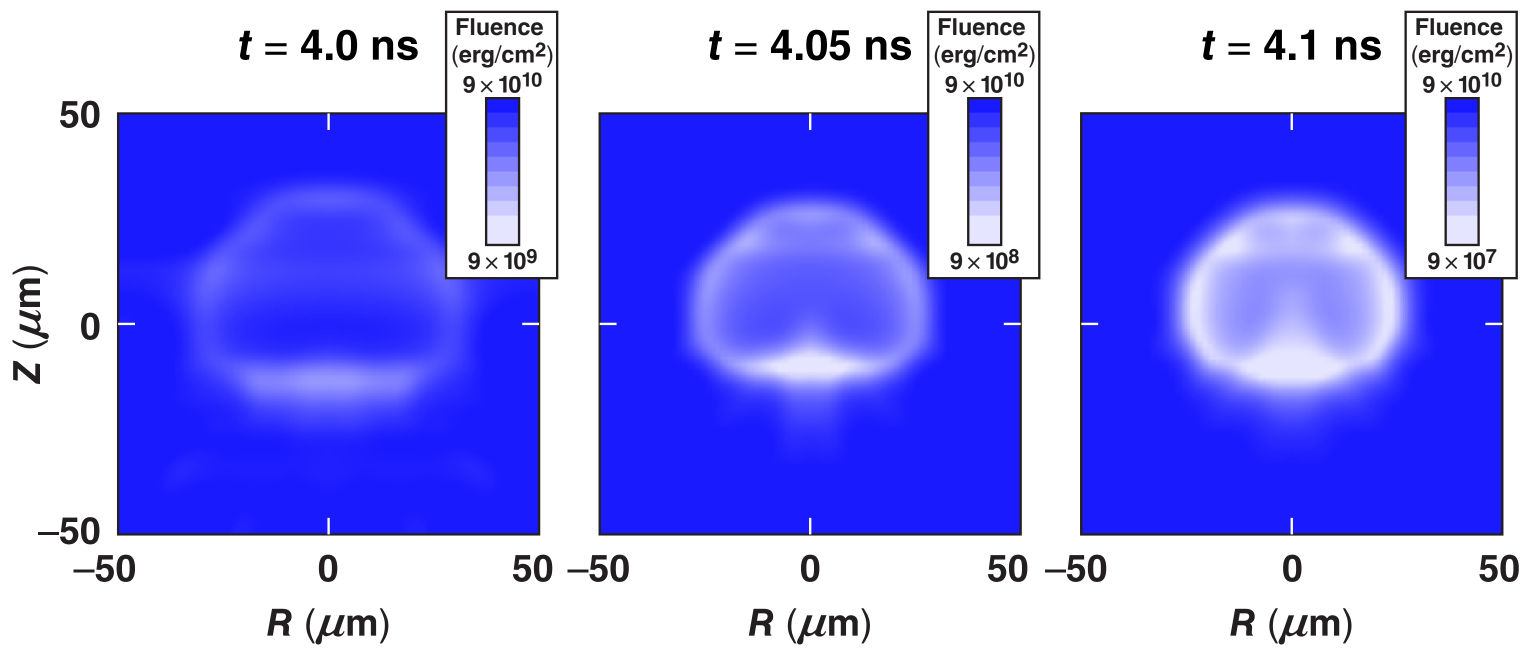
Simulation and Optimization of Backlit Imaging of Cryogenic Implosions on OMEGA

Shot 47206: 10-μm shell, 95-μm cryo D_2. $\langle \rho R \rangle_p$ = 202 mg/cm^2
Simulated Al Lyα radiographs: 30-ps, 10-eV, 5-μm resolutions



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Summary

Emission-line backlighter sources driven by OMEGA EP will provide useful images of cryogenic shells imploded on OMEGA

UR LLE

- Simulated images of multidimensional cryogenic implosions demonstrate a minimum backlighter intensity for resolving shell structure, corresponding to a brightness of T_{rad} = 500 eV.
- The measured backlighter fluence is an order of magnitude higher than this minimum.
- Simulations of backlighters and radiographs are based on quantitative atomic physics and radiative transport.

TC8266

Collaborators

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Related talks: F. J. Marshall (NO5.00001)
A. Shvydky (TO5.00007)

Radiographs measure the mass-density structure of imploded cryogenic shells

- **A backlight brightness of T_{rad} = 500 eV is needed to exceed the implosion self-emission.**

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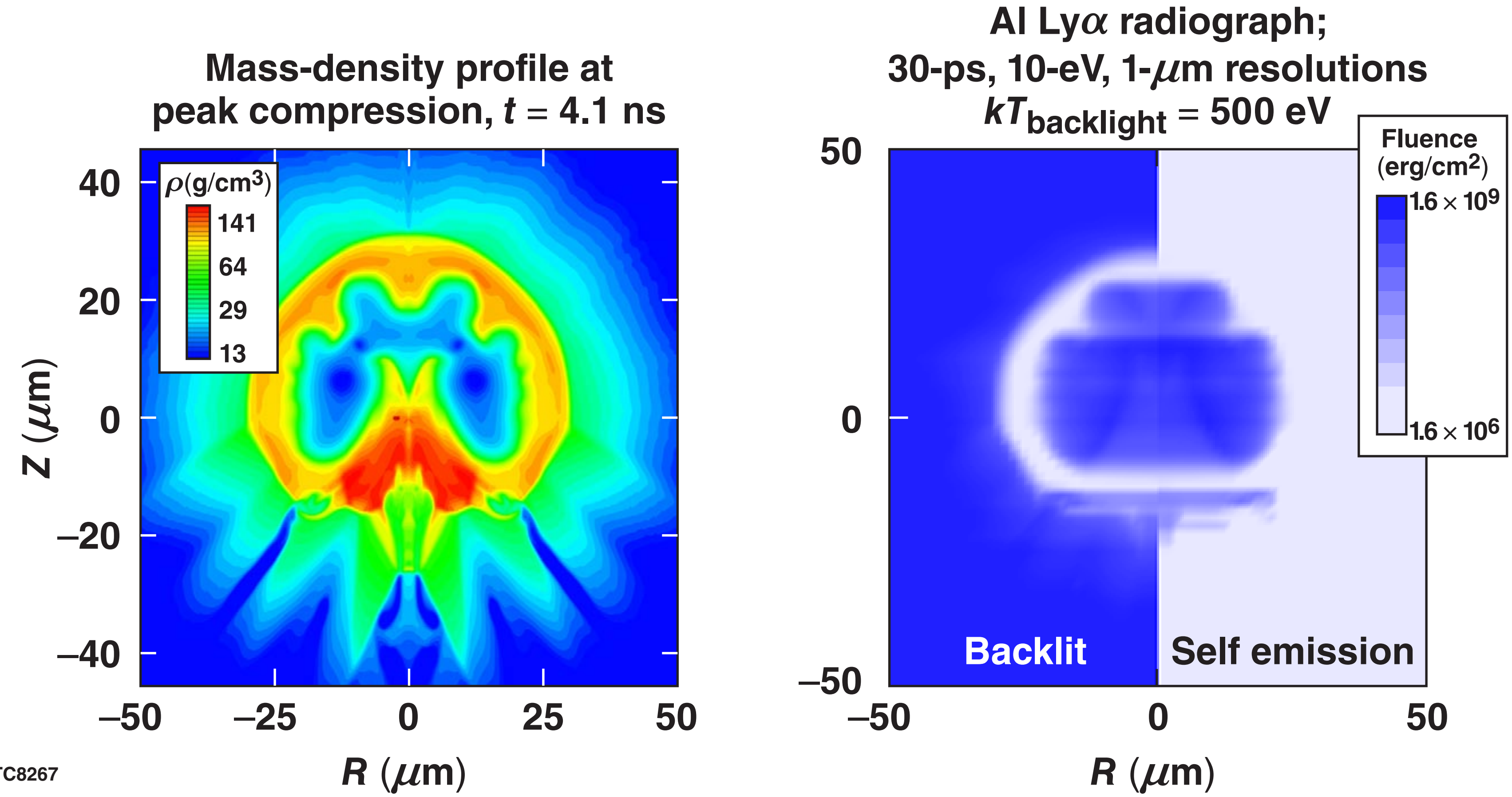

TC8267

The attenuation of aluminum K-shell backlighter lines by compressed cryogenic shells is appropriate for radiography

UR LLE

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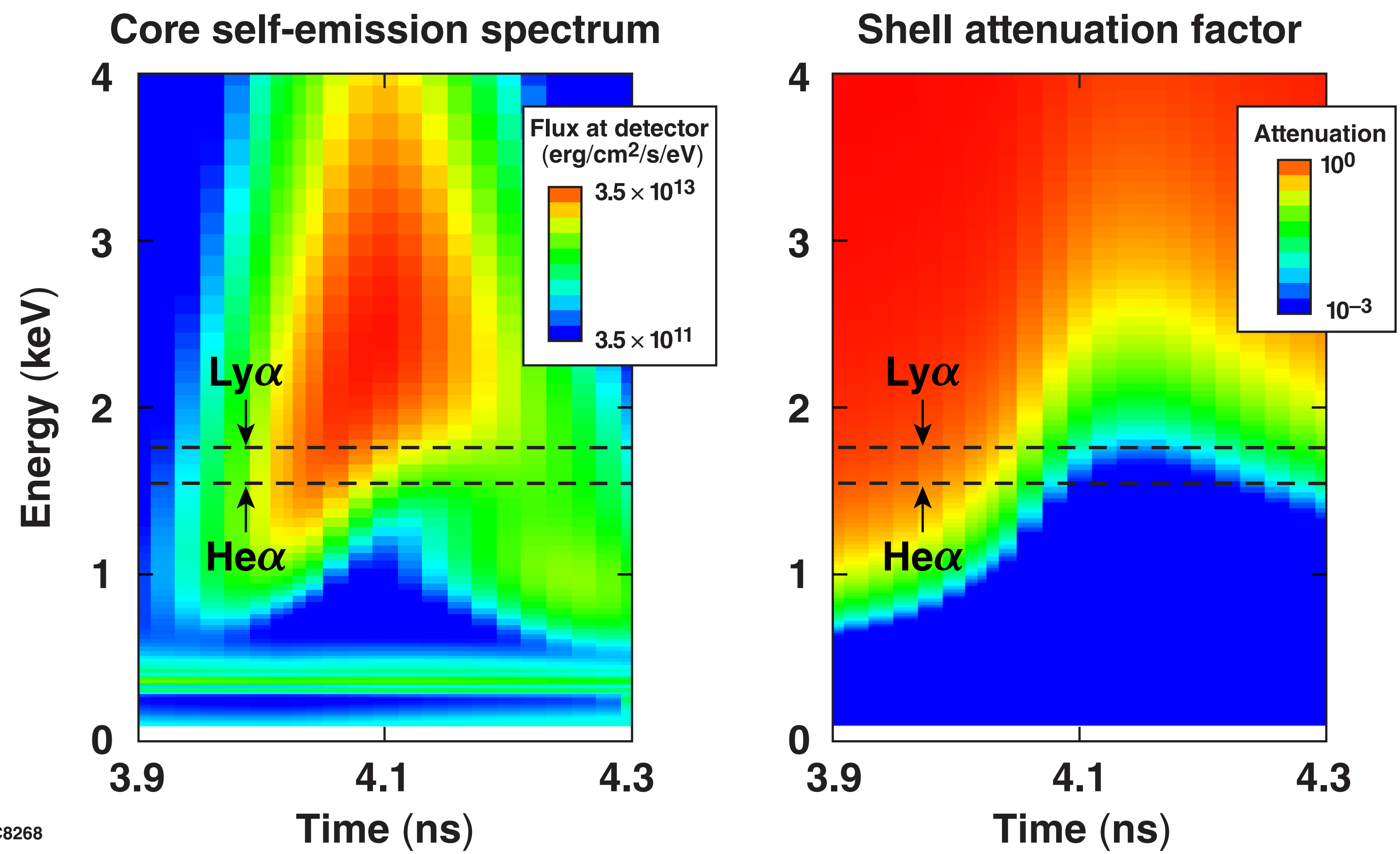


TC8268

The simulation of cryogenic-implosion radiographs employs several codes

- *LILAC* simulates the hydrodynamics of the short-pulse foil targets.
  - High-intensity absorption and fast-electron transport are included.
  - Hydrodynamics in 1-D is a significant limitation.

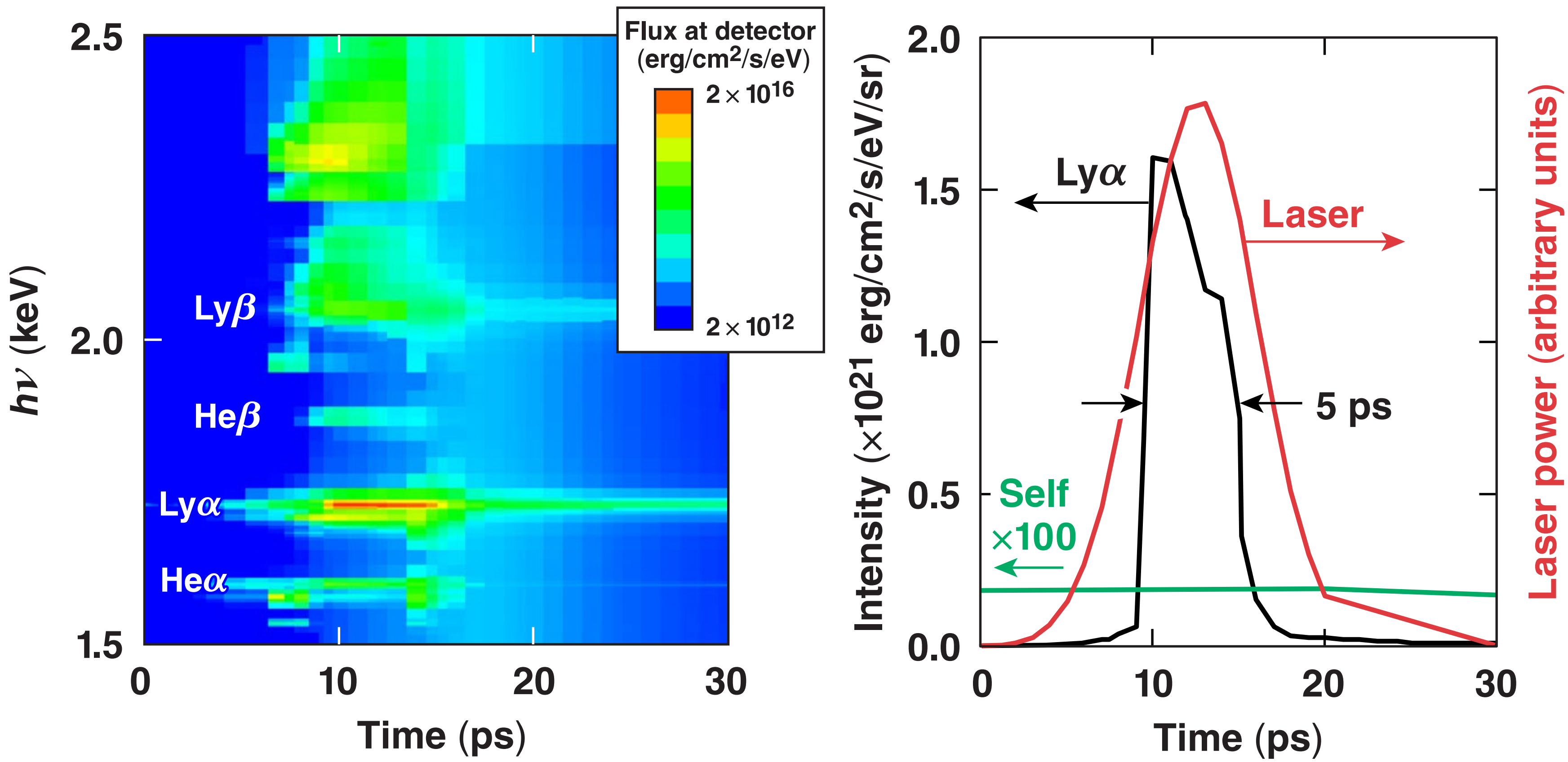
- Cryogenic target implosions are simulated in 2-D by *DRACO*, including the effects of target offset and irradiation nonuniformity.

- Backlight emission and implosion radiography are simulated by *Spect3D*.*
  - Radiation transport is solved using opacity and emissivity obtained from detailed atomic modeling.
  - Time-dependent atomic-level kinetics includes self-consistent photoexcitation.

*Prism Computational Sciences, Inc., Madison, WI.

Simulated line emission follows the laser pulse

1×10^{18} W/cm^2, 8-ps pulse on 10-μm Al, planar *LILAC/Spect3D*



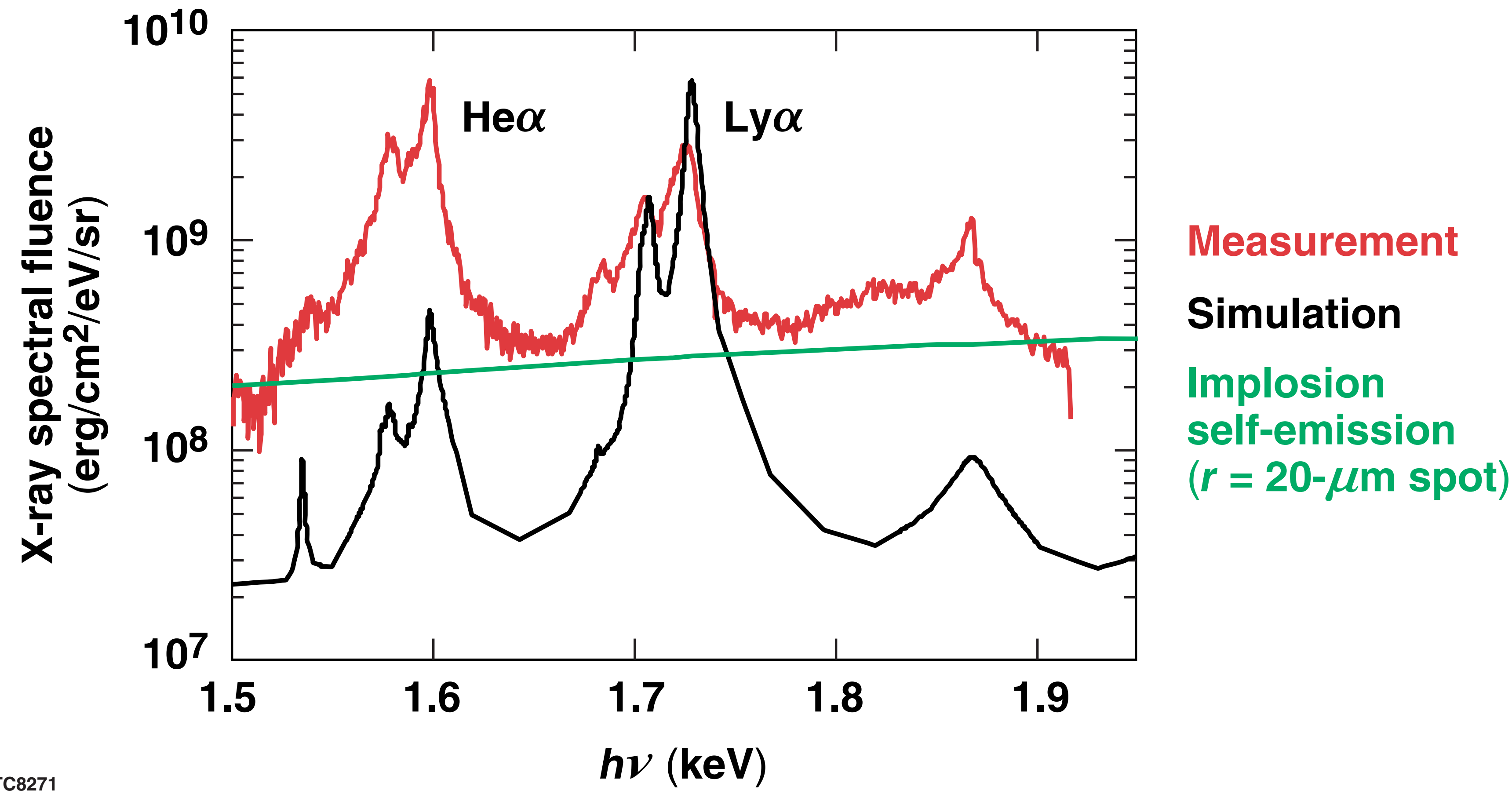
Self-emission from within
a r = 20-μm spot

TC8270

Simulated backlighter fluence is comparable to values inferred from time-integrated measurements

Simulation: 5×10^{17} W/cm^2, 8-ps pulse on 10-μm Al, planar *LILAC/Spect3D*

OMEGA EP shot 3732: 200 J, 1.25×10^{18} W/cm^2, 8-ps pulse on 10-μm Al foil



TC8271

Radiograph contrast is adequate over a limited interval of time near peak compression

Simulated Al Lyα radiographs: 30-ps, 10-eV, 5-μm resolutions

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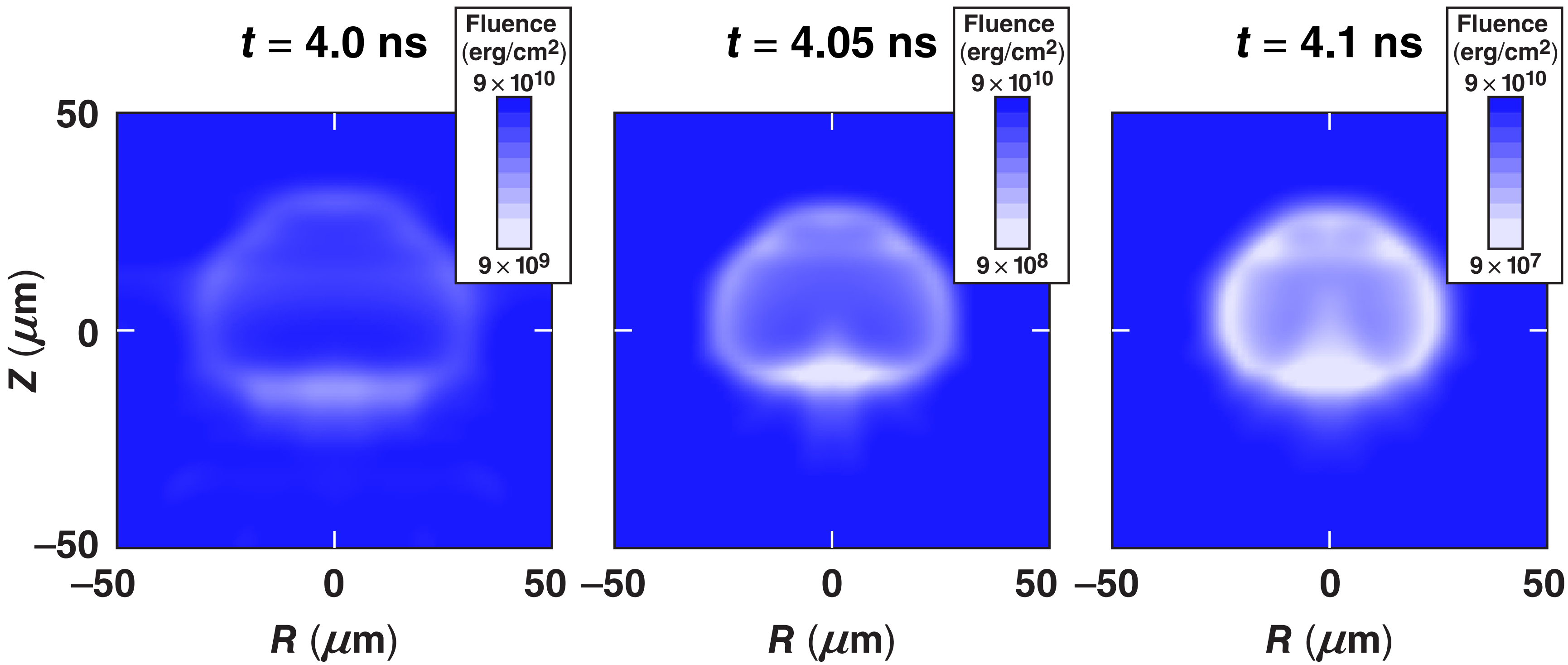
Simulated Lyα backlighter



TC8272

Summary/Conclusions

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