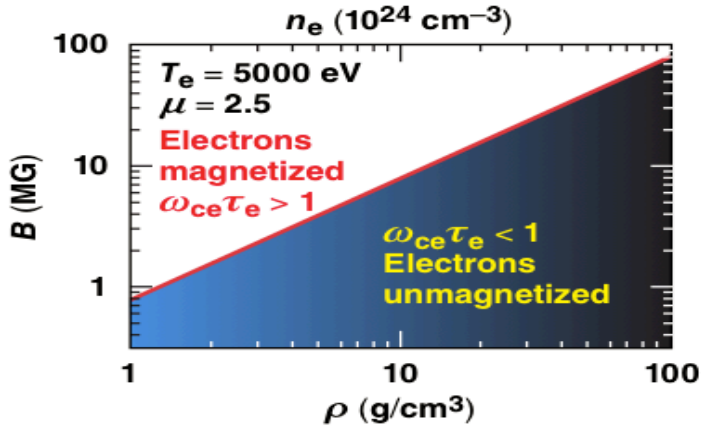
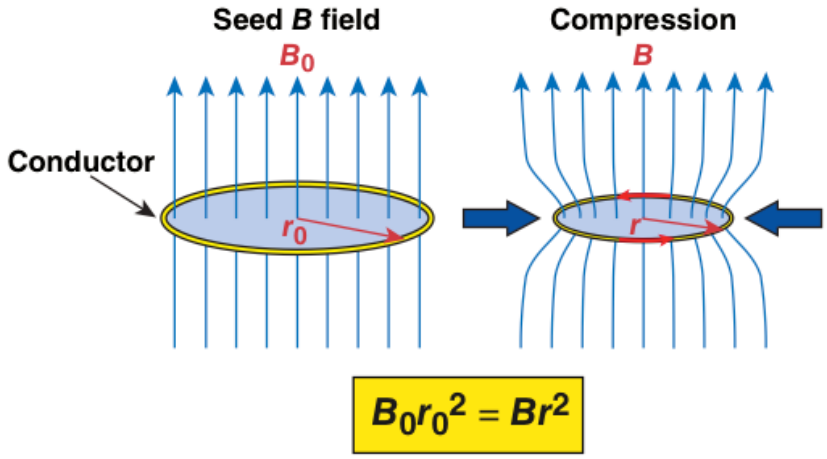
Developing magnetic platforms for basic HED Science

- Tens of megagauss fields are needed to magnetize electrons at typical ICF parameters

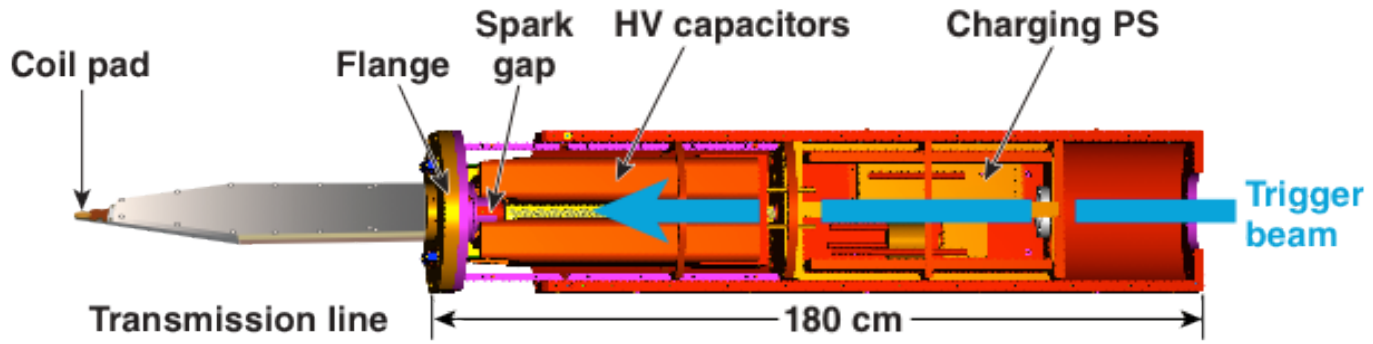


- It can be created by compression of a seed field
- If compression is faster than magnetic diffusion, magnetic flux is conserved

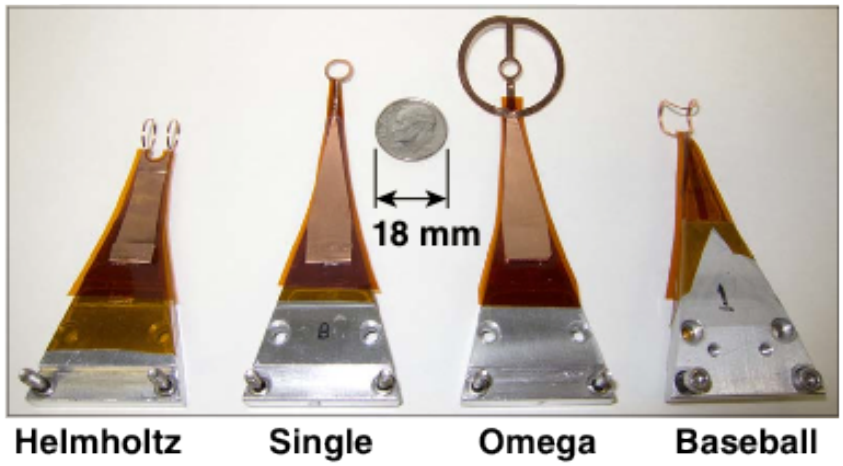


- Magnetization of plasma electrons inhibits heat-conduction losses

The seed B field is created by a compact, self-contained magnetic field generator



- MIFEDS–Magnetized Inertial Fusion Electrical Discharge System
- Various coils were tested
- Seed fields up to 150 kG can be obtained (depends on the coil size and geometry)



O. V. Gotchev *et al.*, Rev. Sci. Instrum. 80, 043504 (2009).

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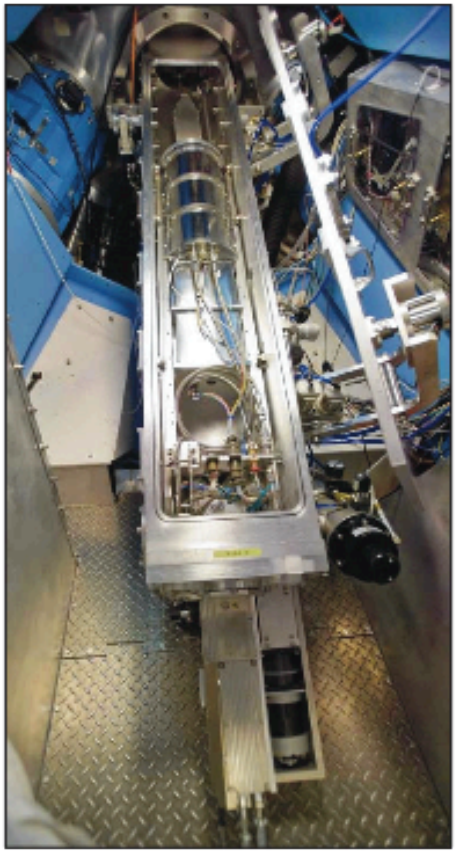
MIFEDS is installed in an OMEGA Diagnostic Inserter



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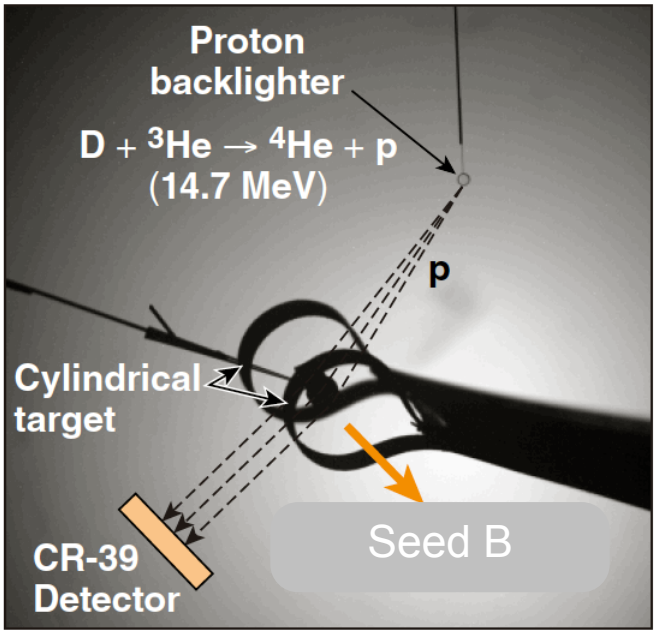
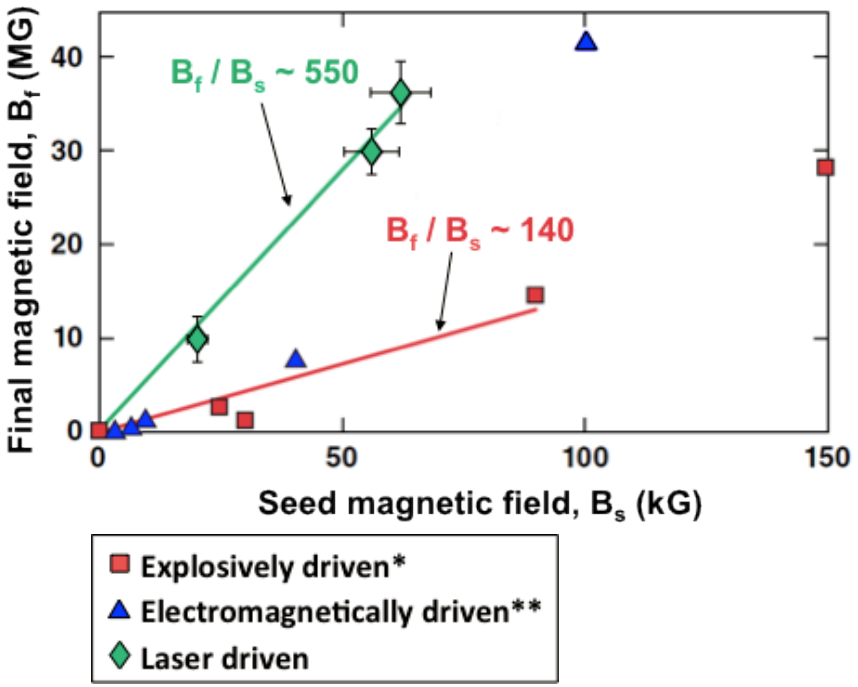
Compressed magnetic fields up to 30 MG were inferred in cylindrical implosions using proton deflectometry





Field compression of ~ 550 has been achieved. Agrees with flux conservation

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

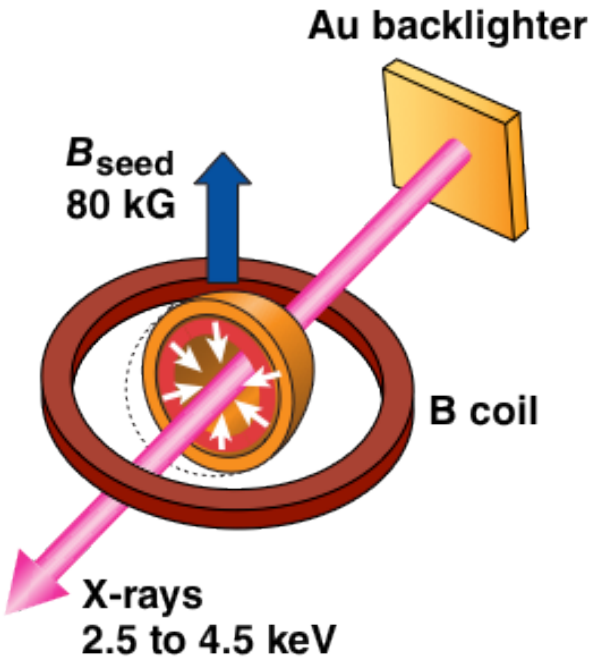
E19780

*A. D. Sakharov, Sov. Phys. Usp. **9**, 294 (1966)

F. S. Felber *et al.*, Phys. Fluids **31, 2053 (1988)

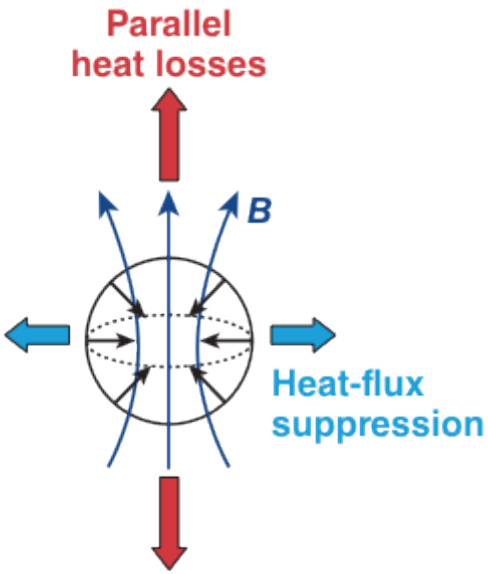
Single-coil B field was used for fusion-enhancement measurements in spherical geometry

- Single-coil provides stronger seed fields (80 kG), less interference with laser beam
- 40 beams (18 kJ/1 ns) were used for compression
- Implosion uniformity is diagnosed using x-ray BL radiography
- nTOF diagnostic was used for Ti and neutron-yield measurements

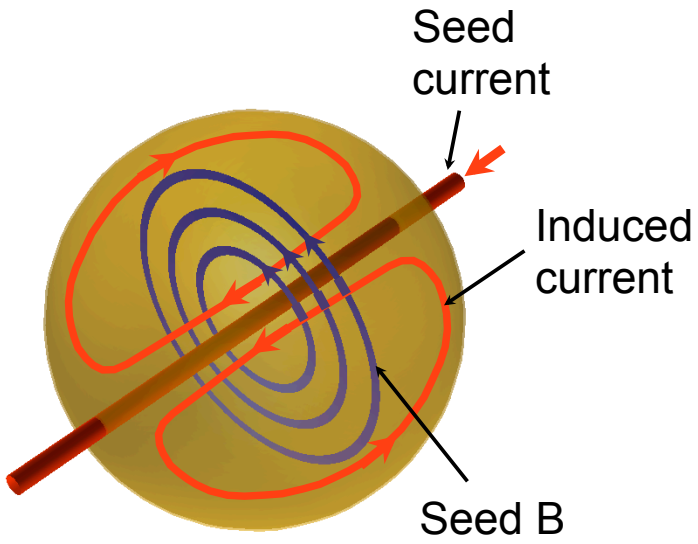


The fusion enhancement is thought to be limited by the open-field line geometry

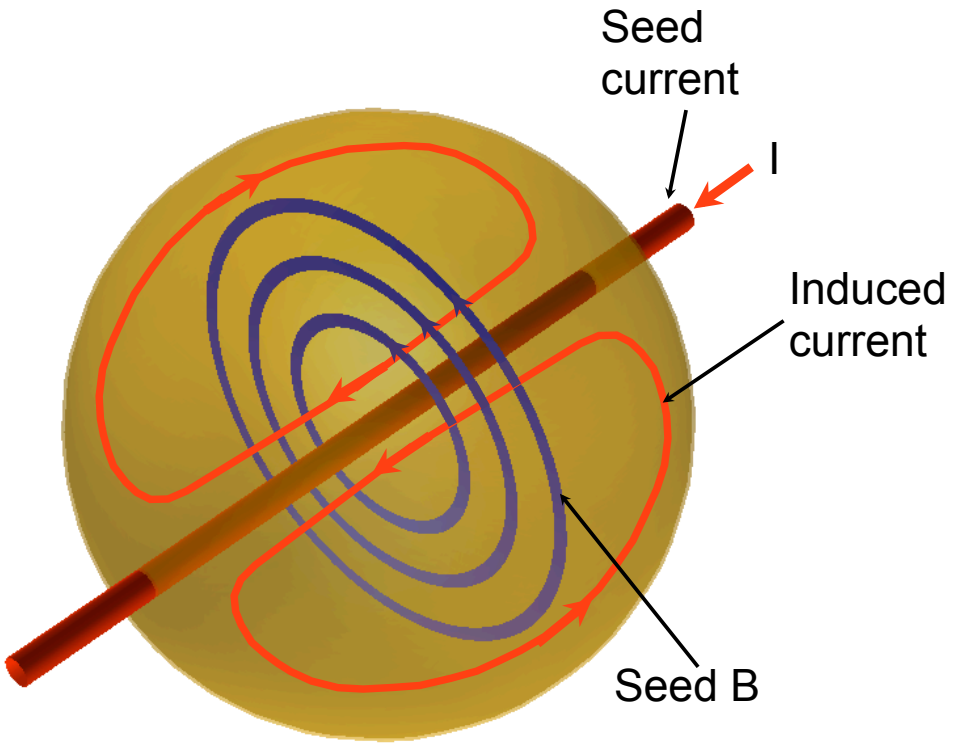
- Ratio of open field-lines area to target–surface area ~1/2, so less than 50% of conduction losses is reduced
- Challenge: create closed-flux surfaces inside the shell



- Could be done (for example) by driving current through the target



Closed magnetic field lines can be created by driving current through the target



I = 10 kA
B = 10 T (at r = 200 μm)