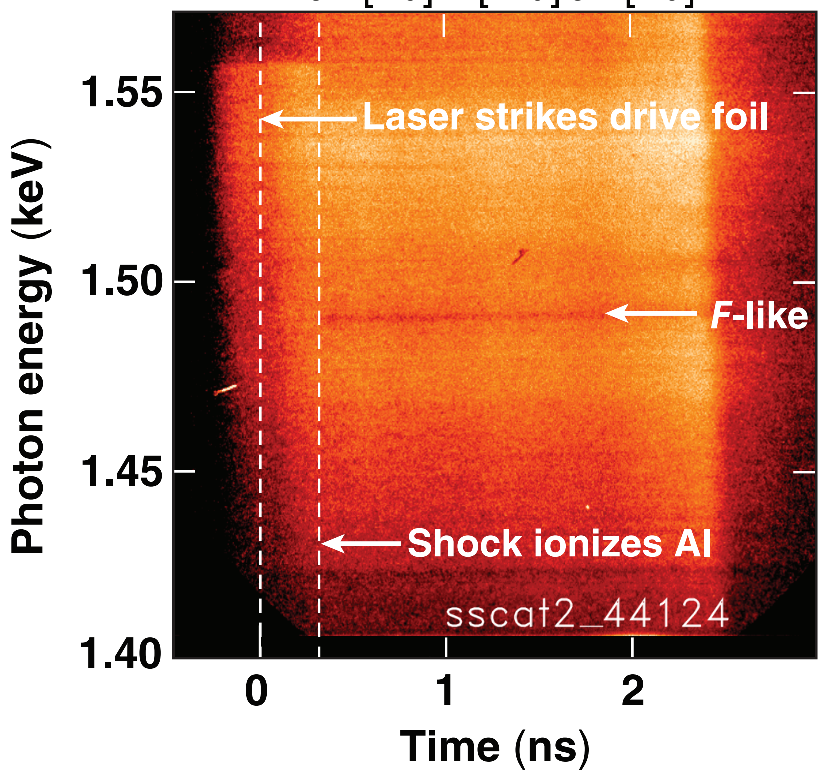
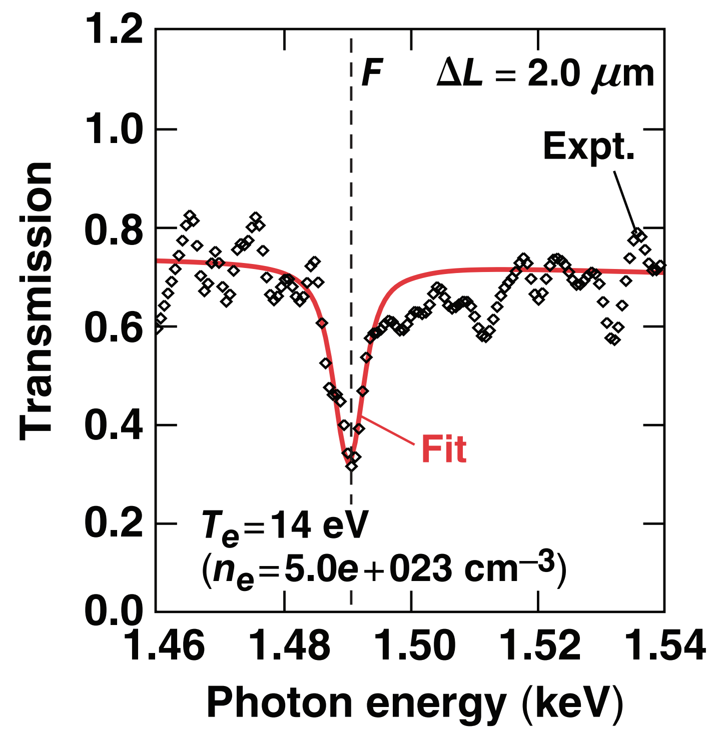
Investigation of Direct-Drive Shock-Heating using X-ray Absorption Spectroscopy

Drive intensity: 1×10^{14} W/cm^2
CH[10]Al[2.0]CH[40]





H. Sawada *et al.*
University of Rochester
Laboratory for Laser Energetics

48th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Philadelphia, PA
30 October–3 November 2006

Summary

Localized T_e measurements of direct-drive, shock-heated conditions are inferred with x-ray absorption spectroscopy

UR LLE

- Plastic targets (50 μm) with a buried tracer layer of Al (0.5 to 2.0 μm) were irradiated with 0.1 to 1.0 $\times$ 10^{15} W/cm^2 on the OMEGA Laser System.
- The measured time-resolved Al 1*s*–2*p* absorption lines were analyzed with a detailed atomic physics code to infer T_e and n_e.
- The inferred T_e's are close to the predictions of a 1-D hydrodynamics code for drive intensities of 1 $\times$ 10^{14} W/cm^2, but are higher than the 1-D predictions for 1.0 $\times$ 10^{15} W/cm^2.

Collaborators

S. P. Regan, R. Epstein, D. Li, V. N. Goncharov, P. B. Radha, D. D. Meyerhofer, T. R. Boehly, V. A. Smalyuk, T. C. Sangster, and B. Yaakobi

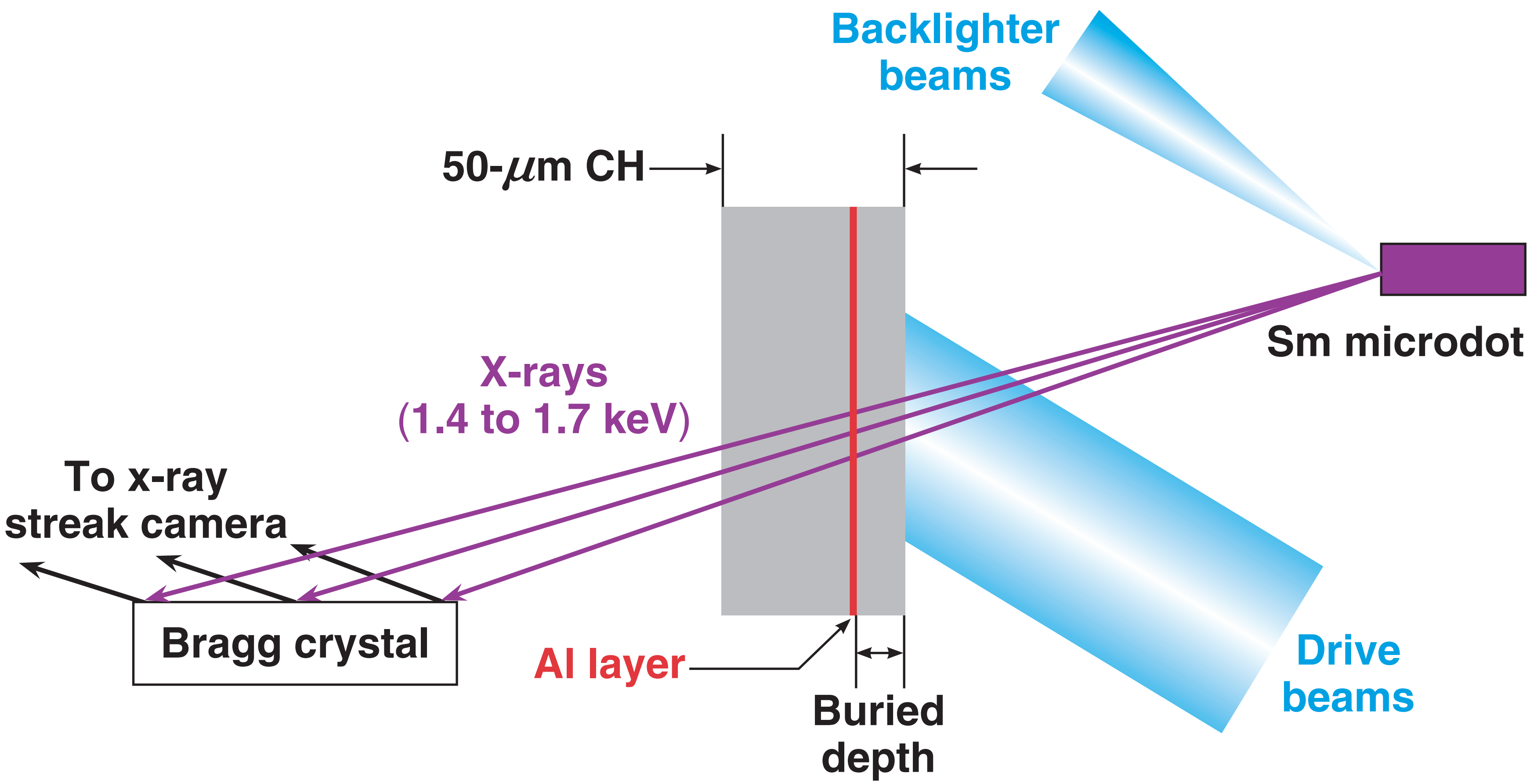
Laboratory for Laser Energetics
University of Rochester

R. C. Mancini

University of Nevada
Reno

Related talks: R. Epstein – ZO1.0005
S. P. Regan – RI1.00001

X-ray absorption spectroscopy of a CH planar target with a Al tracer layer was performed with a Sm backlighter

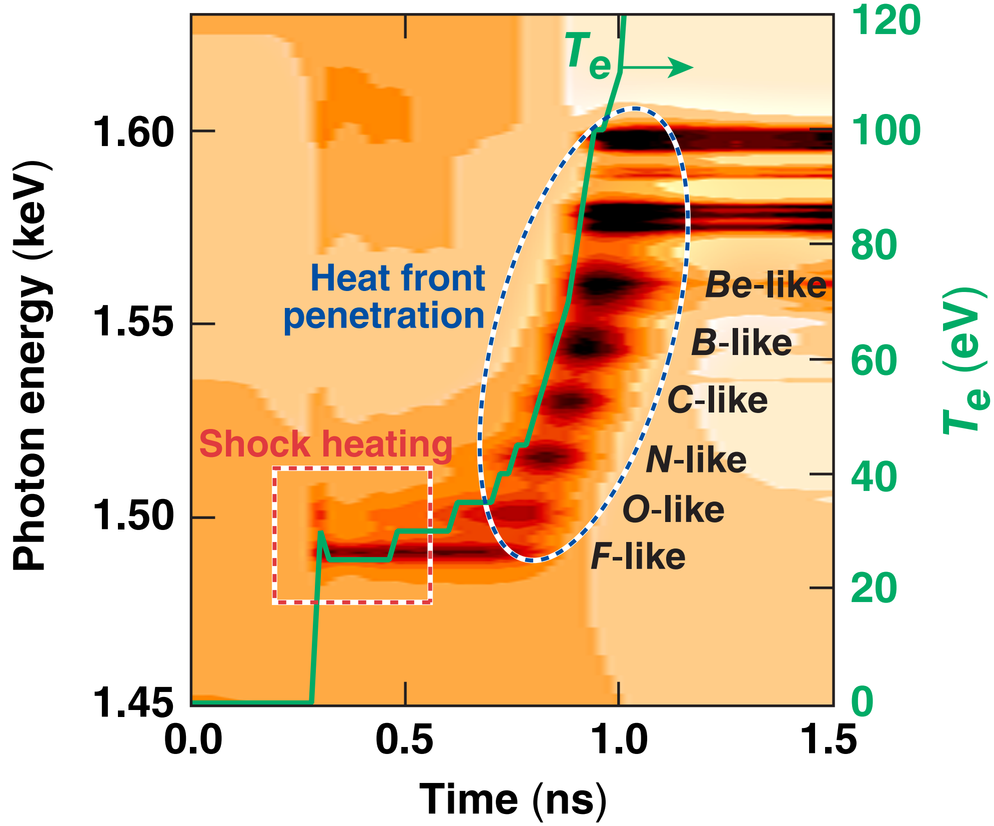


Background x-ray continuum emission from CH plasma is subtracted from the transmitted spectrum.

E14880a

Higher charge states of Al are ionized in succession and absorbed in 1*s*–2*p* transitions as the T_e increases

***LILAC*/Spect3D* simulated 1*s*–2*p* absorption spectra**

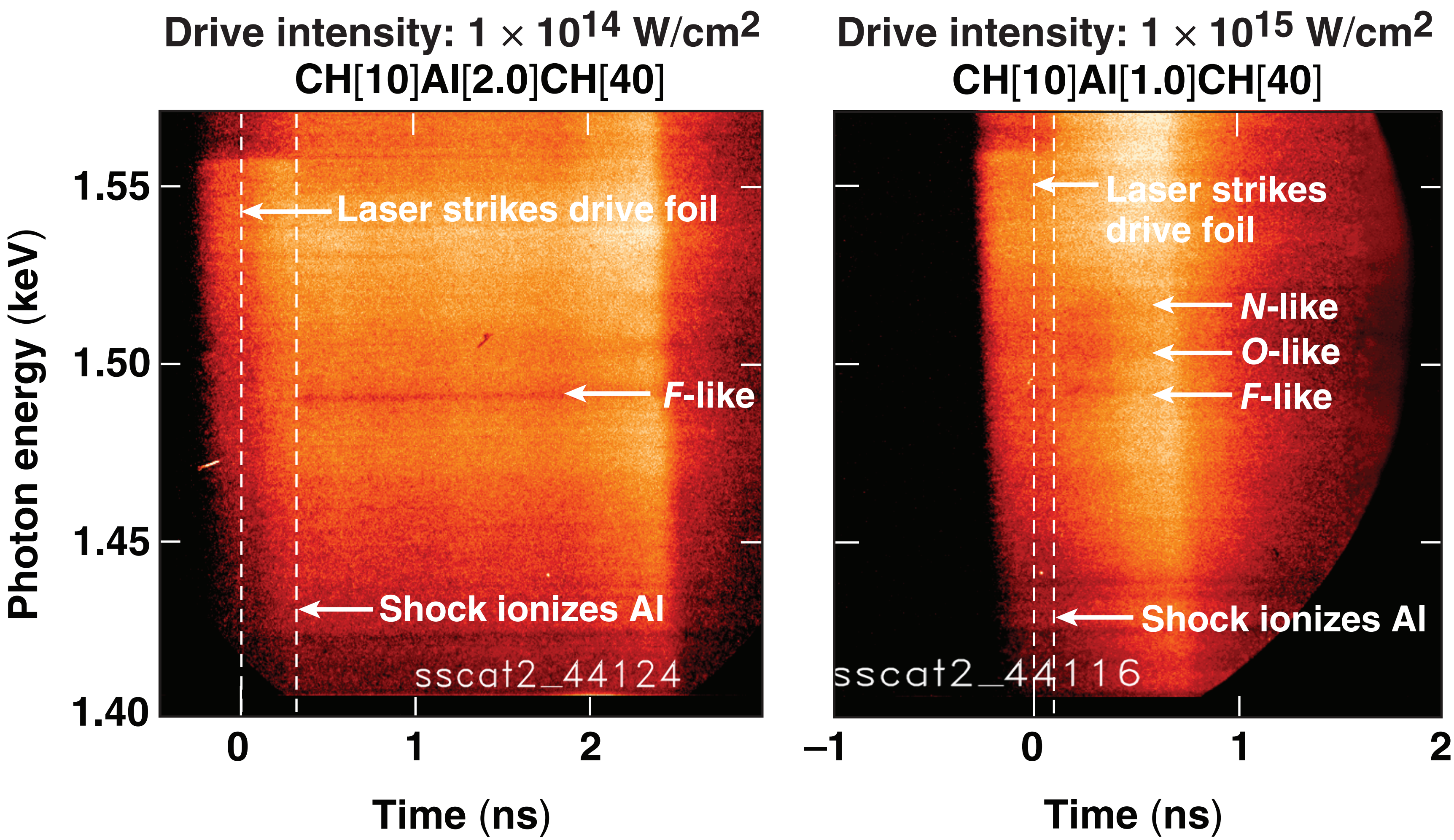


- n_e can be inferred from the Stark-broadened absorption lines for $n_e > 10^{23}$ cm^{-3}

E15228a

*Prism Computational Sciences Inc., Madison, WI 53711

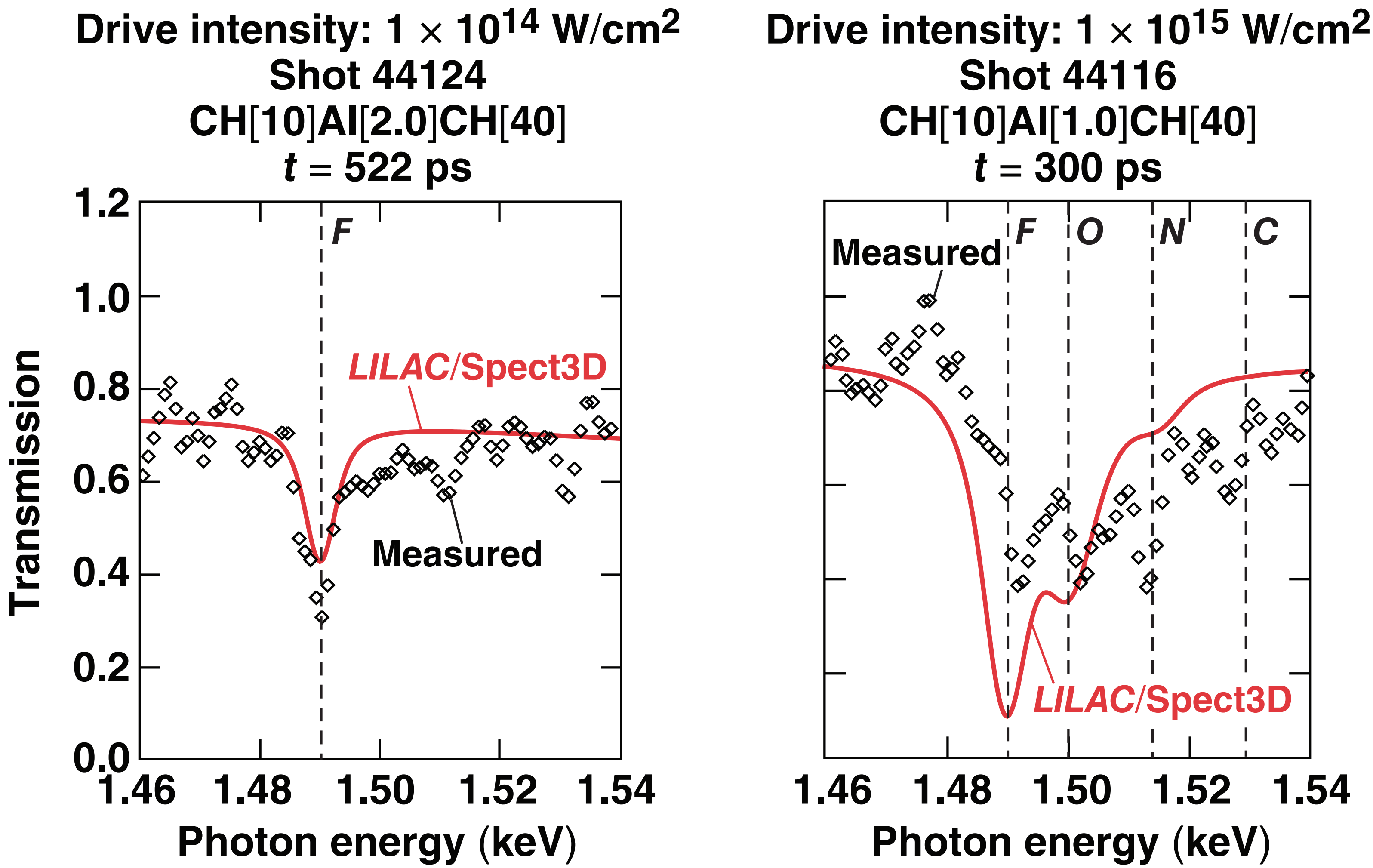
Significant changes are observed in the Al 1*s*–2*p* absorption spectra as the drive intensity is increased



E15202

Absorption spectra predicted with *LILAC*/Spect3D are close to measured spectra for the lower drive intensity

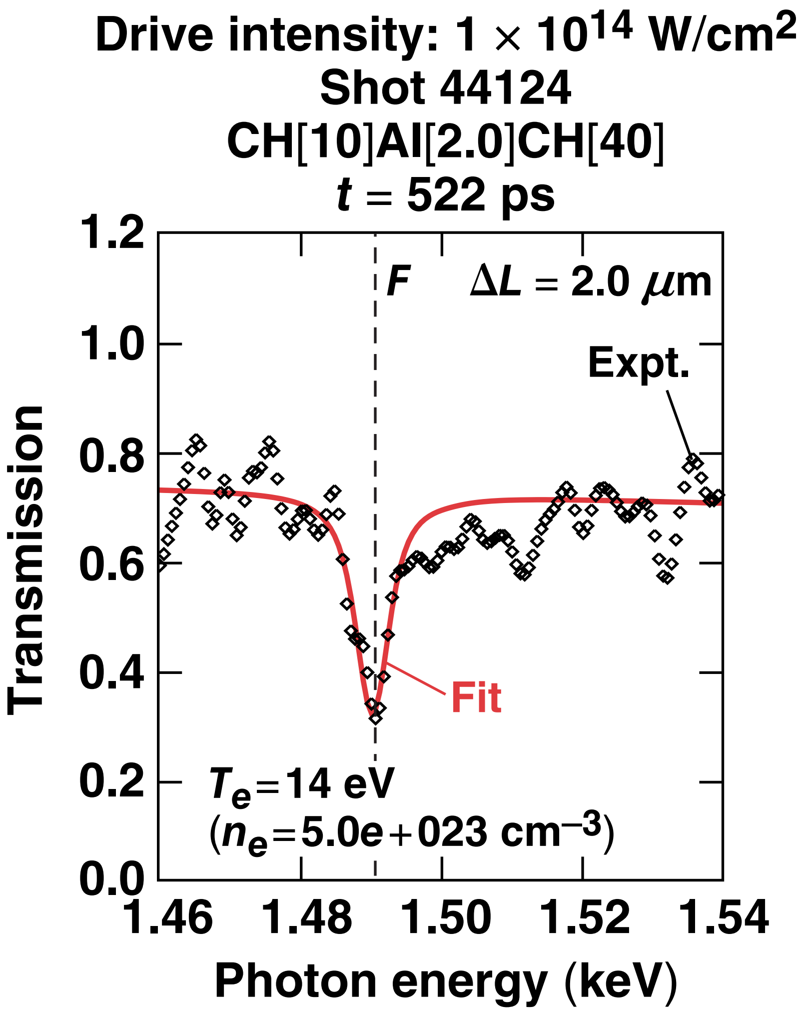
UR LLE



Spectra with 1 × 10^{15} W/cm^2 drive indicate a higher T_e than the 1-D prediction.

E15180

Measured spectra were fit with PrismSpect to infer T_e and n_e assuming uniform plasma conditions



PrismSpect inputs

- T_e
- n_i or ρ
- $\rho\Delta L$ (constant in 1-D)

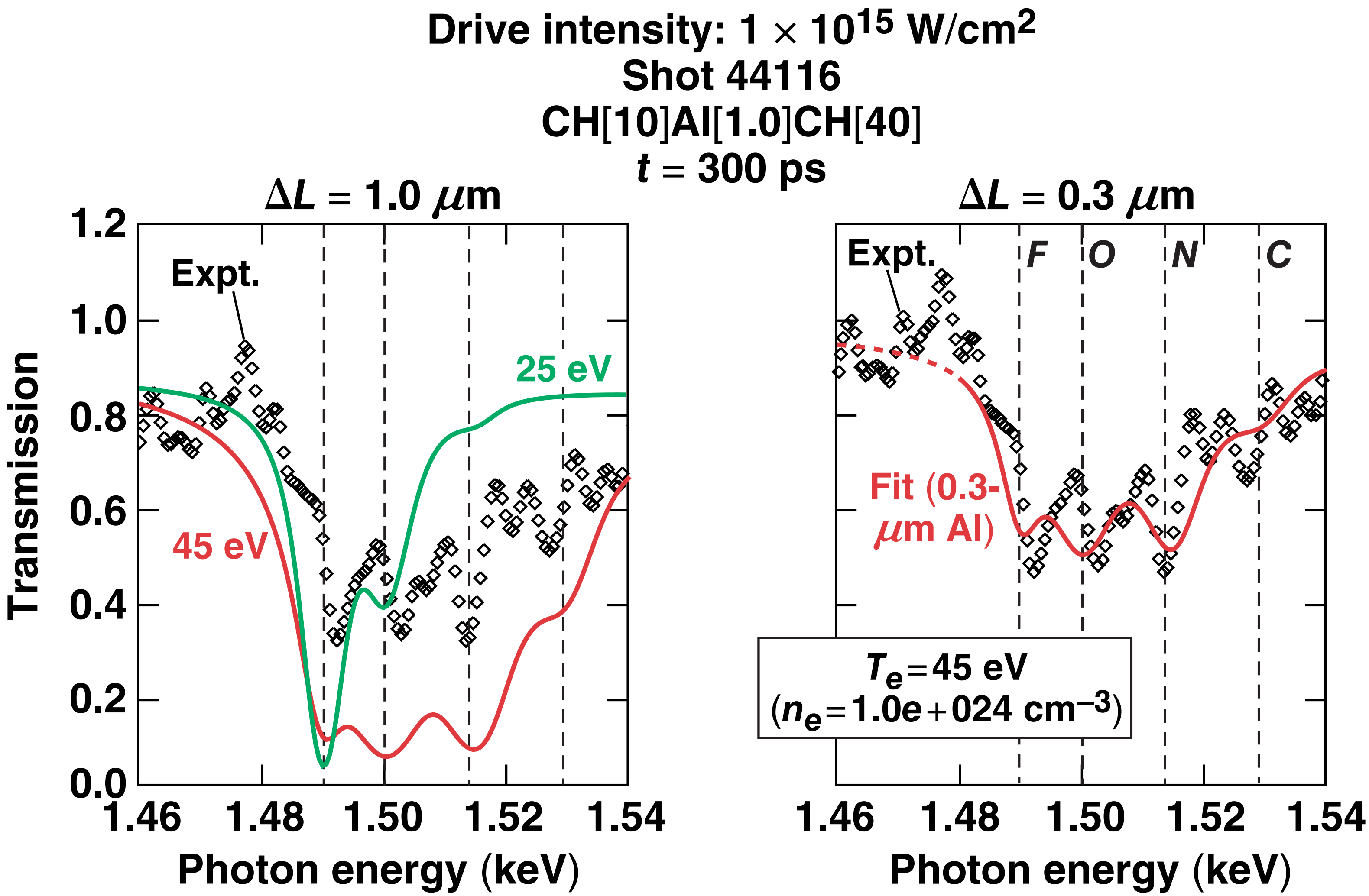
Transmission spectrum

$$T(\nu) = \exp\left[-\kappa(\nu, n_e, T_e)\,\rho\Delta L\right]$$

Absorption coefficient

E15181

The measured opacities were lower than calculated for the drive intensity of 1×10^{15} W/cm^2

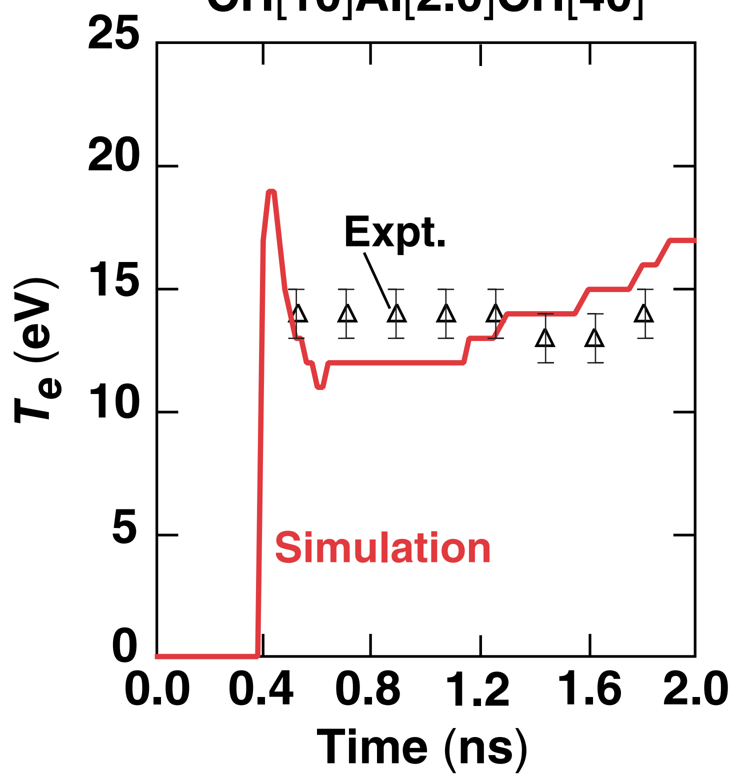


- Reducing the thickness of the Al layer has a negligible effect on the T_e inference.

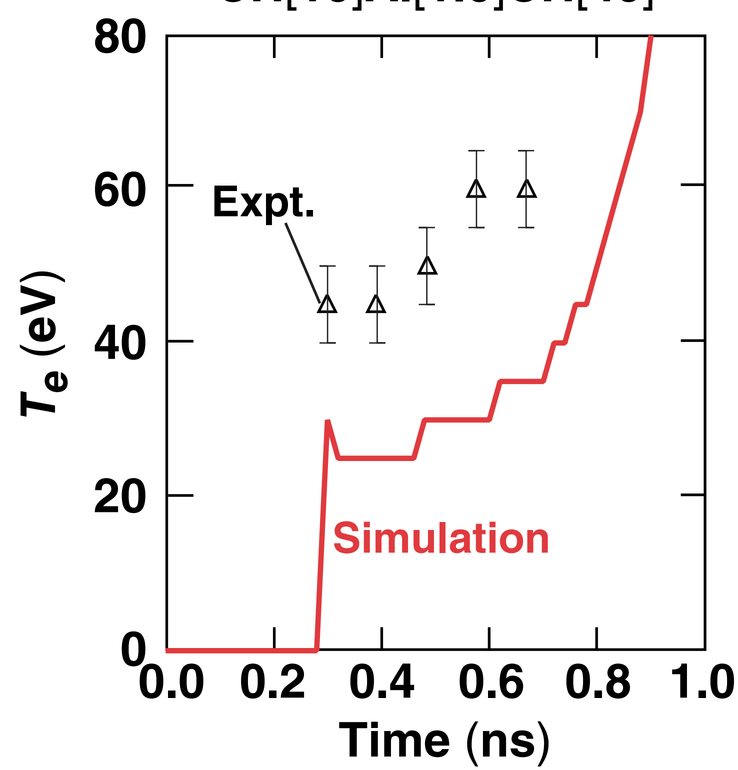
E15182

The inferred T_e is close to the 1-D prediction for the drive intensity of 1×10^{14} W/cm^2

Drive intensity: 1×10^{14} W/cm^2
Shot 44124
CH[10]Al[2.0]CH[40]



Drive intensity: 1×10^{15} W/cm^2
Shot 44116
CH[10]Al[1.0]CH[40]



- The inferred T_e is ~20 eV higher than the 1-D prediction for the drive intensity of 1×10^{15} W/cm^2

Summary/Conclusions

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