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Final Work: Integral Model of Hydrodynamic Instabilities in Inertial Fusion Implosions

Hiroshi Azechi

Institute of Laser Engineering, University of Osaka

azechi.hiroshi.p7t@osaka-u.ac.jp (speaker):

Mima's final work was to develop an integral model predicting high fusion gain. The model includes the following processes.

1. One-dimensional implosion dynamics
2. Initial perturbations of target roughness and laser imprint
3. Rayleigh-Taylor instability growth
4. Hot spot eroded by Rayleigh-Taylor spikes [1]

and is then rigorously tested in the past implosion experiments at GEKKO [2][3] and hopefully in the recent thermonuclear ignition at NIF [4]. Finally, the model predicts future target with gain as high as 100.

References

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[2] C. Yamanaka and S. Nakai, Nature **319**, 757 (1986); H. Takabe *et al.*, Phys. Fluids **31**, 2844 (1988).

[3] H. Azechi *et al*., Laser and Particle Beams **9**, 193 (1991).

[4] O.A. Hurricane et al., Phys. Rev. Lett. **132**, 065103 (2024); H. Abu-Shawareb *et al.*, Phys. Rev. Lett. **132**, 065102 (2024).

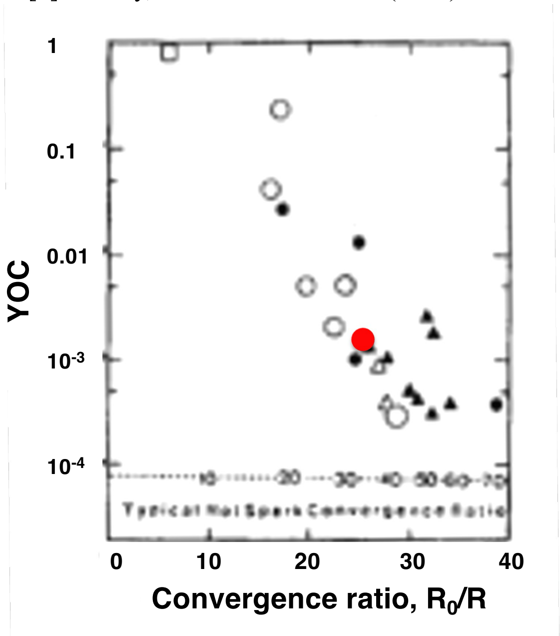

Figure 1. YOC: Neutron yield over the one predicted by 1D clean simulation. Black triangles are the data of highest density implosions. The red point is the model prediction consistent with the data.