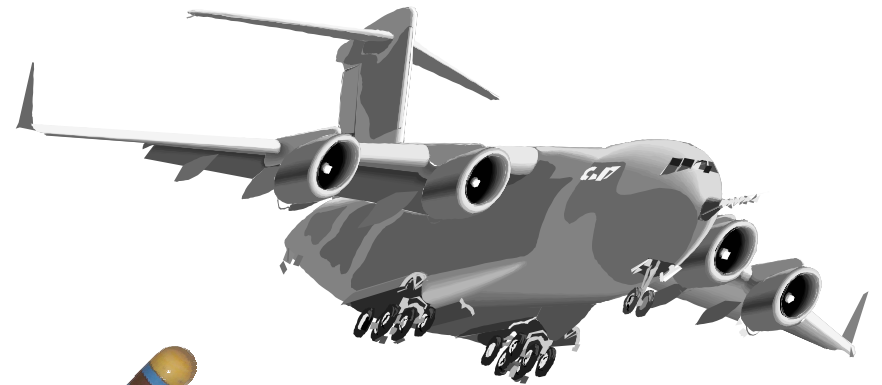


# Dual Thrust Modified Smokey Sam for Low Cost Testing and Simulation

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**EO Sensor Technology Division**  
**Sensor Directorate**  
**Air Force Research Laboratory**



# Project Description



- **Objective(s):**
  - Develop a low cost, dynamic stimulation capability for EO/IR missile warning and directed IRCM system
- **Requirements**
  - Provide motions and nominally representative rocket plume signature of MANPADS threats
  - Provide method to stimulate Close Loop Laser IRCM testing
  - Provide method to detect laser emissions from directed IRCM systems
  - Provide controlled trajectory for operations in close quarters, or heavy clutter areas as well as free flight
- **Technical Approach:**
  - Use GTR-18A SMOKEY SAM rocket as baseline capability
  - Naval Surface Warfare Center – Indian Head modifies rocket motor
  - Develop cable launch system for control flight
  - Demonstrate both free & cable launch to validate capability
  - Measures in-band intensities with reference to MANPADS
  - Conduct testing to demonstrate capability



# Background



- **Smokey Sam is well used rocket for training of aircrews**
- **Testing using Smokey Sam rockets were useful in functional tests for laboratory programs**
- **An improved capability was thought to be useful but needed to be low cost for S&T use!**

**Smokey Sam  
Compared to  
Redeye**



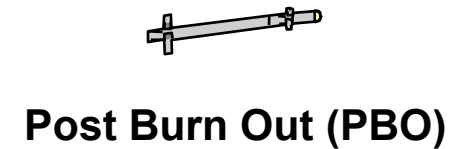
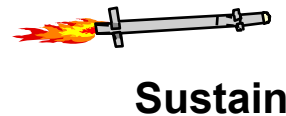
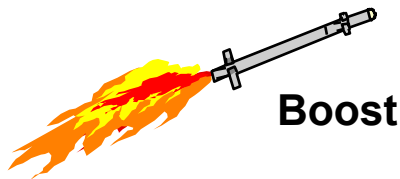
# Generic IR SAM Shot Signature



- **Baseline missile launch and flyout case:**
  - Boost for 1.5 seconds
  - Sustain from 1.5-7.1 seconds
  - Burnout at 7.1 seconds

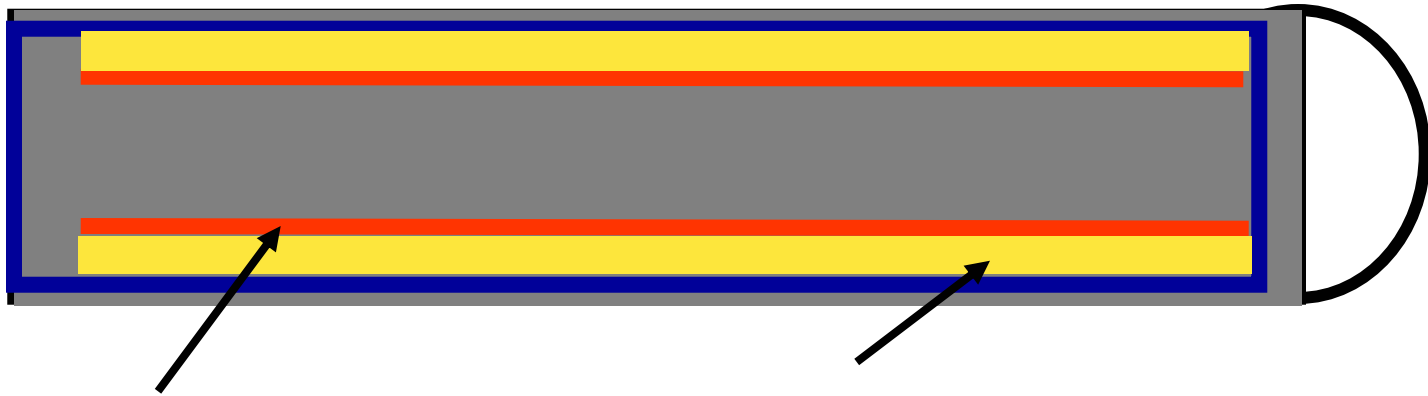


- **Standard atmospheric cases (Desert, Urban, Maritime)**
- **Signatures at nominal viewing angle**
  - Boost: IR=100 W/ster EO=10 mW/ster
  - Sustain: IR=10 W/ster EO=3 mW/ster
  - Burn Out: IR=0.1 W/ster EO=0 mW/ster





# Rocket Motor Modifications



**Standard  
Propellant Grain**

**High Thrust Propellant Grain  
Modification**

- The GTR-18A Rocket Motor was modified for a two part laminated grain
- External grain is standard zinc based fuel
- Internal grain is Aluminum based grain used in other operational system
- Combination gives a appearance Boost and Sustain signature
- Thrust is low initial but high for majority of burn given improved trajectory

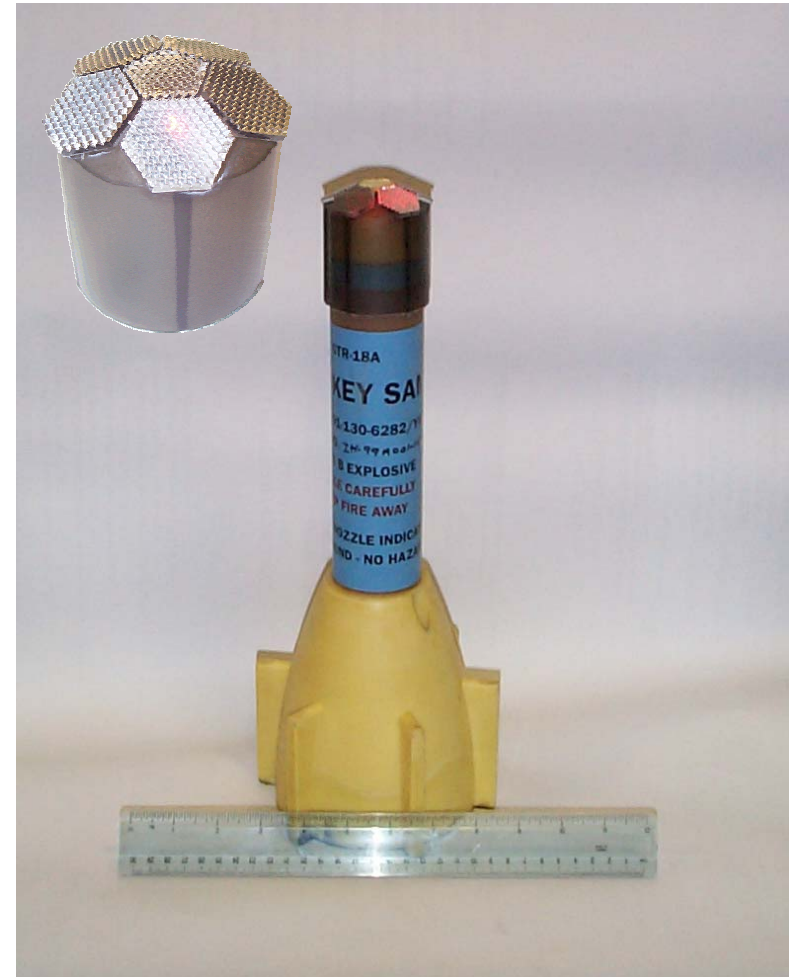




# Smokey Sam Test Rocket



- To provide a reflective surface for laser system, a nose cone modification was developed using coated bicycle reflectors





# Trailer Launch System



- A telescoping mast trailer was procured and modified to support cable launch operations
- 2000 ft steel .25 in cable is stretched and anchored over the mast





# Launcher



- A low cost trolley was develop for the cable system



**Trolley**



**Rocket on trolley  
mounted on launcher**





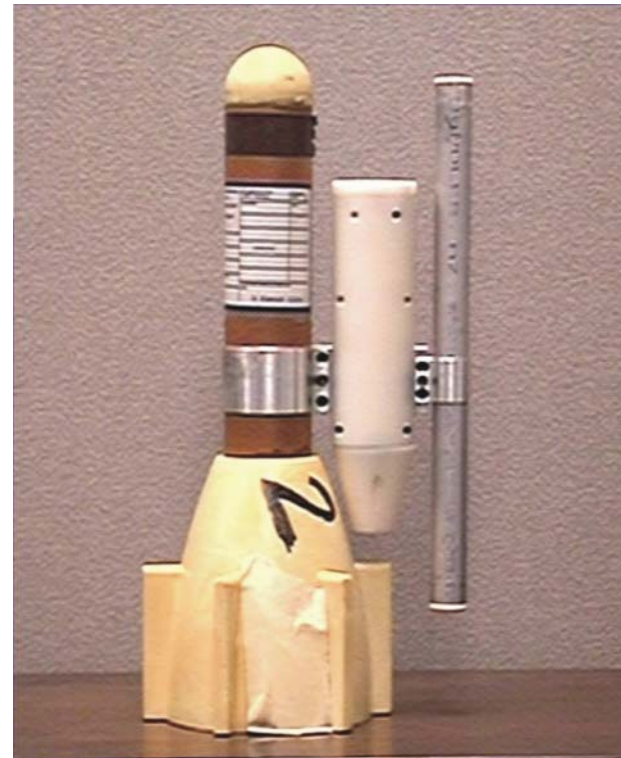
# Detectors System



- **Supporting requirement to detect lasers emissions**



**Detector and recorder mounted on trolley**



**Side view of detector/  
recorder in trolley**



# T&E Supported



- **Laser Infrared Flyout Experiment**
  - 2003 Live Fire Test – WSMR
  - 2004 Live Fire Test – Tonopah
- **Affordable Laser IRCM Survivability Program – MWS testing**
- **Check 6 Testing**
  - 2005 Flight Testing – Aberdeen Proving Grounds
  - 2006 Live Fire Testing - WSMR
- **Missile Launch Detector Upgrade Testing – WPAFB**
- **2005 UK Laser Jammer Test – WPAFB**
- **2006 US Laser Jammer Test – WPAFB**
- **Multiple AFRL MWS testing at WPAFB**





# Development Process



- **DT Smokey Sam is a supported element in the overall development process**
  - **Concept Development**
  - **Analysis, and simulation studies**
  - **Build prototype hardware**
  - **Early testing to confirm design and simulation results**
    - **Smokey Sam firing provide low cost data**
    - **May need a few real missile shots to validate**
  - **Validate design against simulation and empirical data**



# Limitations



- **DT Smokey Sam has limitations**
  - **Dynamics after first few seconds are not representative**
  - **Closure velocity does not present intensity rise factors used by some MWS algorithms**
  - **Eject motor signature not represented by rocket launch**
    - **Working separate eject motor stimulator for MWS testing**

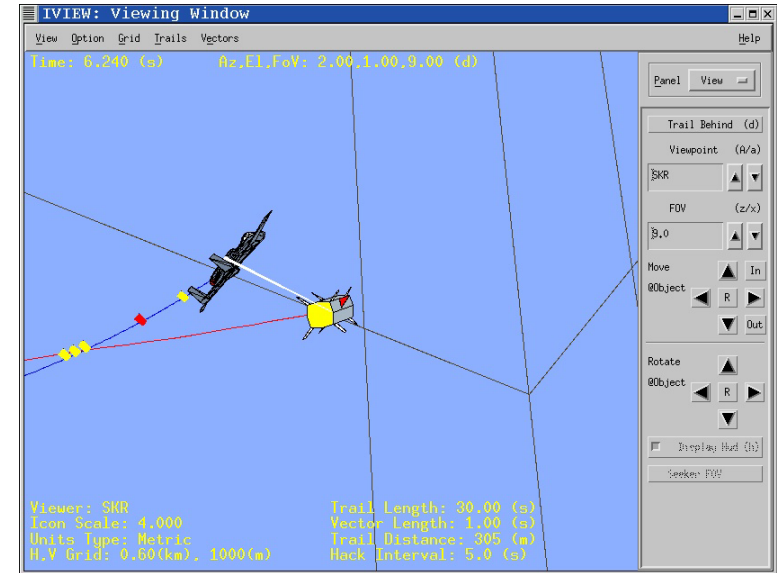
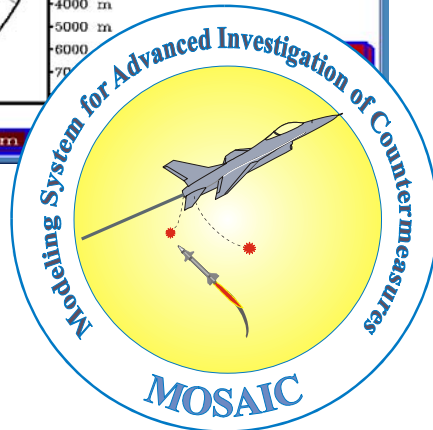
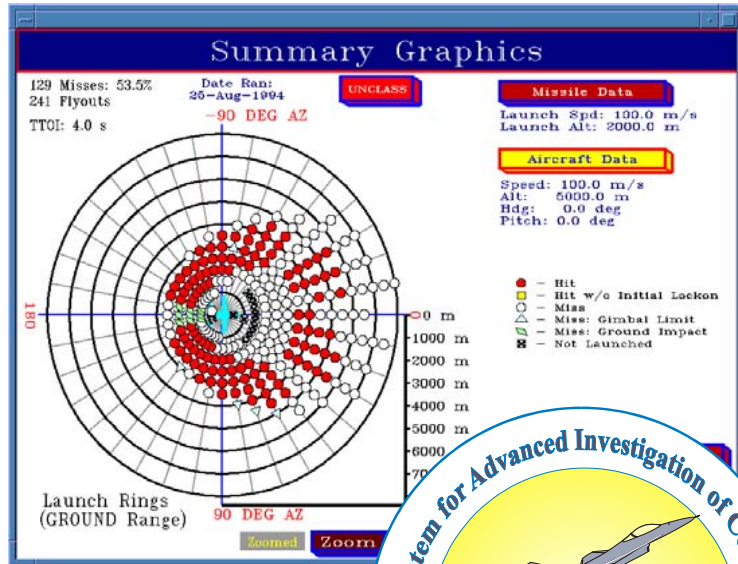




# Modeling & Simulation Link



- Emulation level engagement modeling relies on empirical testing for validation



- Accurate modeling of missile warning performance and laser IRCM tracking is critical to the design and assessment of countermeasures effectiveness



# Recap



- **Dual Pulse Smokey Sam (DTSS) offer a low cost capability for early testing, calibration of optical/infrared missile warning and Directed IRCM systems**
- **Modification of the widely used GTR-18A Smokey Sam rocket with other innovation provides a useful tool for testing**
- **As part of concept development, DTSS can be used to validate initial design, analysis and simulations**
- **DTSS has limitations like all testing tools**