TACOM

Mobility and Firepower for America's Army

HIGH SPIN ARMOR PIERCING WARHEADS DEVELOPMENT WITH Mo AND Ta LINERS

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GENERAL DYNAMICS
Ordnance and Tactical Systems

OCSW AP Warheads

Outline

- Introduction
- Background
- Modeling/Design
- Experimentation
- Redesign
- Conclusions

OCSW AP Warheads

Introduction

- **TACOM-ARDEC Warheads**
  - Long history of anti-armor warheads design
  - Technology development
  - JSSAP/GD-OTS OCSW Application
- **AP Ammunition Requirements**
  - OCSW, M789, LW30, M203 upgrade
  - Lightweight AP warheads
  - Effective over engagement range/spin rates

OCSW SC Warheads

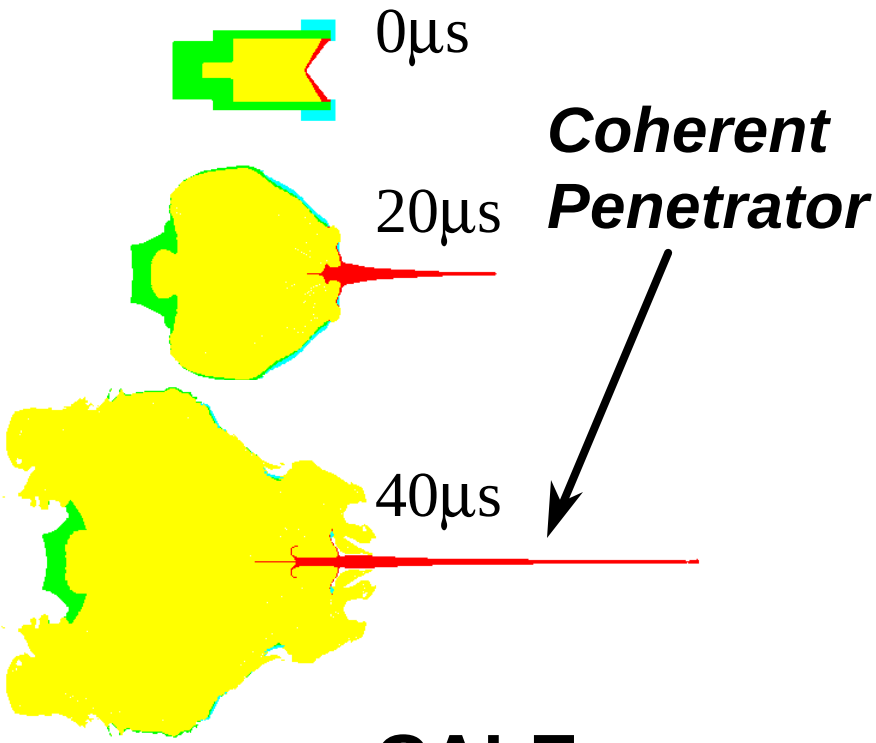
Background

- **Previous Liner material investigation**
  - Cu, Mo, Ag, Ta
  - Primary focus on axisymmetric (cost/time)
  - Base initiated configuration
- **Previous OCSW AP Development**
  - Change to AP nose fuzing: Single design iteration
  - Static spin and gun launched testing completed
- **Current SC focus**
  - Modeling/design development
  - Liner producibility, increased penetration

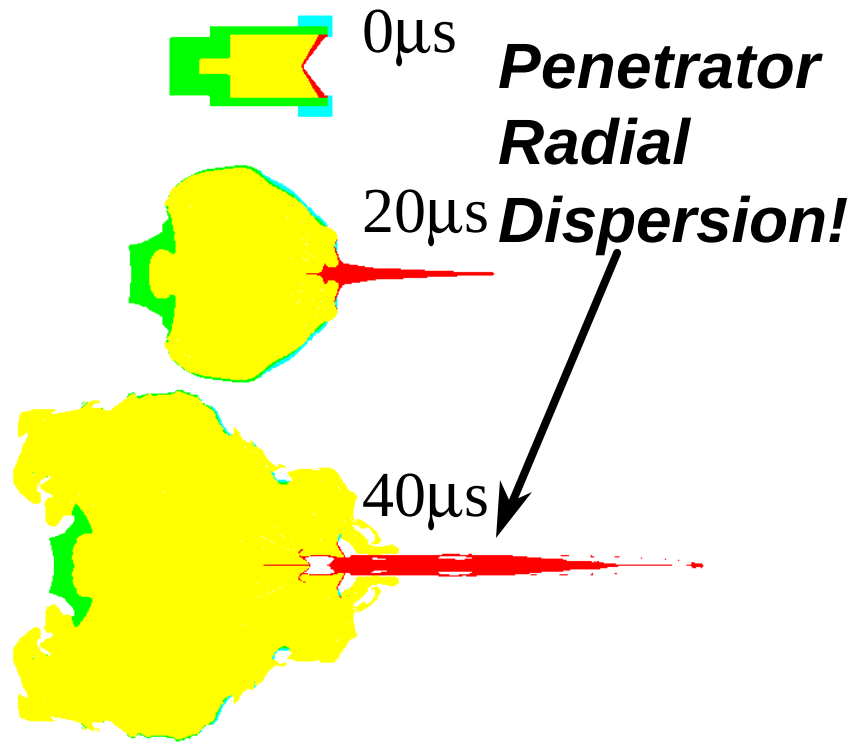
OCSW AP Warheads

High Spin Penetrator Dispersion

No Spin



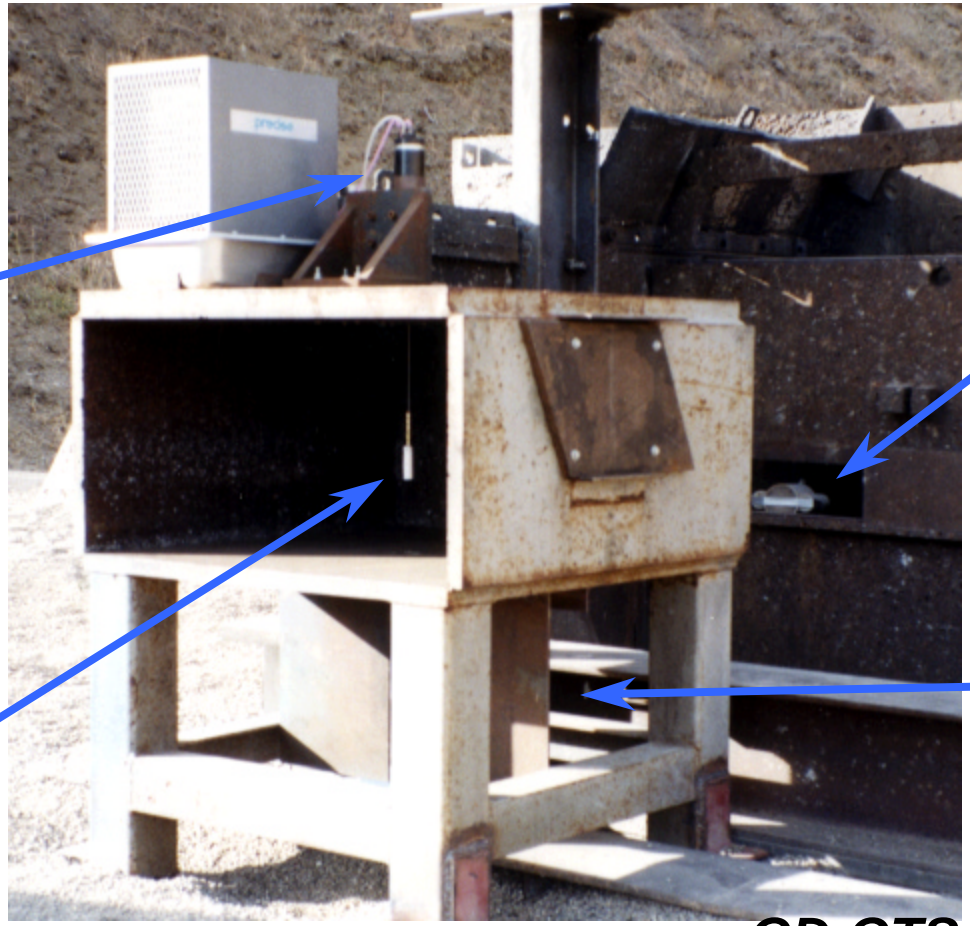
High Spin



- **CALE**
  - Explicit Finite Difference Program
  - 2D Arbitrary Lagrange Eulerian (ALE)
  - Failure, Spin

OCSW AP Warheads

High Spin Test Stand



Spin Motor

X-Ray Head

Warhead

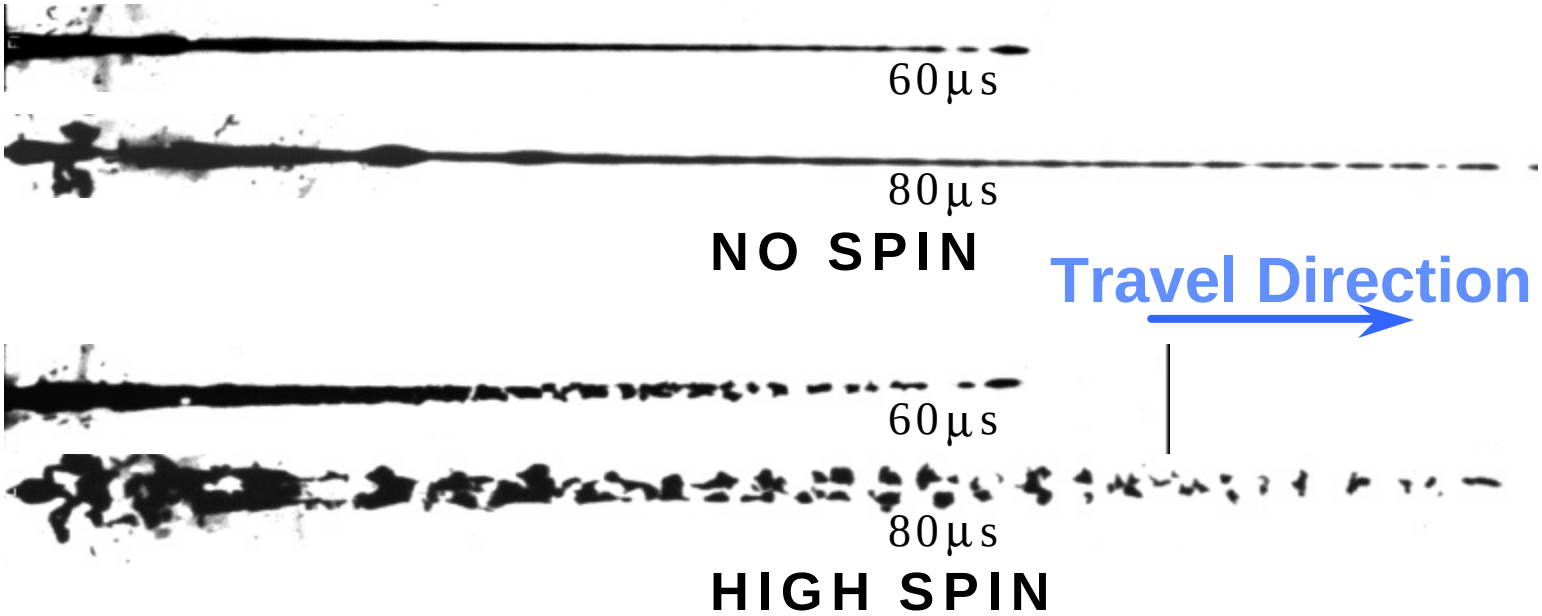
Target/Film Area

GD-OTS Test Facility

OCSW AP Warheads

Flash X-Rays

Baseline Warhead



Excellent Modeling/Experimental Agreement!

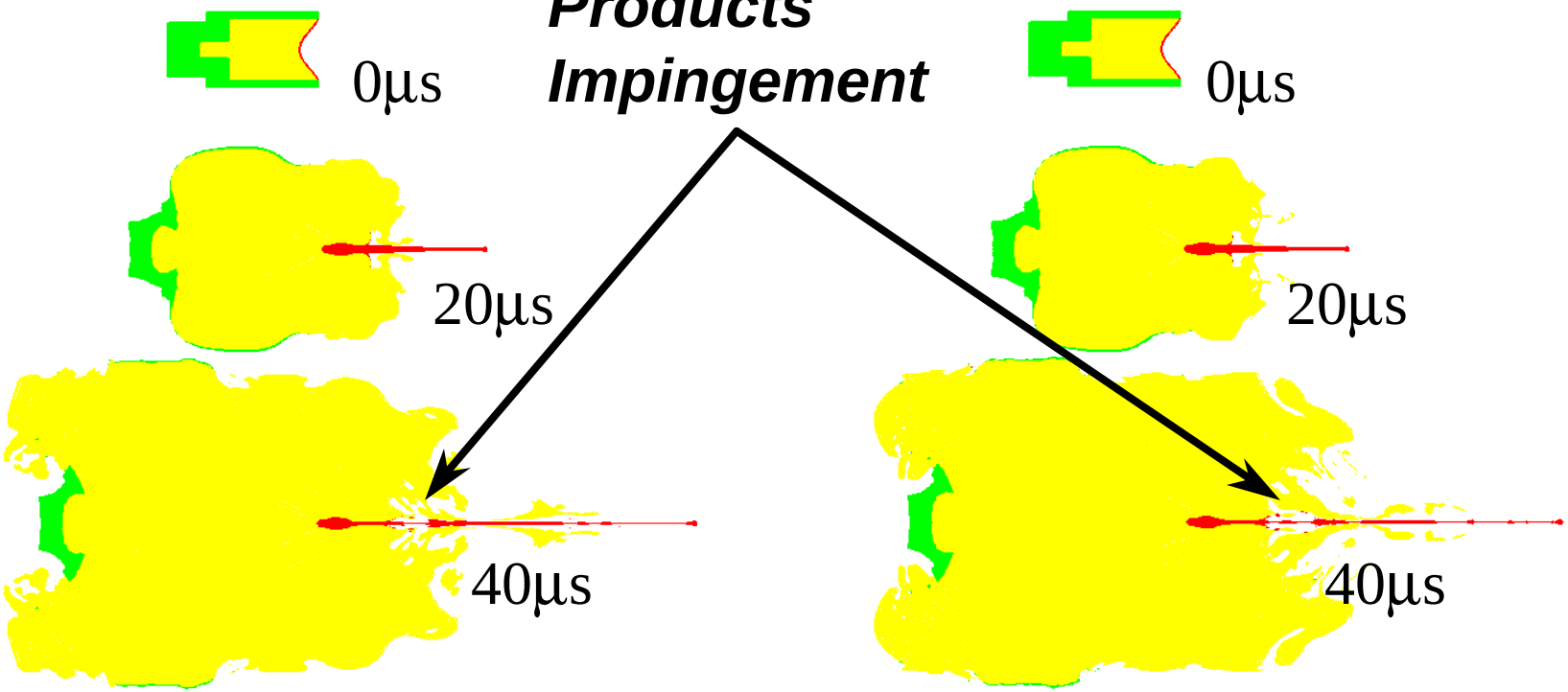
OCSW AP Warheads

Products Impingement

No Spin

Detonation Products Impingement

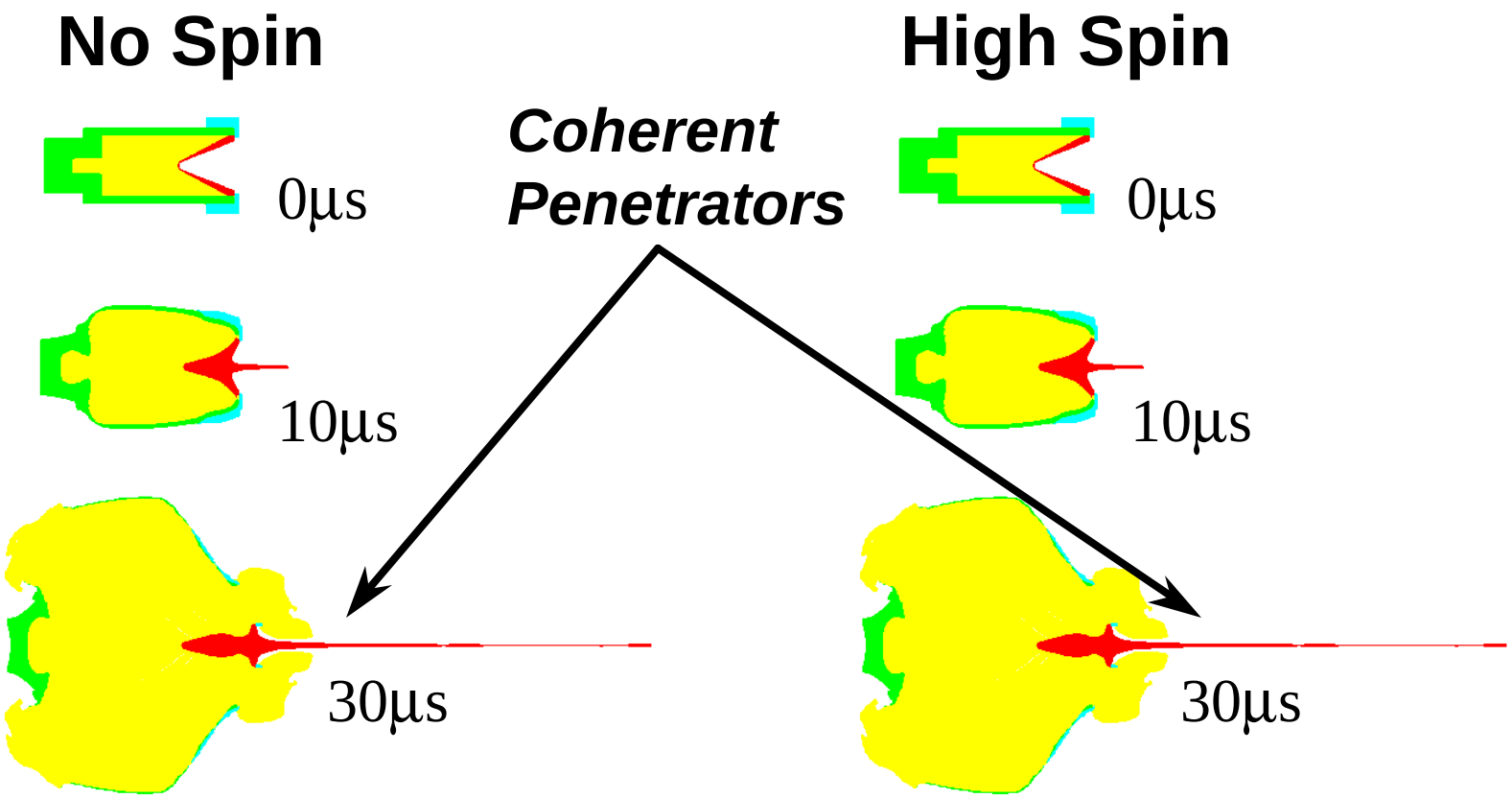
High Spin



Gaseous Guillotine!

OCSW AP Warheads

High Spin Coherent Penetrators



Nearly Identical Unperturbed Penetrators!

OCSW AP Warheads

Flash X-Rays

Radially Dispersed Copper Penetrator

Travel Direction

Radially Dispersed Tantalum Penetrator

- ***Radial dispersion depends on both design and material***
- ***Mass matching of designs doesn't work***

OCSW AP Warheads

Flash X-Rays

Coherent Molybdenum Penetrator

Travel Direction

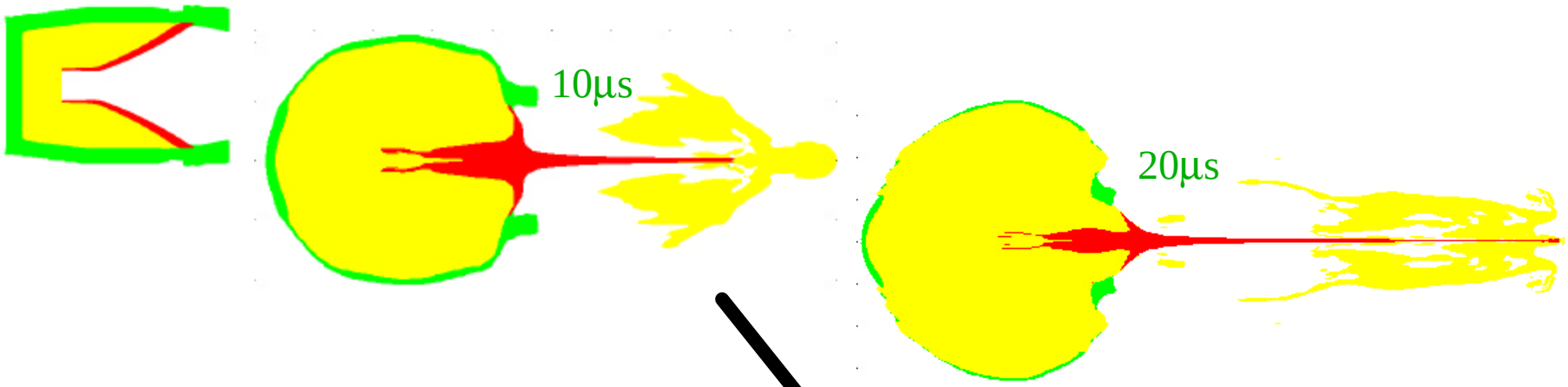
Coherent Tantalum Penetrator

Design must be appropriate for the material!

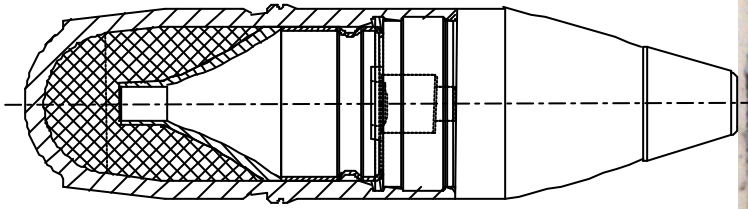
OCSW AP Warheads

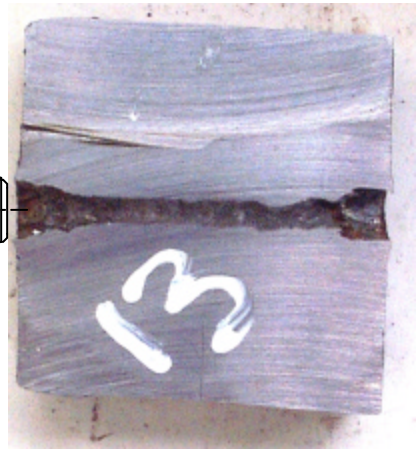
Original Nose Fuzed Design

Trumpet Design



- Single Iteration Nose Fuze
- Trumpet Liner
- LX-14 Explosive
- Static Spin Testing
- Dynamic Gun Testing





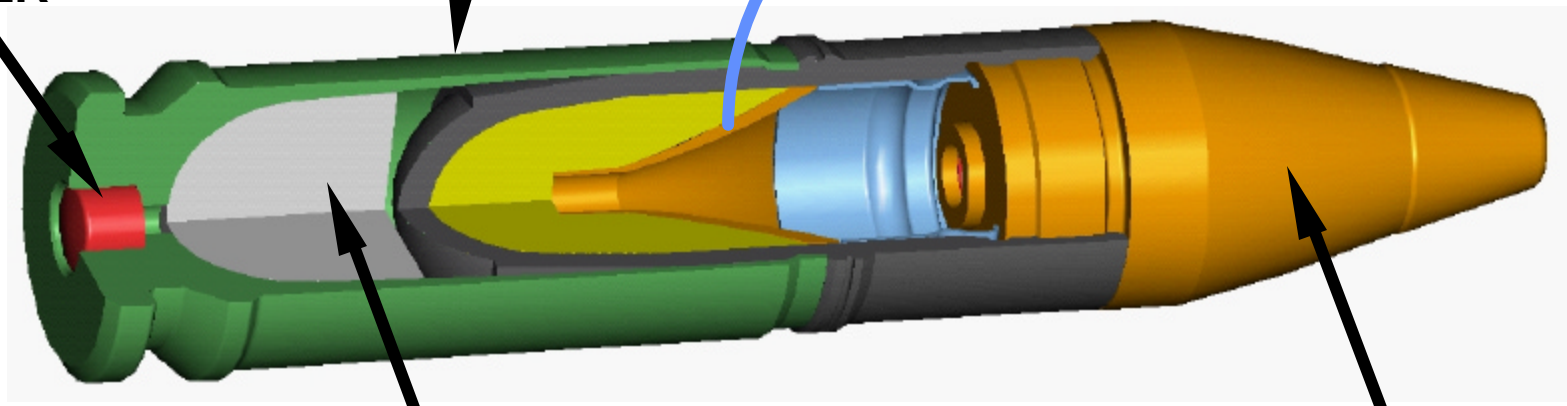
OCSW AP Cartridge

Dynamic Test Configuration

TRUMPET LINER

LOW WEIGHT ALUMINUM CARTRIDGE CASE

STANDARD CAL .50 PRIMER

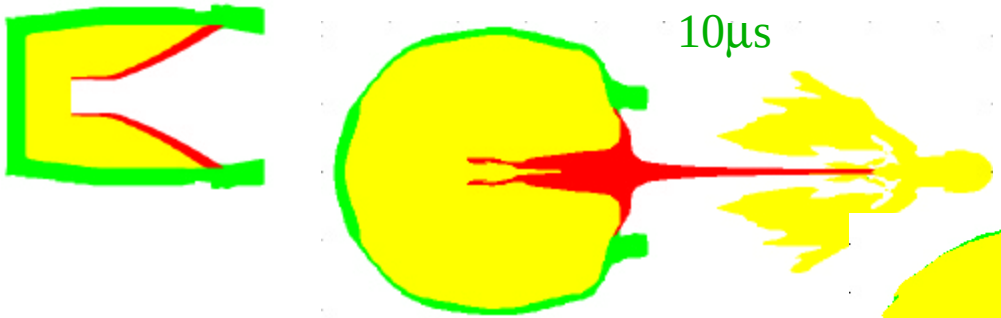


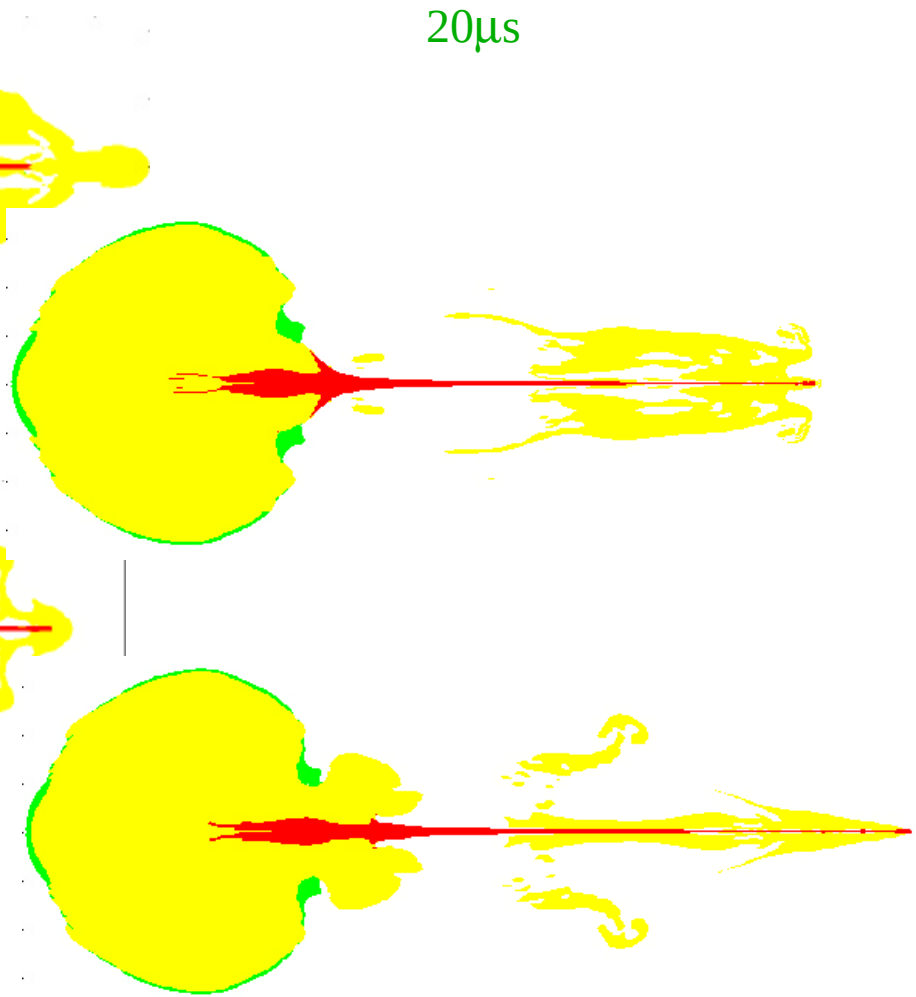
CONVENTIONAL BALL PROPELLANT

MODIFIED FUZE

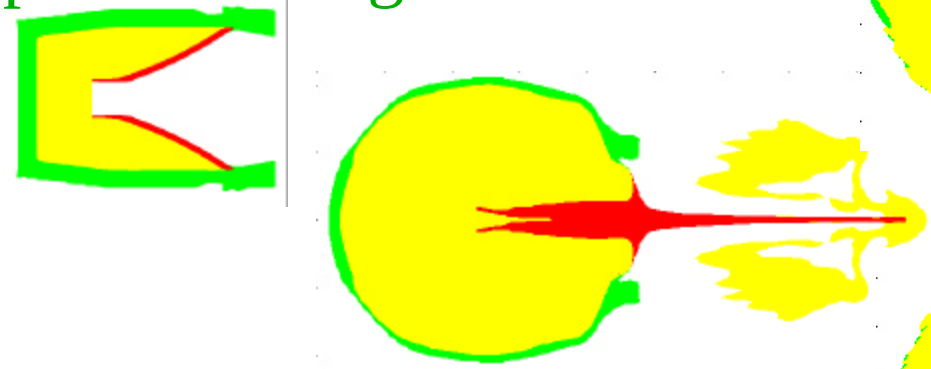
OCSW AP Redesign

Original Design





Improved Design



- *Improved Manufacturability!*
- *IM Explosive (PAX2A)*
- *Increased Performance!*

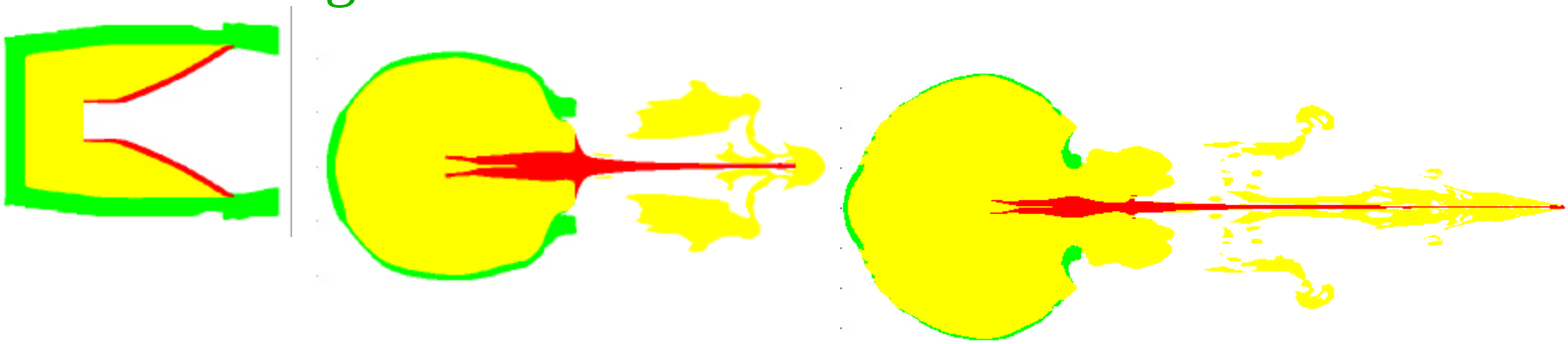
OCSW AP Redesign

Slower Redesign

10μs

20μs

Faster Redesign



- *Slower design yields increased stability*
- *Faster design, if stable, has greater penetration potential.*

OCSW AP Redesign

Density Comparison of Designs at High Spin

20ms, 500rps

Original Design:

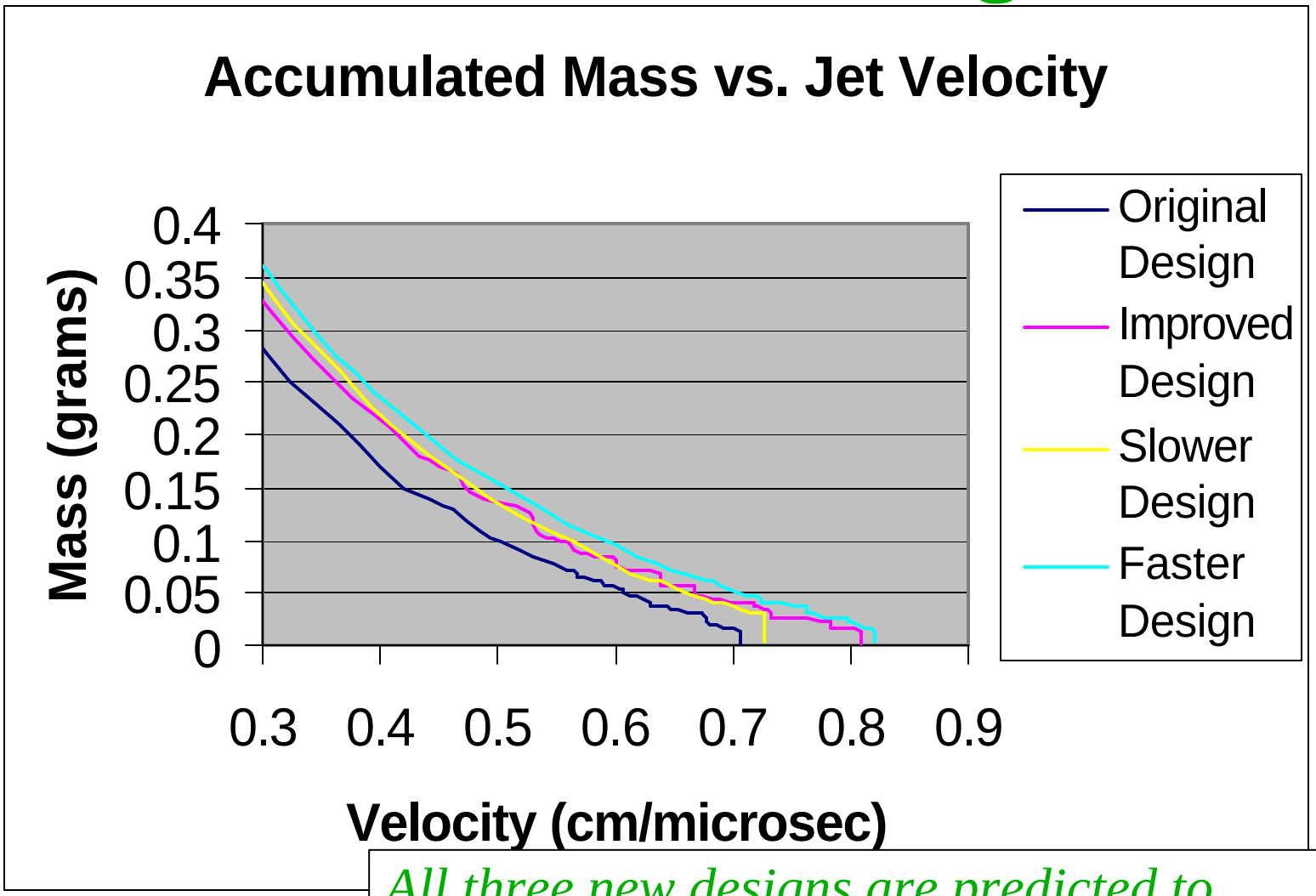
Improved Design:

Slower Design:

Faster Design:

- *Slower design undergoes less radial dispersion*
- *Faster design attains a higher jet velocity*

OCSW AP Redesign



All three new designs are predicted to provide increased performance!

OCSW AP Redesign

Conclusions

- OCSW AP Original Design
  - Nose fused
  - Static Spin Testing
  - Dynamic Gun Firing Demonstration
- OCSW AP Mo and Ta redesigns complete.
  - Improved manufacturability
  - IM explosive (PAX2A)
  - Increased predicted performance
- Manufacturing methods investigation underway