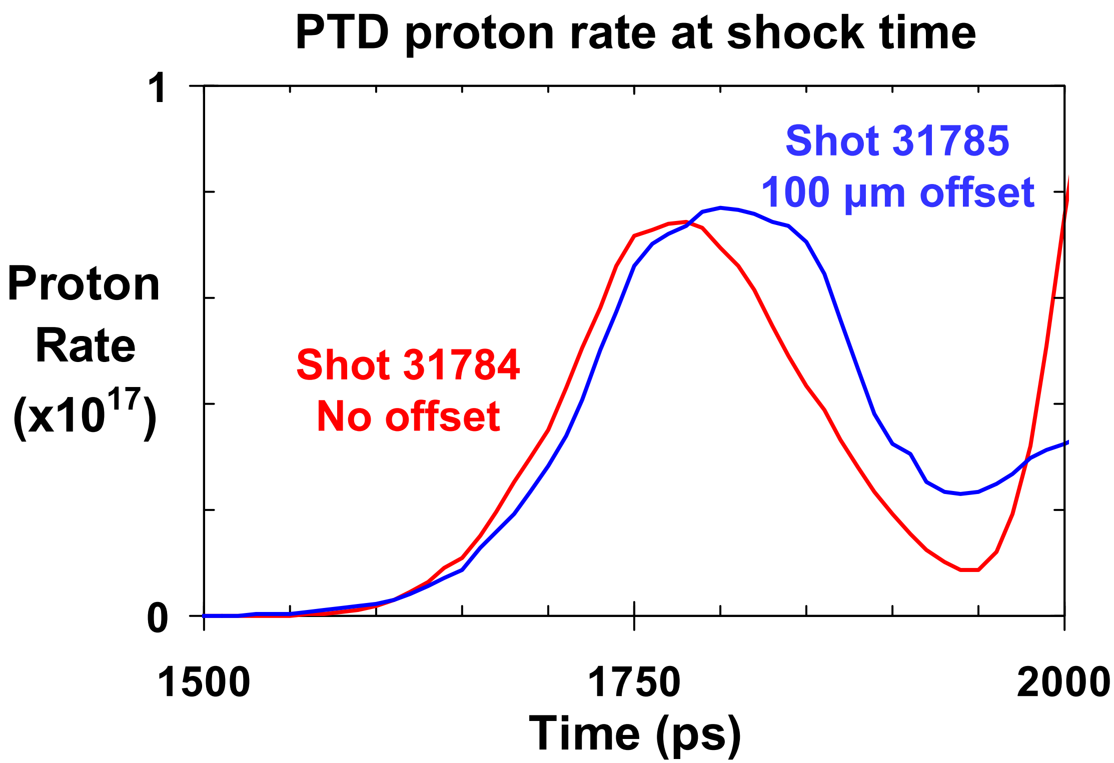
The effects of implosion asymmetry on shock coalescence in OMEGA experiments



J. Ryan Rygg et al.
MIT - PSFC

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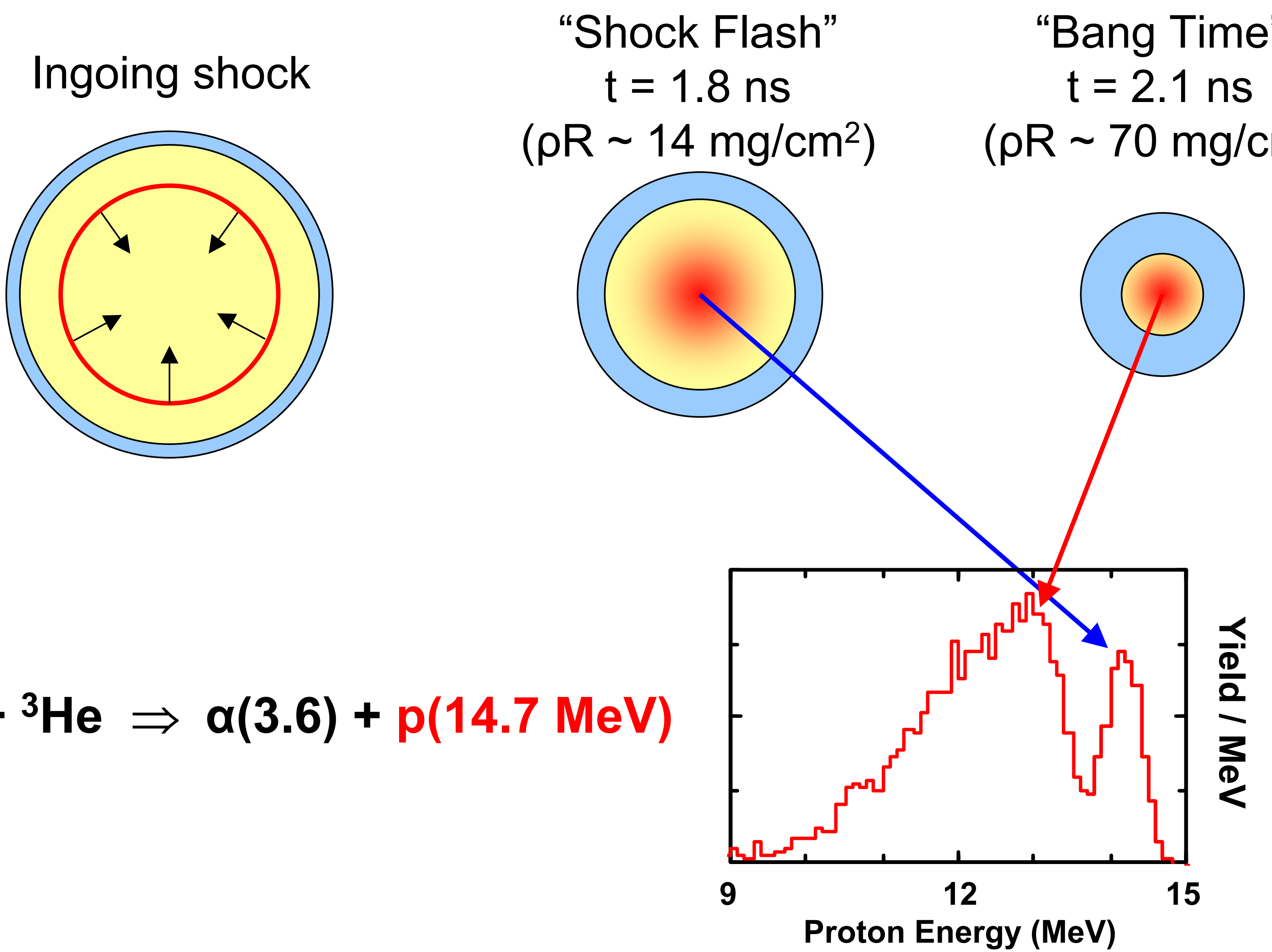
Outline

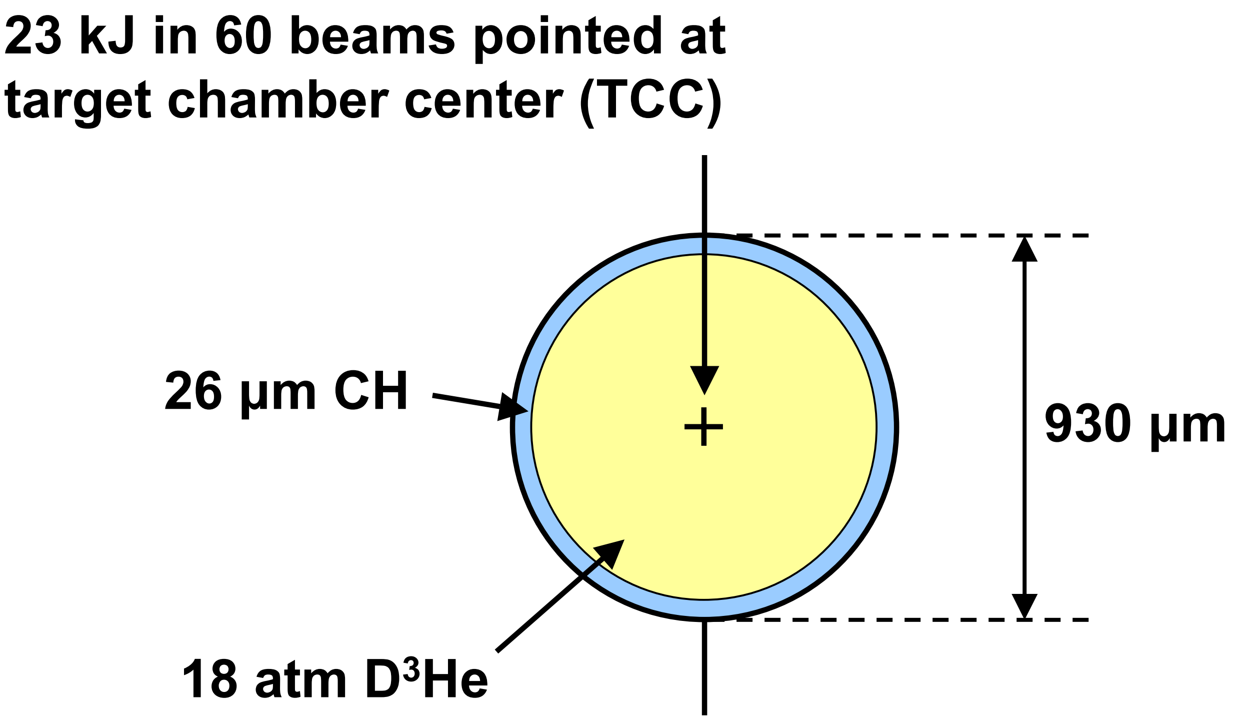
- A series of D^3He filled CH targets were driven on OMEGA with an intensity asymmetry dominated by mode P_1.
- How does the asymmetric drive affect the convergence of the shock?
- How does the D^3He yield of the shock flash depend on the symmetry of the shock convergence?
- How does ρR change between shock time and bang time in these asymmetric implosions?

D-^{3}He protons are emitted at shock time and at bang time

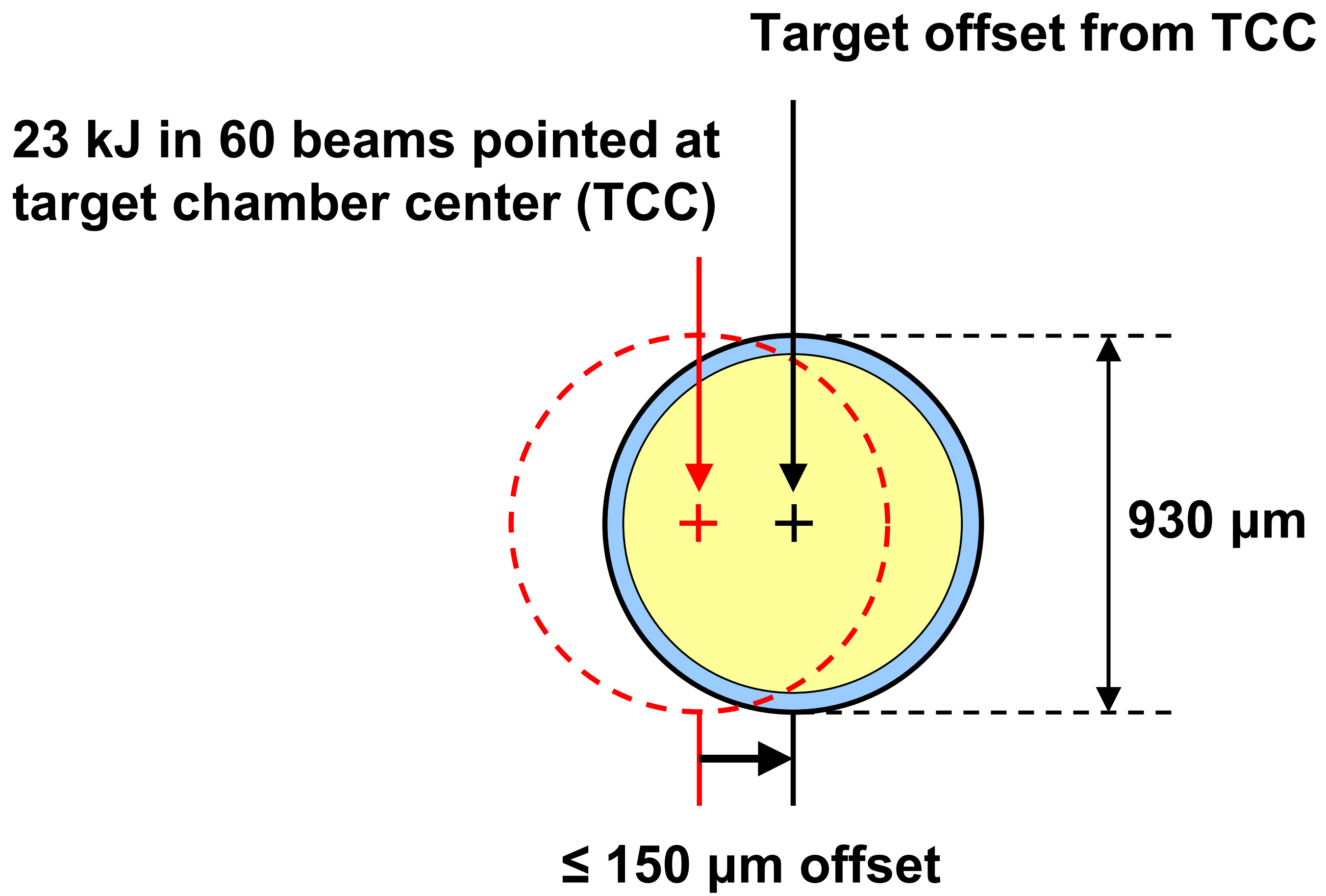


$D + {}^3He \Rightarrow \alpha(3.6) + p(14.7\ MeV)$

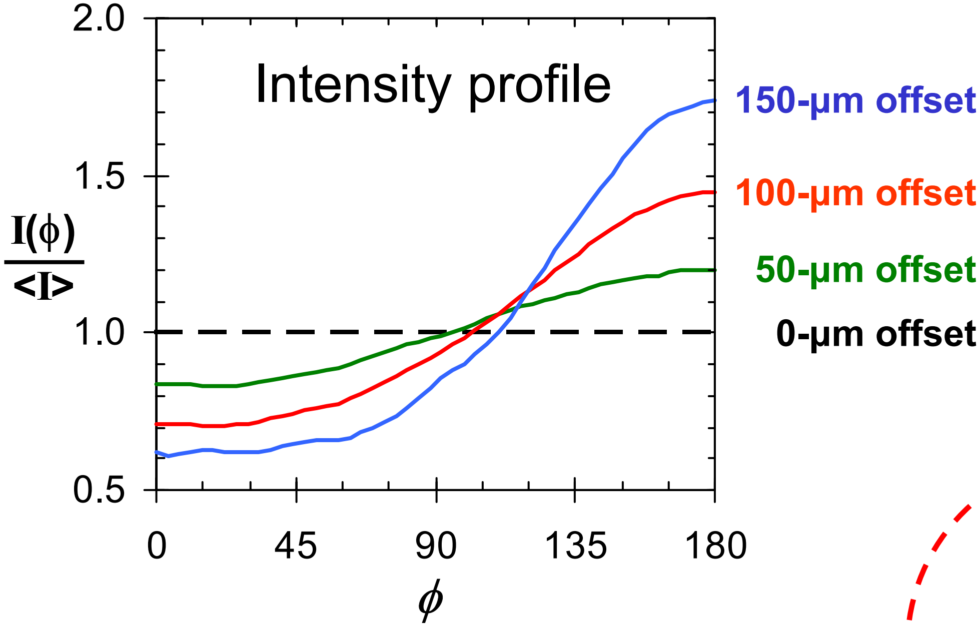
Targets were displaced with respect to beam pointing in order to induce drive asymmetry

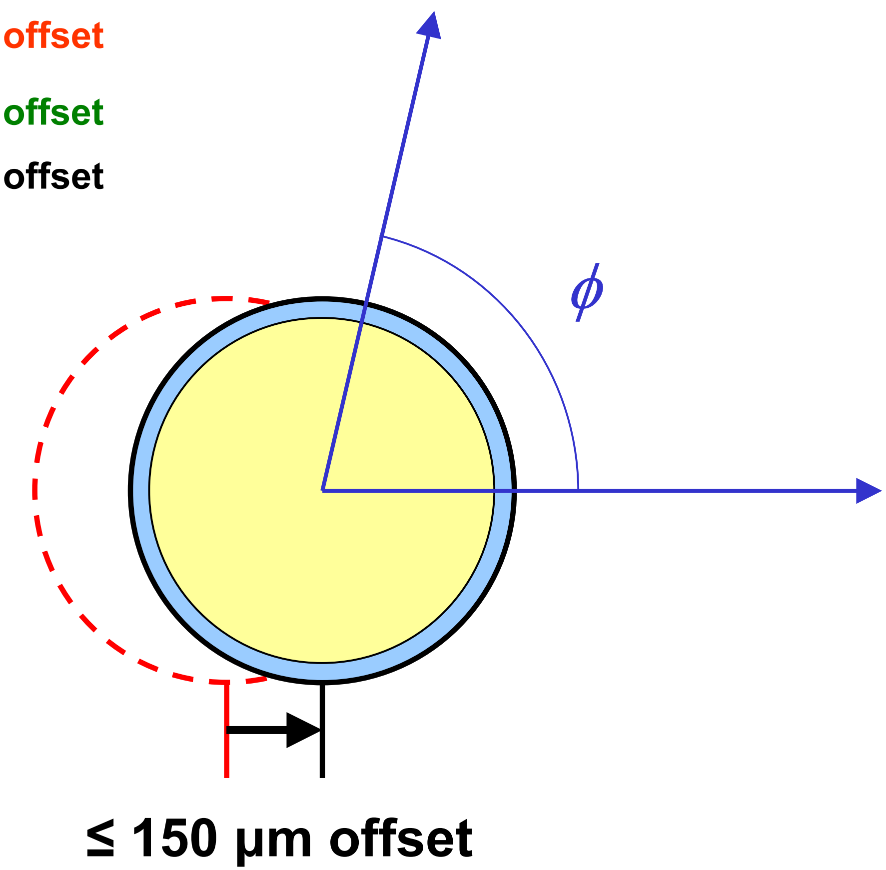


Targets were displaced with respect to beam pointing in order to induce drive asymmetry

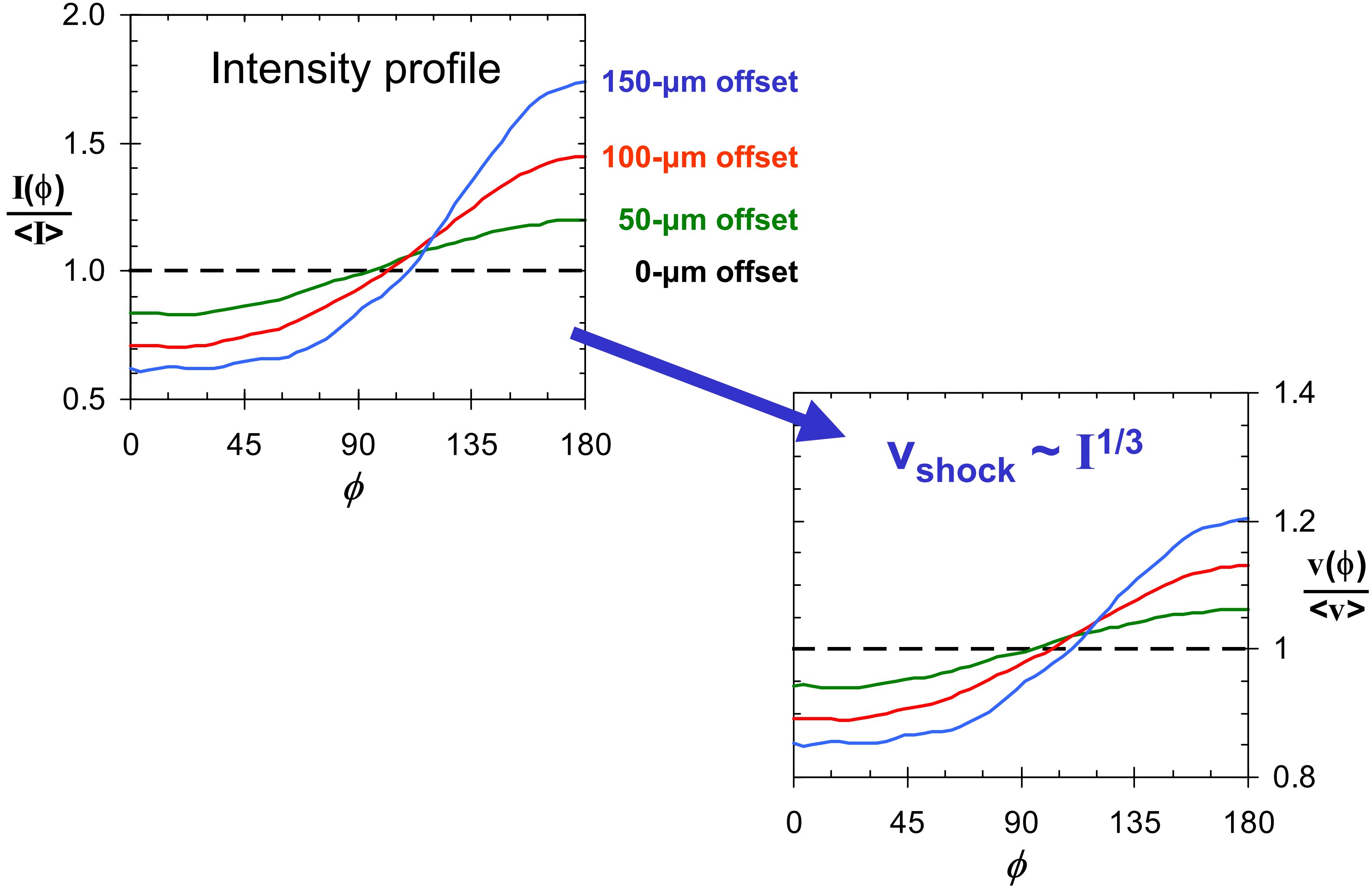


Resulting drive asymmetry is dominated by mode l=1

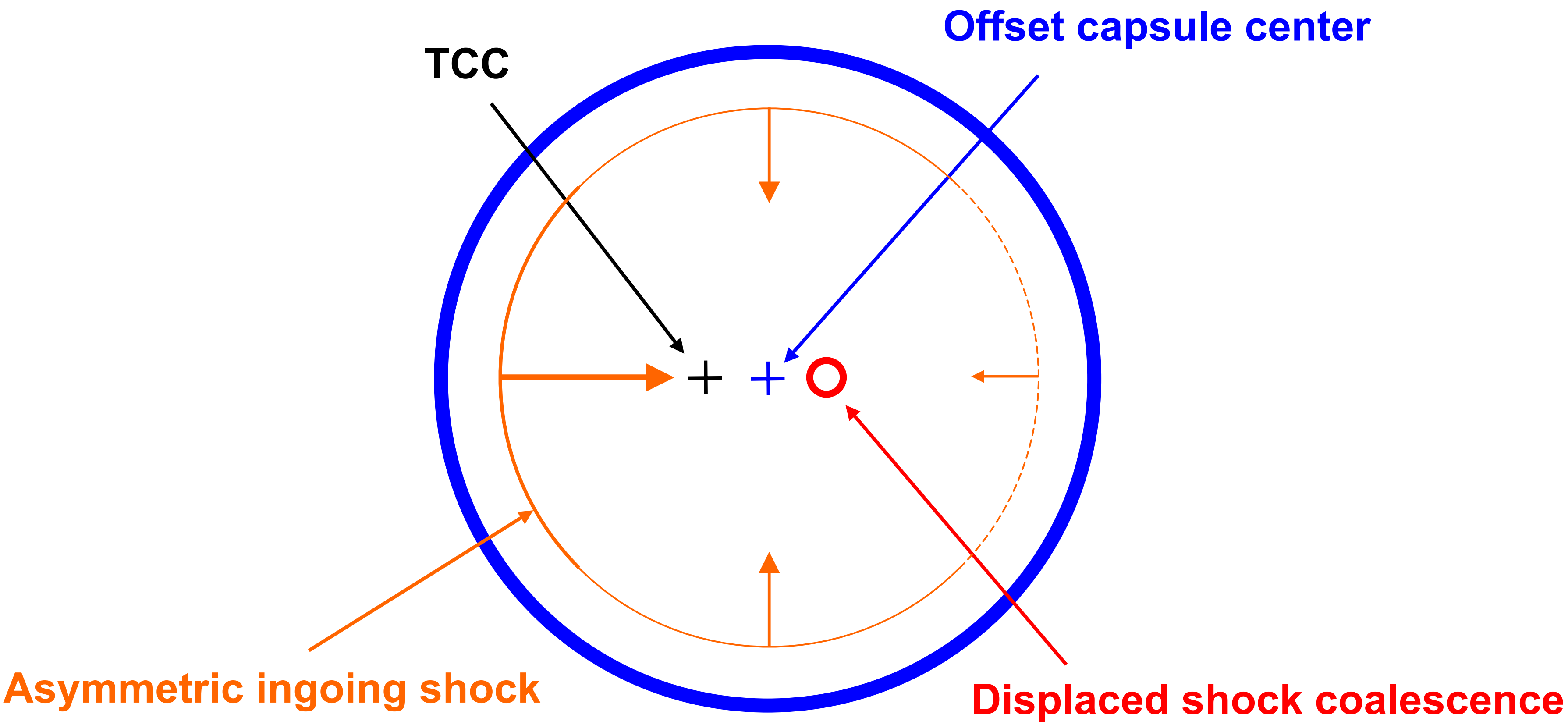




Asymmetric laser drive results in an asymmetric ingoing shock



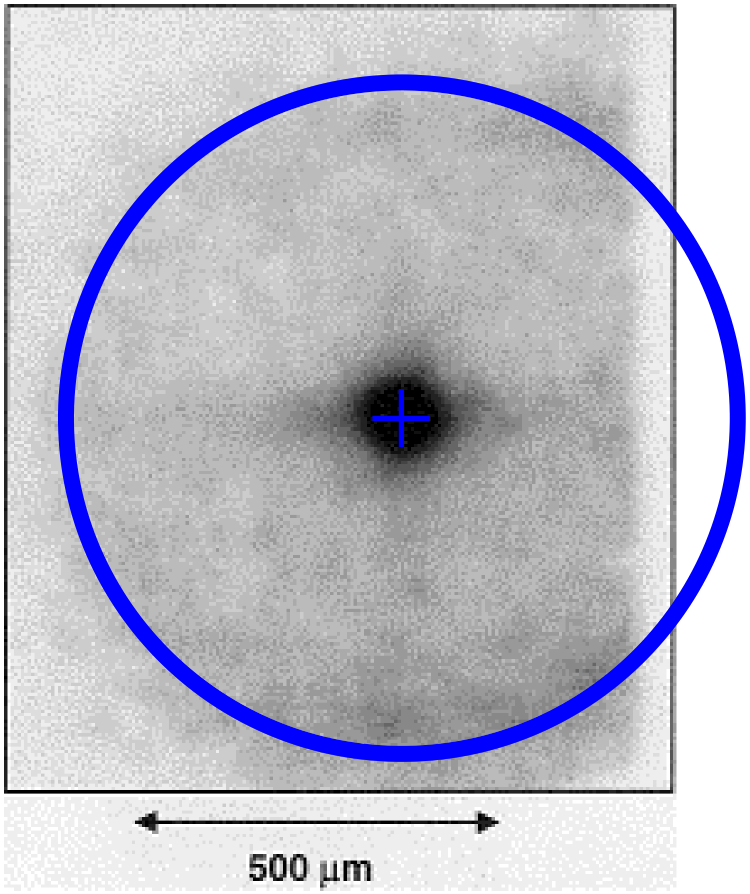
Asymmetric shock speeds lead to a displacement of the shock coalescence



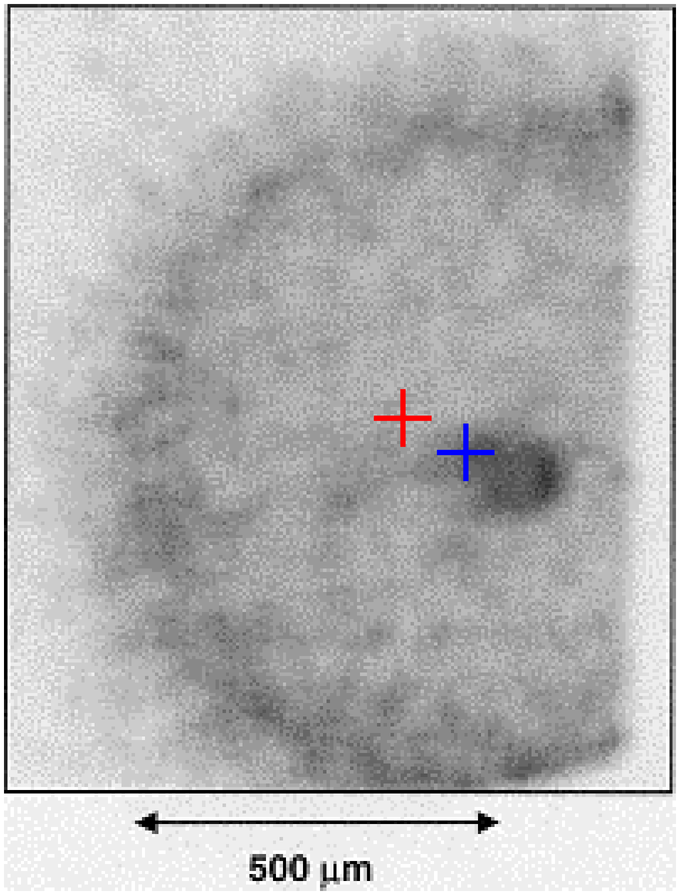
For 100 μm offset from TCC, shock coalescence will be displaced by 105 μm.

X-ray images at shock time confirm the displacement of the shock coalescence

Measured X-ray emission at shock time (~1.8 ns) at $\phi \sim 90^{o}$

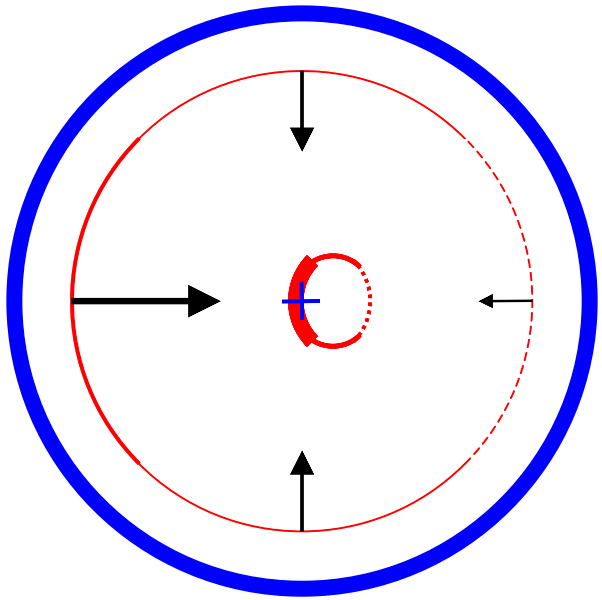


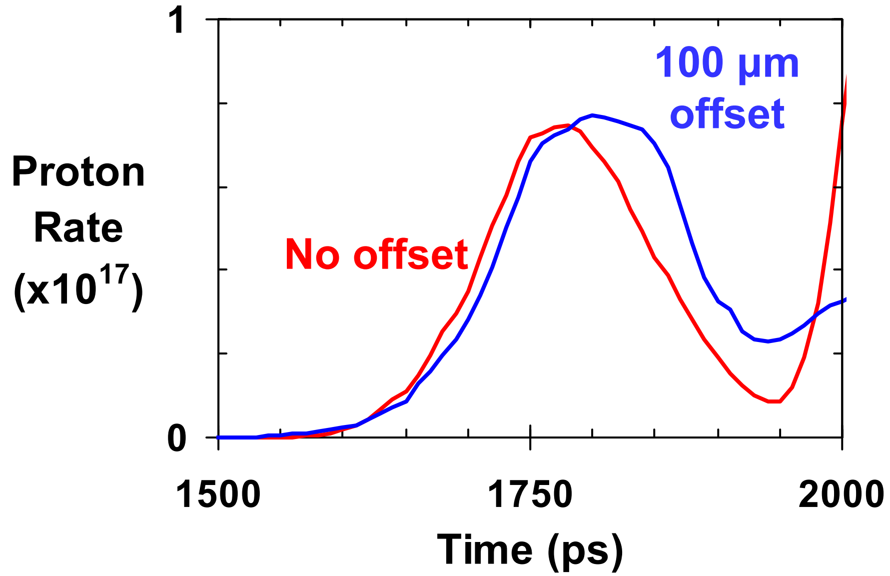
no offset



100 µm offset

The coalescence of displaced shocks is temporally broadened



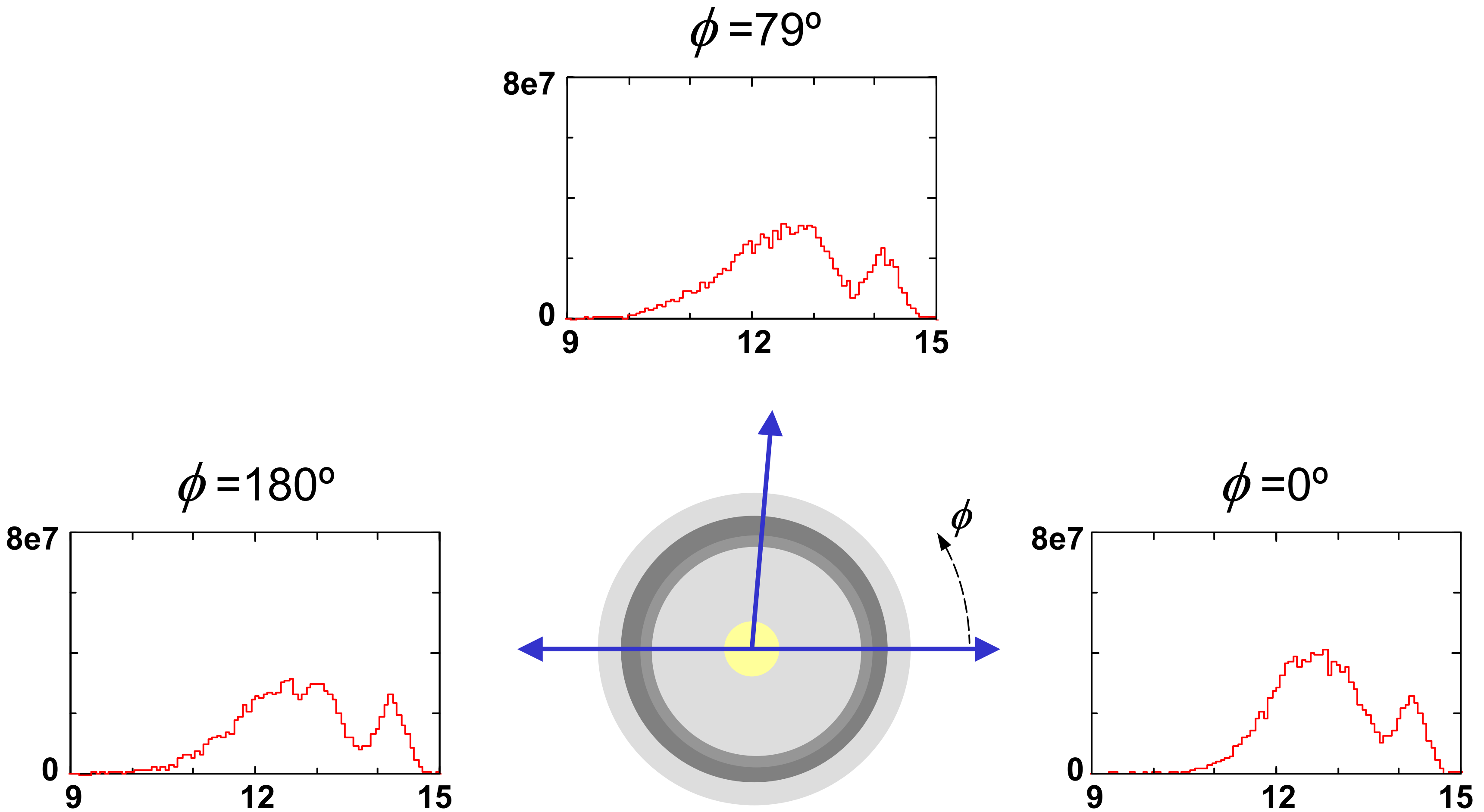


Displaced shocks have a longer duration.

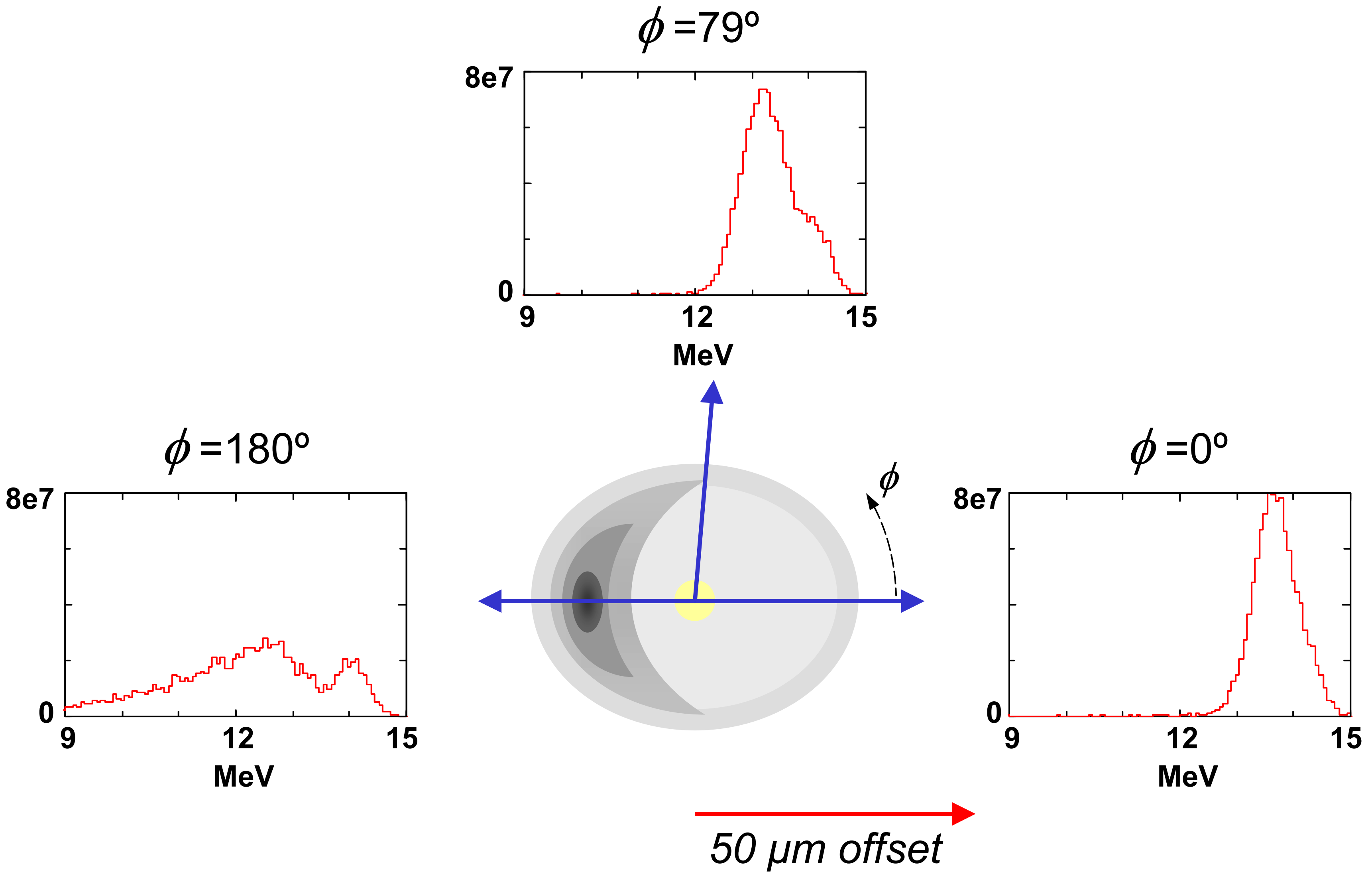
→ ~50 ps extra broadening for 100 µm offset target

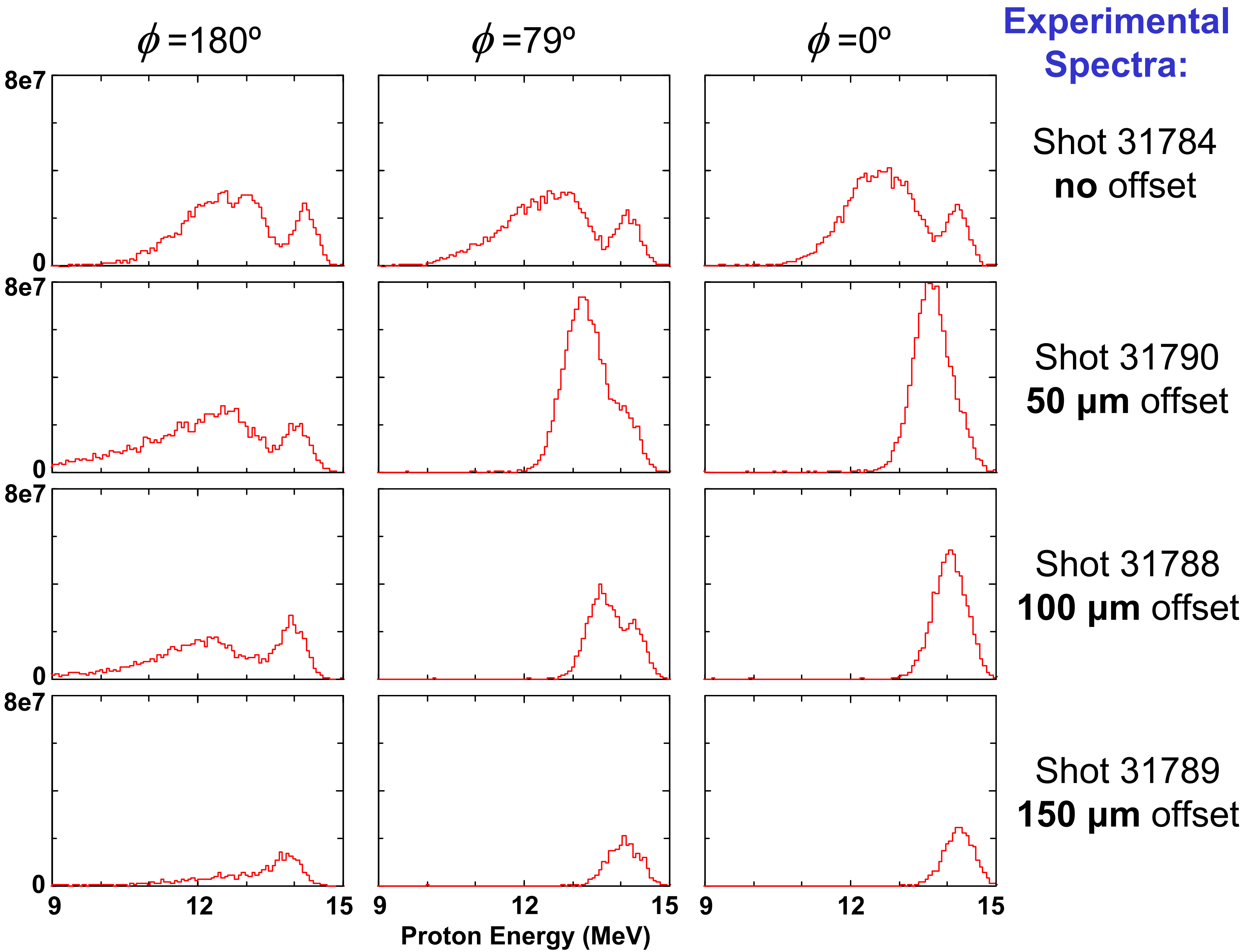
The Proton Temporal Diagnostic confirms the longer duration of shock proton emission for target offset by 100 µm.

For centered shots, shape of D^3He proton spectra are similar at all angles

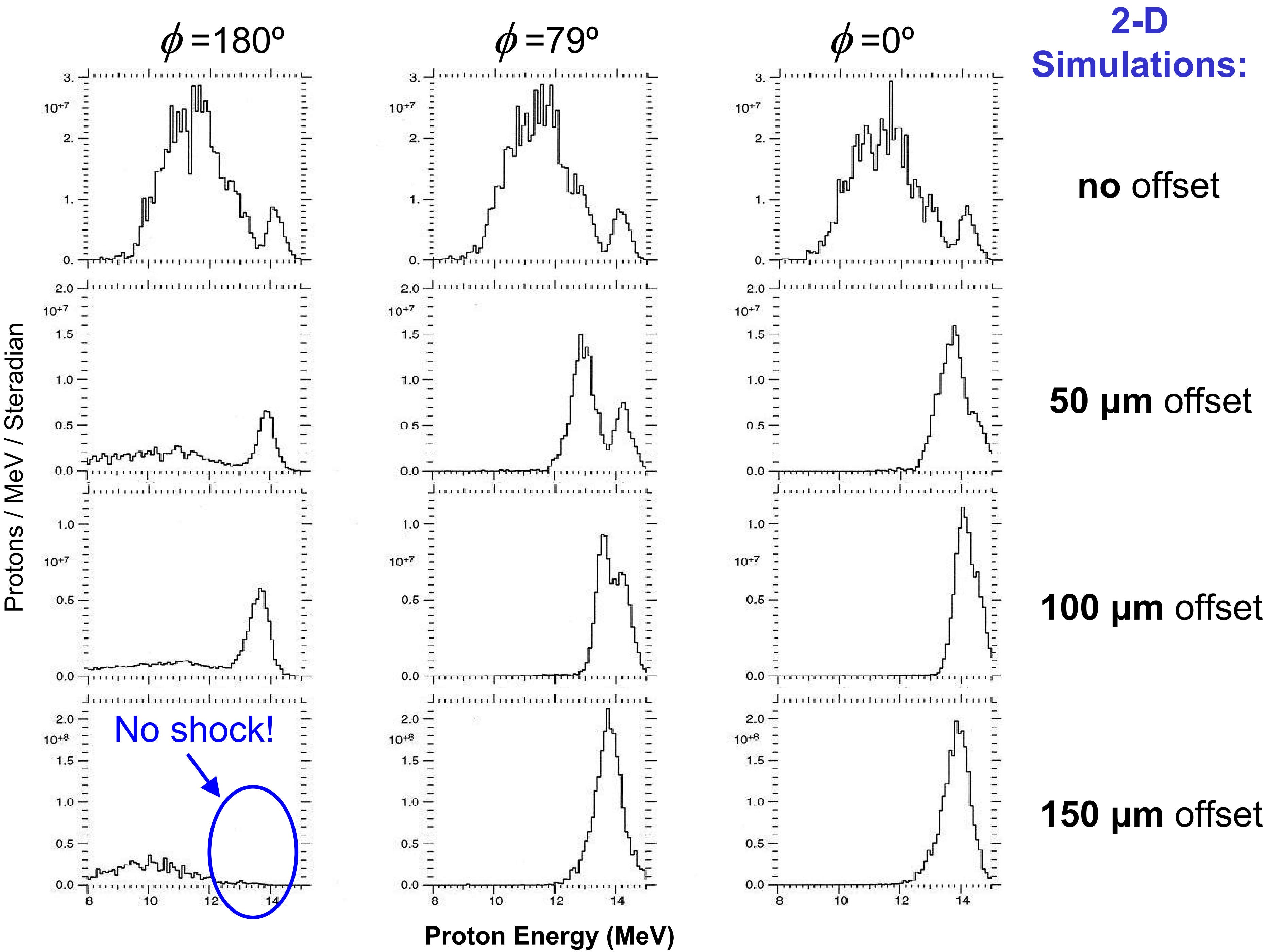


For offset shots, shape of D^3He proton spectra is strongly dependent on angle



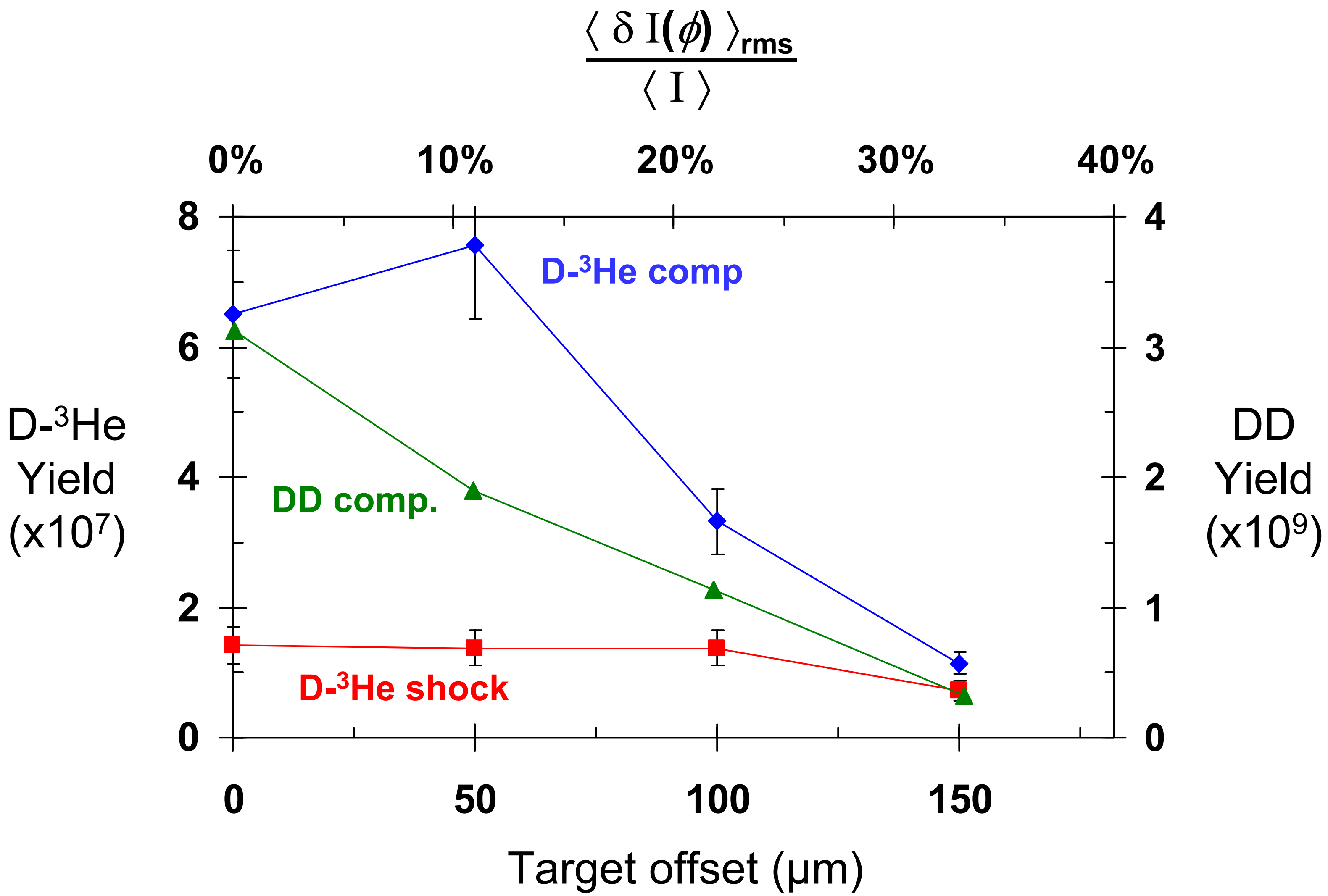


Experimental Spectra:
φ =180º
φ =79º
φ =0º
8e7
0
Shot 31784
no offset
Shot 31790
50 µm offset
Shot 31788
100 µm offset
Shot 31789
150 µm offset
9
12
15
Proton Energy (MeV)



2-D Simulations:
ϕ =180º
ϕ =79º
ϕ =0º
no offset
50 μm offset
100 μm offset
150 μm offset
No shock!
Protons / MeV / Steradian
Proton Energy (MeV)

D^3He proton shock yield is largely insensitive to shock convergence symmetry



Summary

- A series of D^3He filled CH targets were driven on OMEGA with an intensity asymmetry dominated by mode P_1 with an amplitude up to 35% rms.
- How does the asymmetric drive affect the convergence of the shock?
  - The shock coalescence is displaced in space and broadened in time.
- How does the D^3He yield of the shock flash depend on the symmetry of the shock convergence?
  - The D^3He shock yield is less sensitive to drive asymmetries than simulations predict.
- How does ρR change between shock time and bang time in these asymmetric implosions?
  - Fredrick Séguin will address this question in the following talk.