

# The LARED-Integration code for the numerical simulation of the whole implosion process of inertial confined fusion

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## Abstract

The implosion physics process of Inertial Confined Fusion has the following characters, such as multi-material, high distortion, strong discontinuity, and the stratified instability including RT (Rayleigh-Taylor) and RM(Richtmyer-Meshkov). Due to the difficulties in the stratified interface distortion, the traditional ALE methods can't meet the requirement of the high-credibility simulation for the 2D complicated fluid flow. Thus the TCALE (Tracking-Capturing Arbitrary Lagrangian-Eulerian) method are developed in the LARED-Integration code, which is a radiation-hydrodynamic code based on the 2D cylindrical coordinates for the numerical simulation of the indirect-drive Inertial Confined Fusion.

The TCALE method is based on the ALE framework and takes advantage of the interface capturing of the Eulerian method. For the small deformations, the TCALE method only implements the mesh rezoning inside every material and the material interfaces are tracked as the Lagrangian method and the traditional ALE method. For the large deformations, the TCALE method can be rezoned across the interface, and the material interfaces are captured as the Eulerian method and the mixed cell are introduced.

A number of 1-D and 2-D numerical simulations by using the improved LARED-Integration code are presented. For the Sod problem with different  $\gamma$ , the numerical simulations agree quite well with the analytical results. Compared with the referenced result, the shape of interface between the heavy fluid and the light fluid is resolved clearly in the RT instability. Also the shape of the bubble in the RM instability numerical results are considerable compared with the experiment's phenomena. The 2-D implosion process of the multi-layer ignition capsule driven by radiation source is also simulated. The whole physical process can be finished and the numerical results are satisfactory according to the physical analysis.

**Keywords:** LARED-Integration code, Stratified instability, the TCALE method, the ALE method, the Eulerian method.