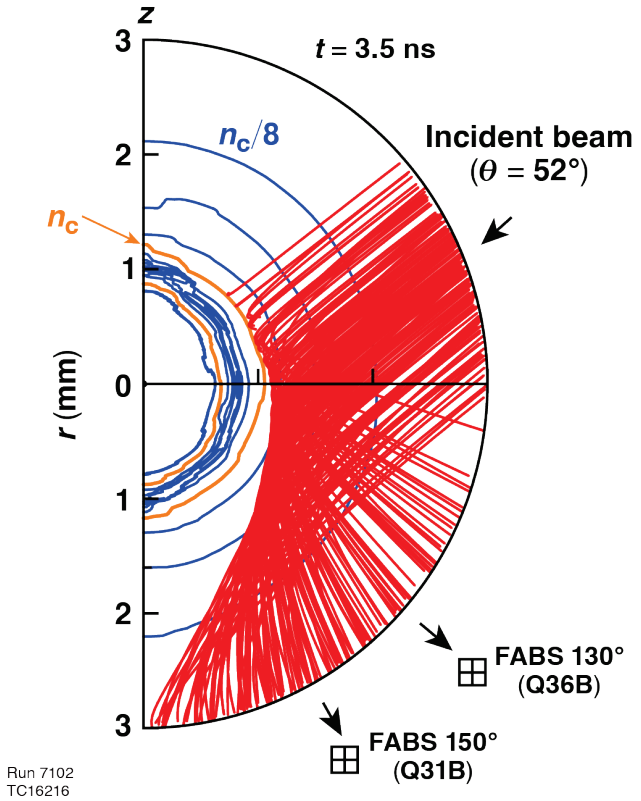
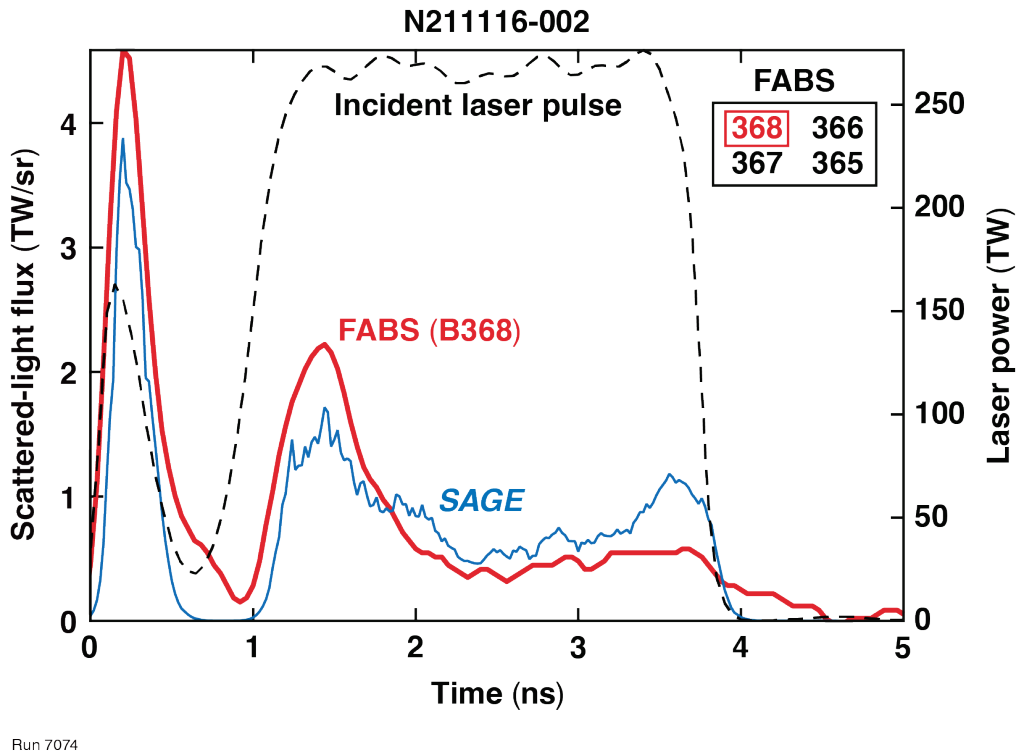
SAGE Hydrodynamic Simulations of Scattered Light from Implosions of Large-Diameter Targets at the National Ignition Facility





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Division of Plasma Physics
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Summary

A comparison of experimental NIF data for large "exploding-pusher" targets with *SAGE* simulations indicates high absorption (>90%)

- The simulations use just inverse bremsstrahlung absorption, suggesting that CBET losses are not significant for these targets
- The simulations largely reproduce both time-integrated and time-resolved data
- The combination of improved FABS and SLTD diagnostics promises to provide a powerful means for understanding target hydrodynamics

CBET: cross-beam energy transfer
FABS: full-aperture backscatter station
SLTD: scattered-light time-history diagnostic

Collaborators

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*Also LLE Summer High School Research Program

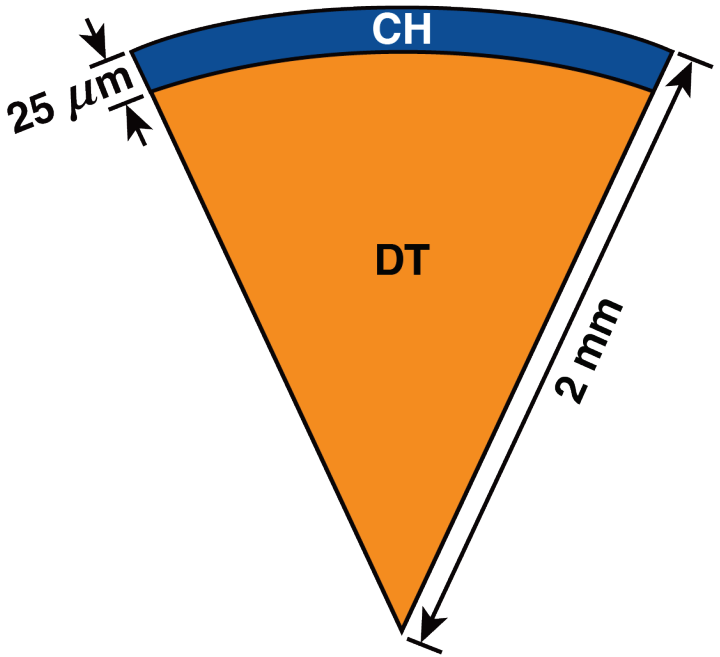
Outline

- Time-integrated scattered light for
  - N190227 (4.0 mm, “Orange”)
  - N201220-001 (3.4 mm)

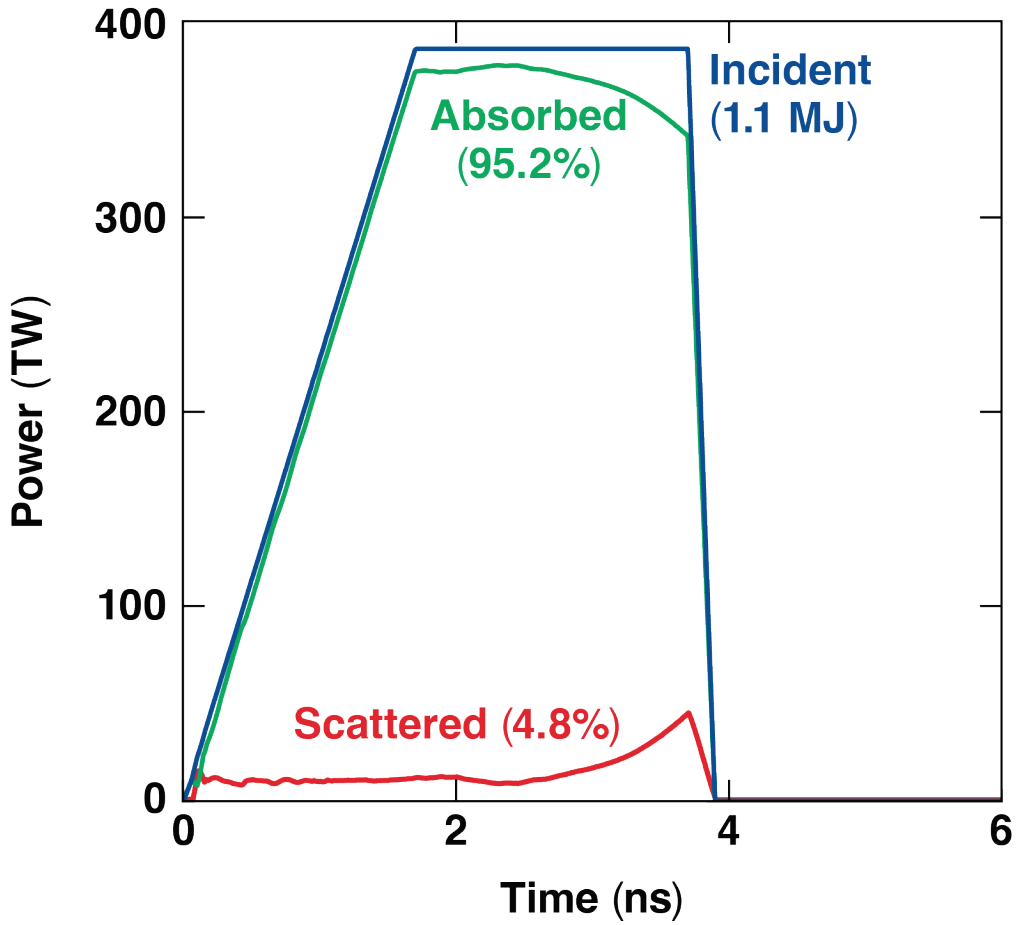
- Time-resolved scattered light for
  - N211116-002 (3.4 mm, picket pulse)

A 4-mm NIF target had a predicted absorption of 95%

- The 1.1-MJ exploding-pusher shot N190227 ("Orange")* produced 1.1×10^{16} neutrons



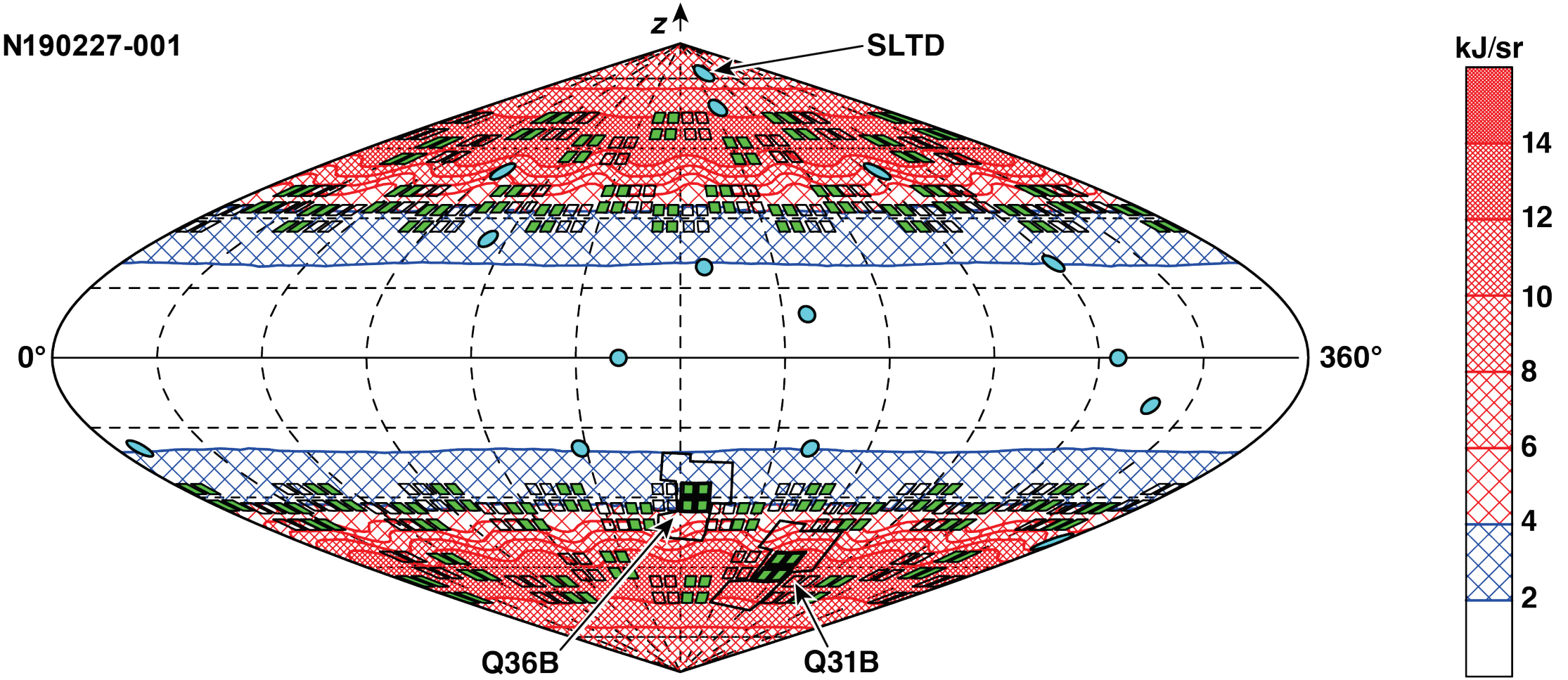
Run 6958
TC16217



*C. B. Yeamans *et al.*, Nucl. Fusion 61, 046031 (2021).

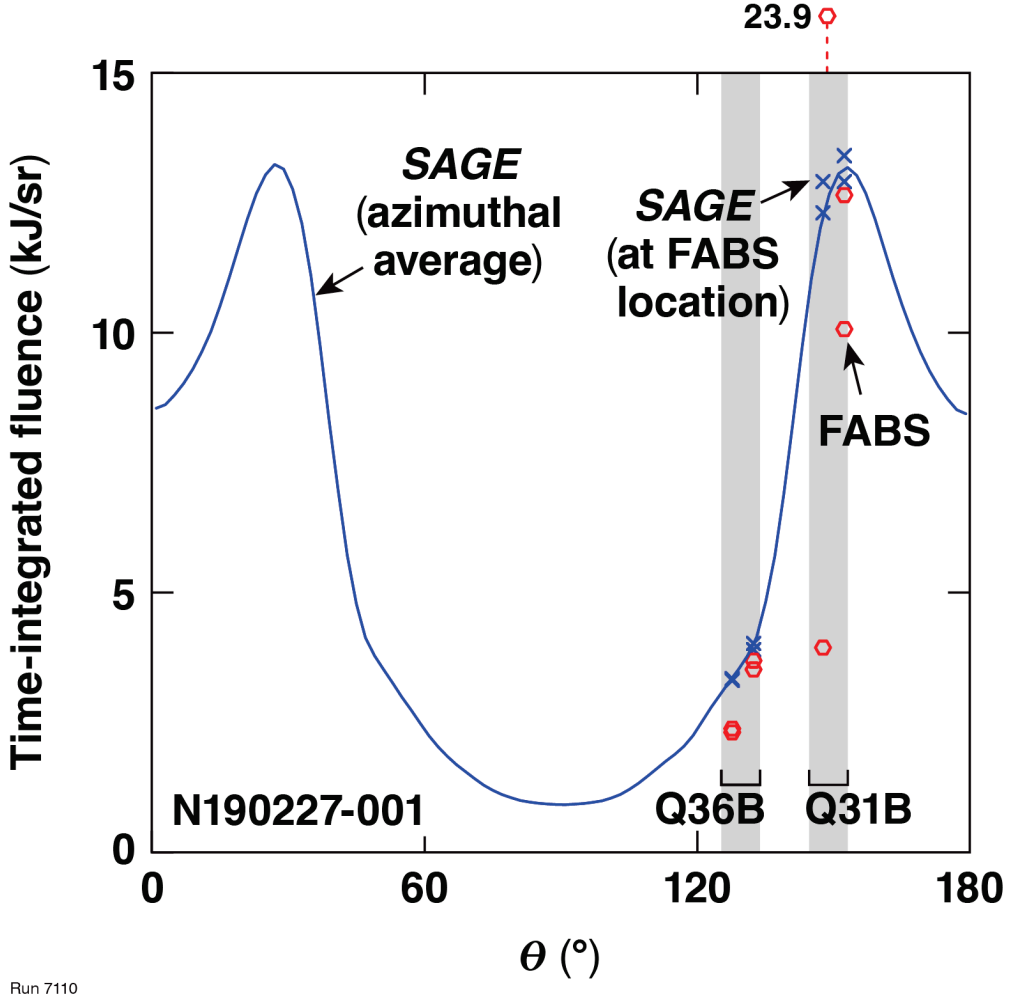
The time-integrated scattered light is sampled by the FABS at Q36B and Q31B and numerous SLTD's

- N190227-001



Run 7110
TC16218

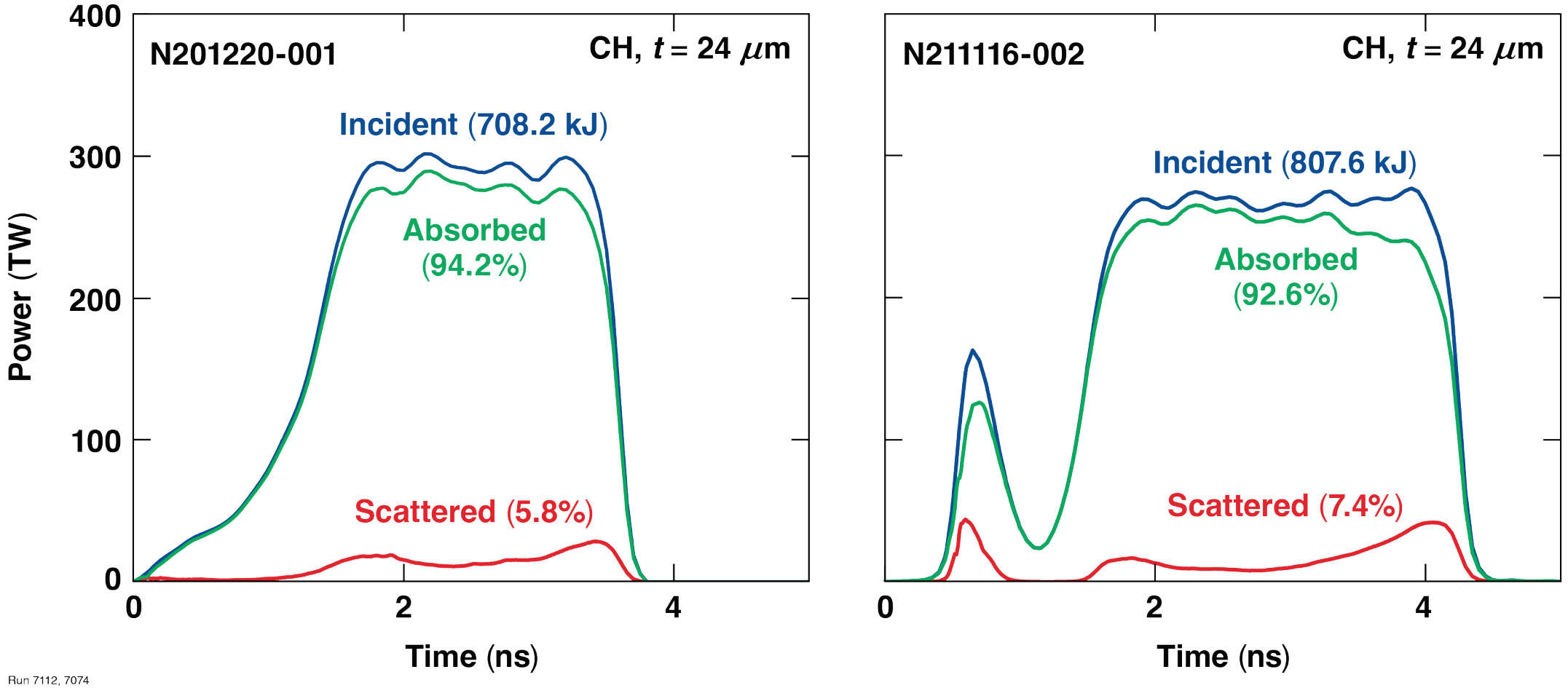
The FABS measurements of the time-integrated scattered light are generally consistent with predictions but there is an issue with Q31B



Run 7110
TC16219

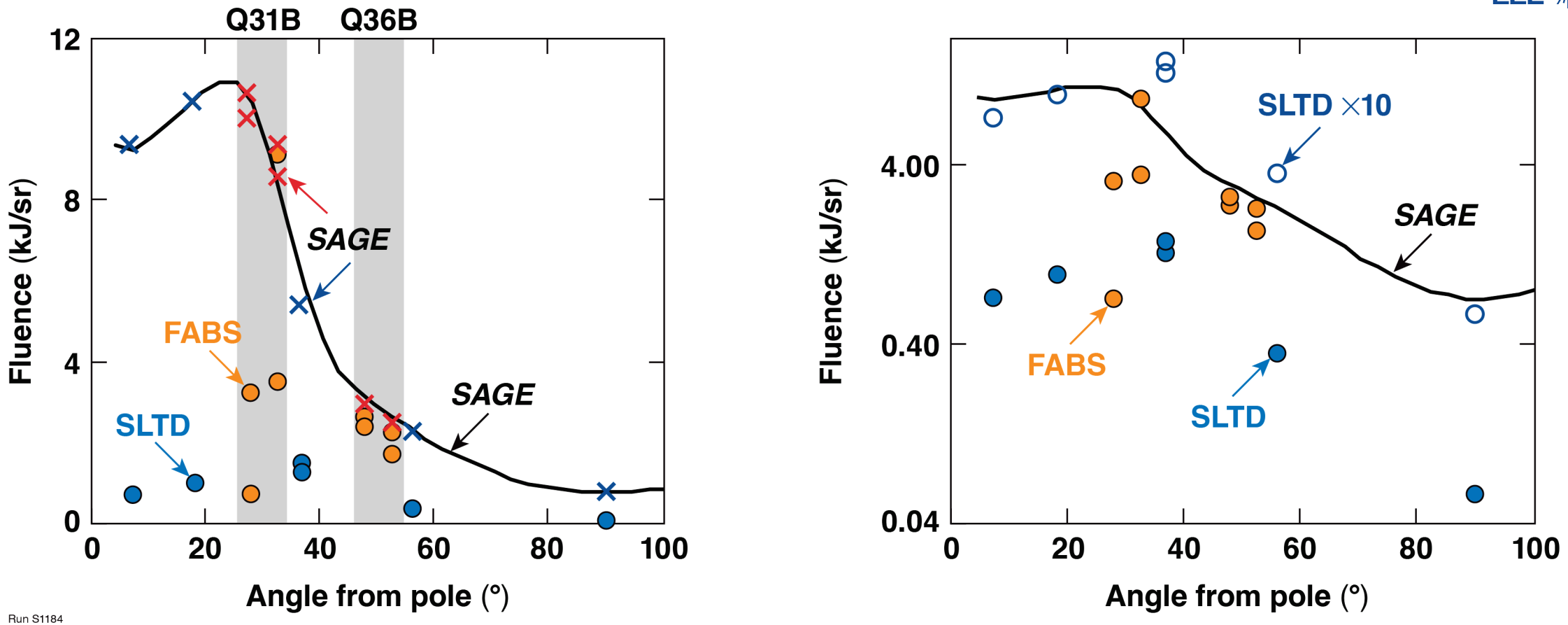
- Curve integrates to 55 kJ (4.8% of incident)

Two 3.4-mm targets were predicted to have similarly high absorption



Run 7112, 7074
TC16220a

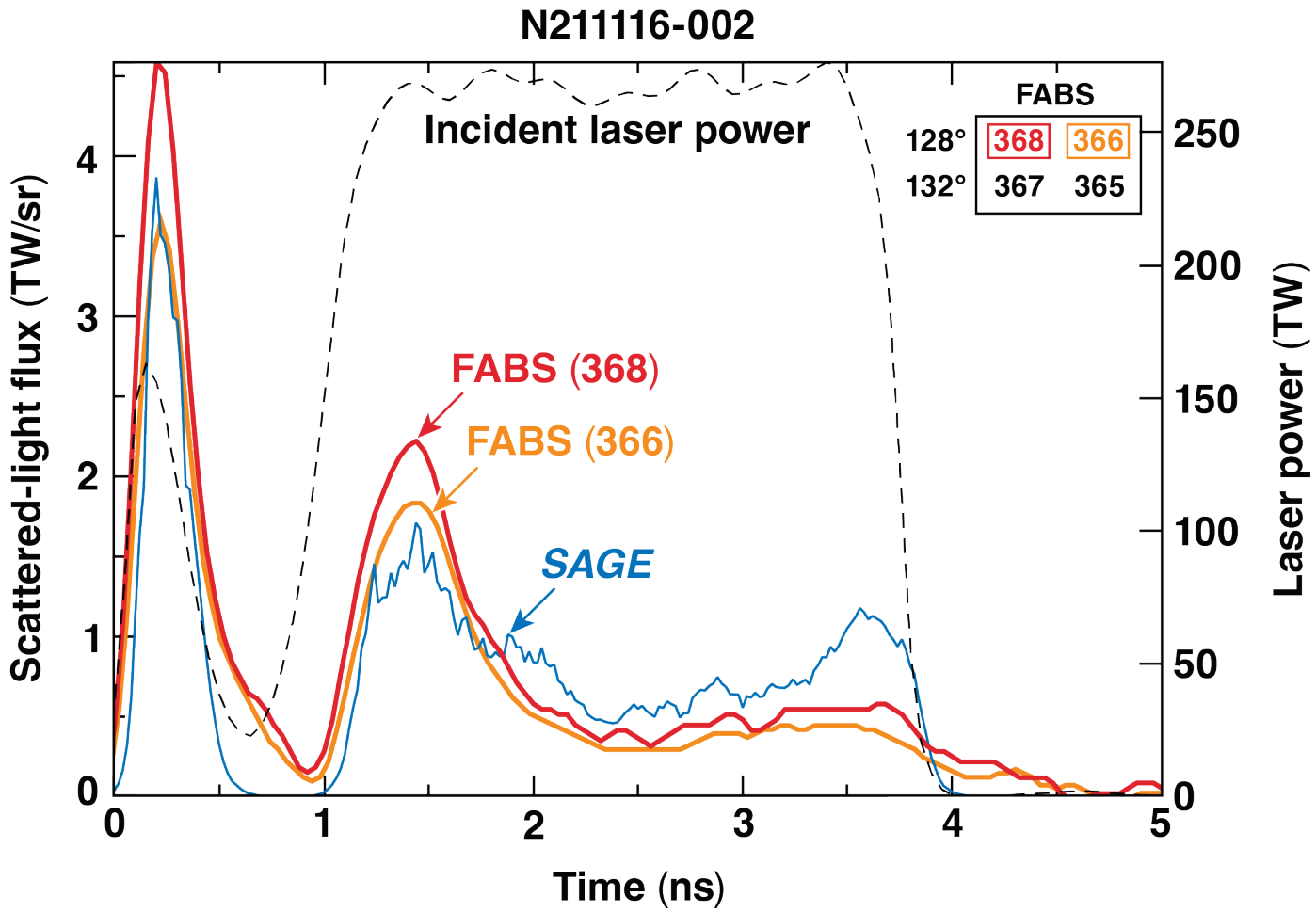
N201220-001 obtained scattered-light data from SLTD's as well as FABS



Run S1184
TC16221

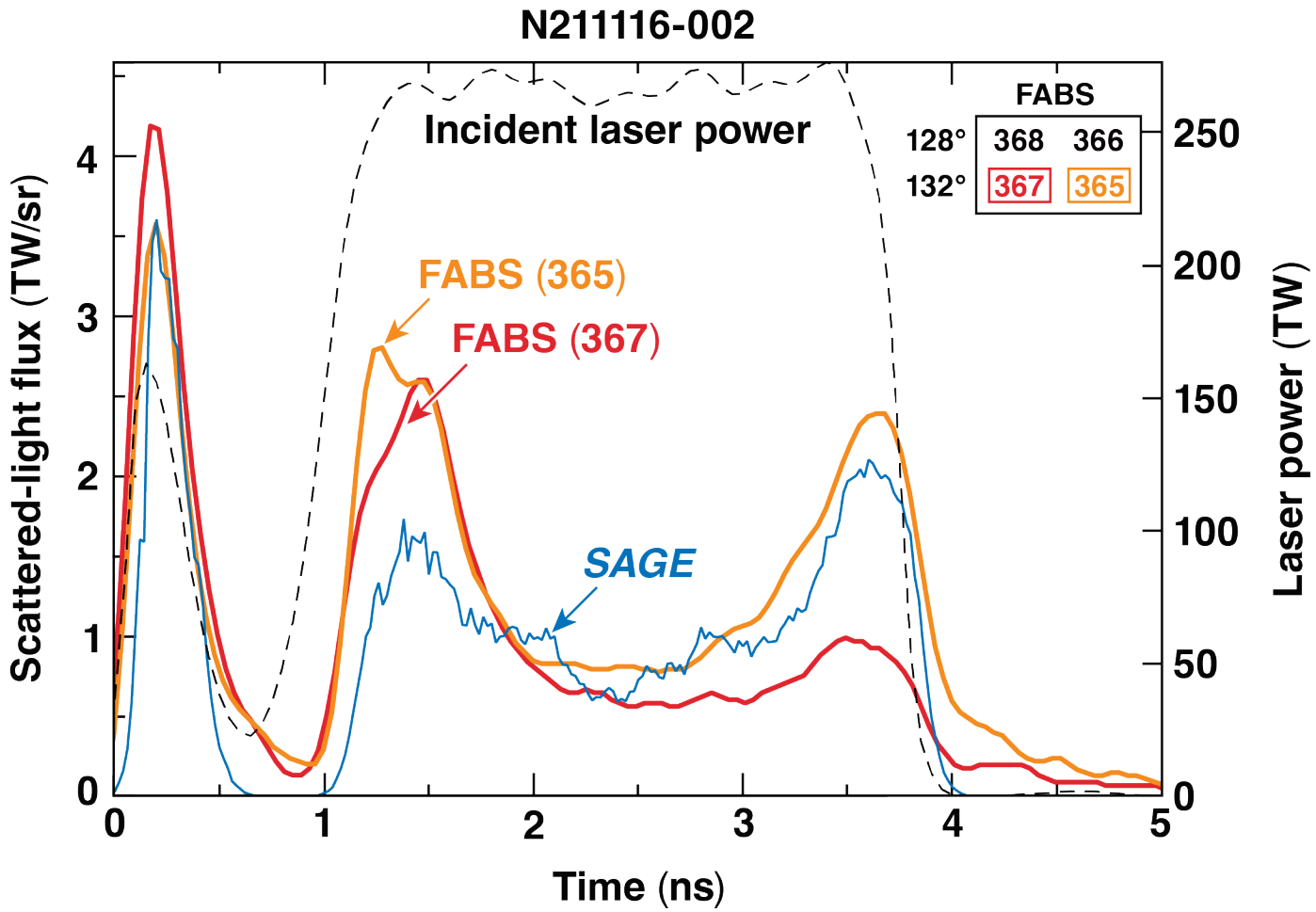
- The 50° FABS are again consistent with *SAGE*
- Though low, the SLTD's showed an angular dependence consistent with *SAGE*

The 128° FABS detectors agree closely with *SAGE* simulations



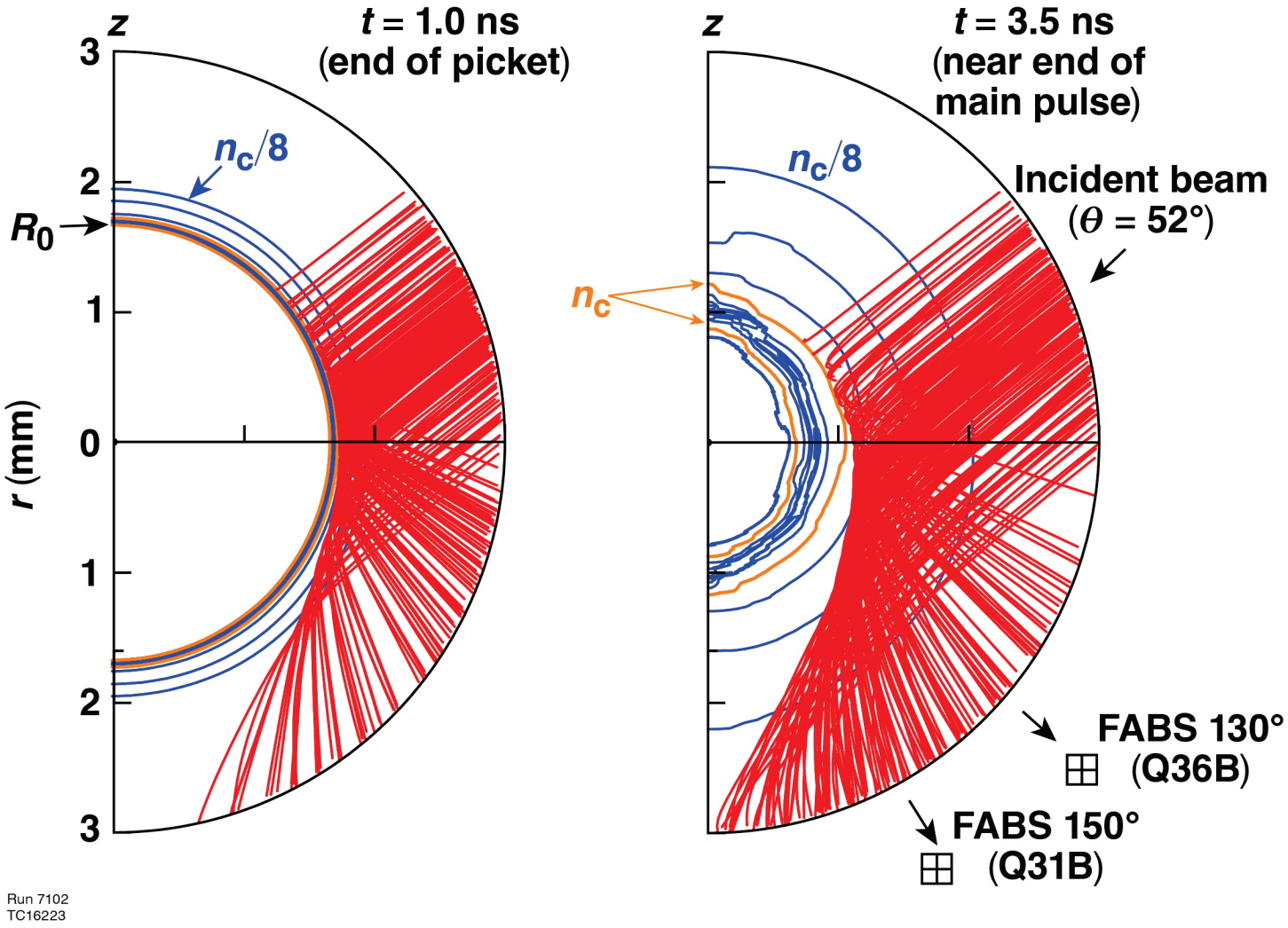
Run 7074
TC16224

The 132° FABS detectors are also consistent with *SAGE* and show a clear late peak



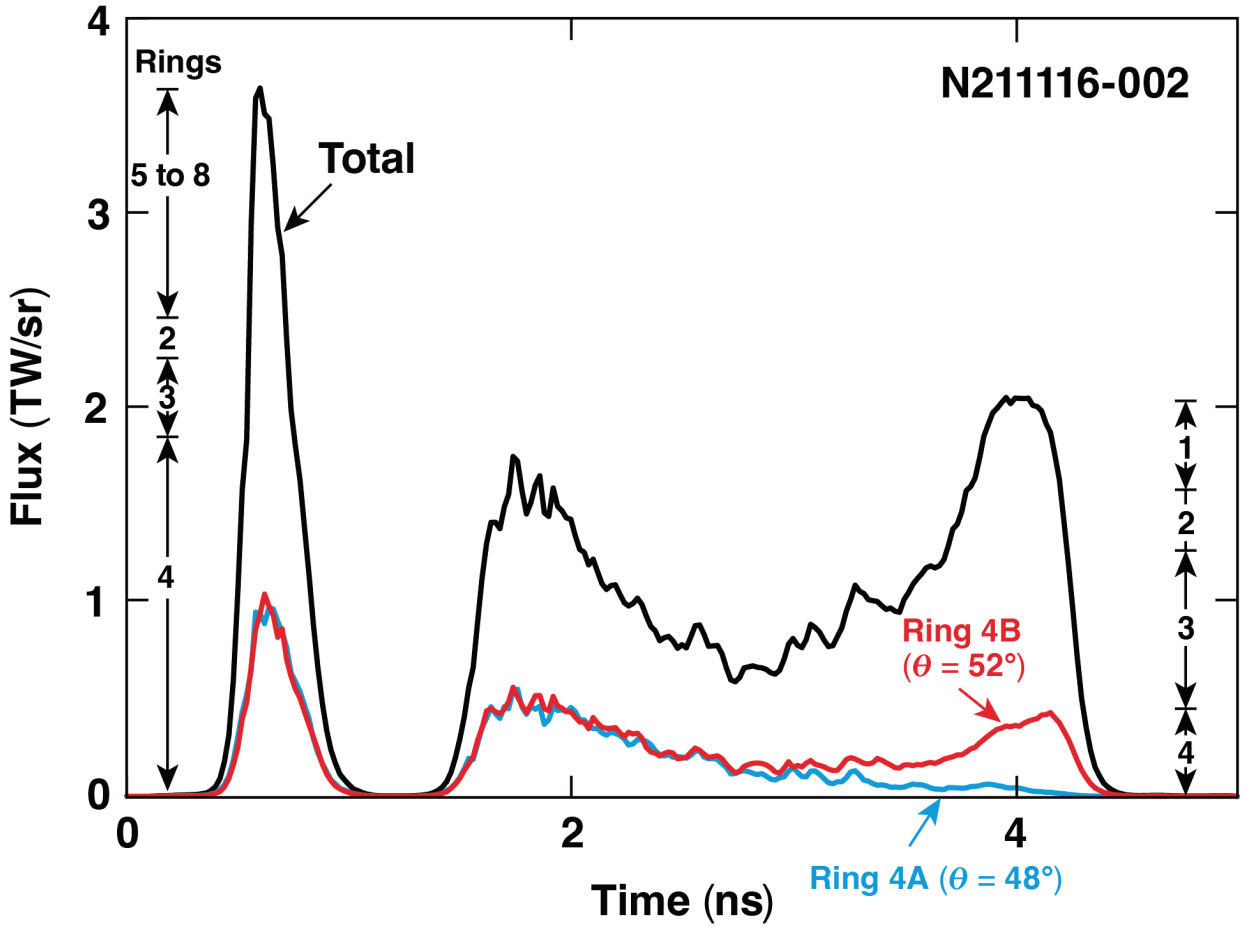
Run 7074
TC16225

Rays near the bottom edge of the beam decouple at later times and contribute to enhanced scattering

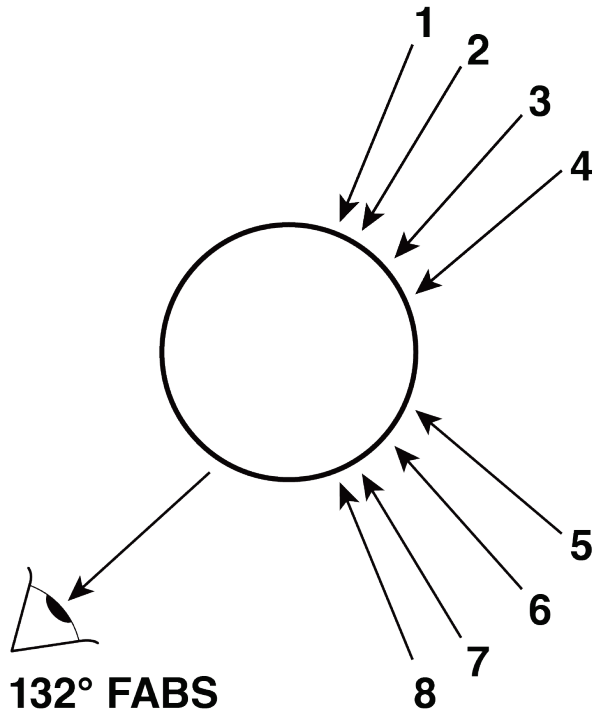


Run 7102
TC16223

The simulated contributions to the 132° FABS of the upper (4A) and lower (4B) beams of the Ring 4 quads diverge at late times

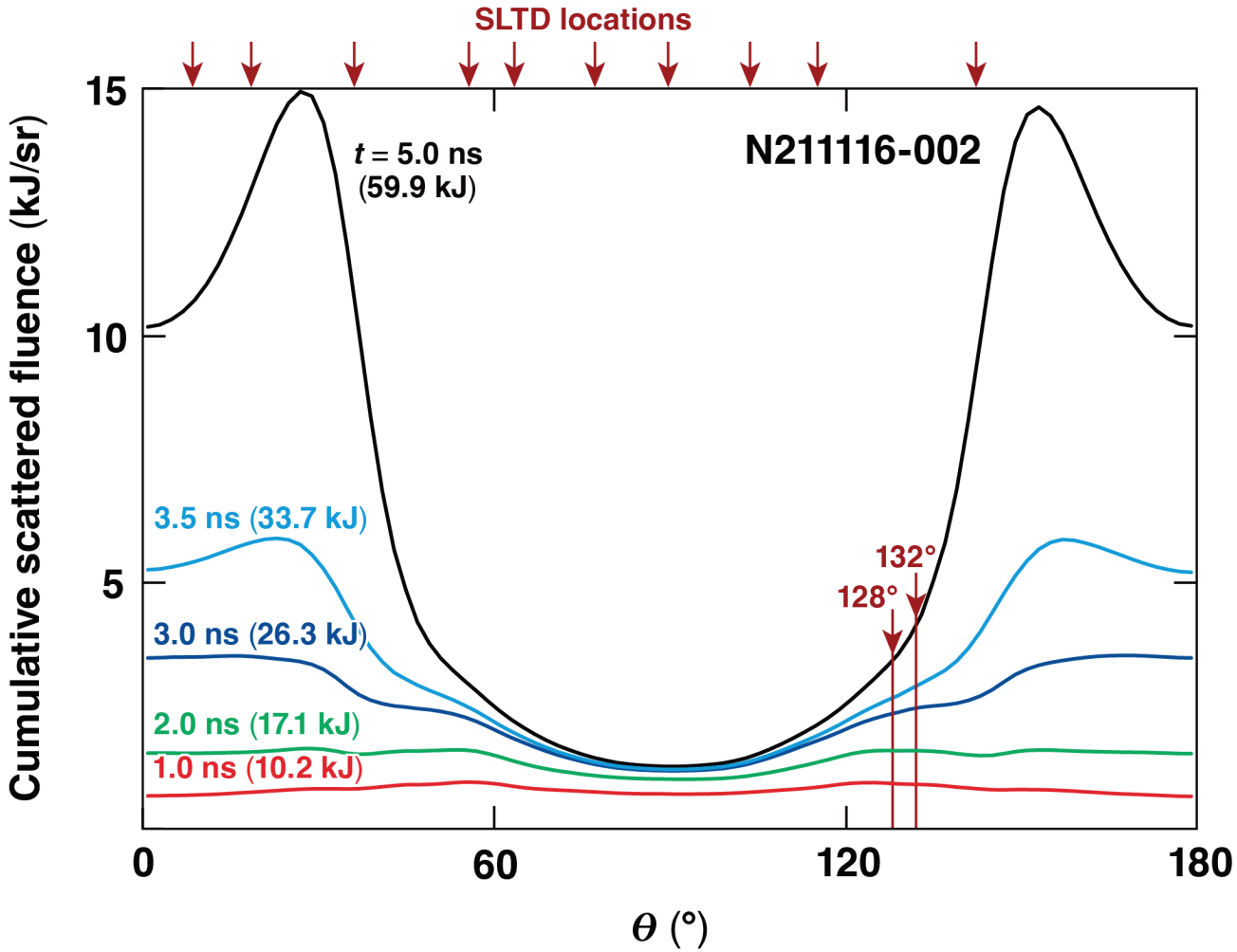


Run 7099
TC16226

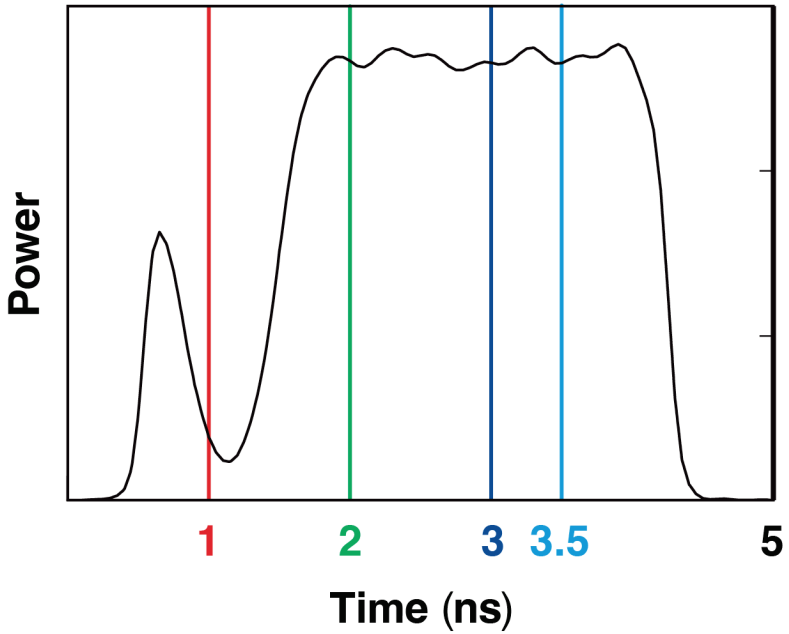


TC16253

The angular distribution of scattered light becomes progressively more peaked at later times



Run 7102
TC16227



TC16254

Summary/Conclusions

A comparison of experimental NIF data for large "exploding-pusher" targets with *SAGE* simulations indicates high absorption (>90%)

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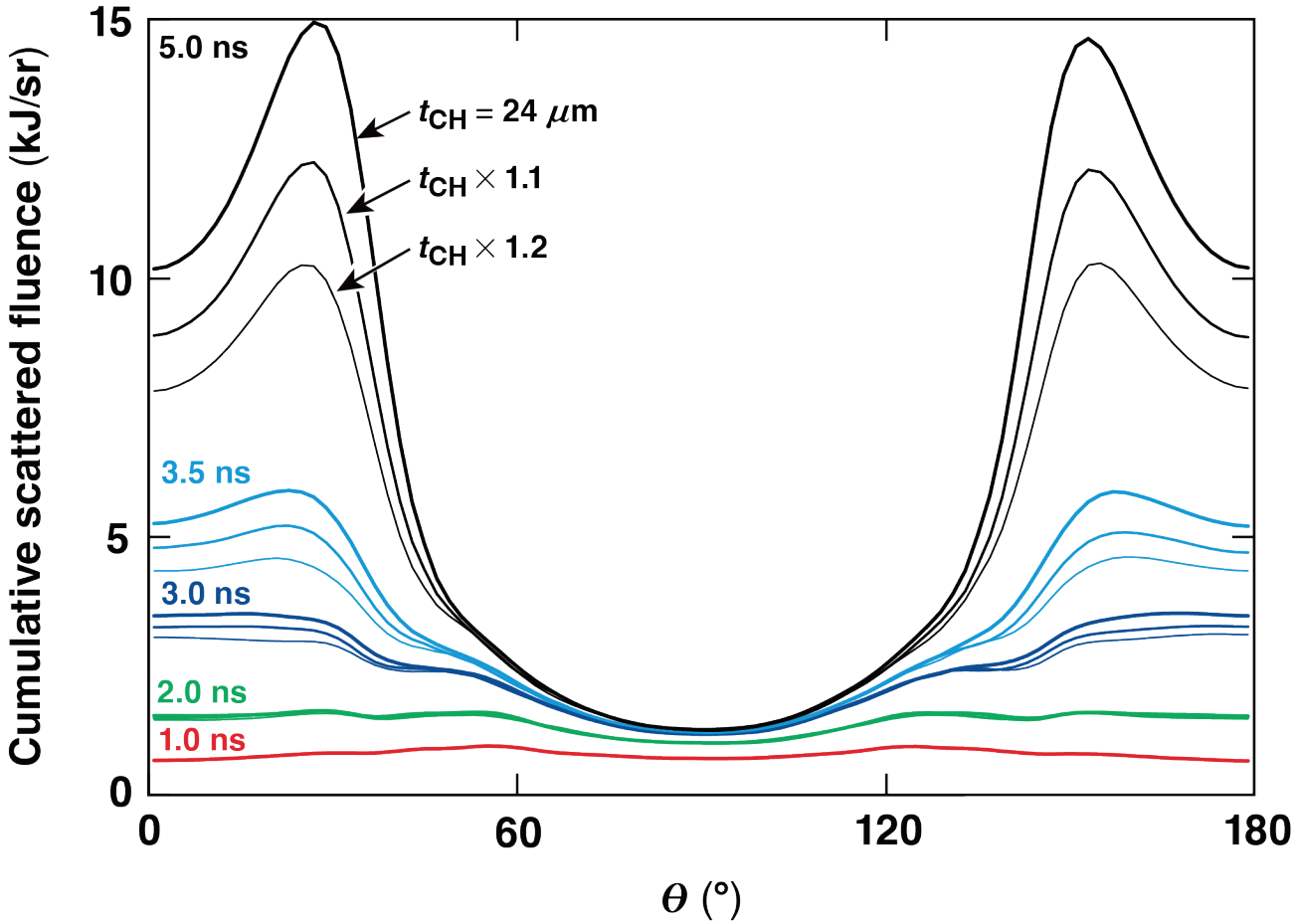
Backup

For slower implosions, obtained using thicker targets, the late peak is smaller but still distinct



Run 7102, 7108, 7109
TC16228