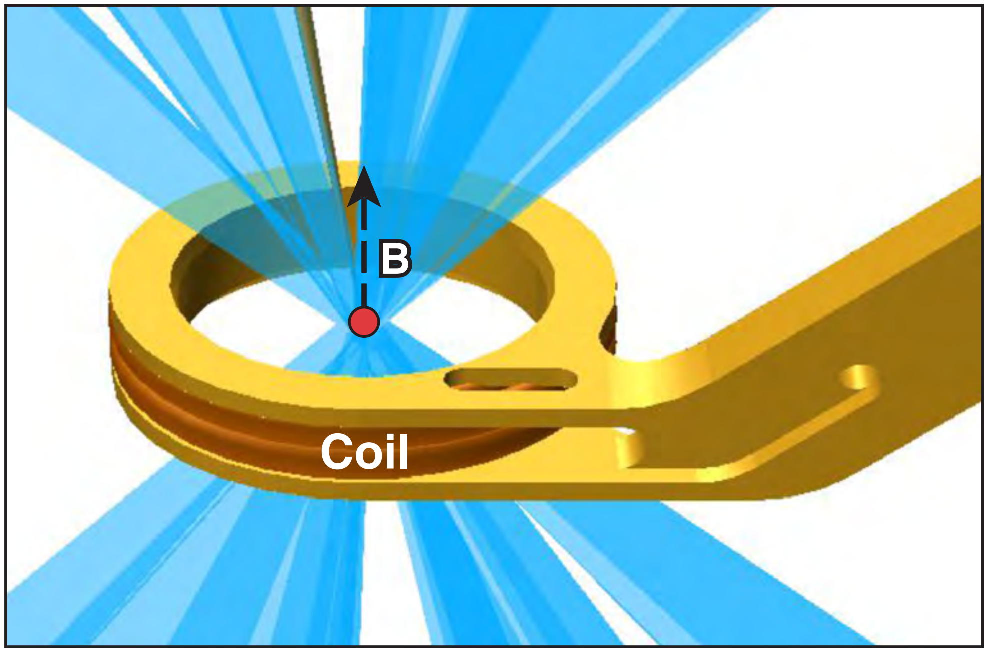
Neutron Yield Enhancement by Magnetizing Implosions on OMEGA



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Summary

Magnetized targets have better performance than non-magnetized targets

- Extended previous magnetized target improvements* to a lower adiabat
- A database of more than 20 shots shows consistent yield enhancement as a result of magnetizing the target
- Neutron yield is enhanced by 25% to 30% as a result of magnetizing the target
- Ion temperature increases by 10% to 15% as a result of magnetizing the target

*P. Y. Chang *et al*., Phys. Rev. Lett. 107, 035006 (2011).

Collaborators

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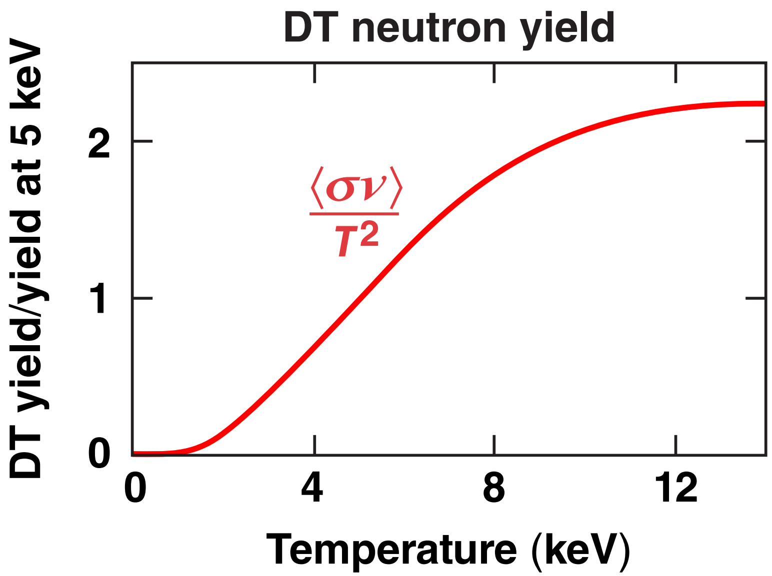
A strong magnetic field in the hot spot can be beneficial to inertial confinement fusion

- A strong magnetic field will reduce the heat losses leading to higher temperature and neutron yield
- Typical hot-spot conditions:

  $\rho \sim 20$ g/cm^3, $T \sim 5$ keV

  B > 10 MG is needed to magnetize the hot spot
- Experiments have shown that seed fields of 50 kG were compressed to more than 30 MG in inertial confinement fusion (ICF) targets*

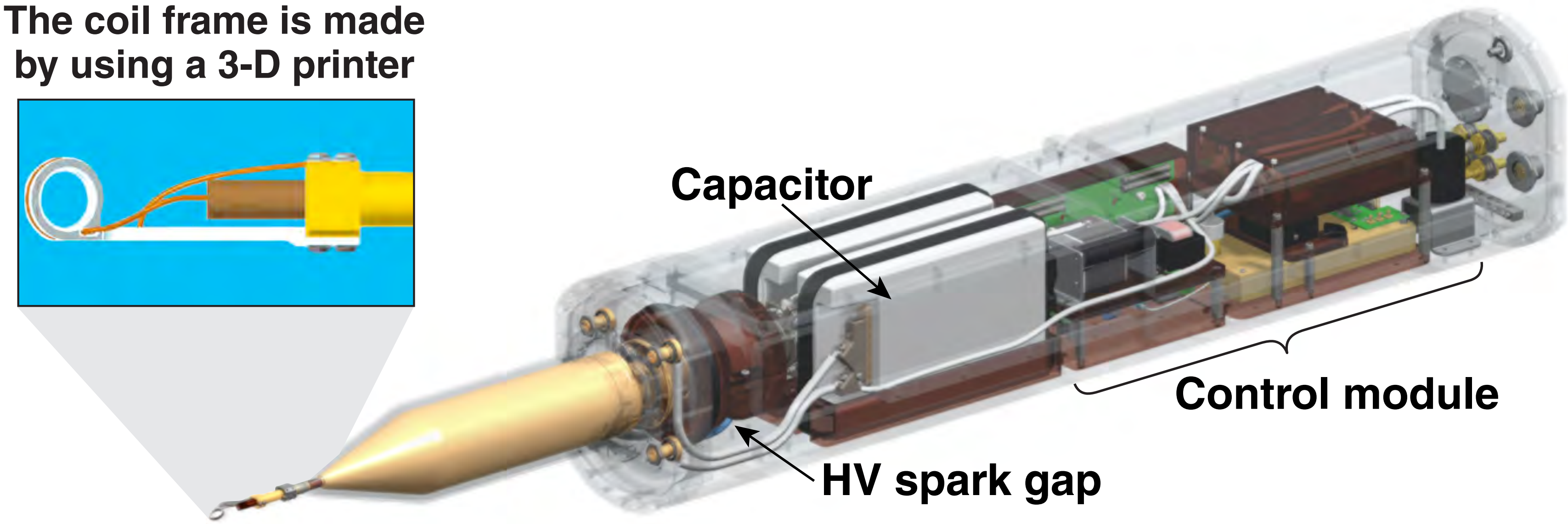


*O. V. Gotchev *et al*., Phys. Rev. Lett. 103, 215004 (2009).

TC10896

The magneto-inertial fusion electrical discharge system upgrade (MIFEDS-U) is more robust for operations and allows for flexible field topologies for different experiments

The coil frame is made by using a 3-D printer



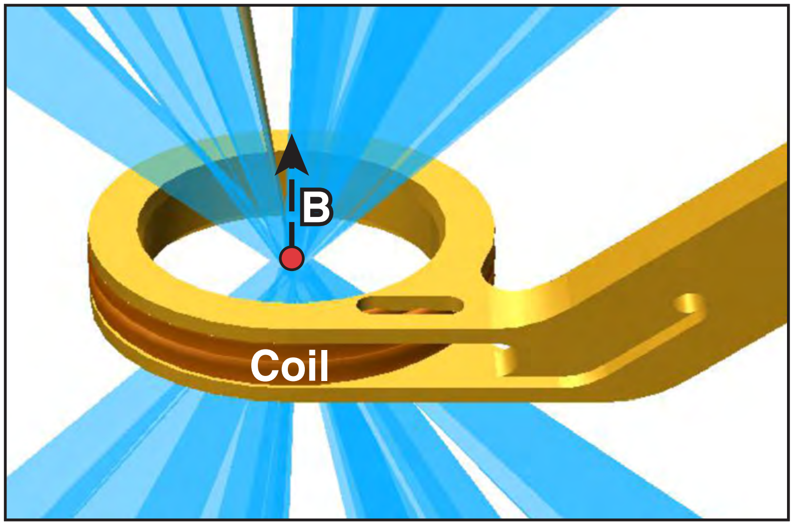
	MIFEDS-U
Energy	Up to 200 J
Maximum current	40 kA
Coil	Multiple turns with 3-D printed frame
B	50 to 100 kG using four turns, $r \sim$ 6-mm coils
Operation	Facility diagnostic

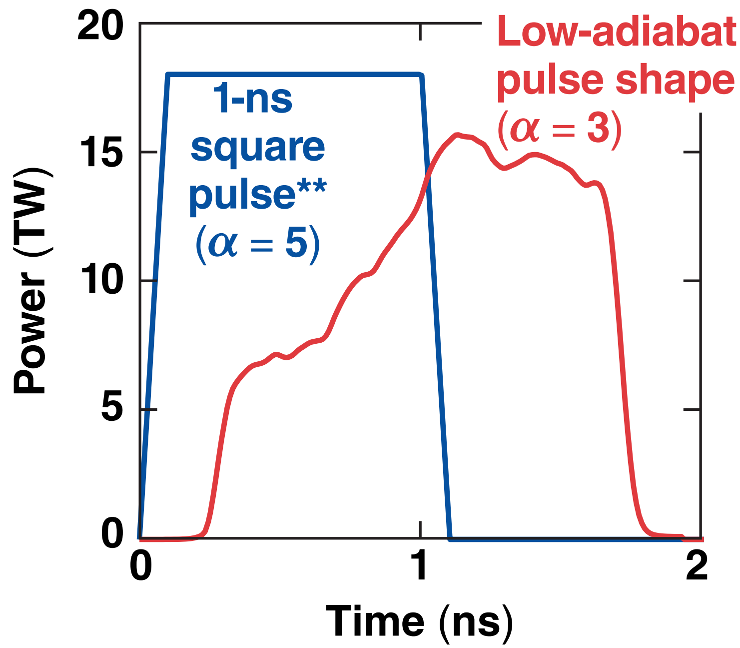
TC10901

D. H. Barnak *et al*., PO7.00005, this conference.

A single coil is used to generate magnetic fields for polar-drive (PD) implosions

40 OMEGA beams in PD configuration*





Target	**MIFEDS coil**
CH-shell	outer diameter = 15.0 mm
thickness = 22.5 μm	inner diameter = 10.9 mm
outer radius = 430 μm	B_{seed} = 7 T
10 atm D_2	

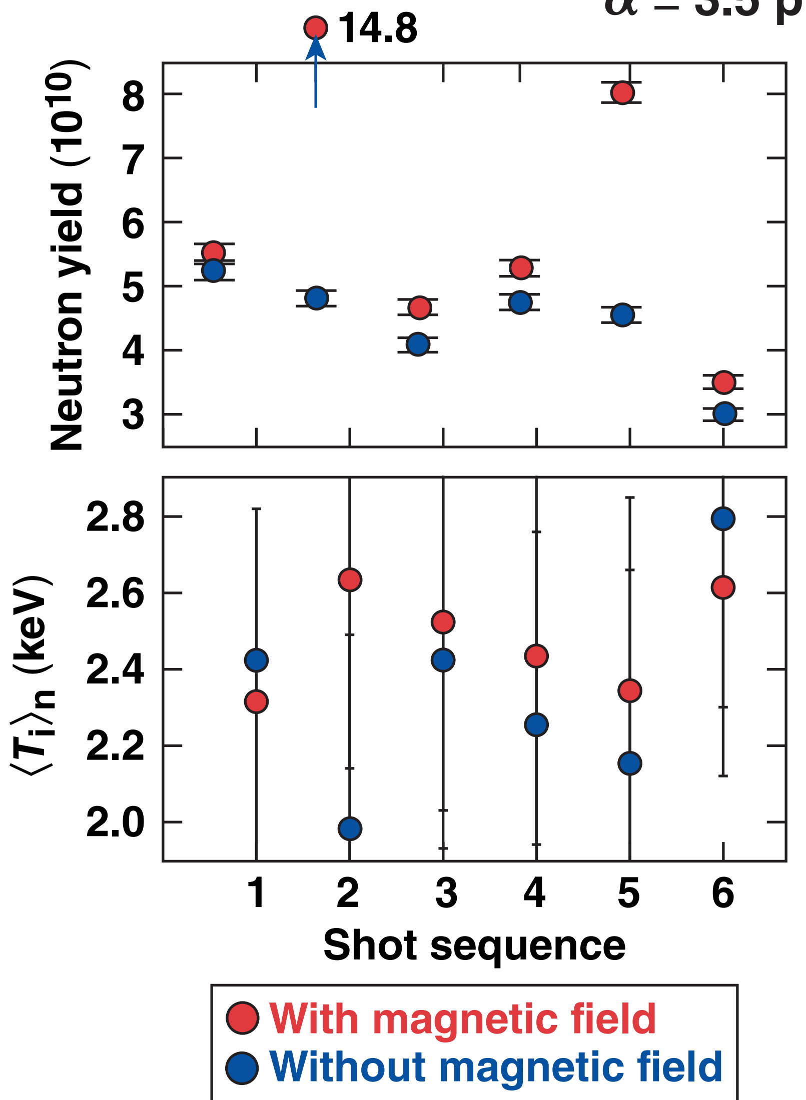
$$\alpha = \frac{P}{P_F}$$

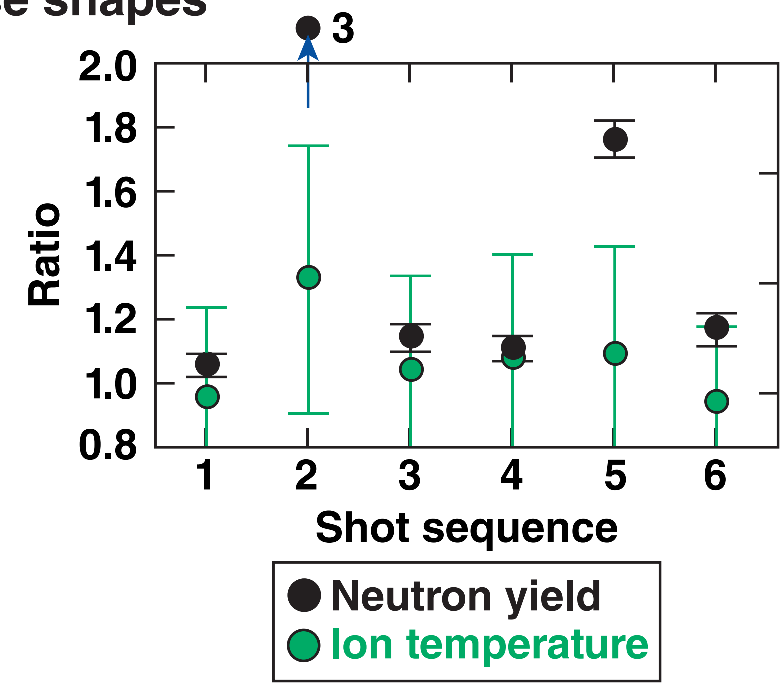
*F. J. Marshall *et al.*, J. Phys. IV (France) 133, 153 (2006).
**P. Y. Chang *et al.*, Phys. Rev. Lett. 107, 035006 (2011).

TC10902

Magnetized targets give a higher neutron yield and ion temperature

α = 3.5 pulse shapes

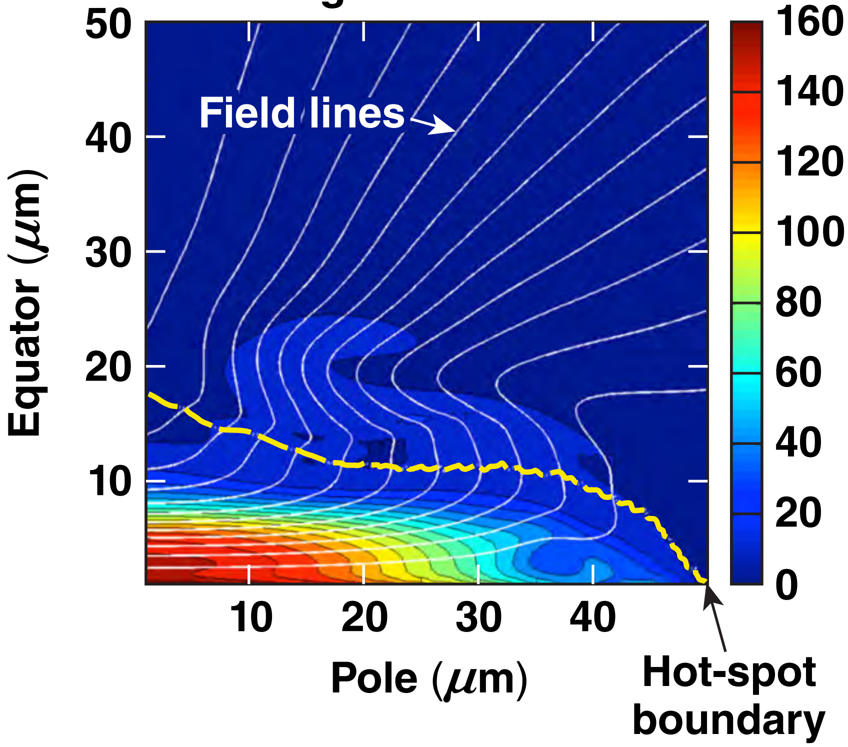


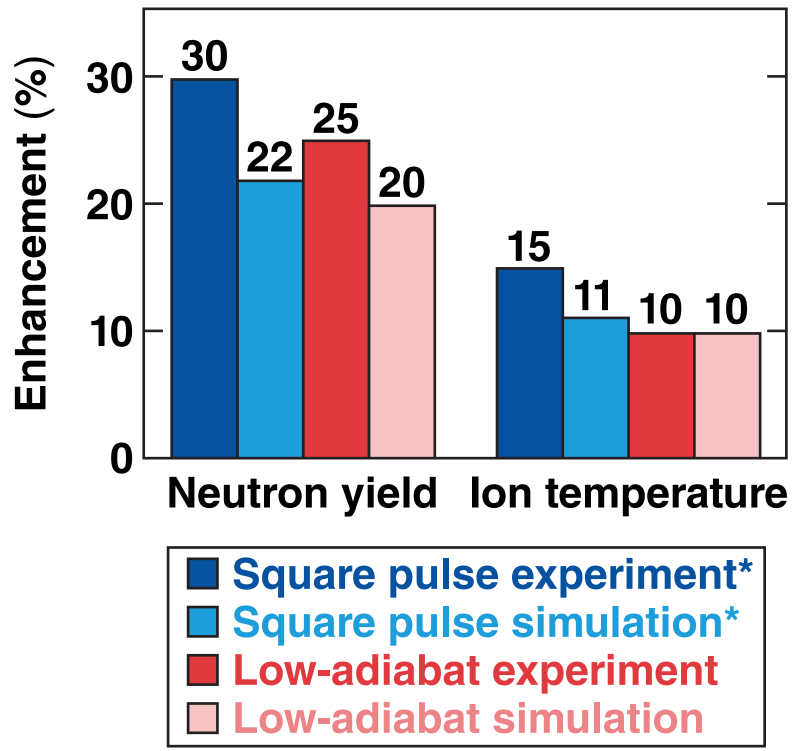


- Targets are grouped in pairs to have similar specifications, such as pressure, shell thickness, and diameter, etc.

Magnetohydrodynamic (MHD) simulations agree with the experimental data

B (MG) at peak compression using *DRACO*-MHD





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