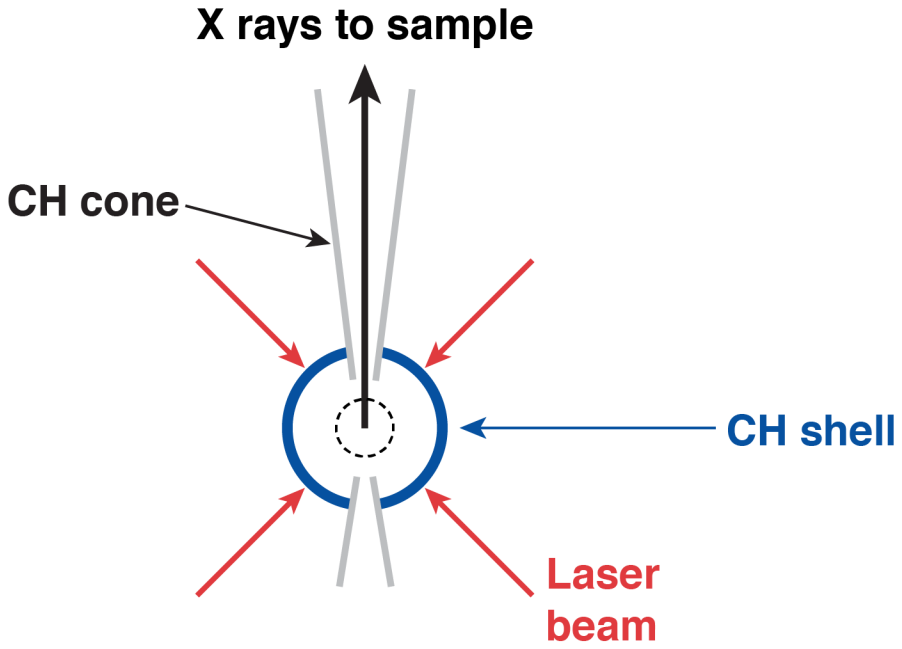
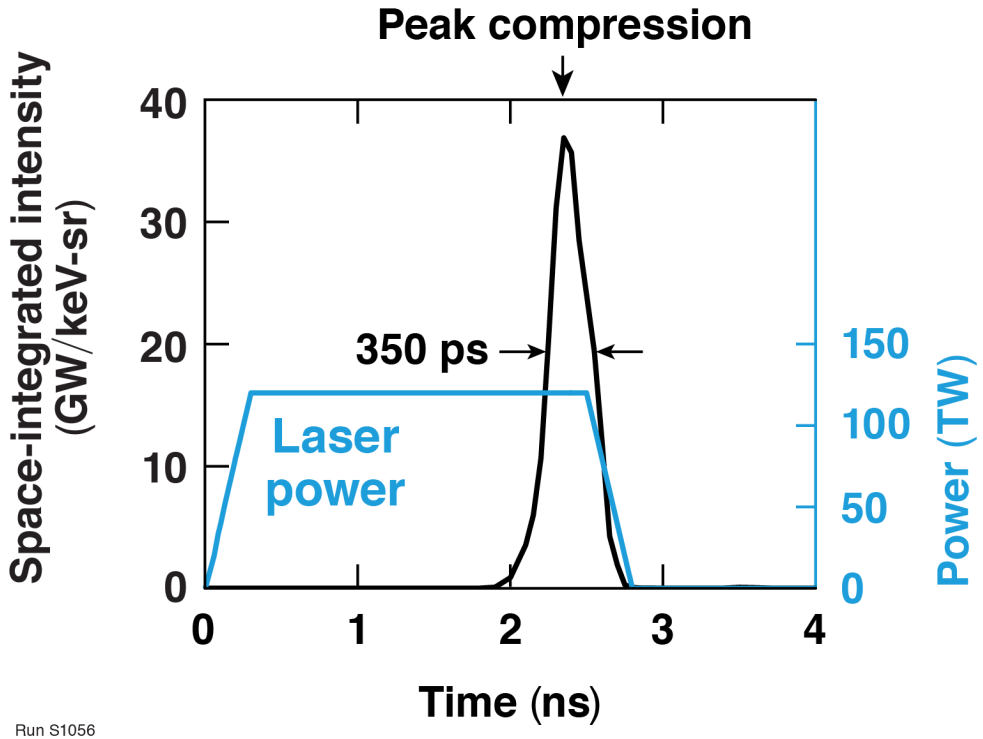
Simulations of Double Cone-in-Shell Implosions for an X-Ray Backlighting Source at the National Ignition Facility



TC14787a



Run S1056
TC15100

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61st Annual Meeting of the
American Physical Society
Division of Plasma Physics
Fort Lauderdale, FL
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Summary

A double cone-in-shell target is being investigated to provide a short-pulse source of x rays for opacity measurements

- The 2-D hydrodynamics code *SAGE* and a new x-ray diagnostic code *ORION* have been used to develop target designs
- Closure of the cone just after implosion time is needed to prevent hot, radiating plasma from escaping through the cone
- Predictions for x-ray yield generally agree with experiment to better than a factor of 2 for
  - a shot without cones
  - a shot with cones

Collaborators

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University of Rochester
Laboratory for Laser Energetics
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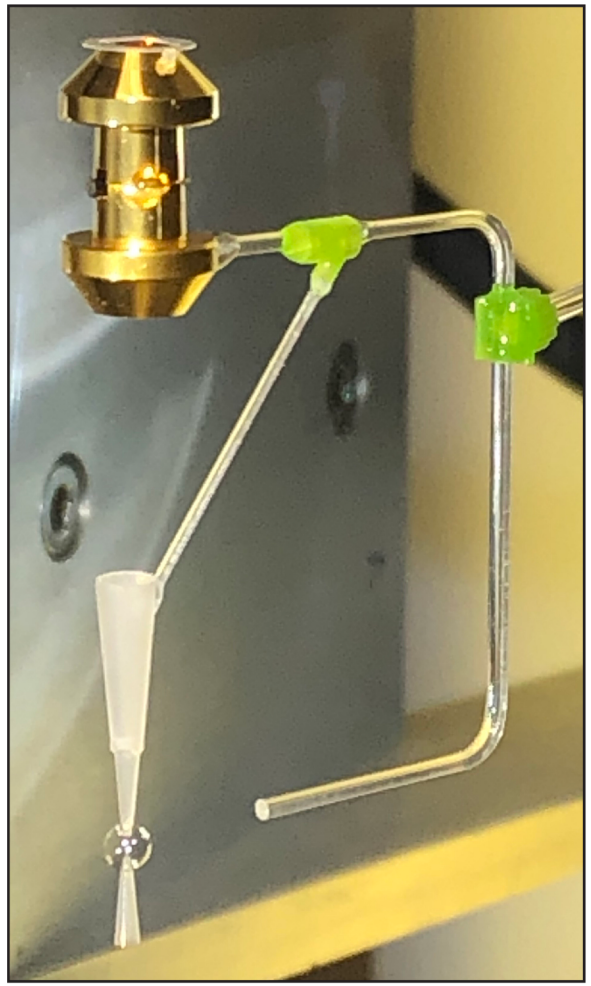
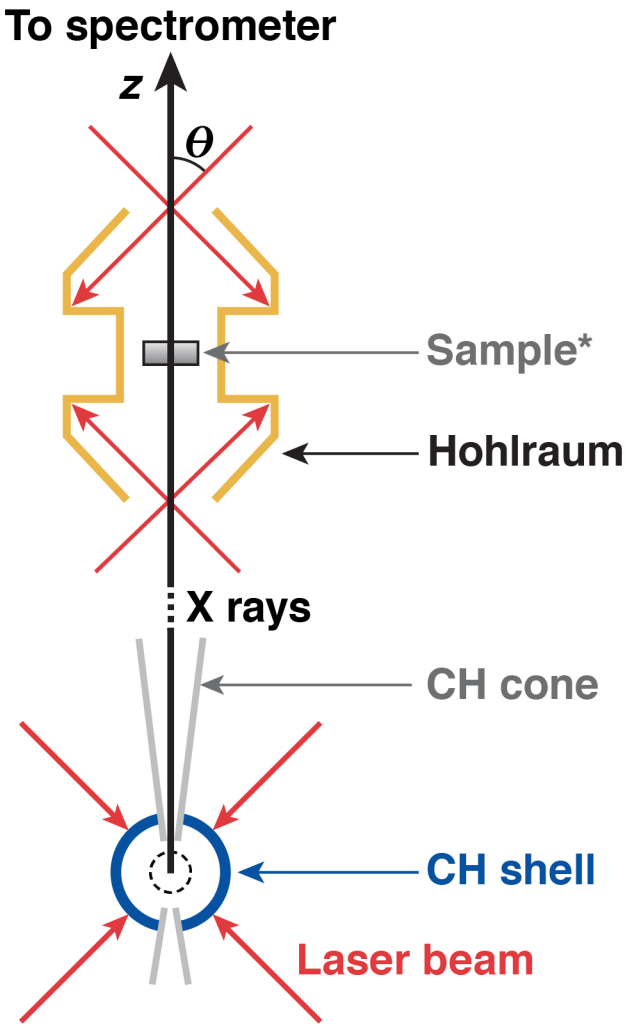
Lawrence Livermore National Laboratory

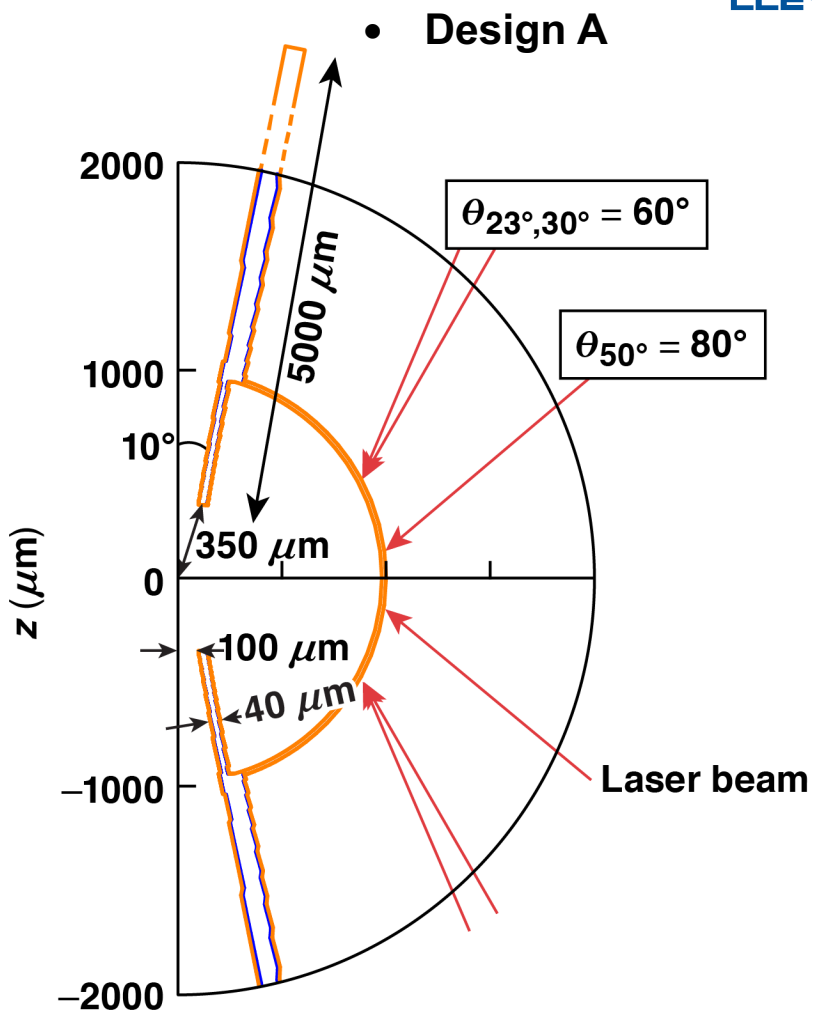
T. Cardenas, H. M. Johns, and T. S. Perry
Los Alamos National Laboratory

Various designs have been modeled for the double cone-in-shell target



TC14787b

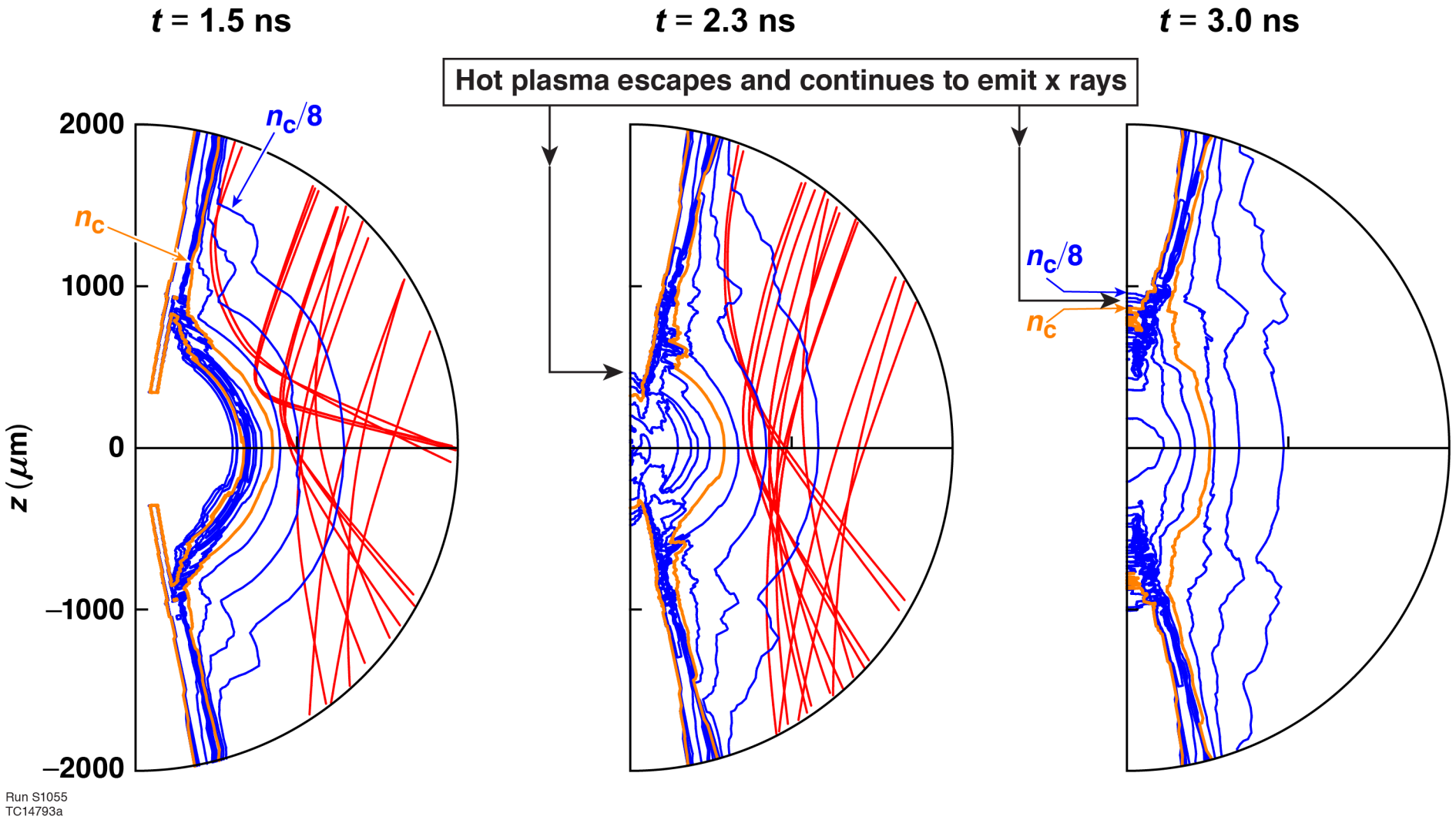




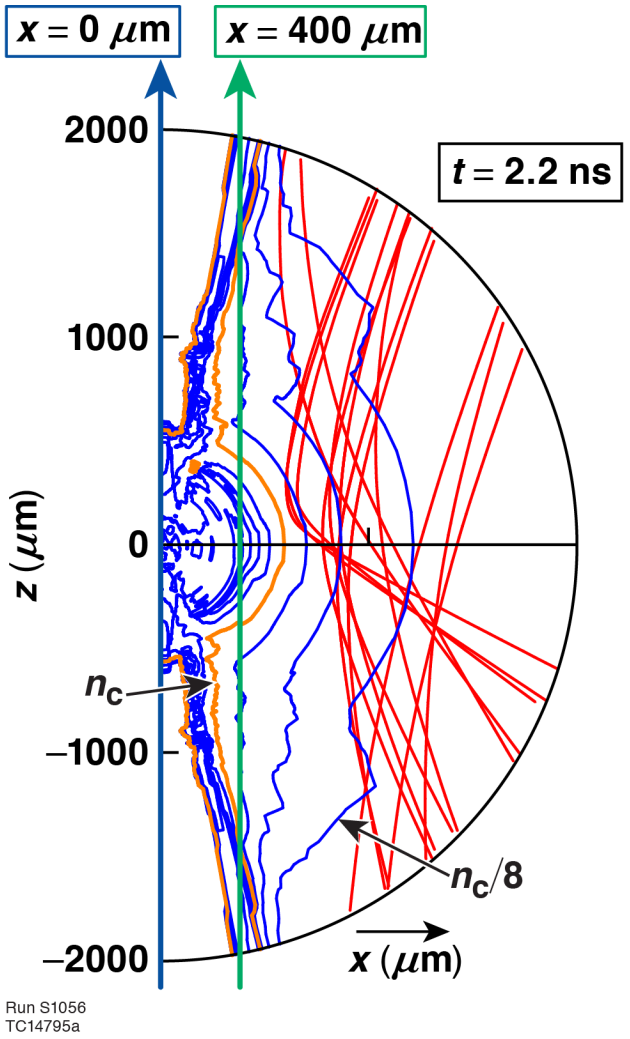
Run S1010
TC14791a

*H. Johns, PI2-00002, this conference.

The shell implodes uniformly, but hot compressed plasma escapes through the cone tip at late times

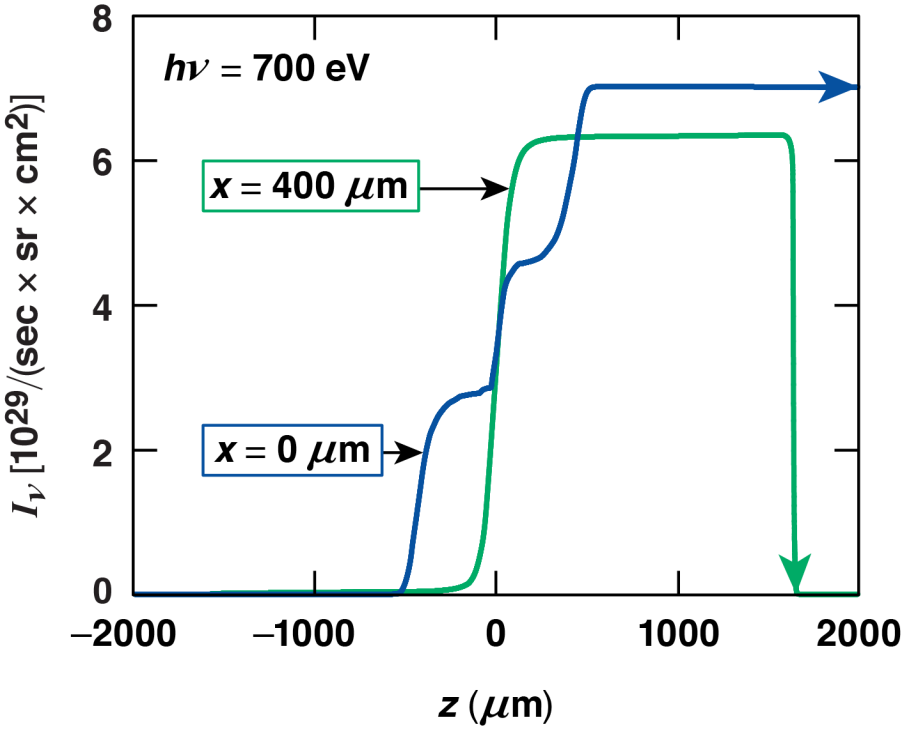


ORION was developed as a postprocessor to *SAGE* to calculate the x-ray emission from imploding cone-in-shell targets

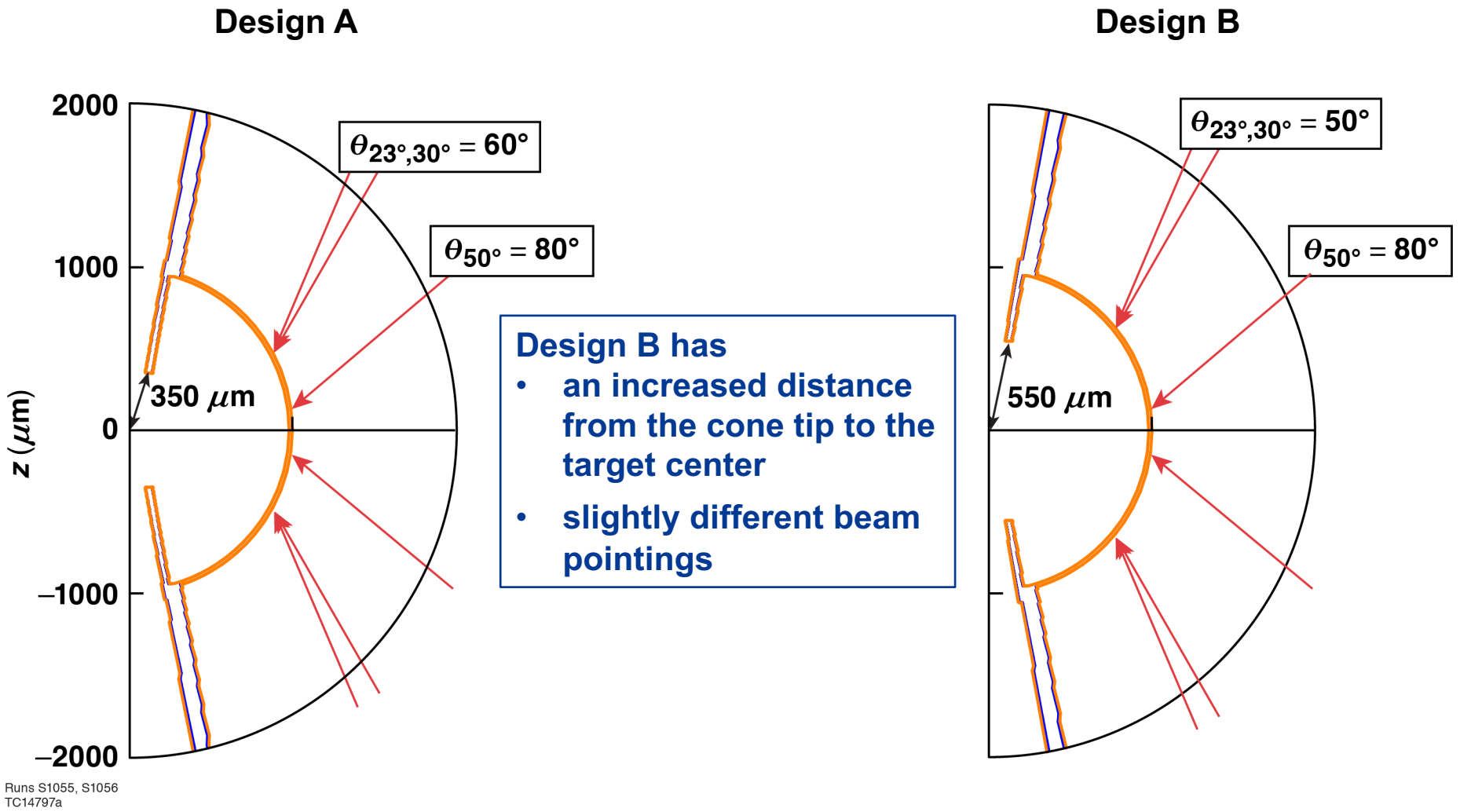


- *ORION* integrates the radiation transfer equation for the spectral brightness I_ν

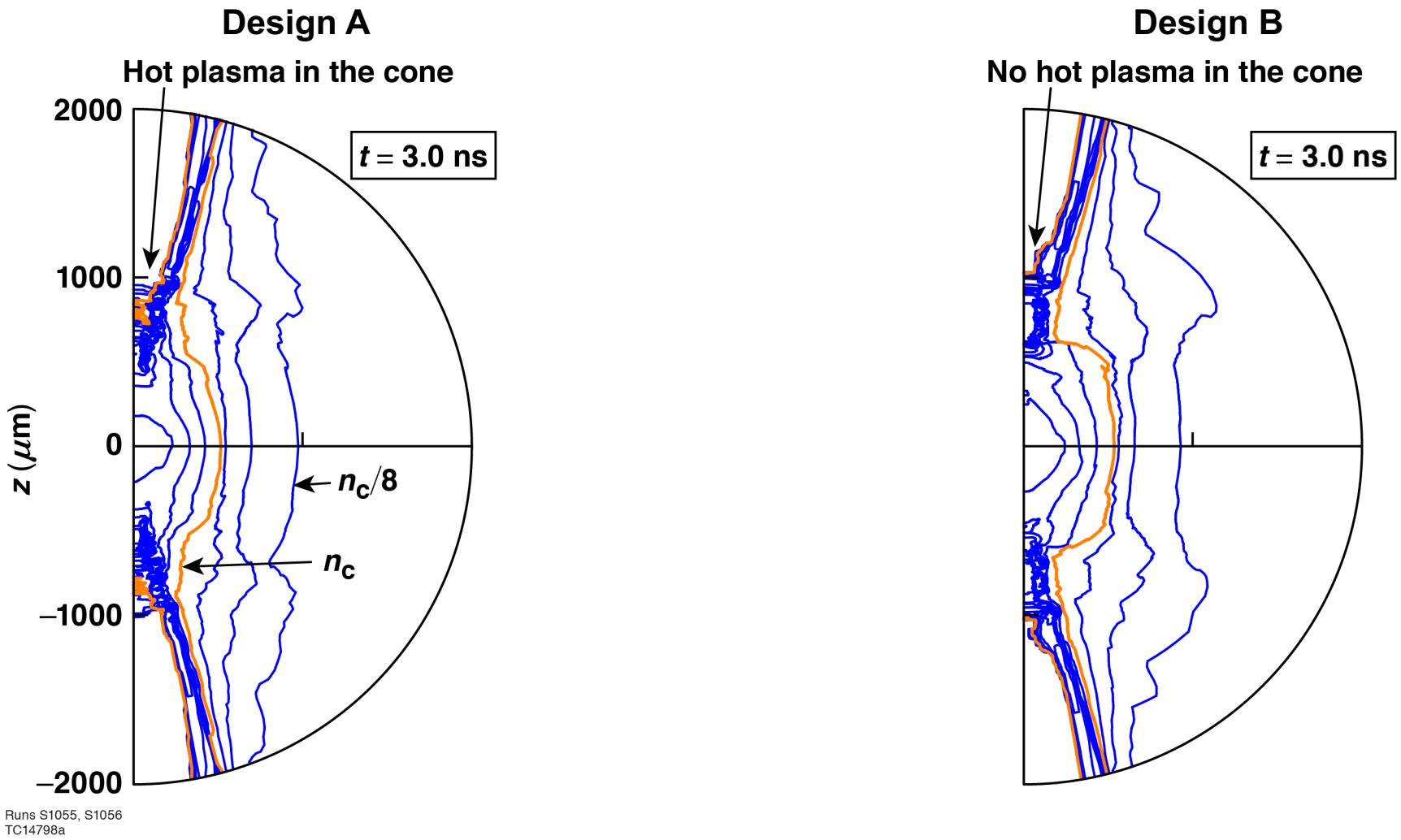
$$\frac{dI_\nu}{ds} = k'_\nu B_\nu - k'_\nu I_\nu$$



Two designs were compared using *SAGE*/*ORION* modeling

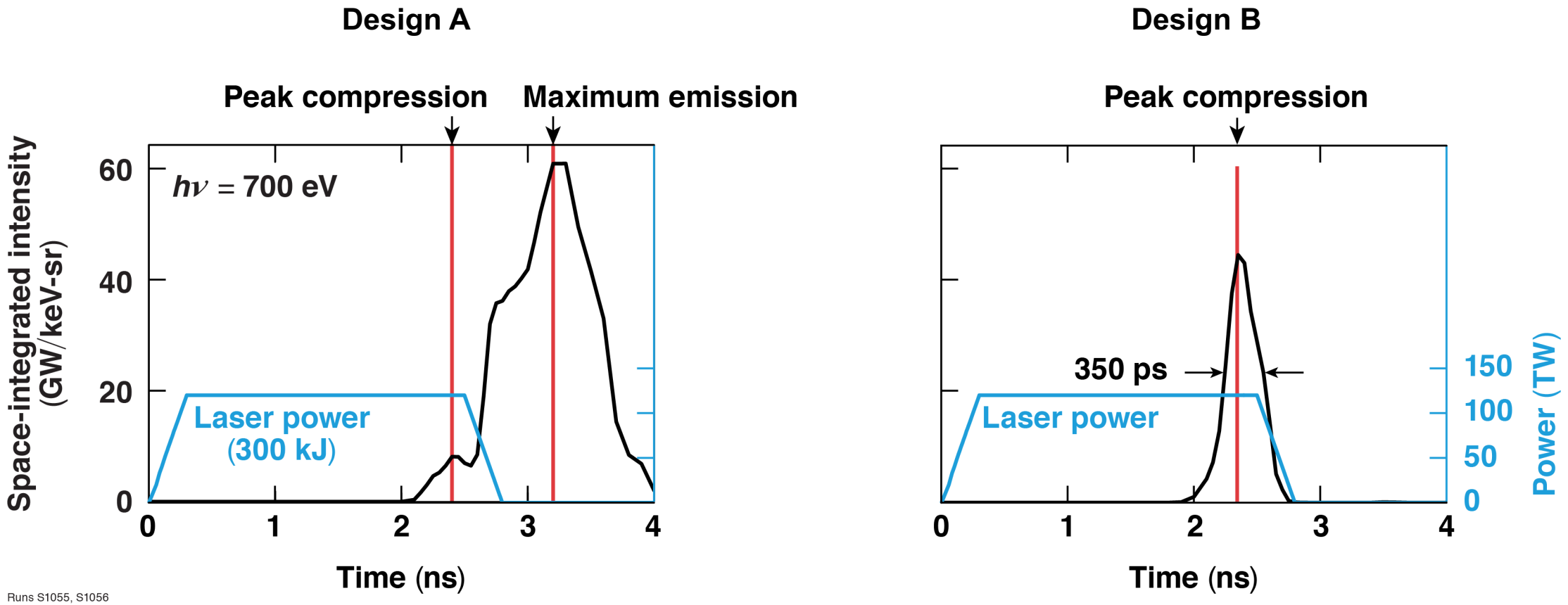


In Design B the cone converged on the vertical axis earlier, blocking the escape of hot plasma through the cone



Runs S1055, S1056
TC14798a

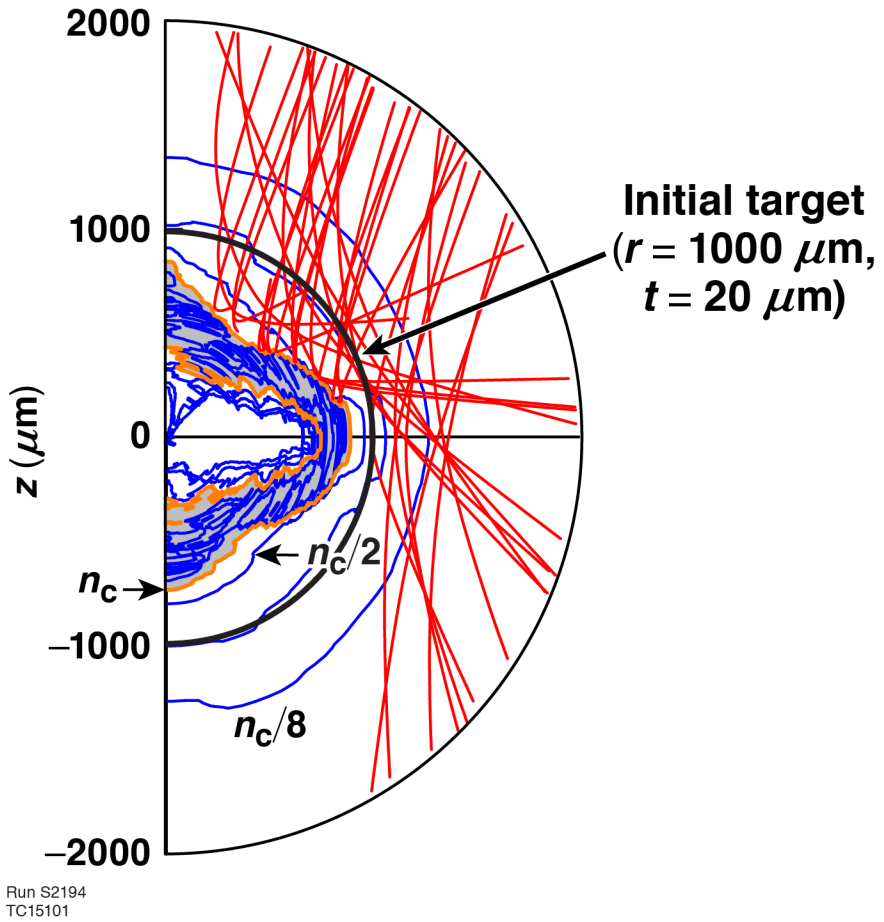
Design B produces a much narrower x-ray signal that corresponds to peak compression



Runs S1055, S1056
TC14800a

- Integrated over a 400-μm radius

An earlier experiment* using no cones and just the inner beams provided data that was compared with *ORION* modeling

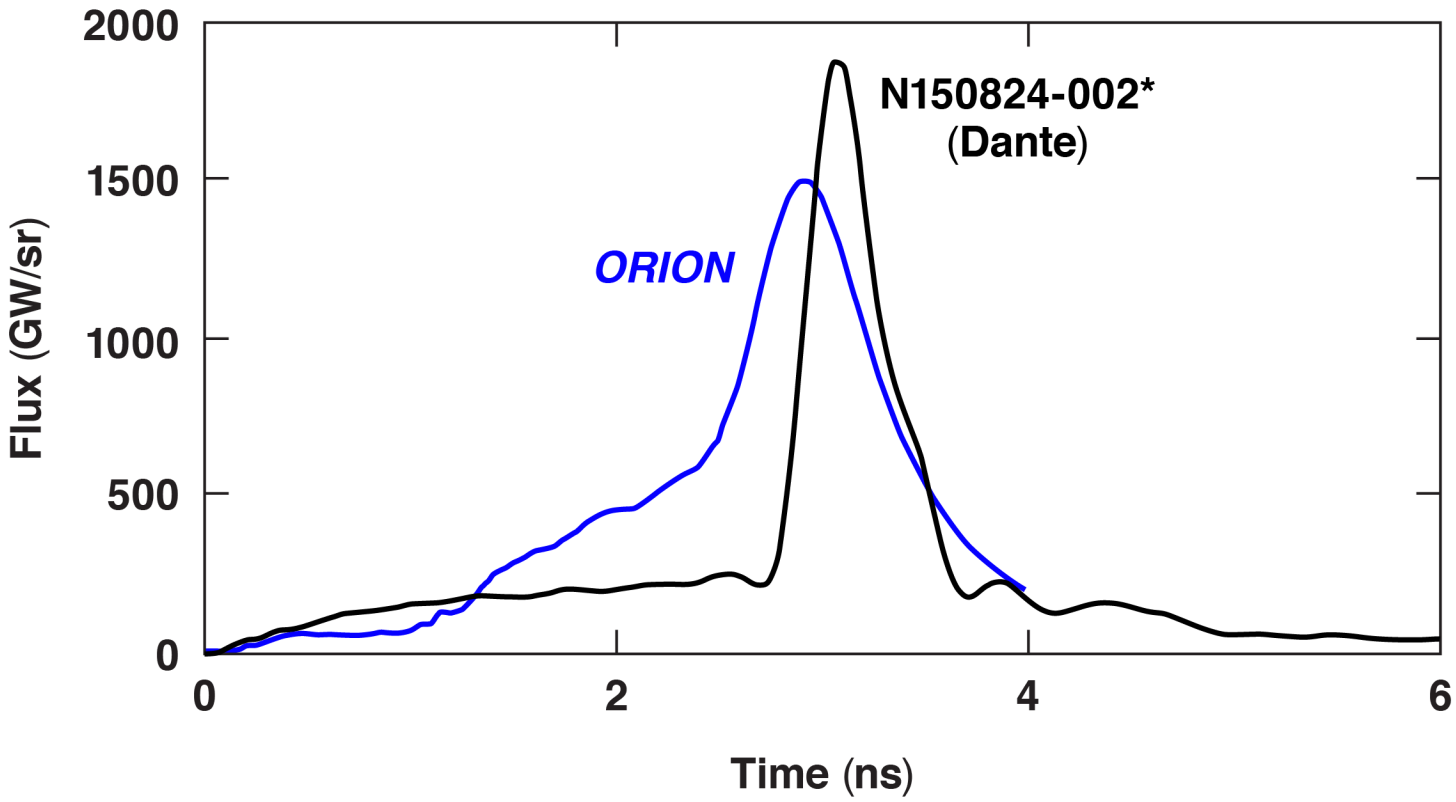


- t = 2 ns
- 200 kJ in θ = 23.5°, 30°

* Y. P. Opachich *et al.*, Phys. Plasmas 24, 063301 (2017).

ORION matches the emission time history measured by Dante within a factor of 2

- **Integral over space and spectrum**

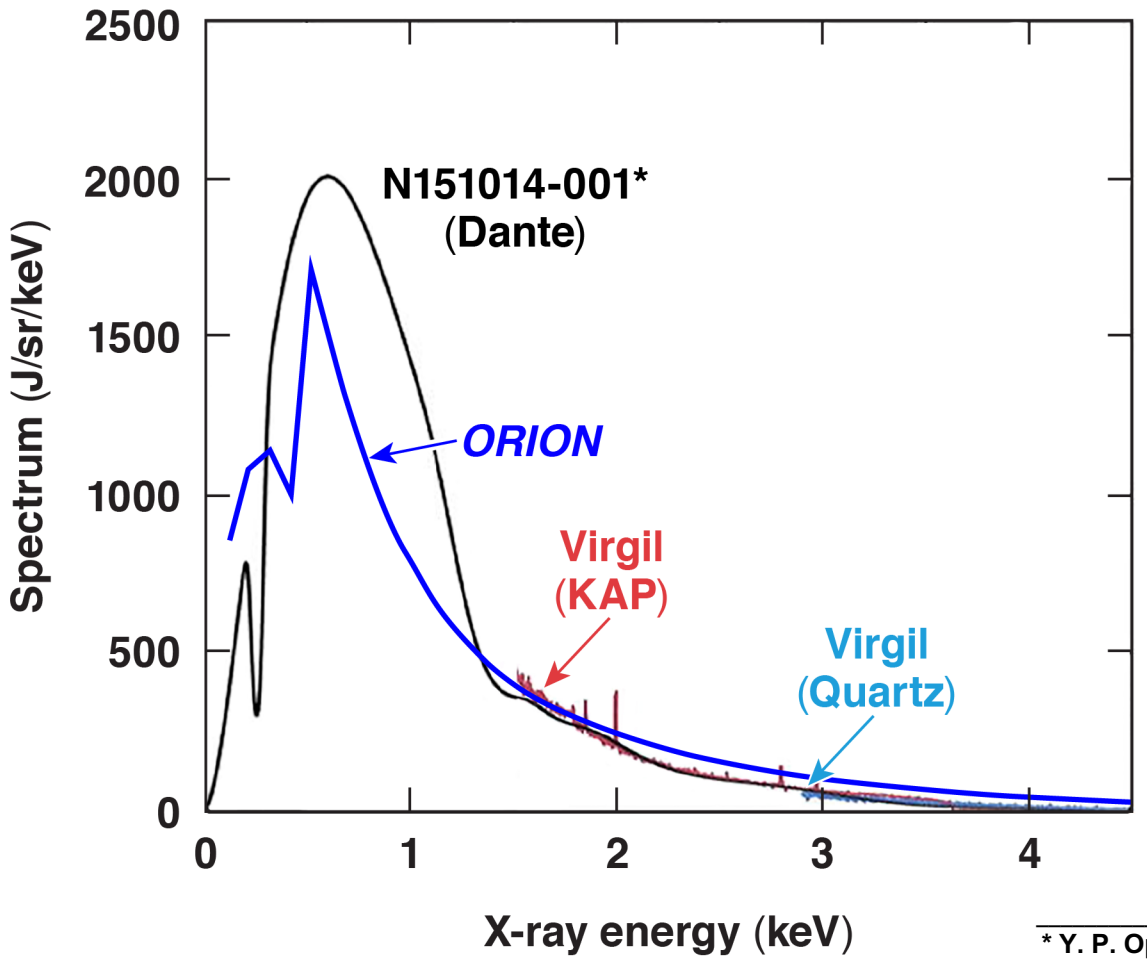


Run S2194
TC15102

* Y. P. Opachich *et al.*, Phys. Plasmas 24, 063301 (2017).

Similar agreement is found for the x-ray spectrum

- Integral over space and time

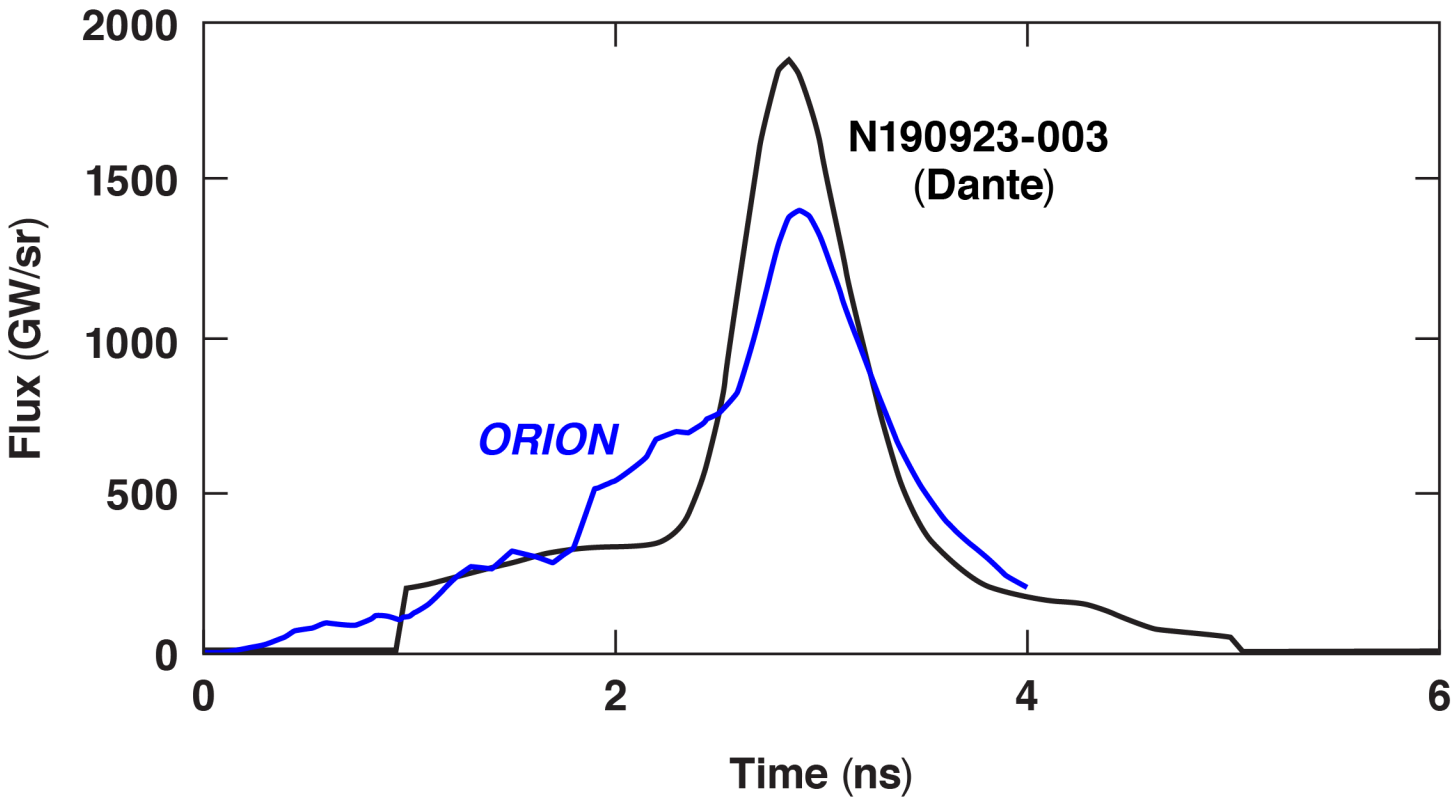


Run S2194
TC15103

* Y. P. Opachich *et al.*, Phys. Plasmas 24, 063301 (2017).
KAP: potassium acid phthalate

Agreement was very close for a double cone-in-shell target

- Integral over space and spectrum
- Viewed from $\theta = 37°$ to the cone axis



Run S1083
TC15104

Summary/Conclusions

A double cone-in-shell target is being investigated to provide a short-pulse source of x rays for opacity measurements

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Experimental and modeling capabilities need to be developed together.