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Evaluation of XHVRB for Capturing Explosive Desensitization in CTH

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Model Equations

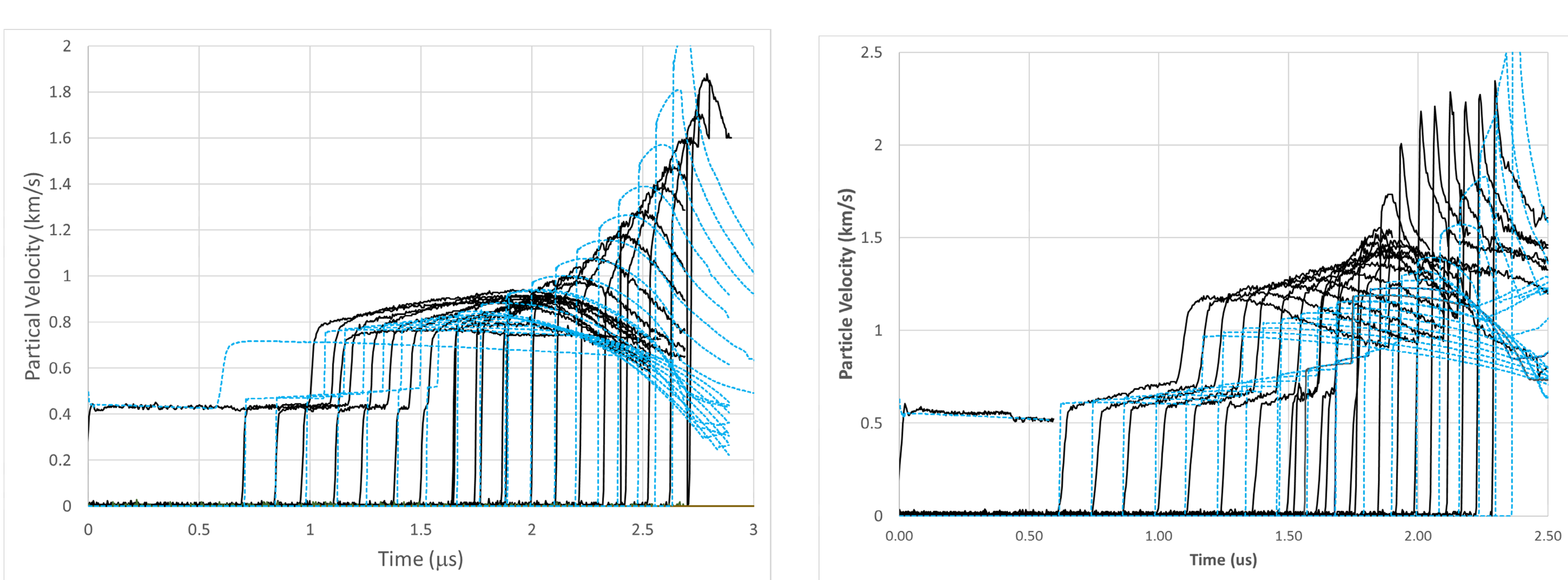
HVRB

$$\phi = \frac{1}{\tau}\int_0^t \left(\frac{P - Pi}{P_r}\right)^{Zr} dt \qquad \varphi = \int_0^t \left[\frac{P_s - Pi}{P_r}\right]^{n_s}\left[\frac{P}{P_r}\right]^{n_b}\frac{dt}{\tau} \qquad h(q_s) = \left(\frac{q_s}{c_{vo}} - \frac{p_i}{p_r}\right)^{n_s} \qquad \frac{\Delta q_s}{c_{vo}} = \frac{\Delta ps/pr}{\left(\frac{p_{su}}{p_0}\right)^{n_d}}$$

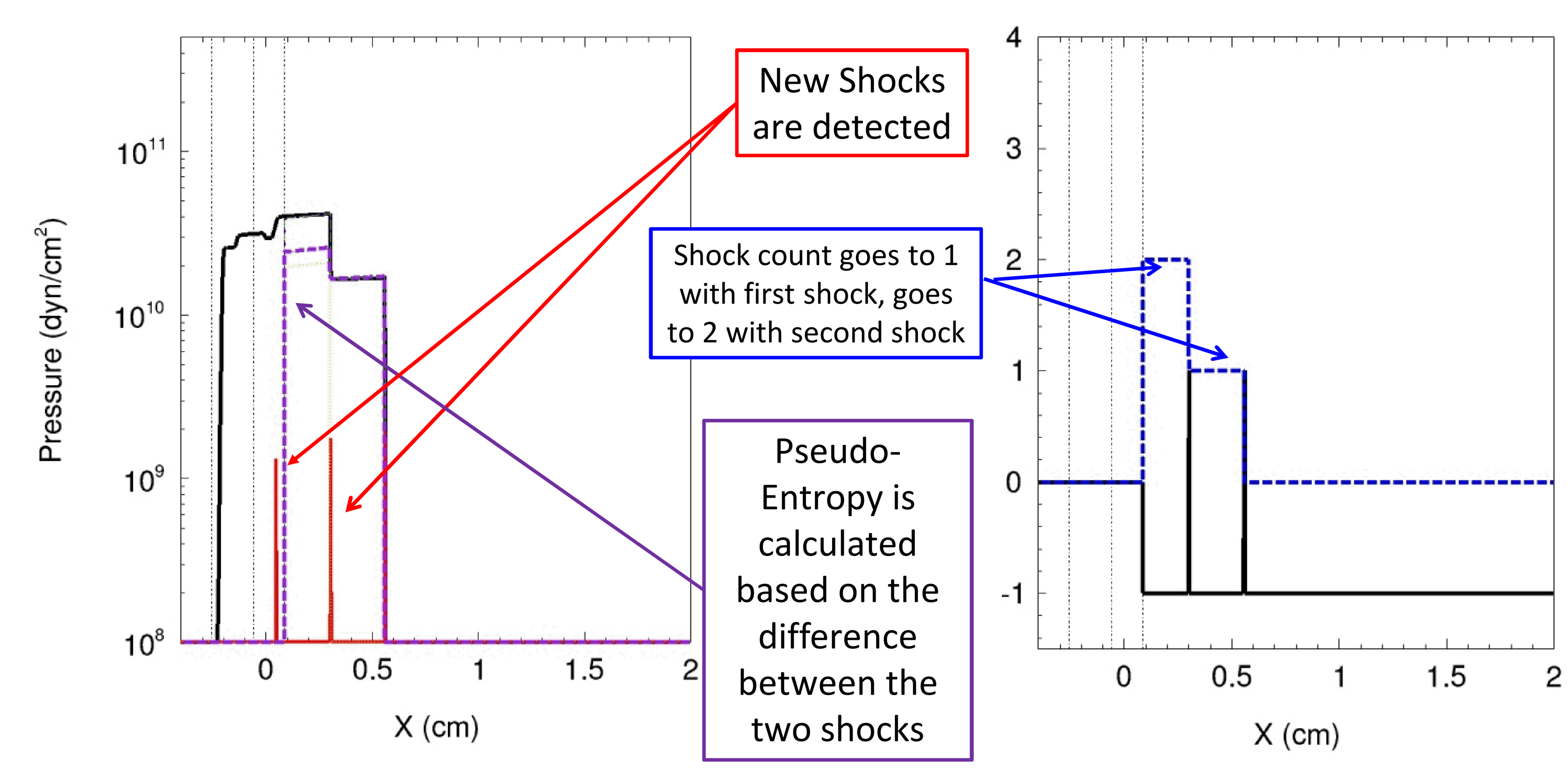
XHVRB is a new reactive flow model for capturing desensitization in explosives due to pre-shock. It differs from HVRB in its shock capturing feature, as well as its expression for the history variable which now depends on pseudo-entropy [1].

1-Dimensional Evaluation

Shock-reshock

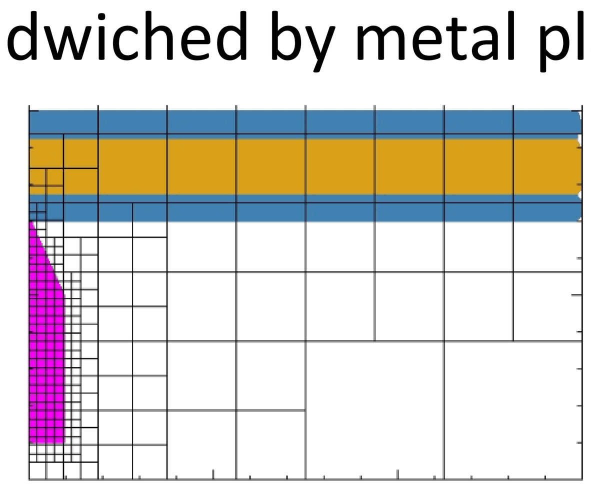


XHVRB is compared to embedded gauge data from a double-shock experiment to demonstrate its ability to capture explosive desensitization [2].

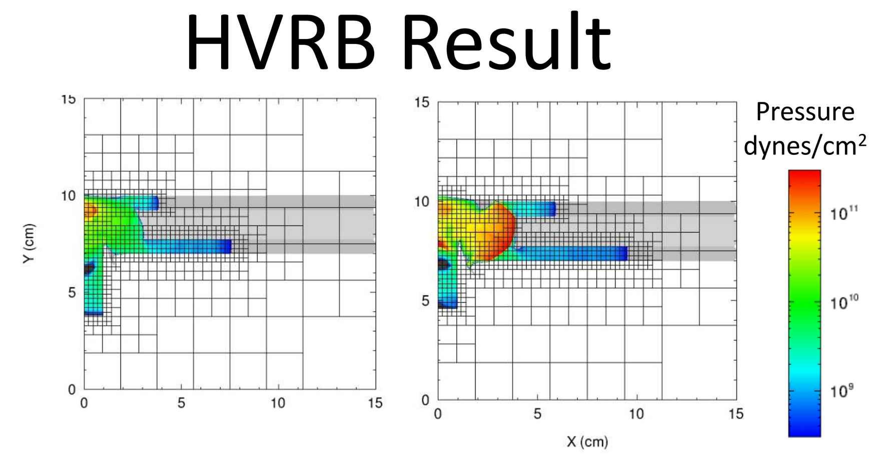


Multi-Dimensional Scenarios

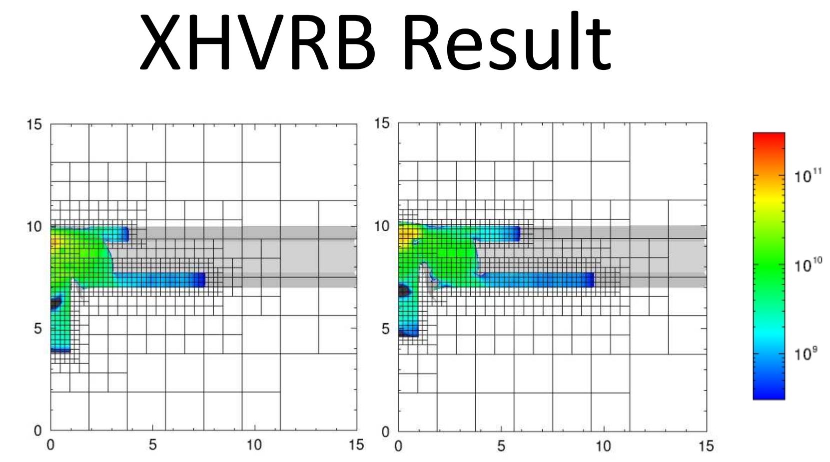
Problem: Penetrator into explosive sandwiched by metal plates



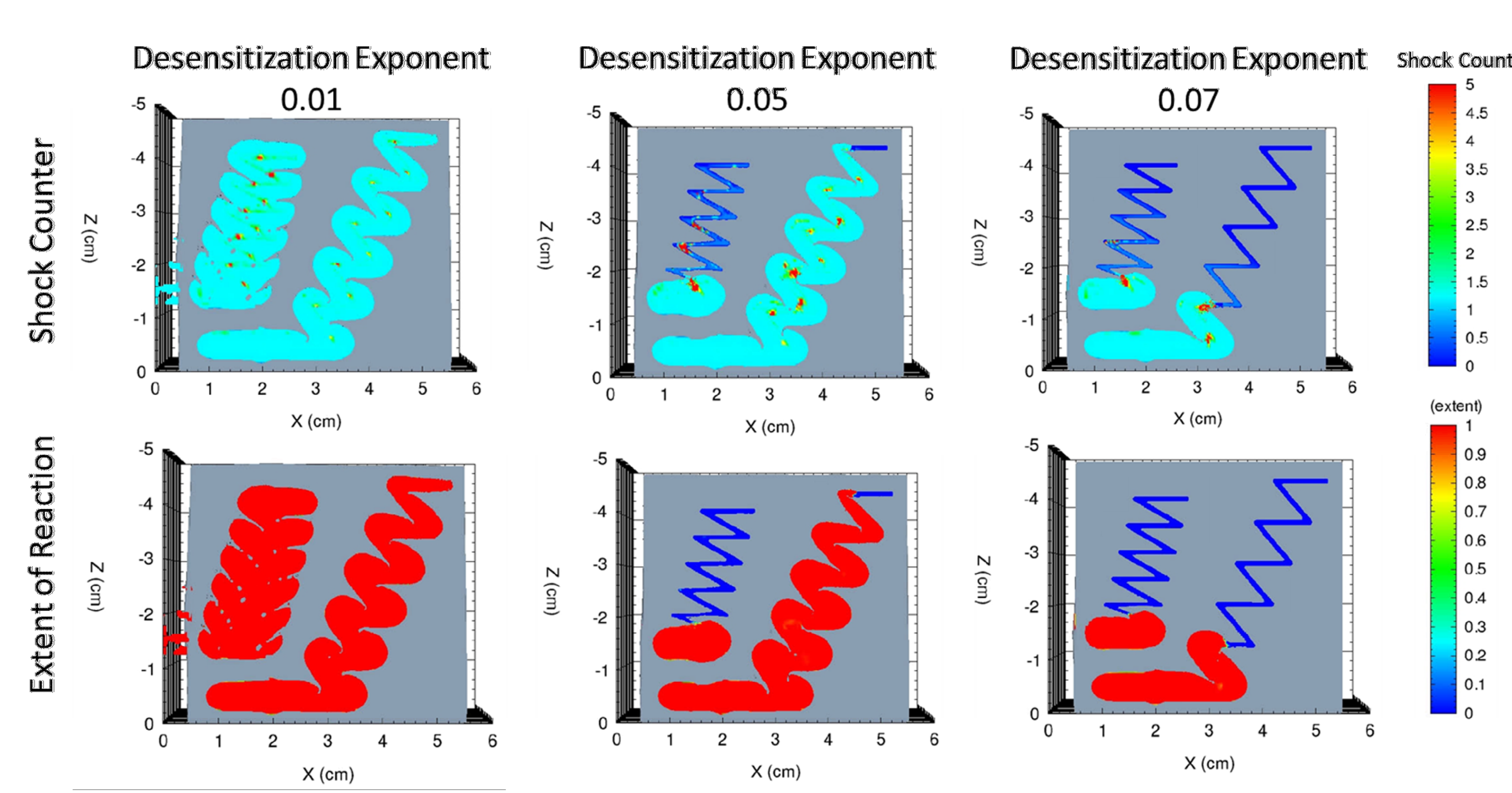
HVRB Result



XHVRB Result



HVRB (top) shows a transition to detonation upon reflection of the shock, but XHVRB (left) effectively desensitizes the explosive and does not transition.



Simulation results from CTH using XHVRB to model detonation propagation in two different tracks giving different pre-shock magnitudes. The shock counter is shown on the top row for three different values of the desensitization exponent, and the extent of reaction is shown on the bottom row.

[1] Starkenberg, IDS 2014, pg. 908
[2] Salisbury et al., IDS 2010, pg. 271

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