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Title:	James Space Performance Characterization of an Interaction Detonator
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James Space Performance Characterization of an Interaction Detonator

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Abstract

Interaction detonators make use of shock wave interactions within an explosive to achieve initiation. Thereby achieving in a group an effect that will not be achieved individually. In this work, the interactions are analyzed in terms of the James initiation criterion to help understand the initiation mechanism.

James Initiation Criterion and James Space

The James Criterion is

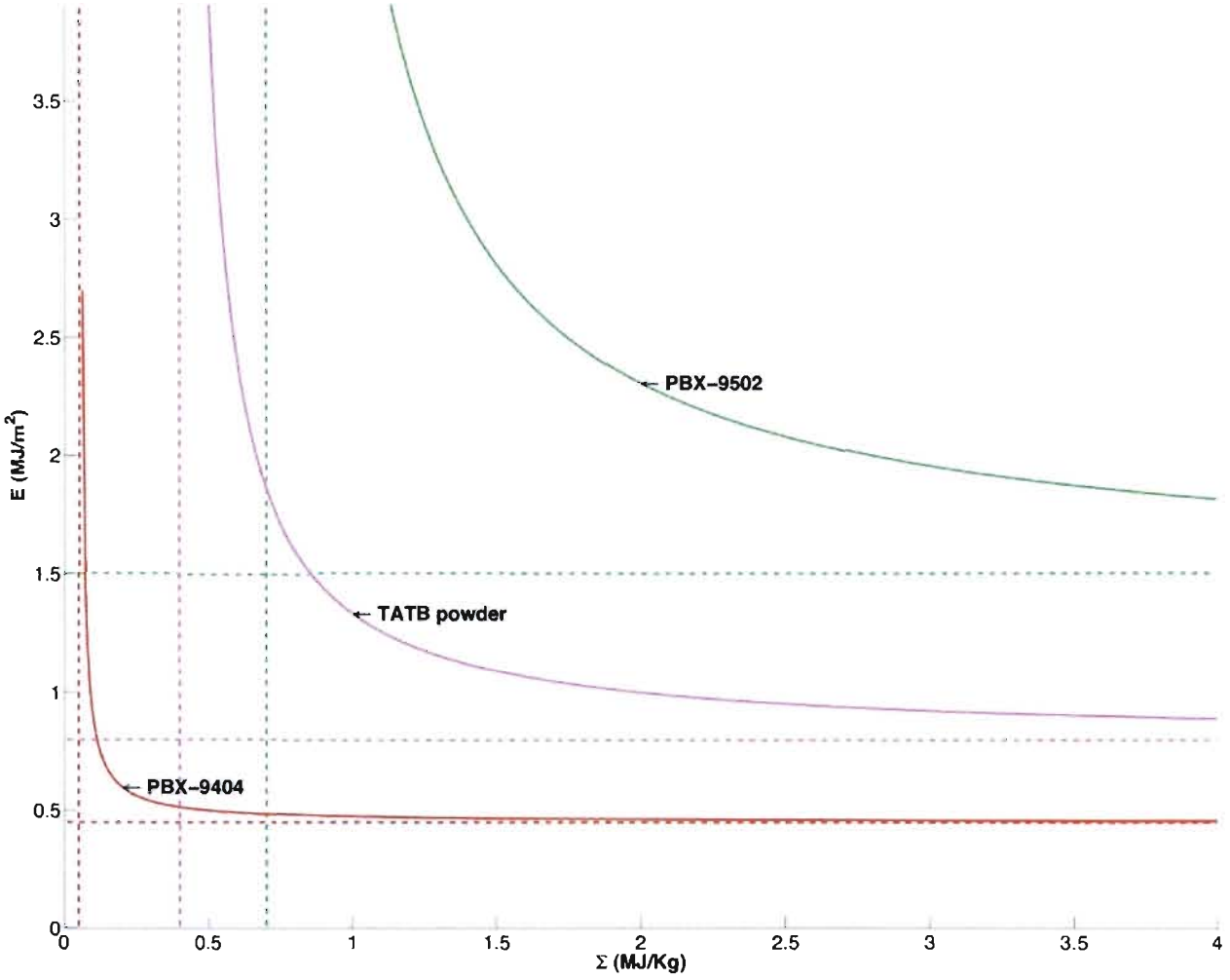
$$1 = \frac{E_C}{E} + \frac{\Sigma_C}{\Sigma}$$

Where,

$$E_C = \int P u_P \, d\tau,$$

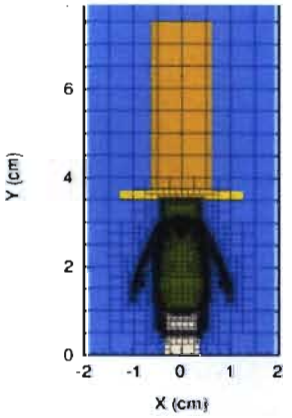
$$\Sigma_C = \frac{u_P^2}{2}$$

James, H. R., *PEP* 1996

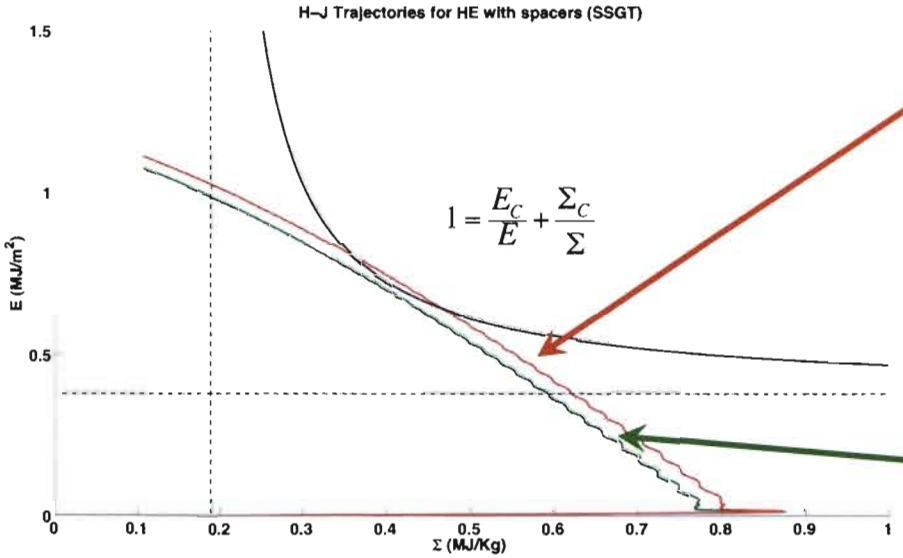


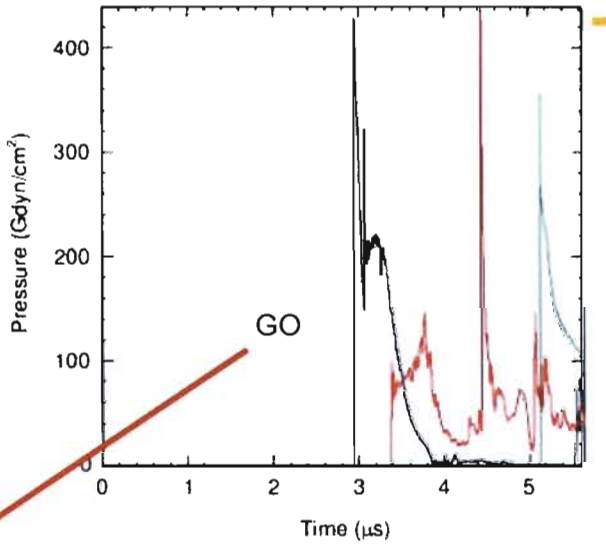
Detonation Transfer

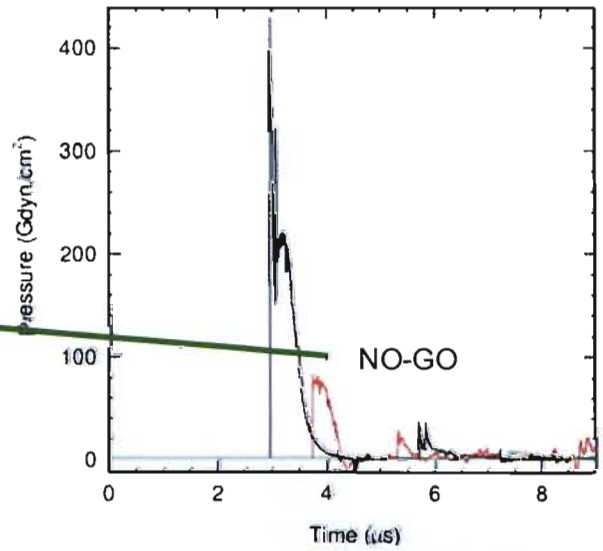
- Experiments and calculations to study conditions that promote or inhibit initiation
  - Consists of donor HE, inert layer, acceptor HE
  - Wave-centric view is detonation to shock to detonation
- What gaps or layers will interrupt/transmit a detonation?
- PDV and Schlieren will be used to characterize the drive and establish basis for calculation input



~10 µm zones with AMR

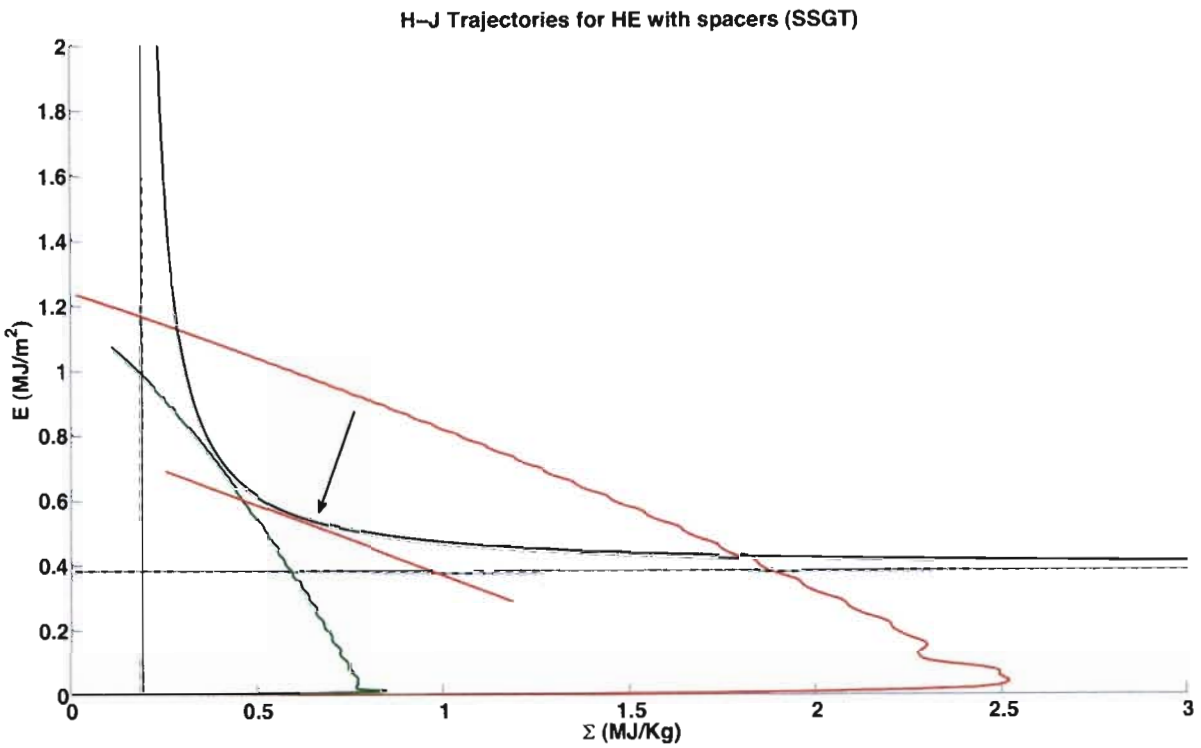




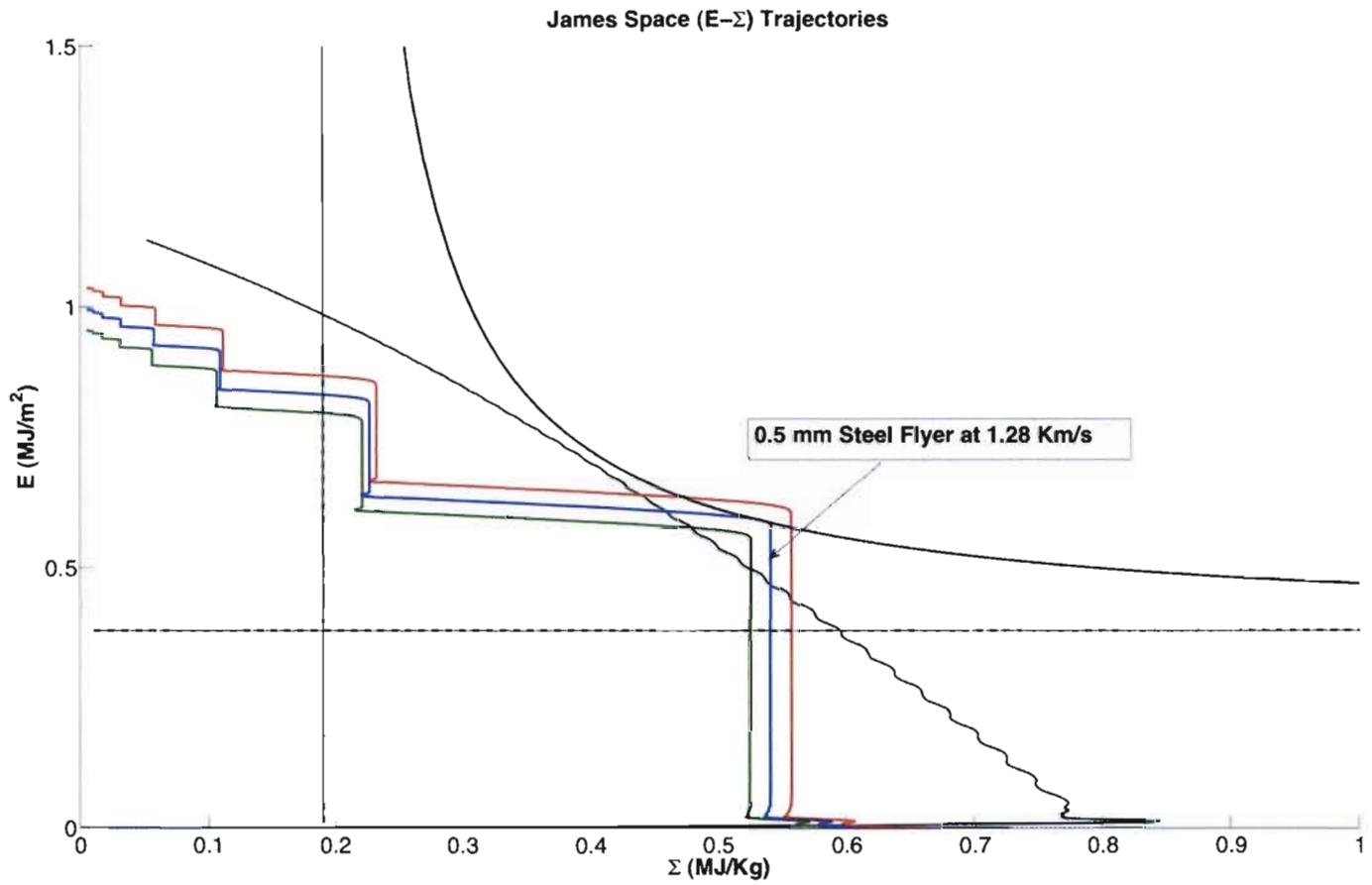


Variations of LANL SSGT for $E_c - \Sigma_c$ Determination

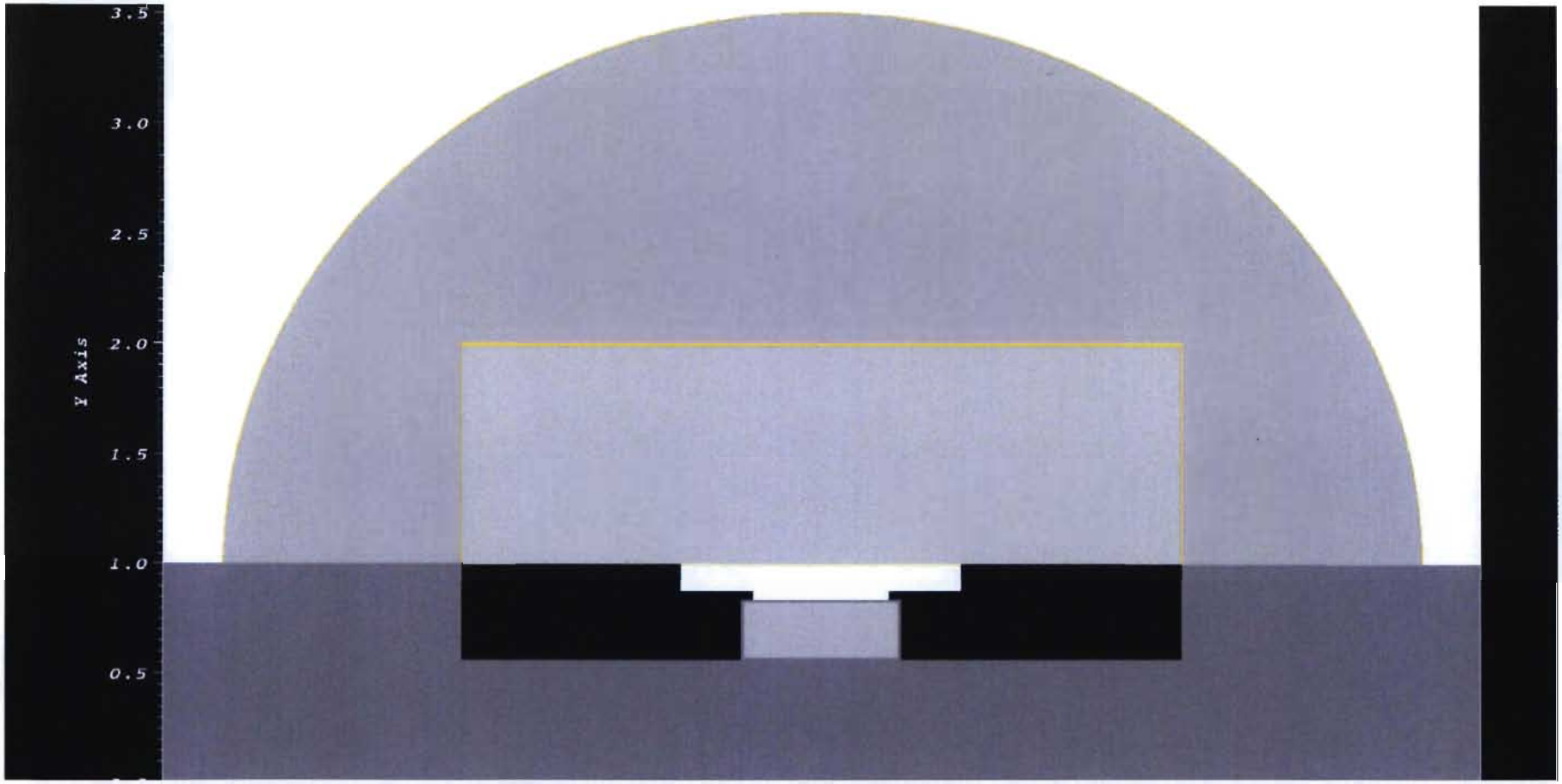
- The standard brass SSGT finds one intersect of the hyperbola
- Using varied (or omitted) attenuators and/or varied HE drive pellets
  - Many intersects could be obtained
  - Therefore the $E_c - \Sigma_c$ parameters could be determined
- Useful addition to other data sources



Flyer Impact Trajectory through James Space

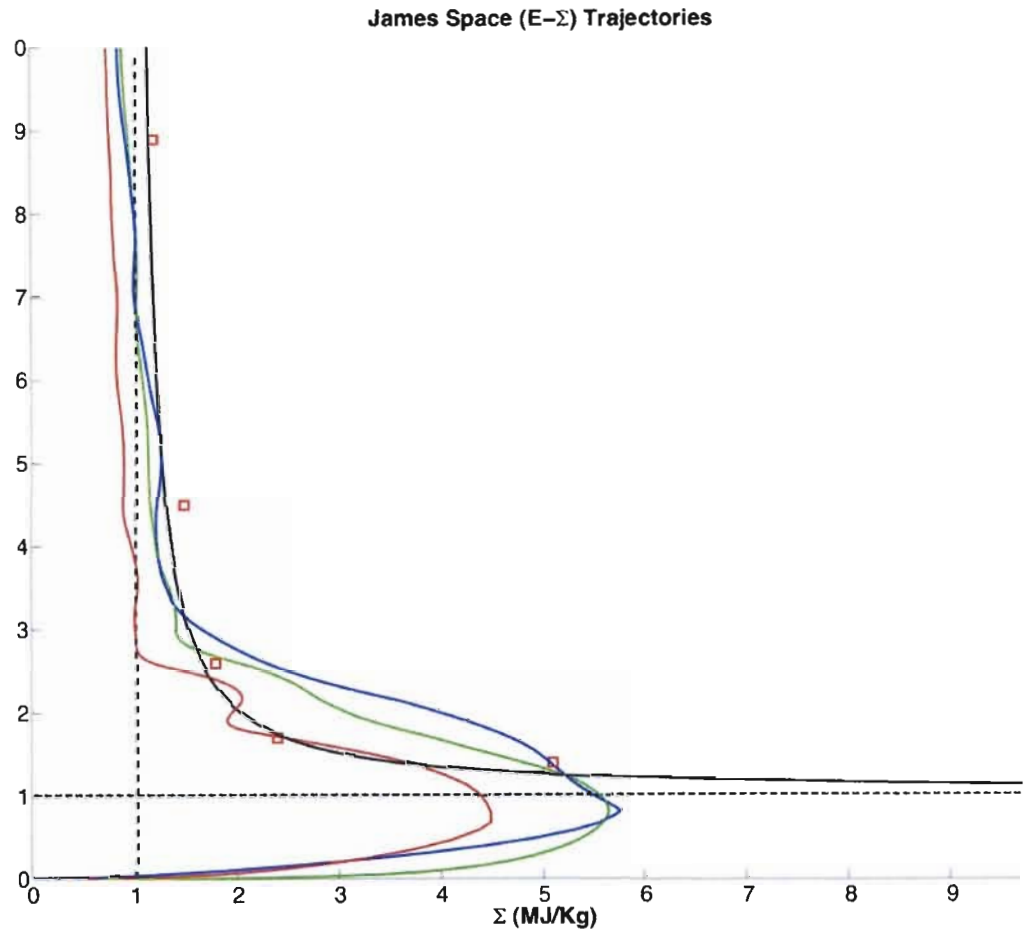


Previously Studied Onionskins in H-J Space



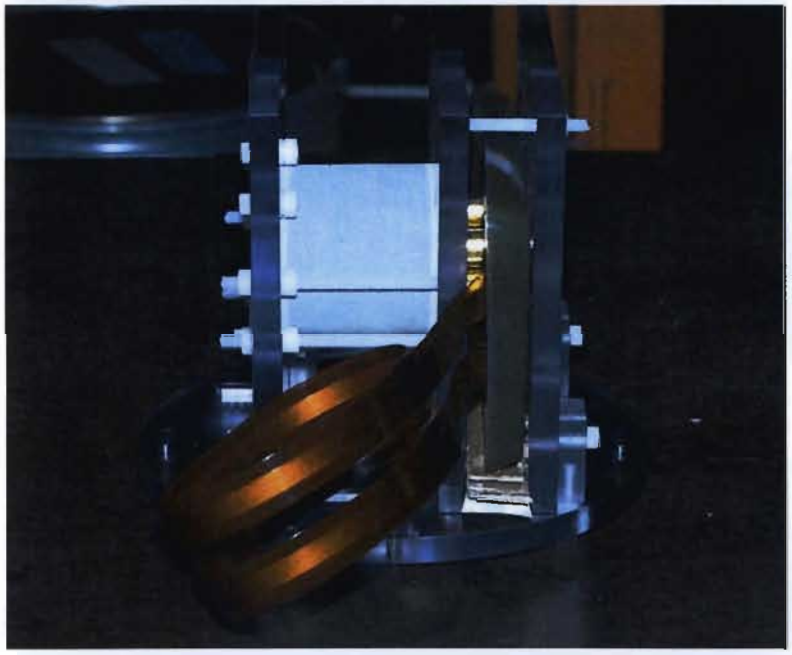
Back to James Space

- Onionskin calculation in ALE3D with Lagrangian tracer points
  - Top, Side, and corner of booster
  - P and u_p used to plot trajectory in James space as before
- All three trajectories pass the James criterion
- Data on LX-17 shown for comparison

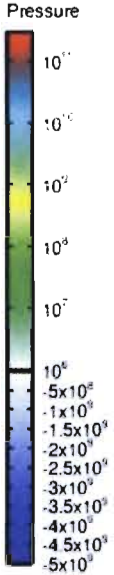


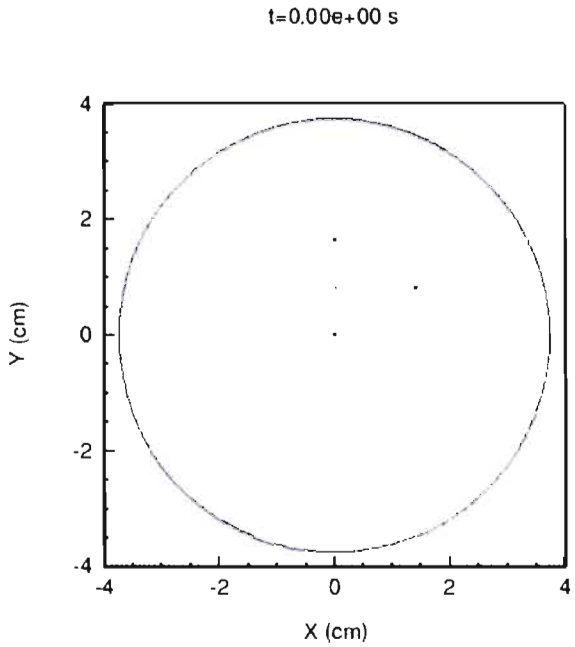
7 Point Interaction Detonator

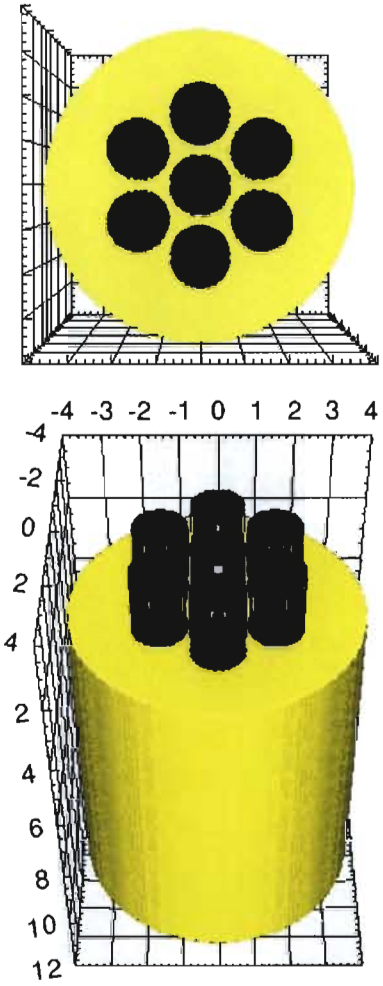
- What about multiple detonator systems?
- Advantage to MDS's is that no single detonator can trigger IHE directly
- It is the shock interaction of multiple detonators *within* the IHE that leads to initiation
- With hydro code calculations we can
  - Simulate misfires
  - Optimize detonator array
  - Study effect of misalignment
  - Get a feel for what the heck is going on in there
  - Interpret this effect in terms of James space



7 Point Interaction Detonator







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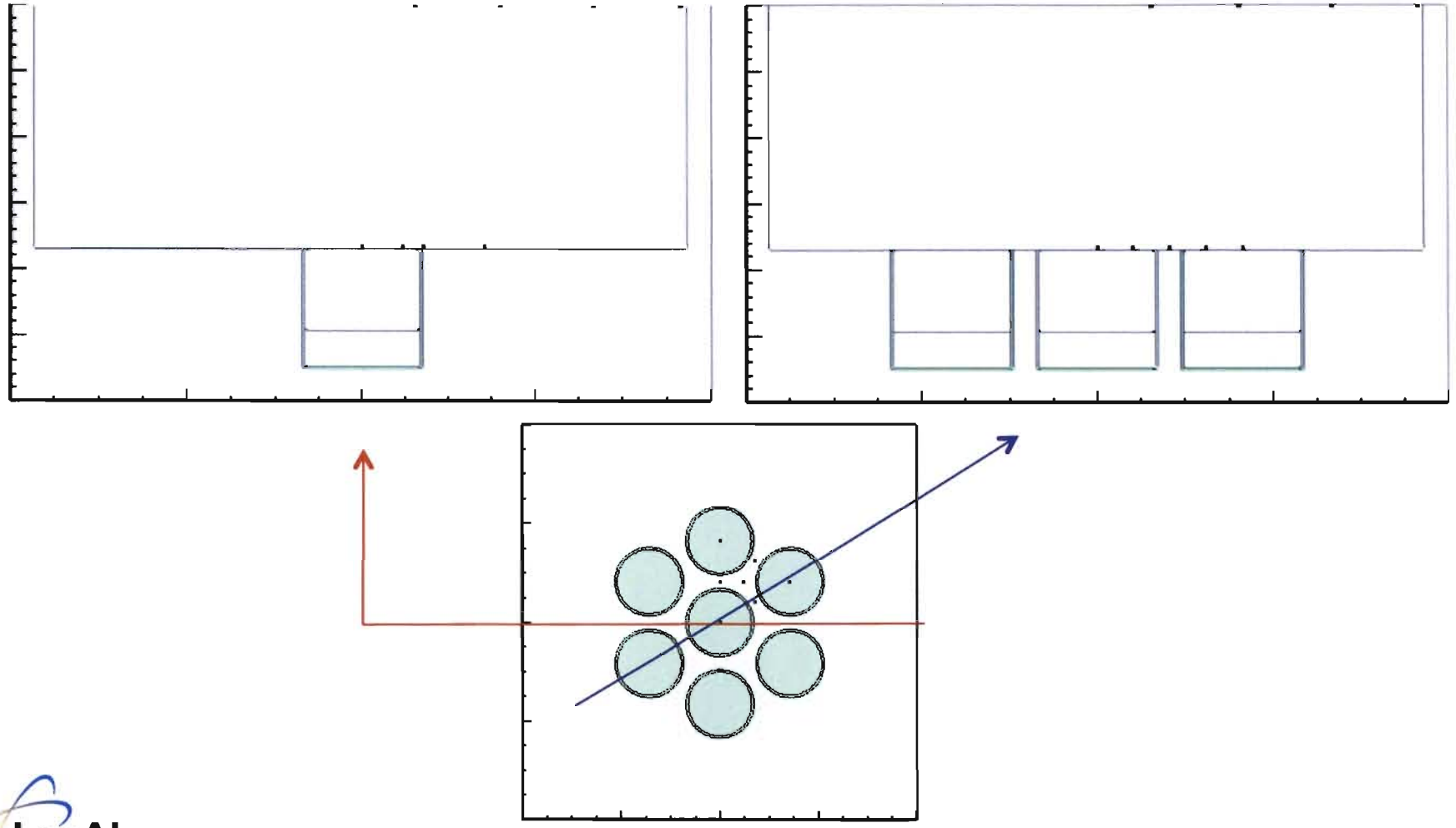
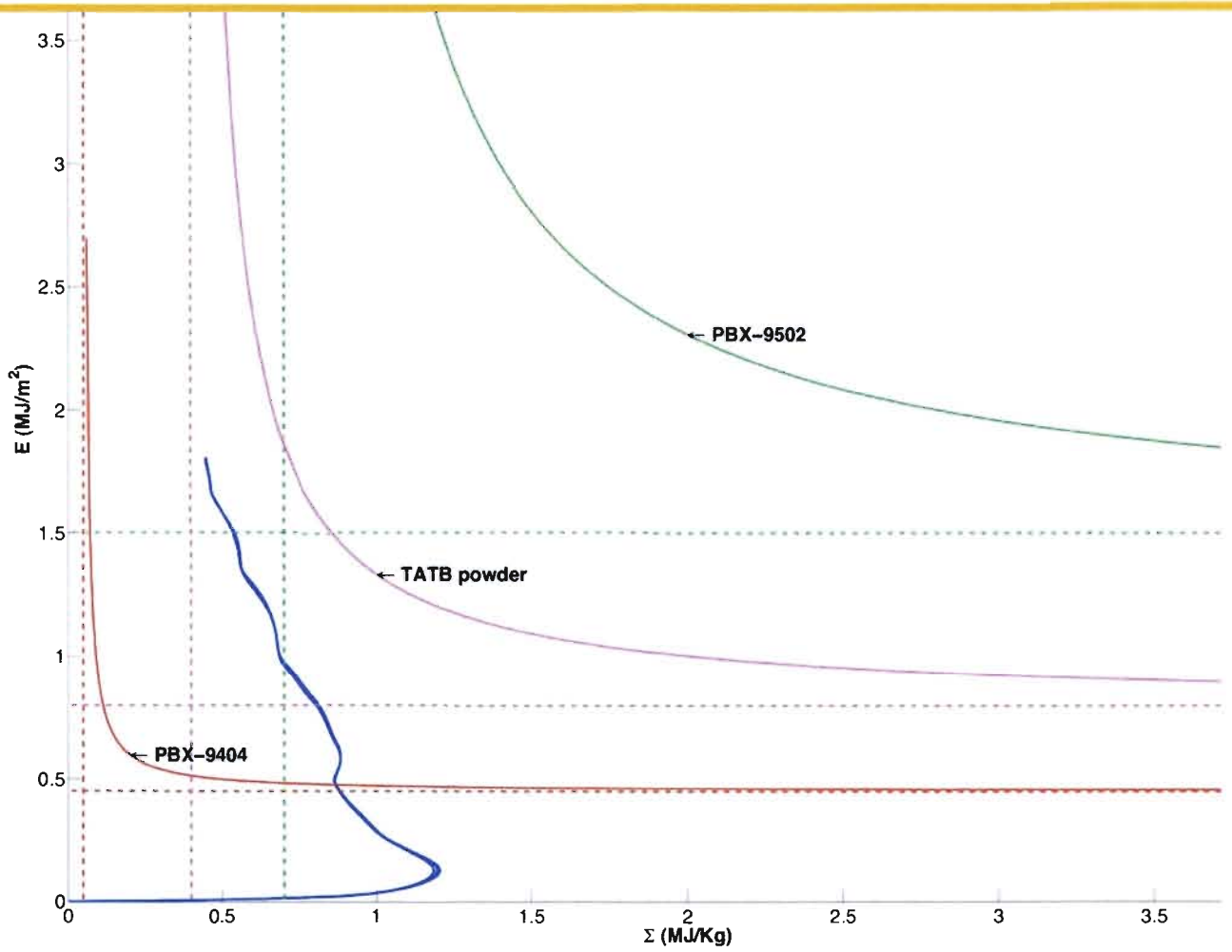
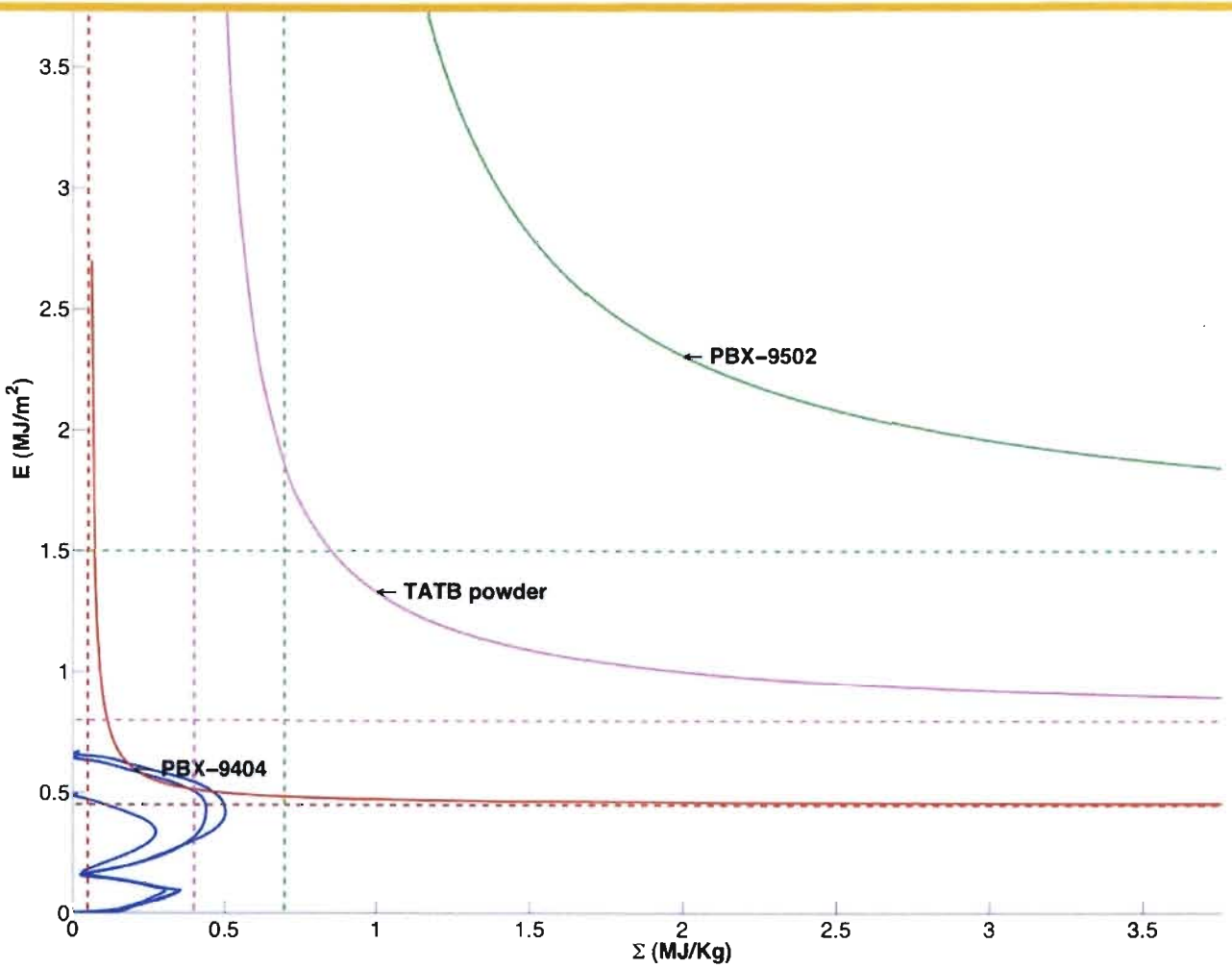


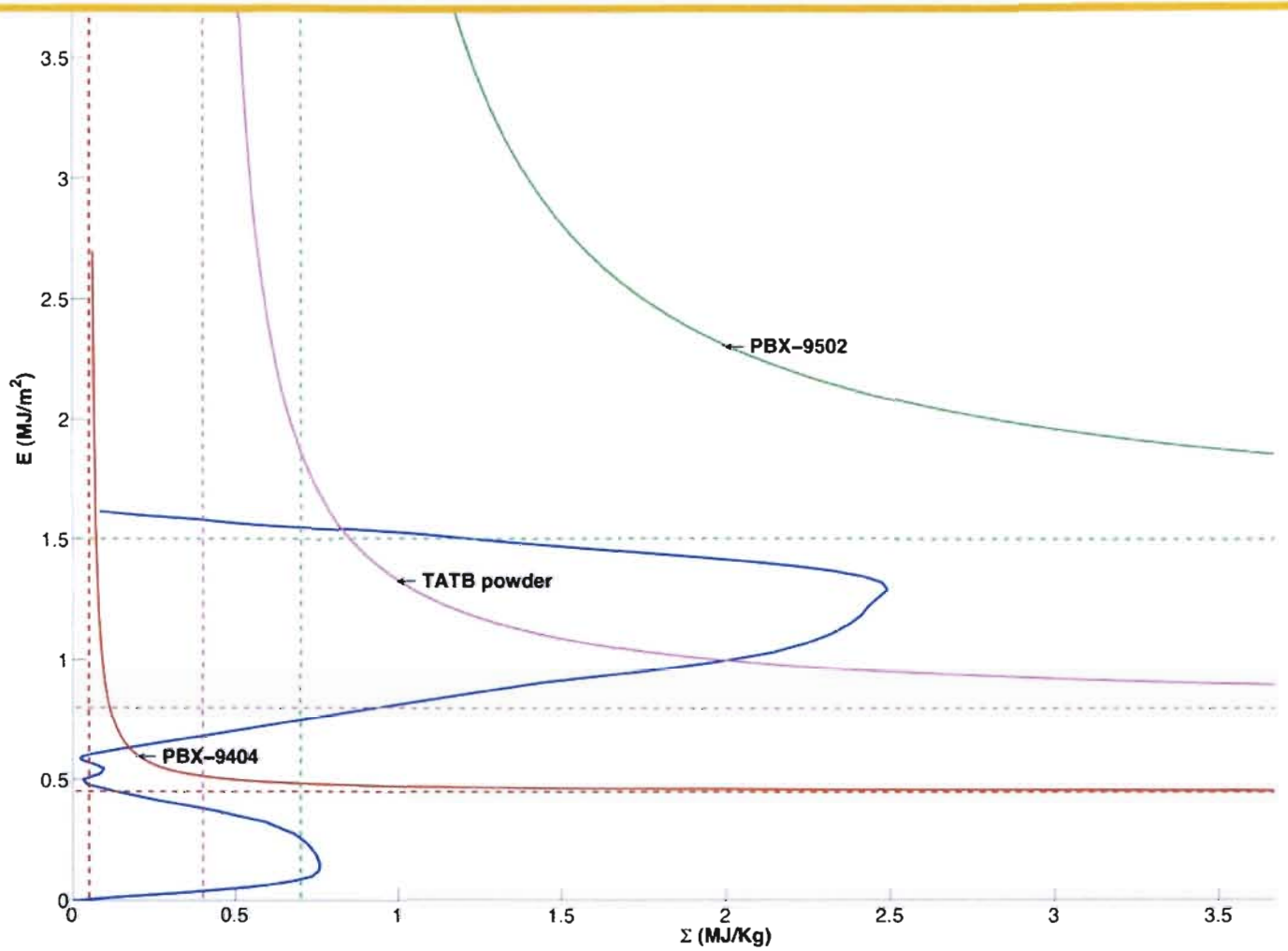
7 Point Interaction Detonator- Single Points



7 Point Interaction Detonator- Double Points

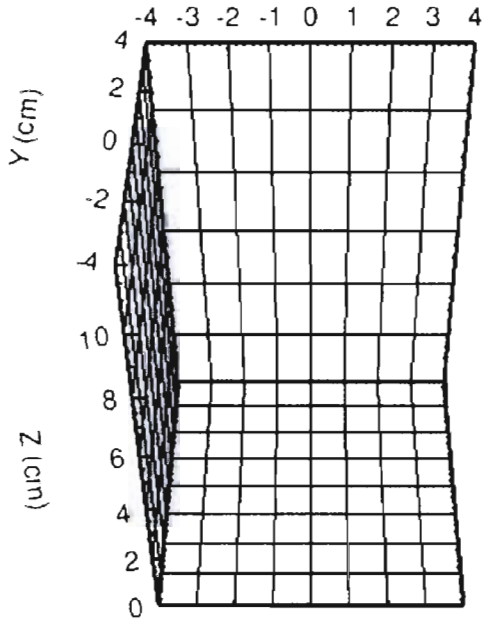


7 Point Interaction Detonator- Triple Point



Continuing work

- Detonator characterization
  - Single detonator shots with PDV and Schlieren into air and PMMA
- Cut back shots with PDV
  - Verify the state at various depths into HE layer
- Gap tests to determine $E_c - \Sigma_c$
  - Improved understanding of safety and performance margins
- Additional calculations as discussed to leverage Prad data etc.



Acknowledgments

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- Hugh James
- W-6