Developments in Medium-Caliber Bursting Munitions

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•ATK Bursting Munition Activities

- Contract: OICW 20mm Subsonic
- IR&D Thrust: 30mm AAAV Applications
- Future Development:
  - 25mm (Bradley), 40mm, 120 and 105mm Tank Ammo

Leverage Common Components & Technology for Cost, Producibility and Reliability

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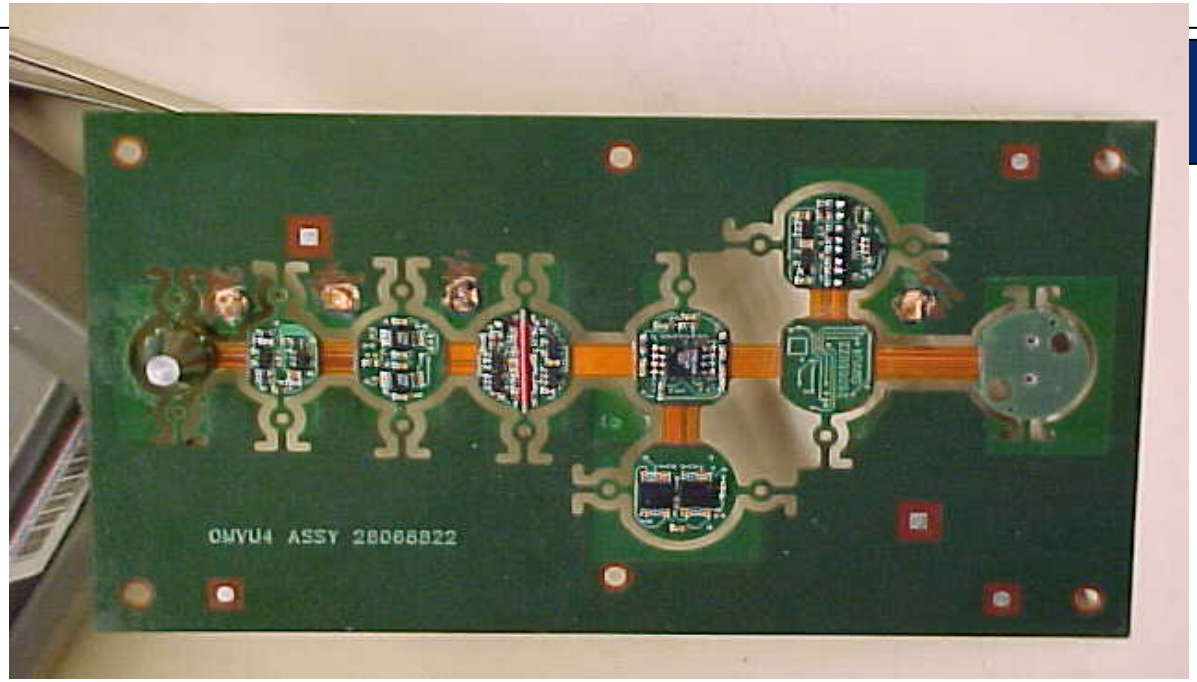
30mm HE-AB Projectile and Cartridge

Cartridge

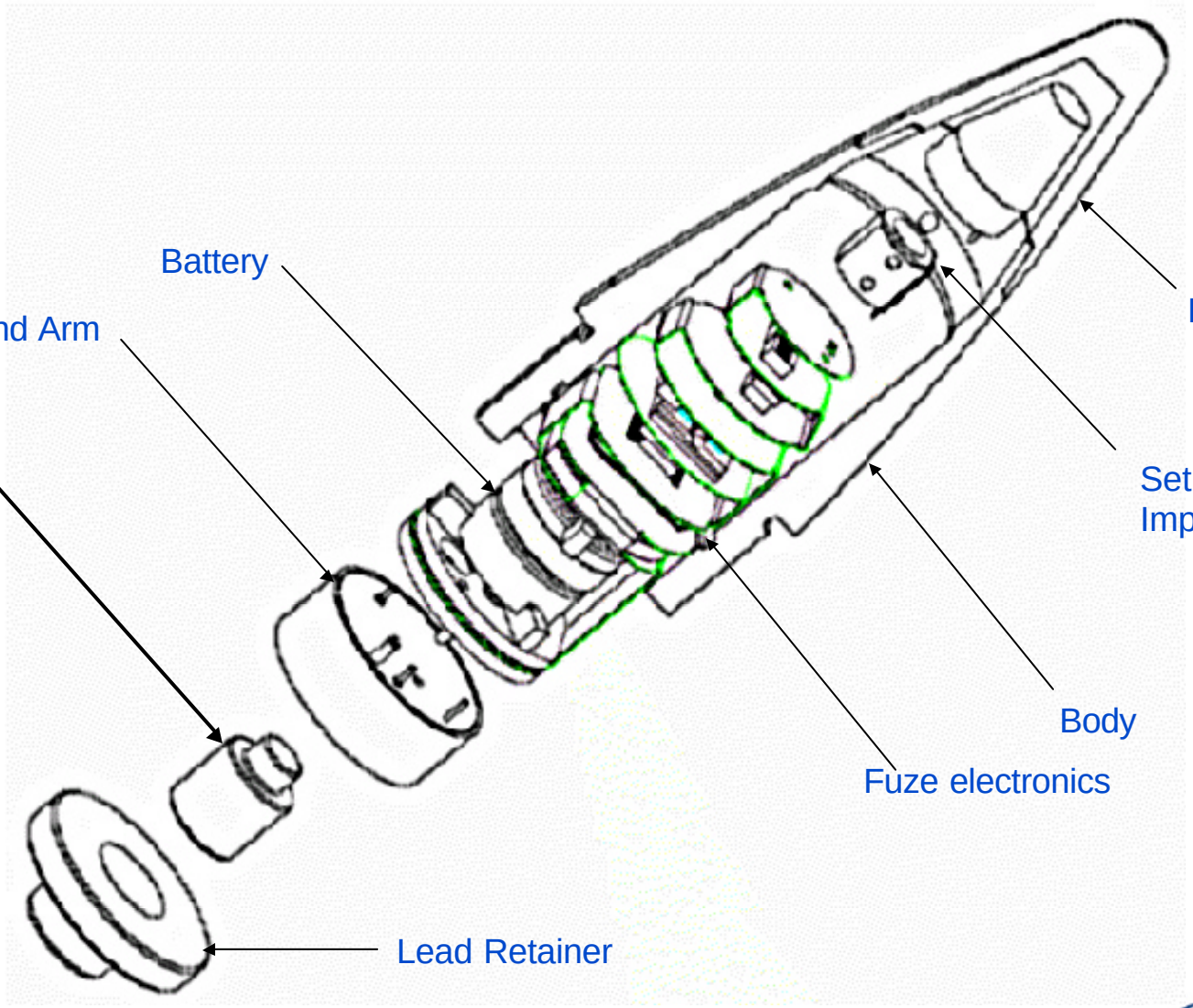
Electronics Functions through 70 Kg Setback

Gun Hardened Electronics Assembly



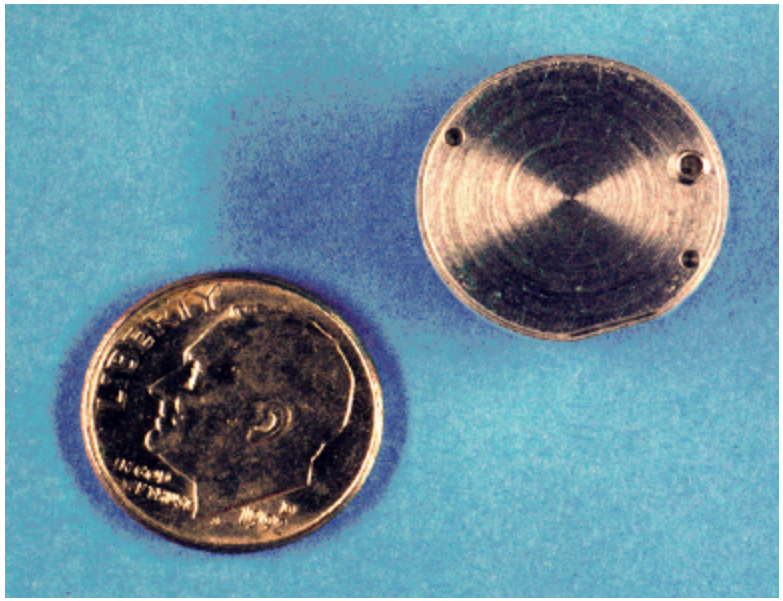
Folded to Fit Projectile Nose

Air Bursting Fuze



Safe & Arm

- Common applications to smoothbore and rifled munitions
- Command arm (outside safe separation) for MOUT
- Less than .1 cubic inch of volume
- Mil Std 1316 E Compliant
- 20 Round Varicomp testing-”Safe to 99.9999 %”
- Additional Out-of-line and environmental testing completed



Setter Design

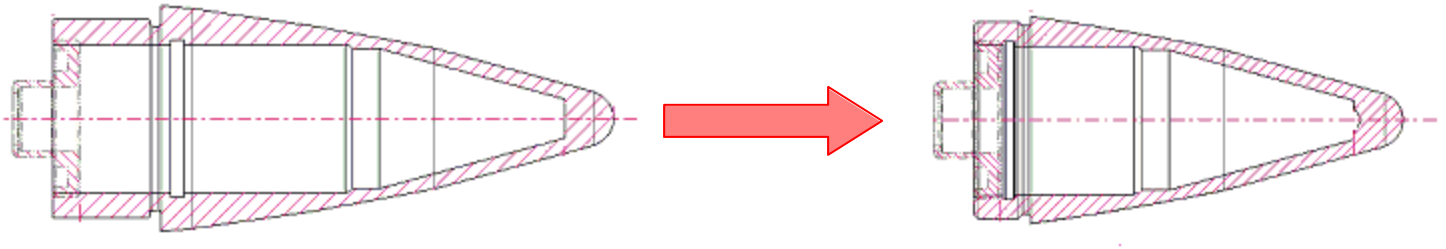
Setter will inductively transfer data to the fuze

Programmable multi-modes

- Fuze power off
- Point Detonate Delay
- Point Detonate
- Airburst @ Time
- Airburst @ Turns
- Hybrid Airburst (Times & Turns)

30mm Design Update

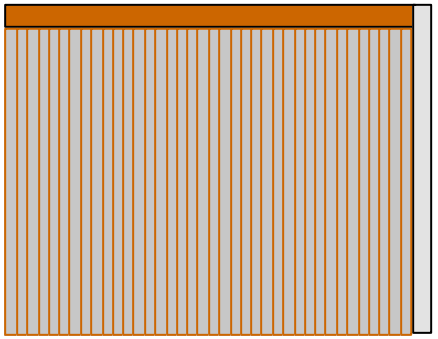
- Low power design: Reduce Current Drain to 20% of Present
- Power Source
  - Integrate Reserve Battery
  - Set-Back Generators
- Packaging Improvements
  - Smaller fuze

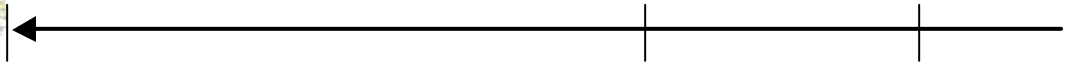


Onboard Data Collection for Sensor Development

Ballistic Softcatch Technology

30mm Bursting Round w/Titanium Nose





Setback | **Data Collection** | **Impact** | **Data Transfer to Nonvolatile Memory**

- **Round loaded and fired**
- **Capability to record 8 seconds of data**
- **Titanium nose protects electronics as it slows from Impact velocities of 1000 to 460 m/s**

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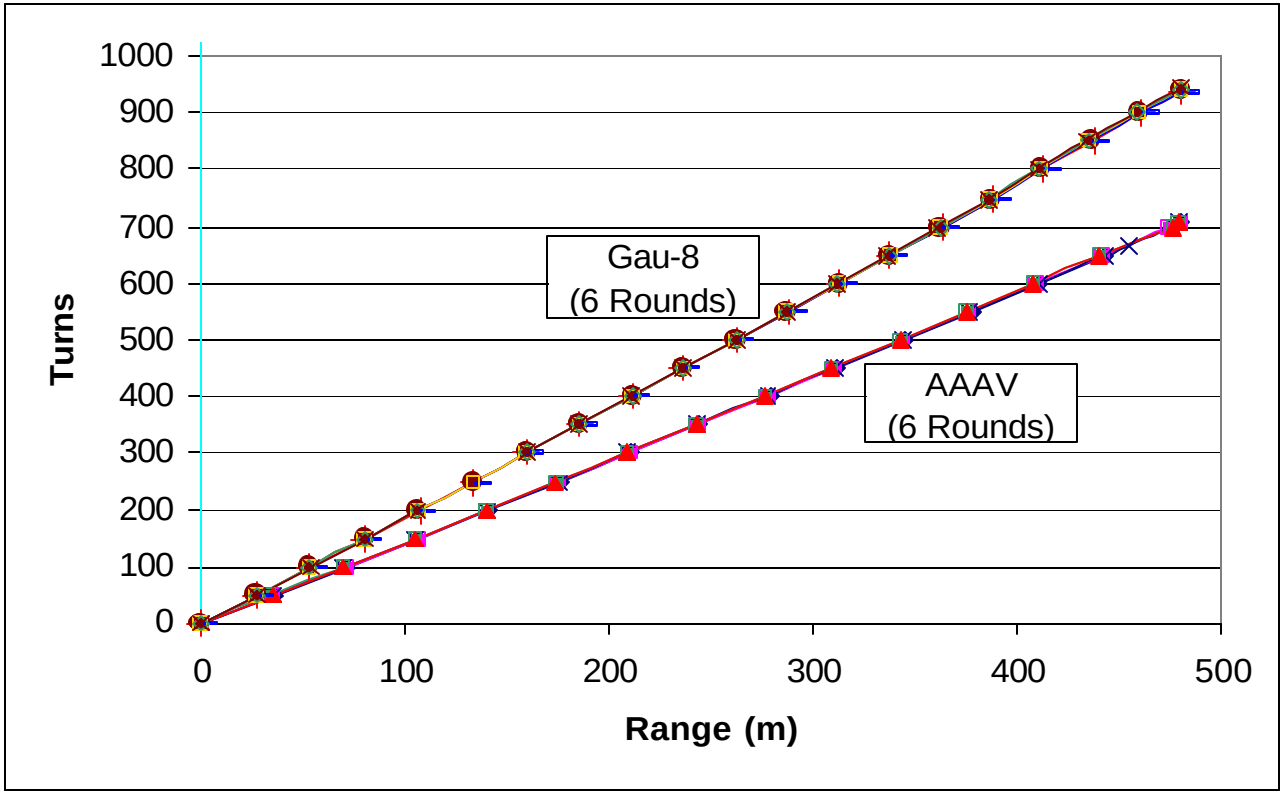
OBR Data Reduction

- **Simple, Rugged OBR clock synchronized at setting**
- **Radar Track ties time, turns and distance together**
  - **OBR clock accuracy: 0.5%**
- **500 meter tests in both Gau – 8 and AAAV Barrels, 2000 meter AAAV ongoing**



HE Air Burst Testing

- Five Full up HE Rounds Tested in December, 2002
- Set for Air Burst at 471 meters utilizing Turns count Mode.
- First HE Air Burst test for Lethal Supersonic Rounds
- Burst Range determined from Raw Radar Doppler Signal and confirmed by Video Tape
- Precision Air Bursting Achieved—Comparable to subsonic 20mm OICW results at same range

Ballistic Results

Round	Muzzle Velocity m/s	TOF-air burst sec	Range m	Decay m/s/m	
305-66	1087.8	0.4685	470.19	0.365	
306-74	1093.8	0.4675	471.7	0.3694	
307-68	1097.6	0.4655	470.99	0.3759	
308-67	1089.2	0.4691	471.07	0.3679	
309-54	1092	0.4667	469.33	0.3779	
	1092.1	**0.4677**	**470.99**	**0.3696**	**Mean**
	3.9	**0.0014**	**0.9**	**0.0055**	**1s**

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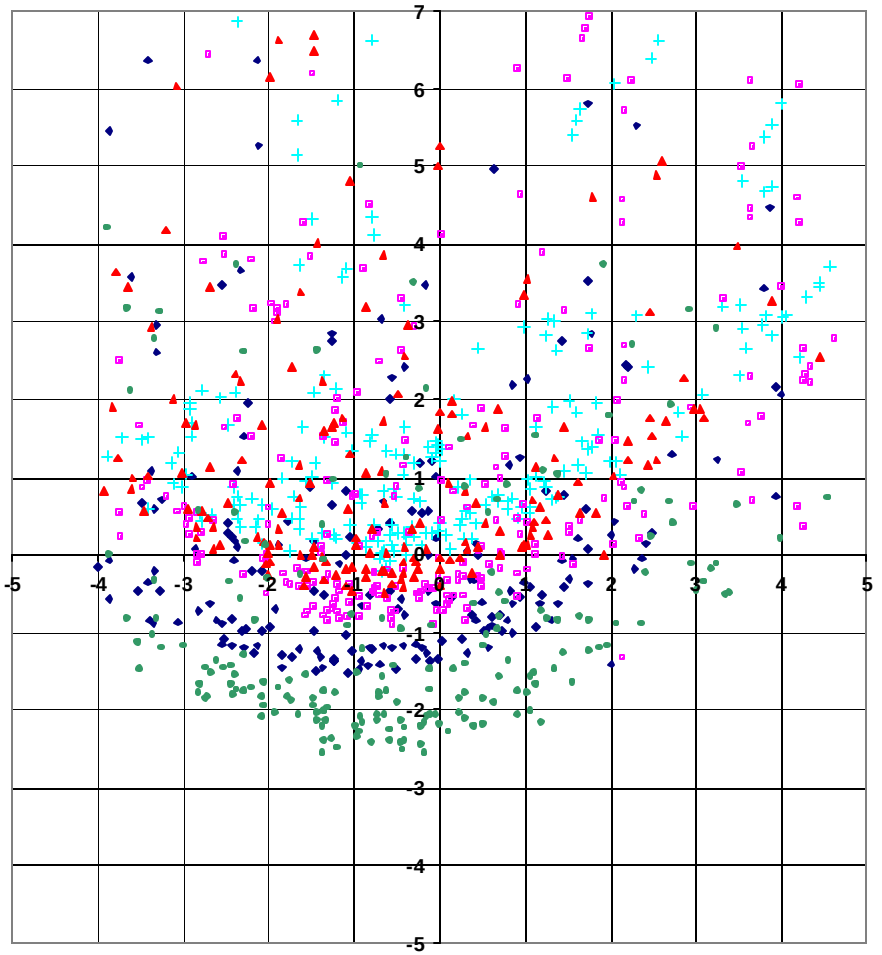
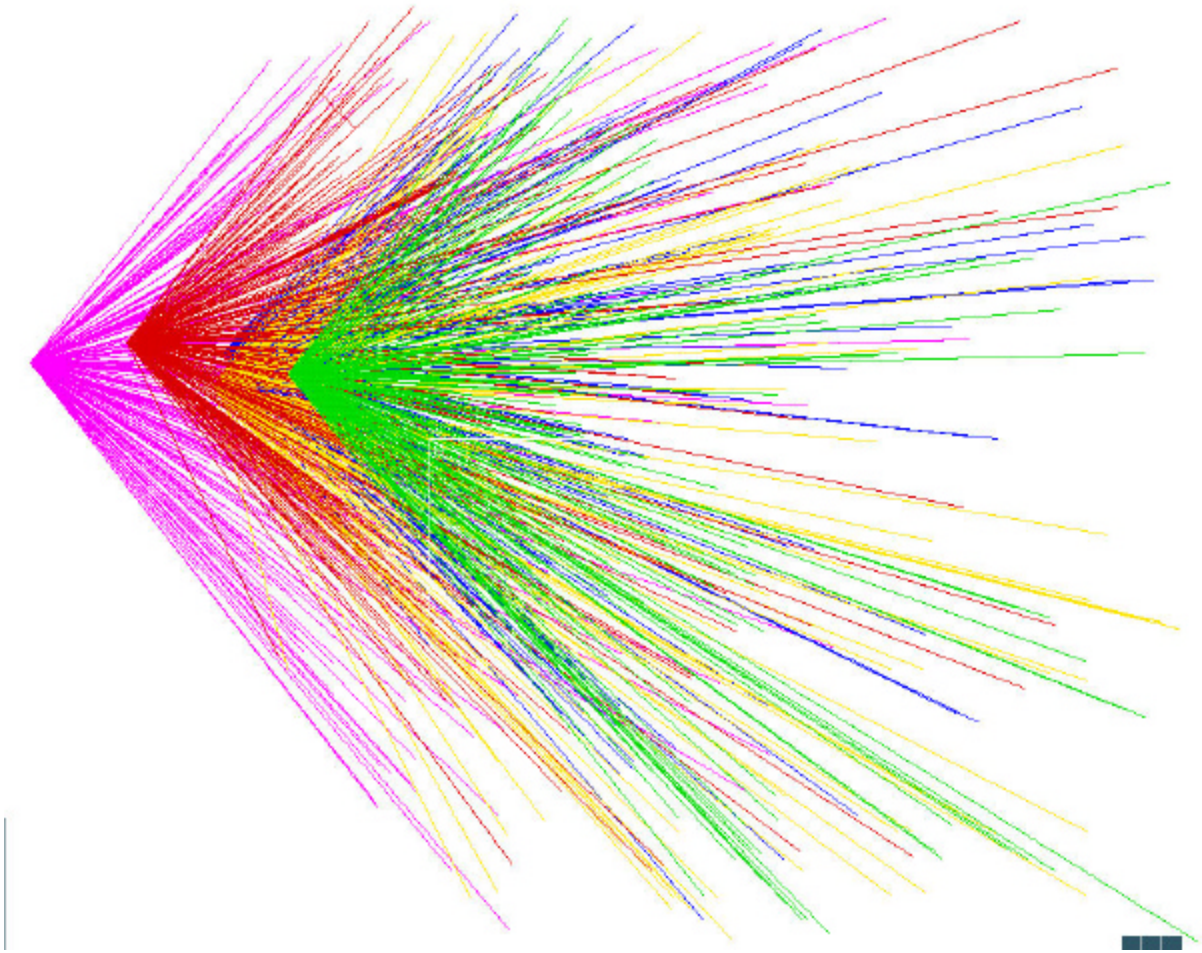
Images – 12-07-2001 Test

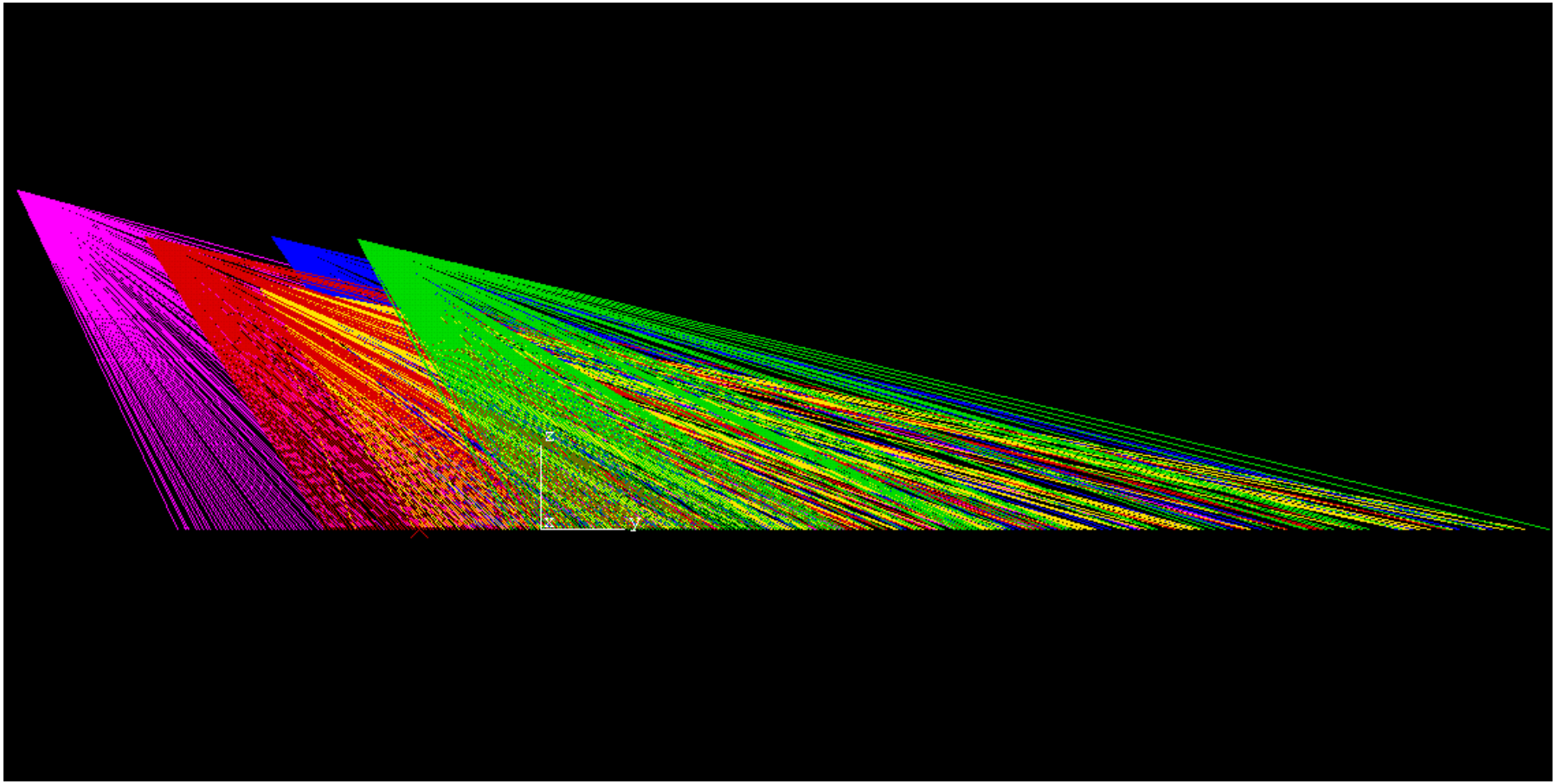
Warhead Fragment Distribution – Ground Plane



Warhead Fragment Trajectories – Top View



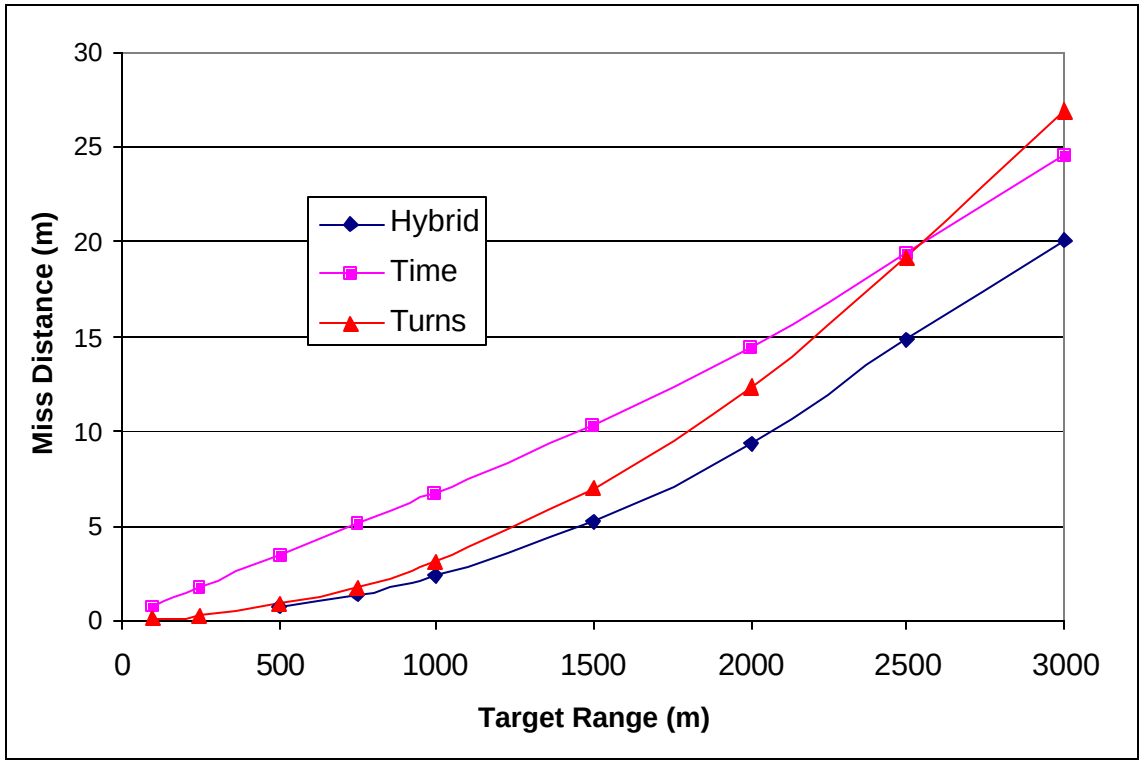
Warhead Fragment Trajectories – Side View



Air Bursting Algorithms

- Fundamental Challenge of Air Burst: Target no longer “events” Round
- First Order Methods: Timer or Turns Counter estimates when desired range to burst is reached. Assuming accurate Range and MET Data, Random (round-to-round) Errors will define accuracy.
- Second Order: Reduce round-to-round Muzzle Velocity error
  - External Measurement
  - “Hybrid” Utilize on-board timer and turns counter - No need for Gun Muzzle modifications)
- Third Order: Direct Range estimate (1-D IMU)
  - Integrate Axial accelerometer twice on the fly
  - Requires higher CPU capabilities, accelerometer must survive Set-back g’s with no zero shift and be accurate to the 0.1 g level

Miss Distances for Typical Error Budget



OBR, HE Tests confirm simple Turns Counter effective close-in (<1000 m), Hybrid improves accuracy at greater ranges

Accuracy Estimates from OBR Flight Data

AAAV Barrel @ 500 Meters

	Range Errors in meters		
SN	time counter	turns counter	hybrid
29	1.30	0.64	0.95
25	5.29	-0.64	-1.32
60	-2.20	-1.40	-1.40
65	-3.30	-1.30	-1.20
58	-3.30	-2.40	-2.00
71	-3.00	-2.60	-2.30
Grouped	**3.49**	**1.19**	**1.14**

Gau 8 Barrel @ 500 Meters

	Range Errors in meters		
SN	time counter	turns counter	hybrid
10	2.28	0.47	-1.00
11	2.21	0.47	-1.41
10(2)	3.94	0.23	-0.89
6	-3.14	0.70	-0.21
11(2)	-1.88	-1.20	-1.20
8	0.09	-0.24	-0.13
15	-2.14	-0.24	-0.13
9	-3.36	-0.96	0.20
14	-7.51	-1.20	-0.62
Grouped	**3.56**	**0.75**	**0.56**

AAAV Barrel @ 2000 Meters

	Range Errors in meters		
SN	time counter	turns counter	hybrid
73	30.20	11.50	8.20

Air Burst Video

Video of Full-up HE Air Burst Rounds 12/07/2001

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