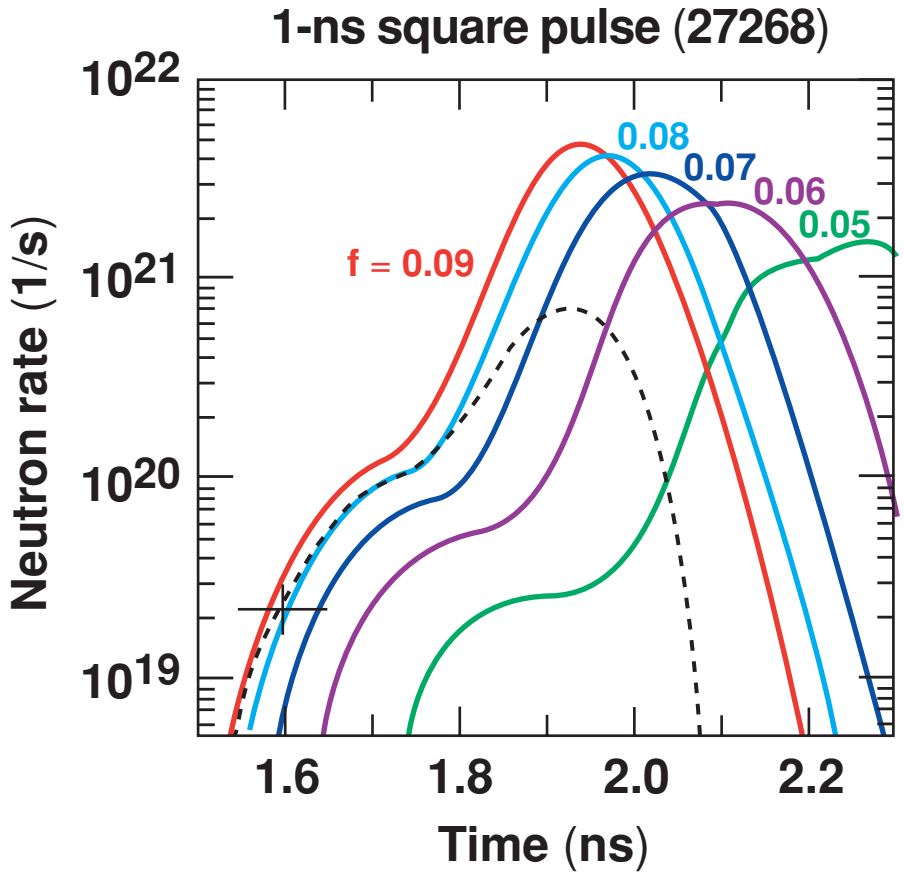
Numerical Investigation of Laser Absorption and Drive Experiments of CH Spherical Shells on the OMEGA Laser



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Summary

Dedicated experiments on the OMEGA laser have measured absorption fraction and implosion timing

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- Neutron temporal diagnostics (NTD) measured the drive efficiency.
- Laser absorption was measured with improved diagnostics.
- The timing and the level of both the shock yield and the onset of the compression yield are sensitive to the flux limiter.
- Absorption measurements require a flux limiter value below 0.06 (harmonic).
- A flux limiter between 0.07 and 0.08 gives general agreement with implosion timing.
- Work is ongoing to reconcile the two results.

The flux limiter affects separately the drive and the laser absorption fraction

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- The flux limiter controls the flow of the absorbed energy into the target and affects
  - the drive through the mass ablation rate and
  - the absorption fraction through the electron temperature in the corona.
- It is active at and inside the critical surface.
- Two methods are used to compute the thermal flux:
  - the sharp cutoff: $Q = \min (Q_{SH}, Q_{FS})$
  - the harmonic mean: $Q = (Q_{SH} Q_{FS})/(Q_{SH} + Q_{FS})$

The laser absorption is modeled in *LILAC* with 2-D ray tracing and classical inverse bremsstrahlung

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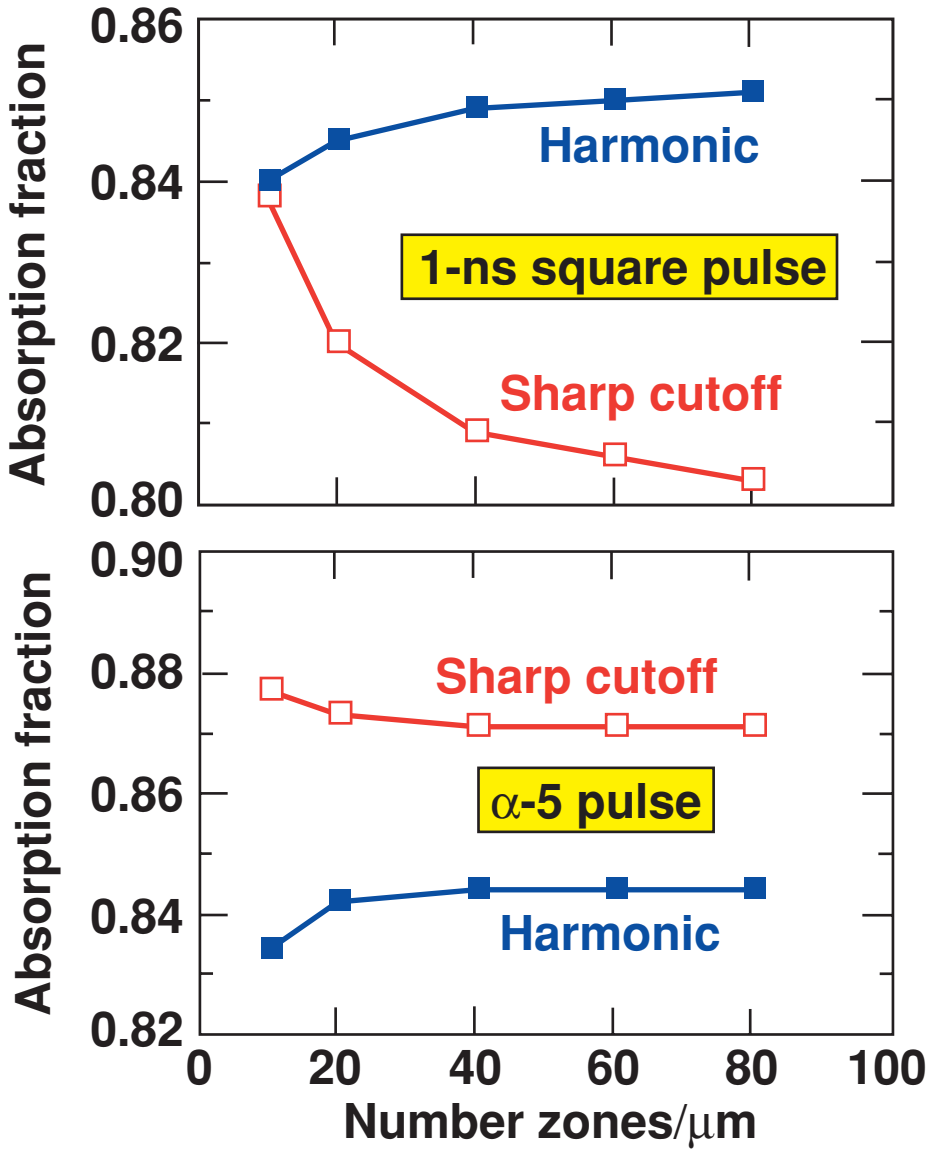
- The ray trace uses the measured DPP spatial distribution, including the effect of SSD and PS.
- The absorption model includes the Langdon effect.
- The density profile at and below the critical surface is zoning dependent.
- The harmonic mean method is less sensitive to zoning than the sharp-cutoff method.



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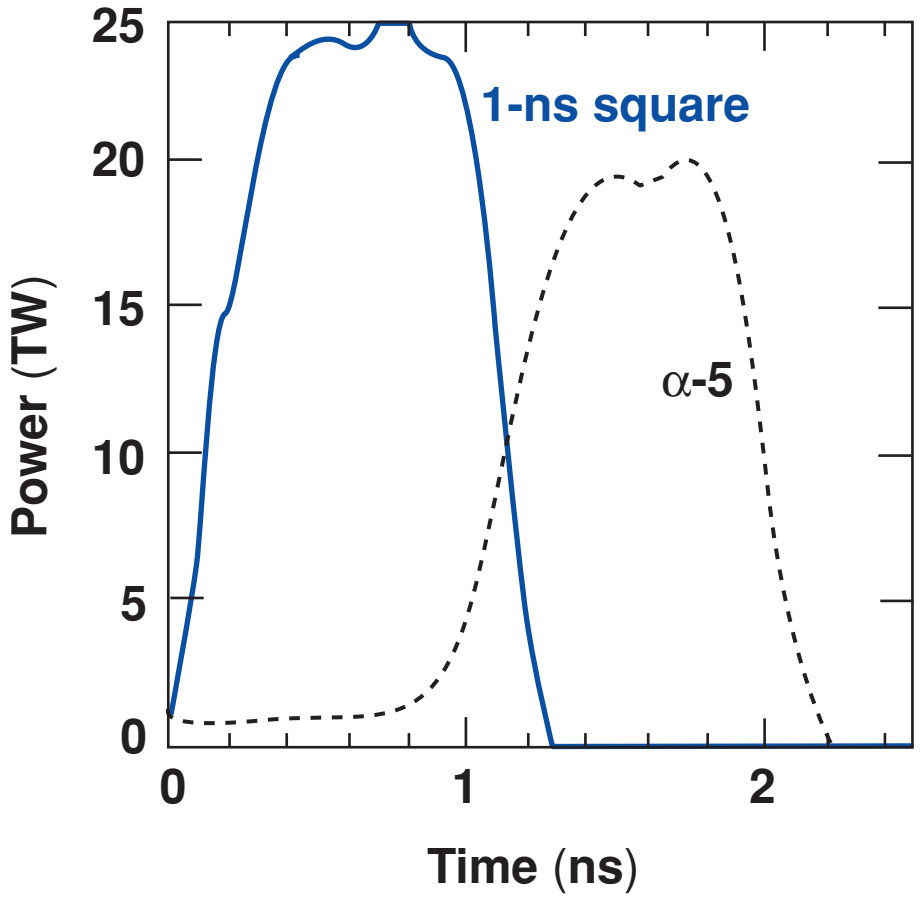
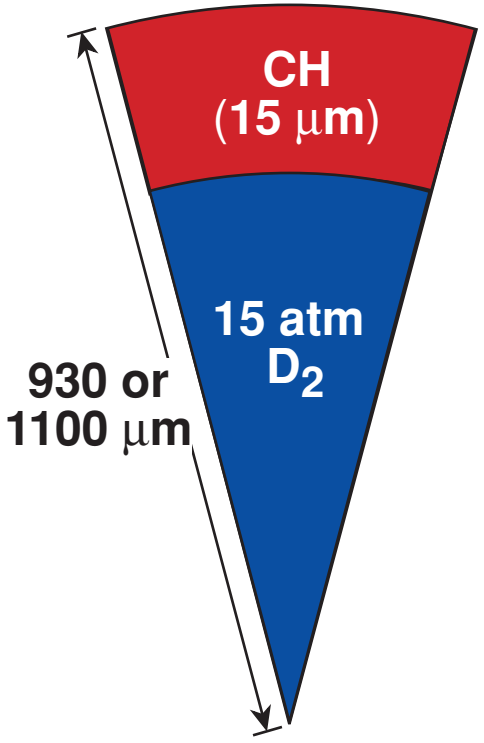
Targets with two different radii were irradiated by two different pulses





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The absorbed energy was measured with two independent diagnostics

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- Two differential plasma calorimeters measure the plasma and scattered light reaching the tank wall (time integrated).
- Two full-aperture backscatter stations (FABS, *f*/6) measure the scattered and refracted light through two focusing lenses (time integrated and time resolved).
- Two subsidiary scattered light diagnostics measure the scattered/refracted light between the lenses (time integrated and time resolved).
- The signals from all six calorimeters are very consistent with overall errors estimated at 2% (absolute) from shot to shot.

The measured and simulated absorption fractions show the same trend over a wide range of experimental conditions

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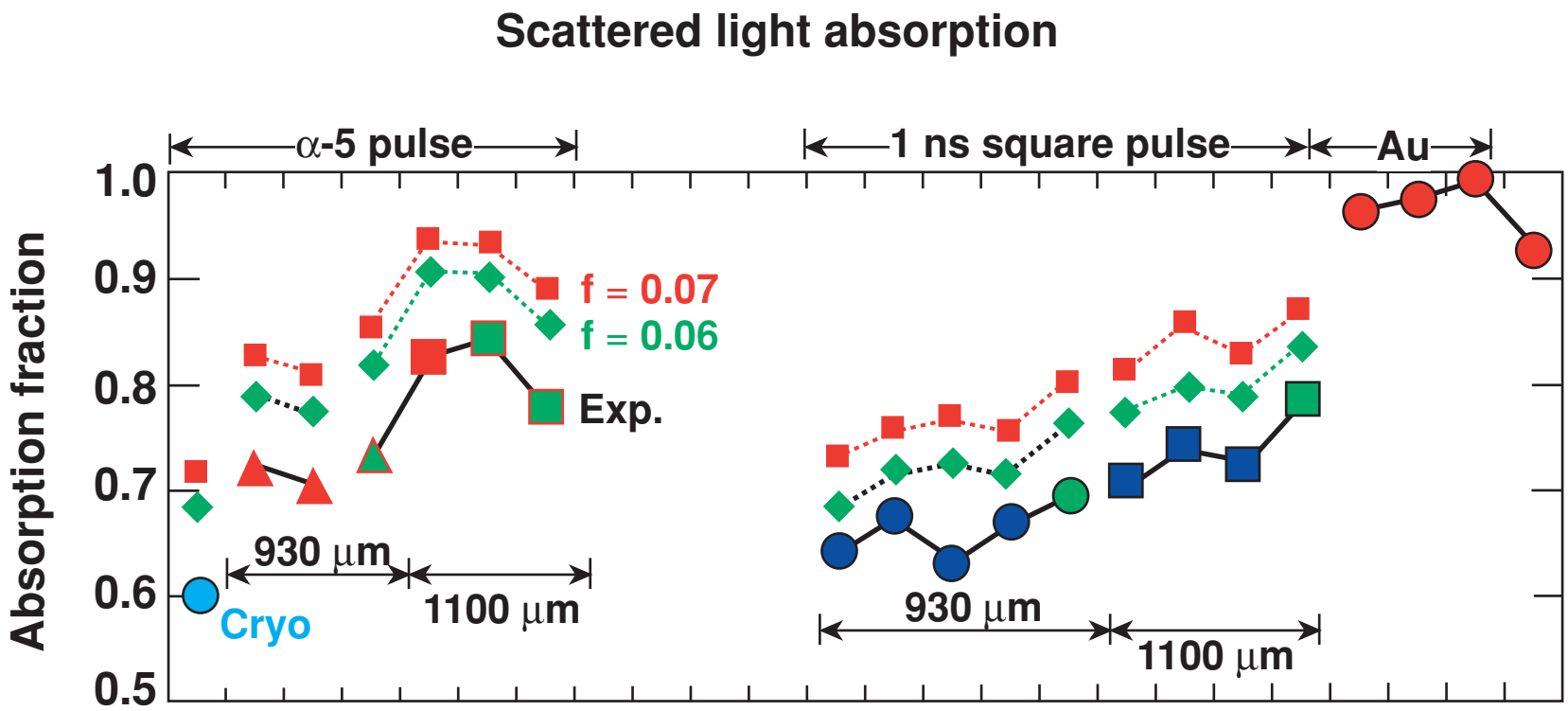

Green fill: CHSi shells
Experimental error bars are size of symbols

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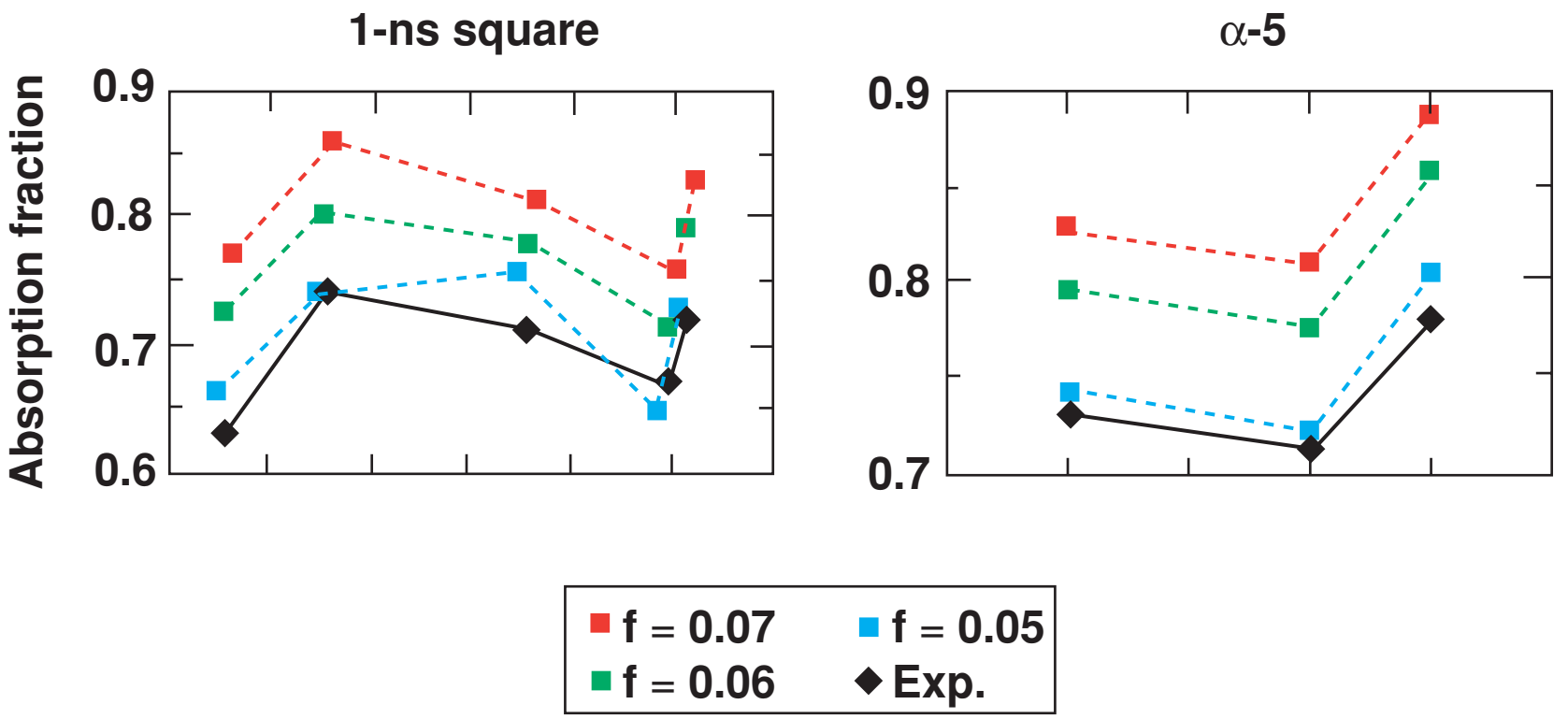
For CH shells *LILAC* needs a low value of flux limiter to match the experimental measurements



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Reconciliation between the results of the absorption and implosion timing is difficult

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- Flux-limiter values between 0.07 and 0.08 are supported by
  - NTD and x-ray timing in the experiments reported here,
  - Ar emission timing in doped-core mix experiments,[1] and
  - Fokker-Plank calculations of the thermal flux.[2, 3]
- Absorption measurements agree with a flux limiter below 0.06.
- Time-dependent flux limiter[3] goes the wrong way.
- Many considered scenarios failed because of the coupling between absorbed energy and drive efficiency through the flux limiter.

[1] S. P. Regan *et al.*, Phys. Plasma 9, 1357 (2002).
[2] J. P. Matte *et al.*, Phys. Rev. Lett. 53, 1461 (1980).
[3] A. Sunahara, Bull. Am. Phys. Soc, 46, 181 (2001).

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