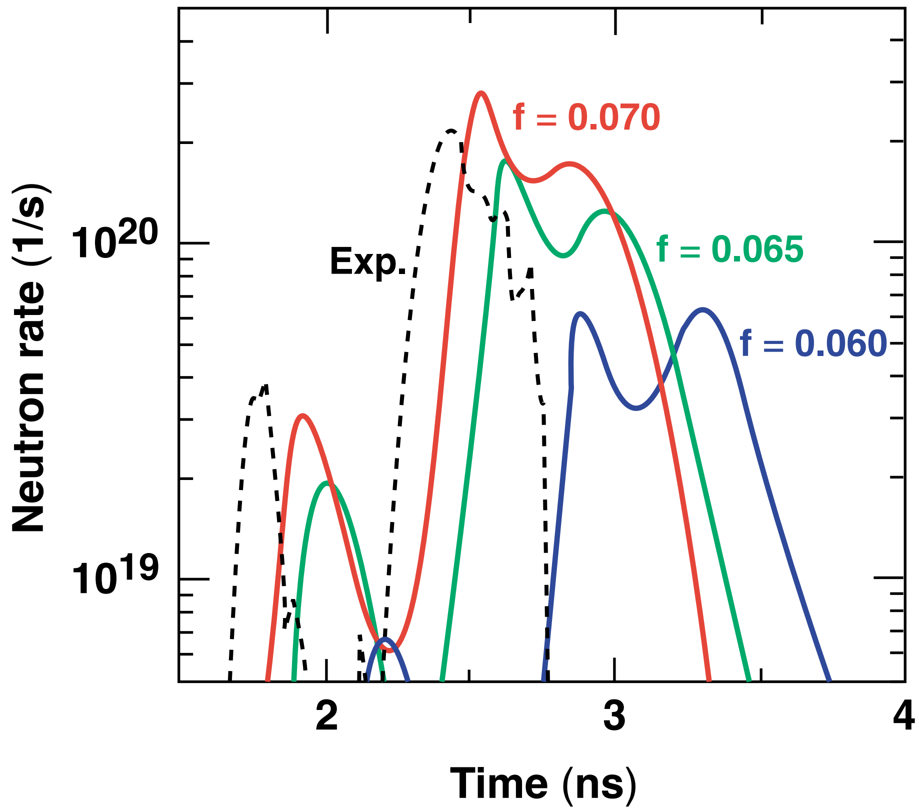
Determination of the Flux Limiter in CH Targets from Experiments on the OMEGA Laser



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31st Annual Anomalous Absorption Conference
Sedona, AZ
3–8 June 2001

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Summary

Simulations of experiments on the OMEGA laser suggest slightly larger values than currently used for the flux limiter

- The increased precision of the neutron time-of-flight (NTD) diagnostic and the reproducibility of laser shots permit a more precise determination of the flux limiter and central cell zoning.
- The timing and the level of both the shock yield and the onset of the compression yield are sensitive to the flux limiter.
- A flux limiter of 0.070 (sharp cutoff) gives general agreement with experiment for 1-ns square pulses and 20-μm CH shells.
- Differences for the 400-ps square pulse and the 28-μm CH shell imply that other factors affect target dynamics.

Conditions are right for improving parameters in the simulations of CH-shell targets using the neutron time-of-flight detector (NTD)

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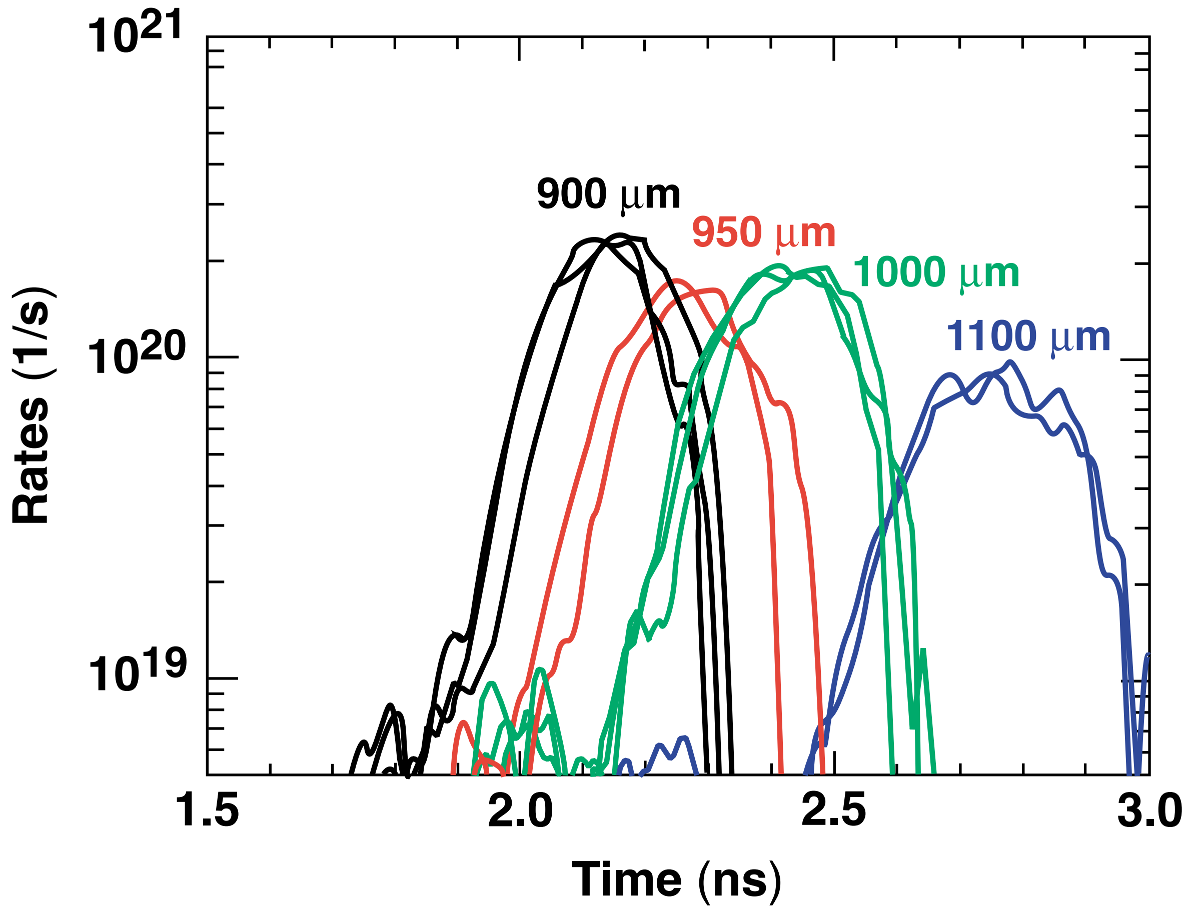
- The OMEGA laser provides reproducible pulse shapes and energy over the span of several months.
- NTD, along with the laser pulse shape diagnostics, provides the timing of neutron yield to within 50 ps.
- The timing of the shock yield and the onset of the compression yield are not affected by two-dimensional effects and mix.
- They can be used to refine simulation parameters, in particular the flux limiter.
- The previous method of determining the flux limiter from the trajectory of glass shells is not satisfactory because
  - CH shells are visible only during the peak of the pulse, and
  - the shell trajectory is not as sensitive to the flux limiter as the time of neutron production.
- Improved measurement of the absorption fraction is being developed.

TC5651

Shots during the same week give reproducible NTD results



18-μm CH, 20 atm D_2
1-ns square pulse,
varying diameter

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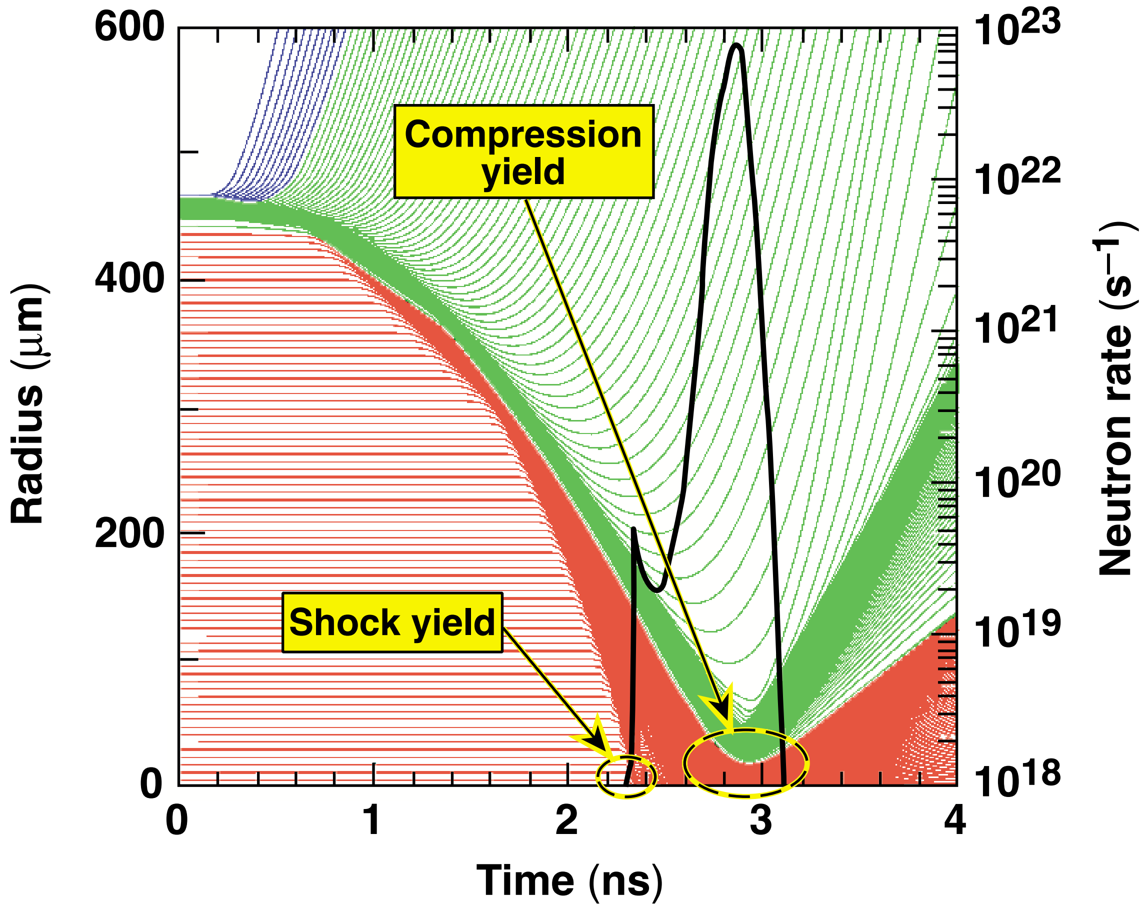
The neutron burn history shows details of the shock arrival and the stagnation phase of the implosion



Experimental conditions		
Pulse	DD fill (atm)	Shell thickness (μm)
1-ns square	20	28
	15	20
	3	20
400-ps square	20	20

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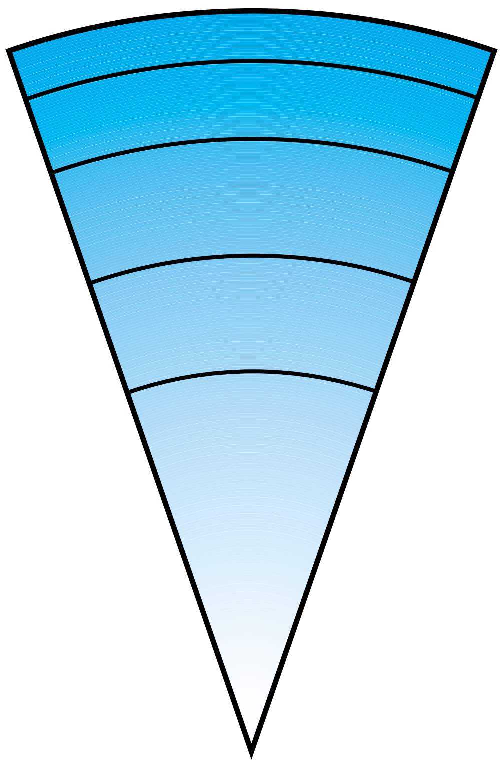
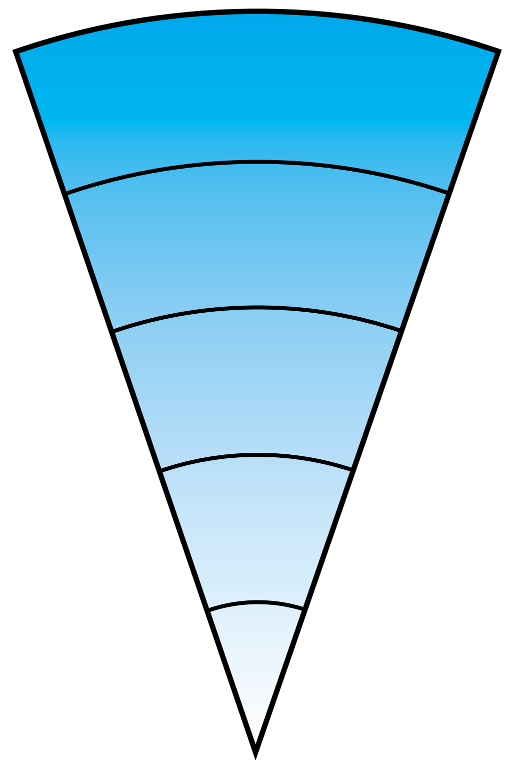
Two different zoning schemes are possible when using the hydrocode LILAC

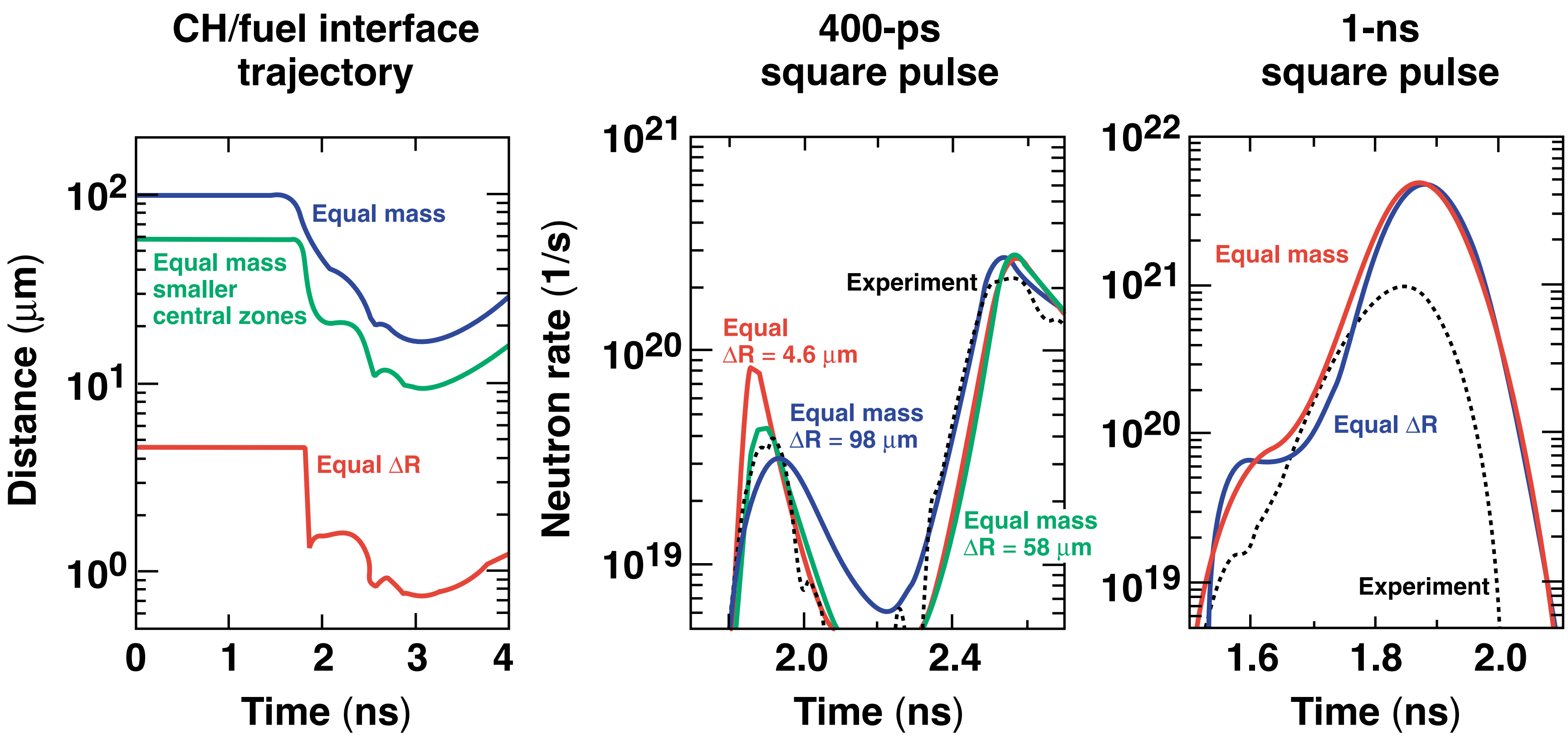
Equal mass zoning



Equal radius zoning



The size of the central zone affects mainly the shock yield for the 400-ps square pulse



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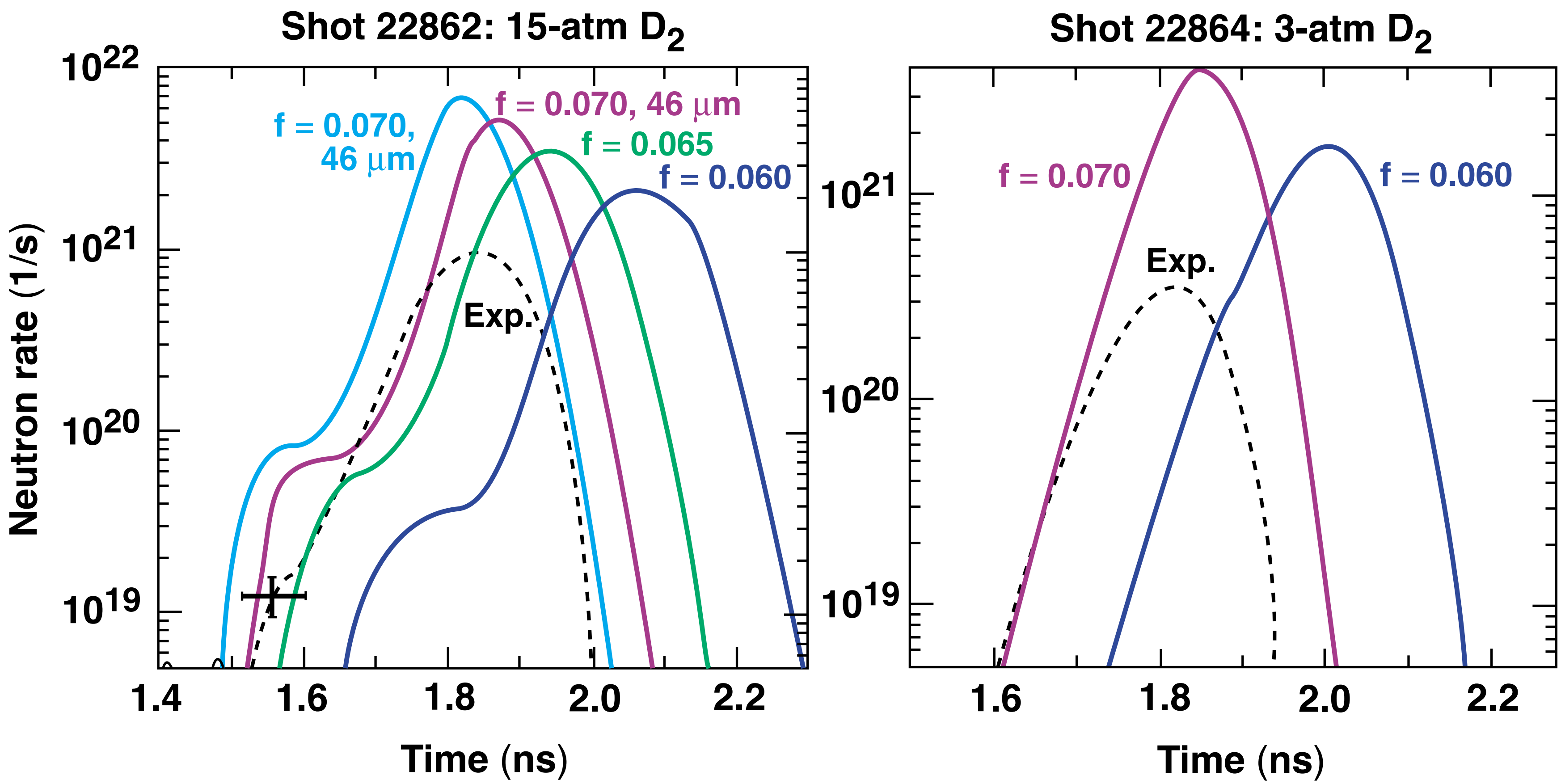
For a 1-ns square pulse and a 20-μm shell, a flux limiter of 0.07 (sharp cutoff) gives the best agreement with experiment for timing of NTD



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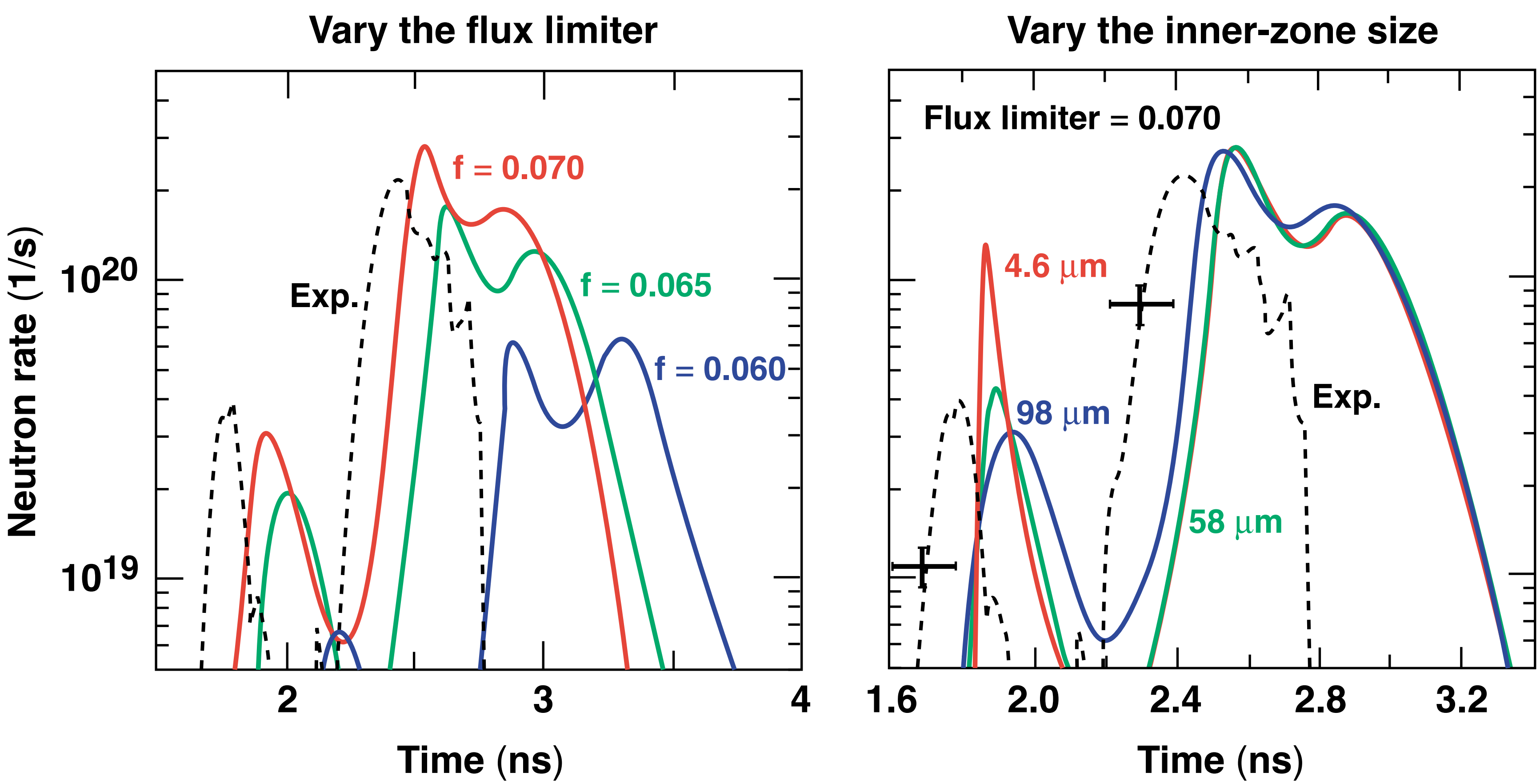
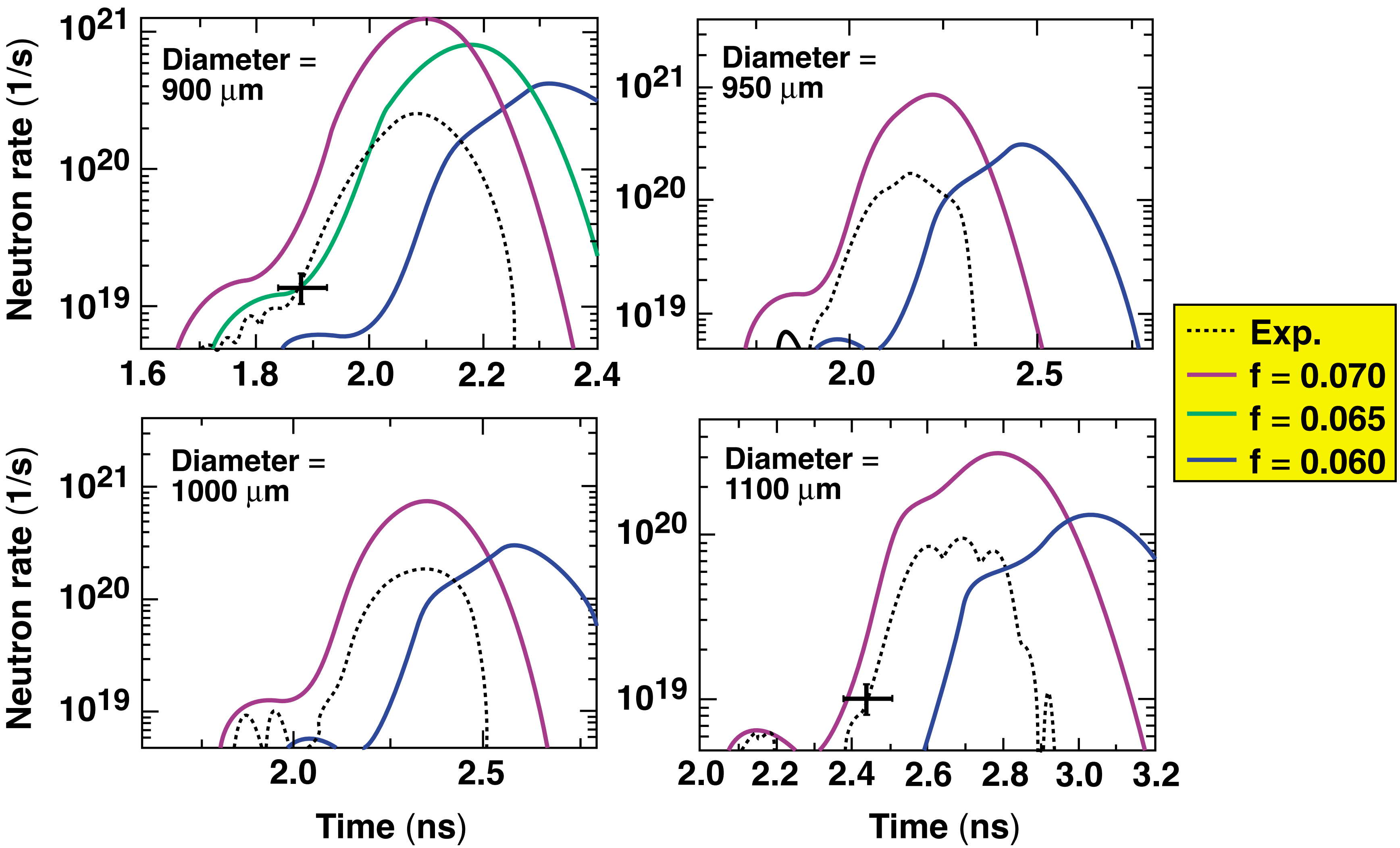
For the 400-ps-pulse case, a flux limiter of 0.070 is not large enough to reproduce the experimental measurement



A flux limiter of 0.070 may be too large for 28-μm-thick shells



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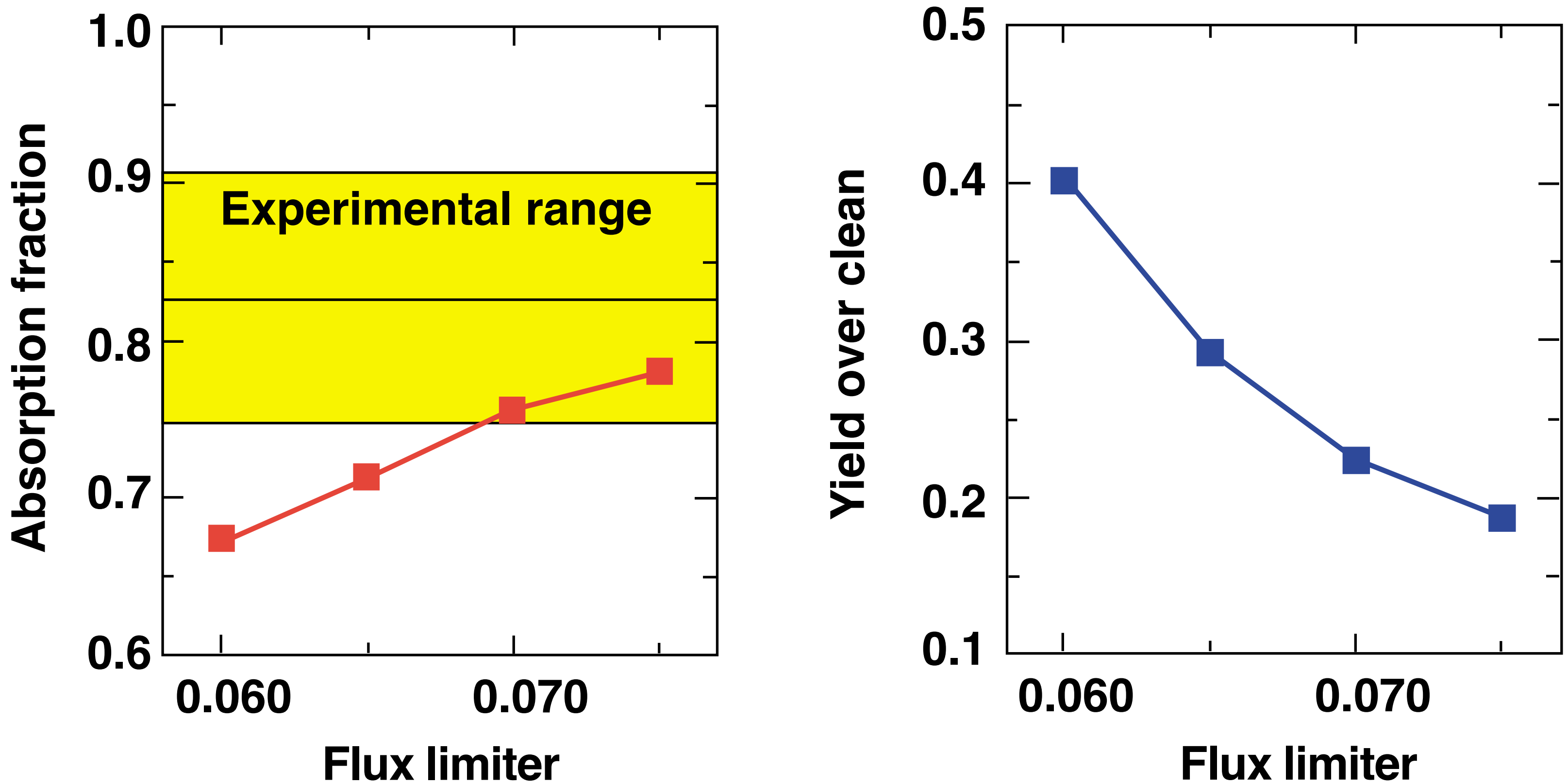
For a 20-μm shell and 1-ns square pulse, increasing the flux limiter brings the absorption fraction into the experimental error range



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Summary/Conclusion

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- Diagnostics are being developed to measure the flux-limiter in crogenic targets.