Advanced wall design to stabilize and enhance ignition hohlraum

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A common feature of the NIF low and high-foot campaigns is the trend of the models to predict faster implosions, and earlier bang times than measured. As a result, time-dependent laser power multipliers are needed in integrated simulations to match implosion data [1]. The x-ray conversion efficiency of the hohlraum is not as high as expected.

In Ref. [2], we studied the gold plasma expansion generated by the wall heating which is provided by the outer laser cones. We showed that the interface of this gold plasma bubble is unstable in gas-filled hohlraums. The Kelvin-Helmholtz (KH) and the Rayleigh-Taylor (RT) hydrodynamic instabilities occur at the gas-gold interface. Roll-ups grow at the bubble interface, and estimated Reynolds number indicates that the area is likely to be turbulent. An enhanced mix between gold and gas could partially explain the low efficiency of the x-ray conversion in this area.

In order to suppress the occurrence of these hydrodynamic instabilities, we have designed an innovative wall for the gas-filled hohlraums. This new design cancels the overall motion of the gold bubble during the picket and the trough of the laser pulse. The gas-gold interface is no more KH unstable, and even becomes RT stable. This reduced wall motion allows the inner cones to easily propagate within the hohlraum. Our simulations indicate that this advanced wall design stabilizes and enhances the hohlraum. This could be an asset to obtain reliable and efficient ignition hohlraums.

References

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