Abstract
Beryllium strength has been investigated under dynamic loading conditions using platforms that span a limited range of pressure and strain-rate space. Multiple Be strength models that are ostensibly calibrated to these experiments persist, and yet they predict different outcomes for results beyond the limited phase space where data exist. We discuss experiments using high explosives (HE) to accelerate a solid roped Be target quasi-isentropically. The interface between the low-density gas phase and the heated solid in the Taylor-Taylor (RT) unstable. The amplitude of the ripples will grow with time, and the Be strength will mitigate the ripple growth. By measuring and modeling the amplitude growth, we can discriminate among various strain-rate hardening models for Be. Our RT designs extend the pressures up to 50 GPa and the strain-rates to $10^9$ s$^{-1}$. As a part of the design process, we analyze existing plate-impactor and Taylor anvil experiments using available models. We present the results of this analysis as well as the designs and preliminary experimental results from the RT experiments.

Analysis of existing data

Methods
We compare 1D and 2D experiments of Be under various loading conditions using: 
- existing data compiled by collaborators at the Russian Federal Nuclear Center (VNIIEF).
- Ares, an ALE hydrodynamics code developed at LLNL.

Plate-impactor experiments (1D)

Fig. 3: Impact of a Be target by a variety of impactor materials (Ta, Sapphire, Al, Steel, Be, Cu) spanning a wide range of impact velocities ($0.0022\text{m/s}$ to $0.2\text{m/s}$). The free surface velocity is measured by VISAR.

Taylor anvil experiments (2D)

Fig. 5: Uniaxial compression of Be cylinders with impact velocities ranging from $0.017\text{m/s}$ to $0.027\text{m/s}$.

Conclusions
The strength models capture the material behavior.
- We are unable to discriminate among the different models using existing data (except for JC and ZA).
- Models diverge significantly in high pressure and high strain-rate regimes.

Background and Motivation
Material strength mitigates RT growth (Fig. 1).
- Hydrodynamic instabilities can quench ignition by mixing the cold fuel with the hot ablator.
- Because of its strength, Be can be an alternative to current CH ablator in the NIF capsules.
- Be can be used as a heat shield in other material experiments (Fig. 9).

Objectives
1. Try to discriminate among various models using existing Be data.
2. Design high pressure RT experiments to explore new regimes.
3. Evaluate the different Be strength models using these new data.

Future RT experiments

Collaboration with RFNC-VNIIEF for HE driven ripped Be tgs
- Characterize RT growth.
- Recover samples to determine deformation physics (dislocation, twinning, ...).
- Predictions show that we will be able to discriminate among some of the models (Fig. 8).

Future laser RT exp. to explore the high strain-rate regime

Summary of Strength Models

- Johnson-Cook\textsuperscript{1}: work hardening, thermal softening, strain-rate hardening
- Steinberg-Guinan\textsuperscript{2}: JC with different ansatz + pressure hardening
- Steinberg-Lund\textsuperscript{3}: SG + strain-rate dependence
- Zerilli-Armstrong\textsuperscript{4}: simplified dislocation mechanics
- Preston-Tonks-Wallace\textsuperscript{5}: combines thermal activation and phonon drag different fits (Preston, Blumenthal, and Chen)\textsuperscript{6}

Bibliography