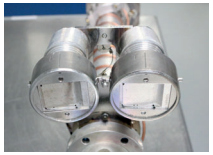
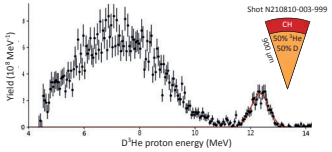
Wedge Range Filter (WRF) proton spectrometers on the NIF





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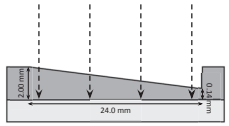
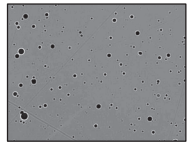
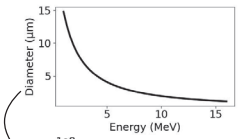
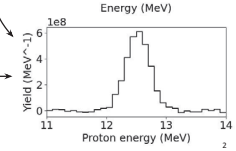
A WRF is a gradient filter combined with a CR-39 detector for proton spectrum measurements

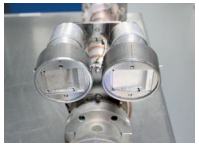


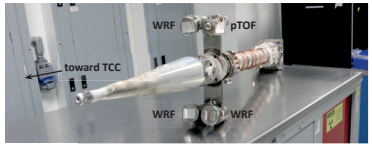






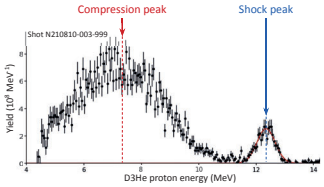
WRFs are easy to field and have a large dynamic range

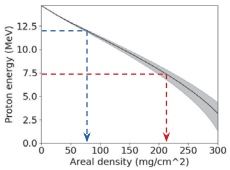




- WRFs mount behind the nosecone, alongside pTOF and SRC.
- Up to four WRFs can be fielded in any DIM.
- A WRF can handle proton yields from about 10^8 to 10^{10} in standard configuration.
- They can be fielded at 10 cm for yields down to 10^6.
- Plans for a retracted configuration for high-yield implosions are in the works.

The shock or compression peak energy indicates the total ρR of an implosion at shock or compression



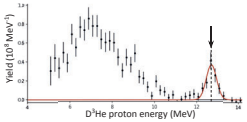


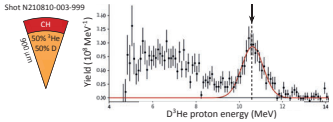
- This can probe densities up to about 250 mg/cm^2 before the particles fall below the measurable range of the WRF.
- For NIF, the compression peak of typical ICF implosions usually falls below this range.

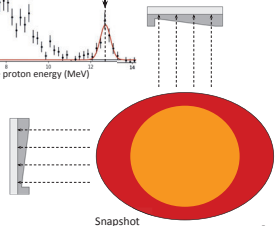
A. Zylstra et al. Rev. Sci. Instrum. 83, 10D901 (2012)

Diagnosing ρR from different directions provides information about P2 asymmetry

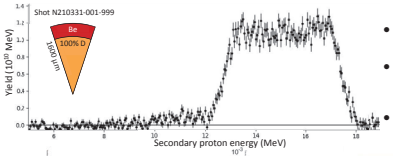
- WRFs can measure ρR on multiple lines of sight.
- Differences in ρR between lines of sight indicate low-mode asymmetries.

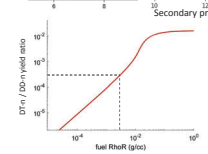


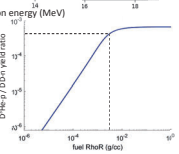




The magnitude of a secondary proton spectrum provides information about the fuel ρR and T_e of an implosion







- The ρR is inferred from the D^{3}He-p : DD-n yield ratio.
- The ρR and T_e are simultaneously inferred from the D^{3}He-p : DD-n and DT-n : DD-n yield ratios.
- This works up to fuel ρR of about 10 mg/cm^2.

H. Rinderknecht et al. Phys. Plasmas 22, 082709 (2015)

Summary

- A WRF is a gradient filter combined with a CR-39 detector for proton spectrum measurements
- WRFs are easy to field and have a large dynamic range
- WRFs diagnose total ρR, fuel ρR, and low-mode asymmetries.

F. Séguin et al. Rev. Sci. Instrum. 74, 975 (2003)
F. Séguin et al. Rev. Sci. Instrum. 83, 10D908 (2012)
A. Zylstra et al. Rev. Sci. Instrum. 83, 10D901 (2012)
H. Rinderknecht et al. Phys. Plasmas 22, 082709 (2015)
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