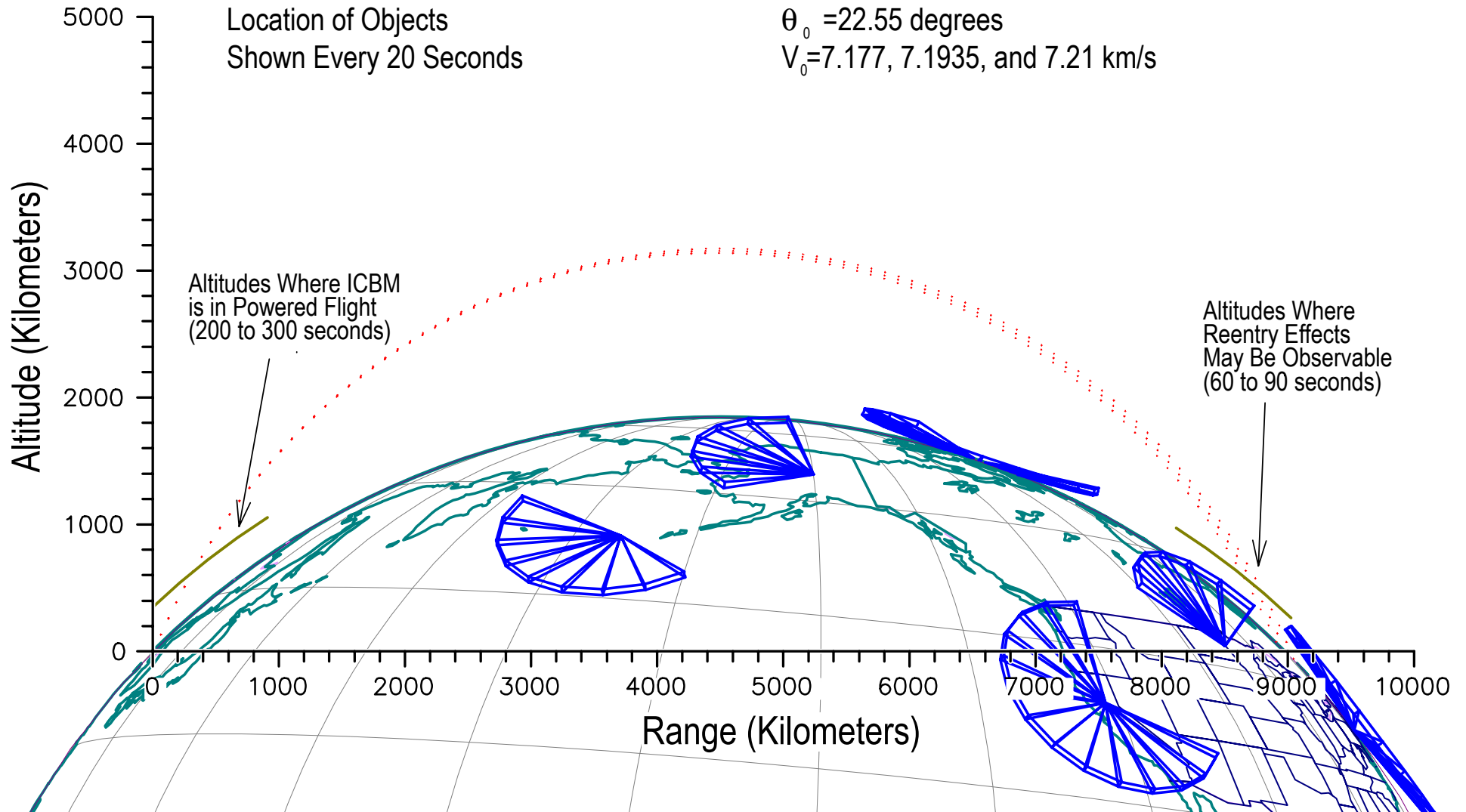
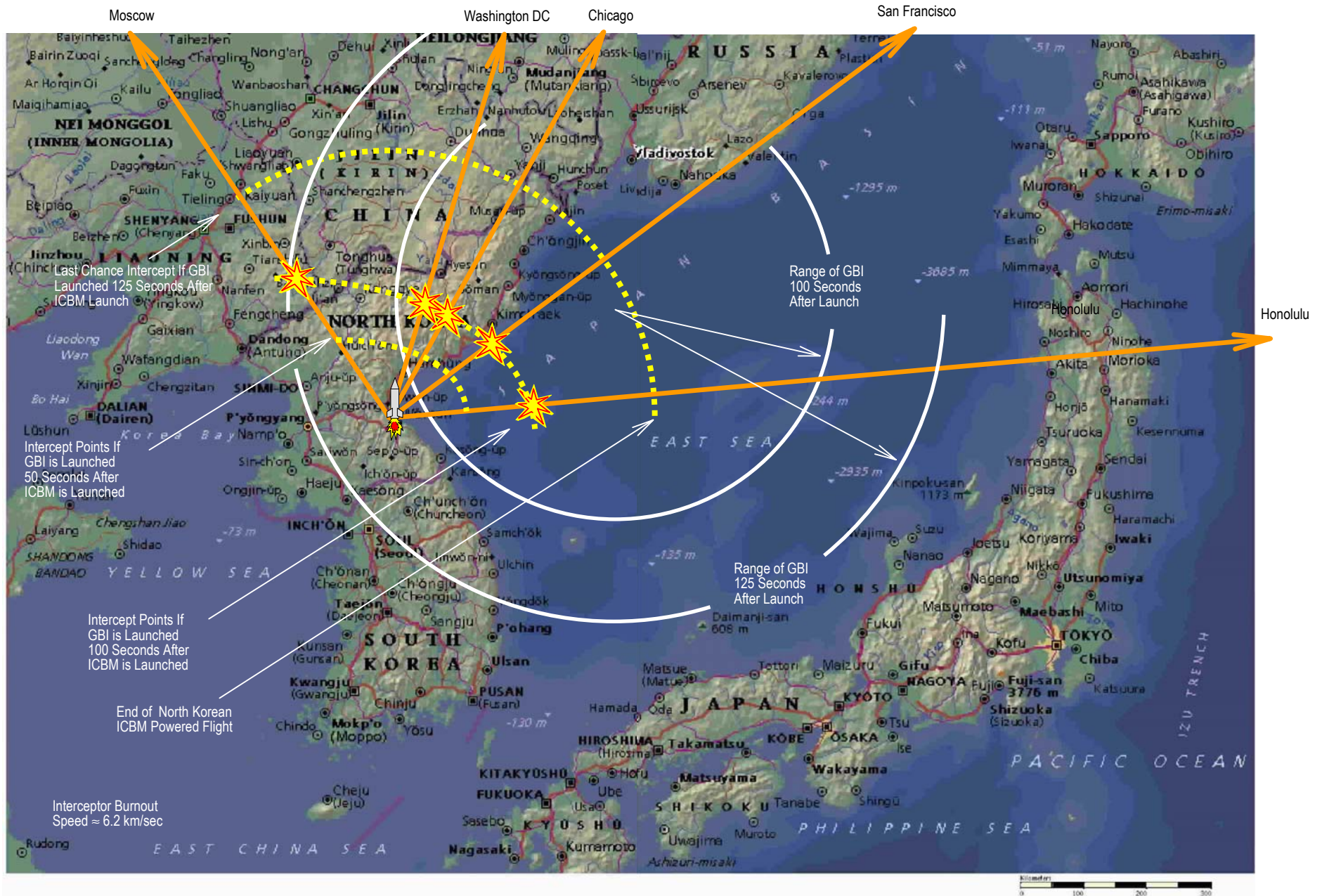


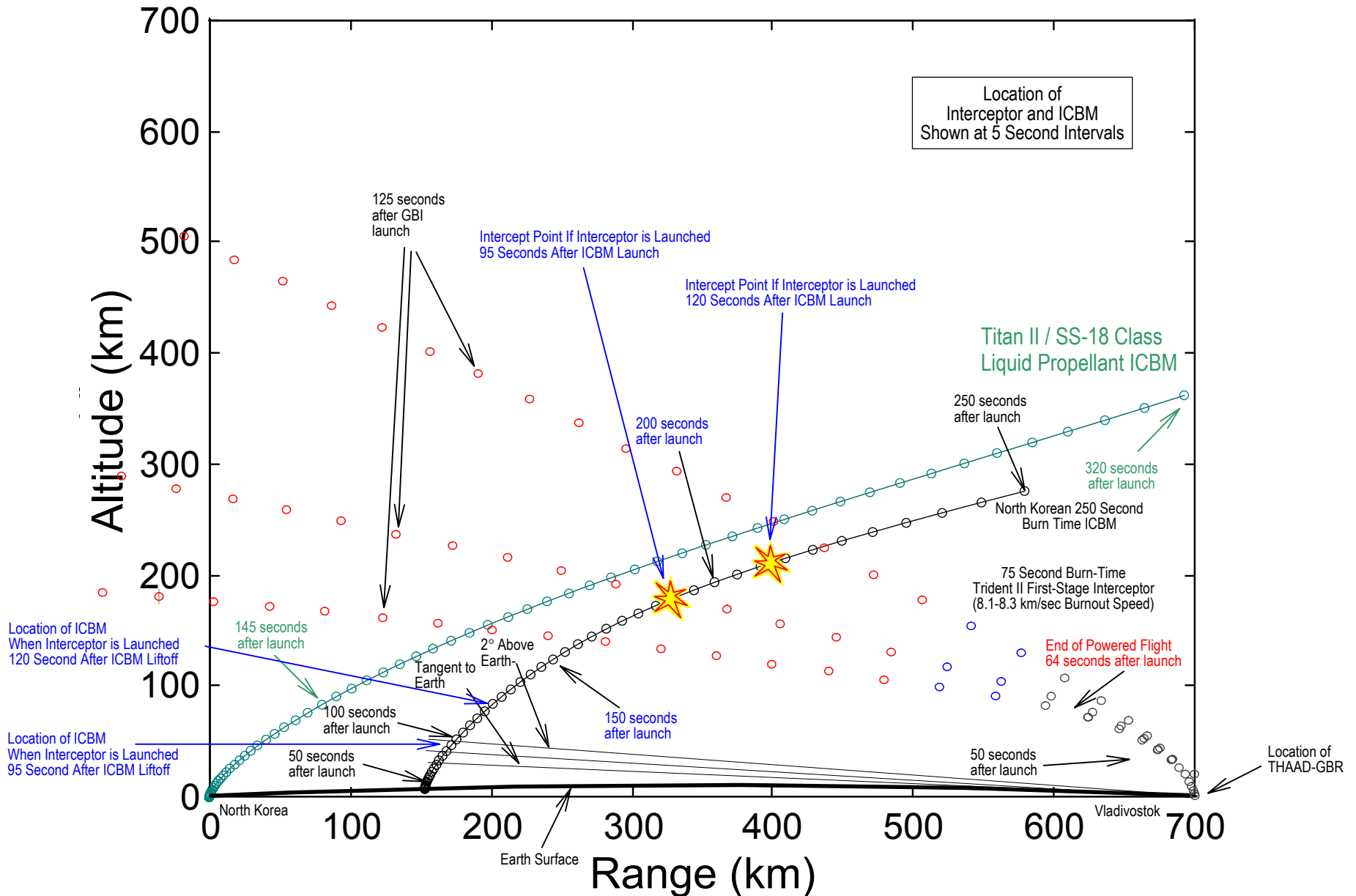
Size of Boost-Phase Region of Ballistic Missile Flight



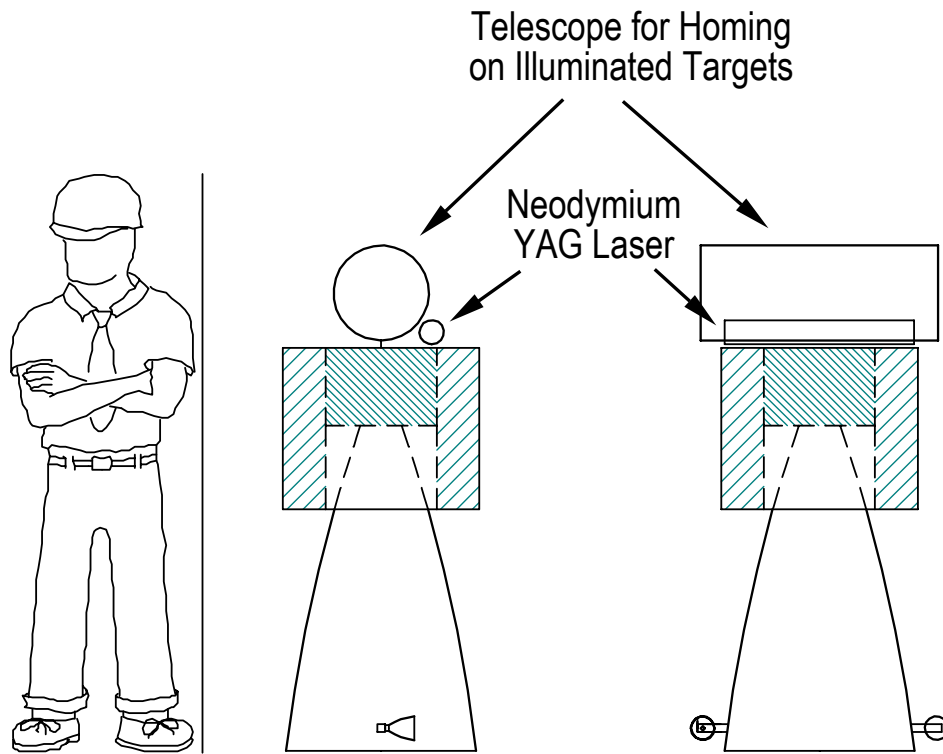
Engagement Region of Trident II First-Stage + Kick-Stage Interceptor Against North Korean 250 Second Burn-Time ICBM



First-Stage Trident II Plus Kick-Stage Interceptor Timelines Against Powered Flight Profiles of 250 and 320 Second Burn-Time ICBMs



Boost-Phase Kill Vehicle Capable of 10 G Maximum Divert Acceleration and 2 km/sec Total Divert Velocity



Total Propellant Weight = 230 lbs
Propellant Density = 72 lb/ft³
Total Propellant Volume = 3.2 ft³
Motor Weight = 80 lbs
Thrust = 4610 lbs
Weight of Tanks and Structure = 46 lbs
Overall Vehicle Weight = 460 lbs
Payload Weight = 100 lbs
Propellant=N₂O₄/MMH
Vacuum Steady State Real Engine Performance
Specific Impulse (lbf-s/lbms) = 295
Throat Diameter = 5.2 inches (.13 meters)
Exit Diameter = 23.2 inches (.59 meters)
Area Ratio=20
Chamber Pressure = 125 psia
Motor Length = 50 inches (1.27 meters)
Chamber Diameter = 13.5 inches (.35 meters)
Spherical Fuel/Oxidizer Tank Diameters = 18 inches
Barrel Tank
Barrel Diameter = 10 inches (.26 meters)
Overall Length = 38.5 inches (.98 meters)
Barrel Length = 28.5 inches (.73 meters)

Characteristics of the Navy Theater-Wide Interceptor that Make It Unsuitable for Anti-ICBM Boost-Phase Interceptor

Navy interceptor Needs:

- To be much bigger and heavier to do the job
- A Much Higher booster burnout speed for Adequate Area Coverage
- Much more divert capability to deal with accelerating targets
- Much higher resolution sensors for homing on the target

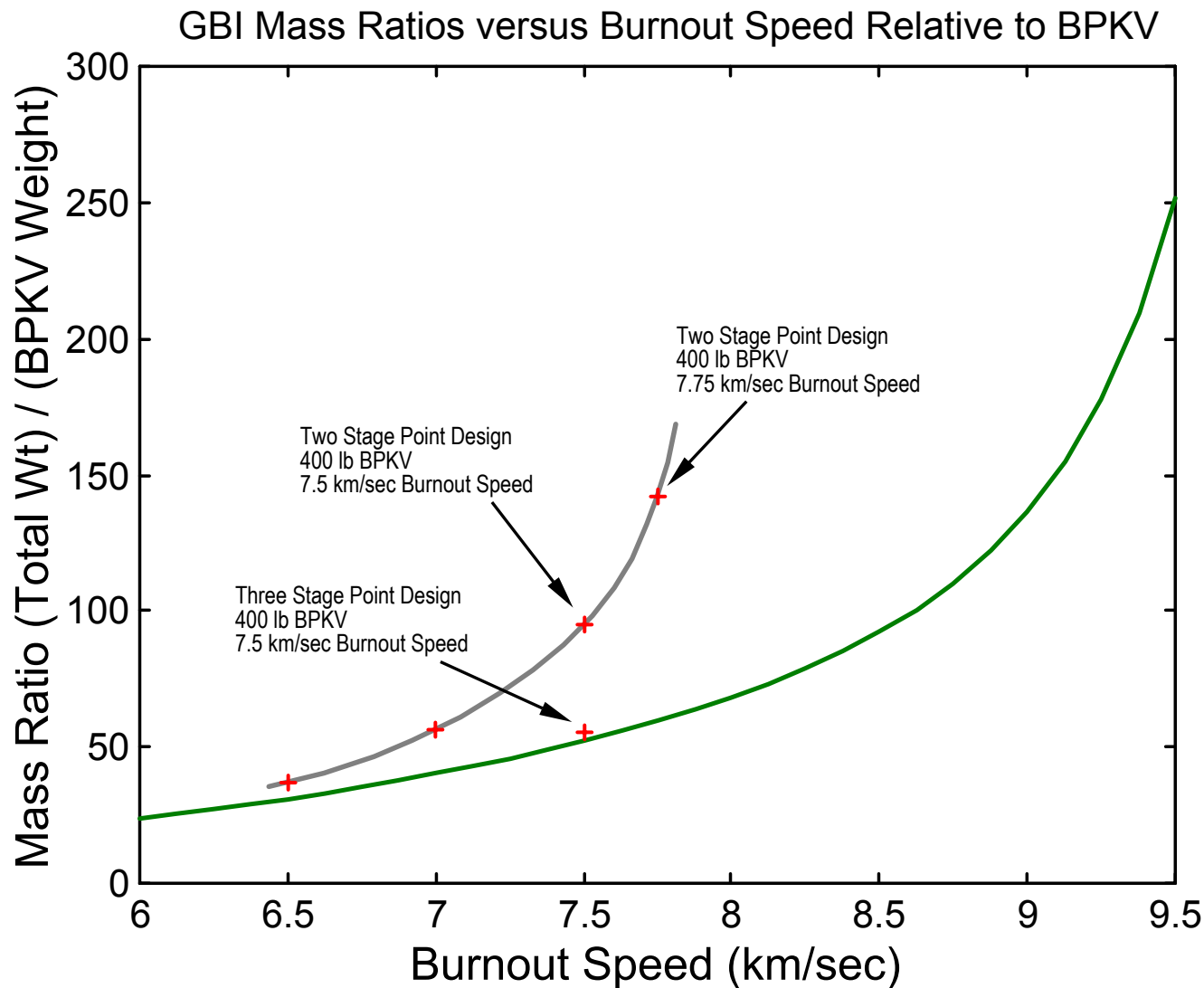
These requirements lead to a much bigger and heavier booster to do the Job
Such a Bigger and Heavier Booster is NOT compatible
with storage and launch systems on standard Navy combat ships.

Navy Upper Tier Interceptor Weight = 3,100 lbs

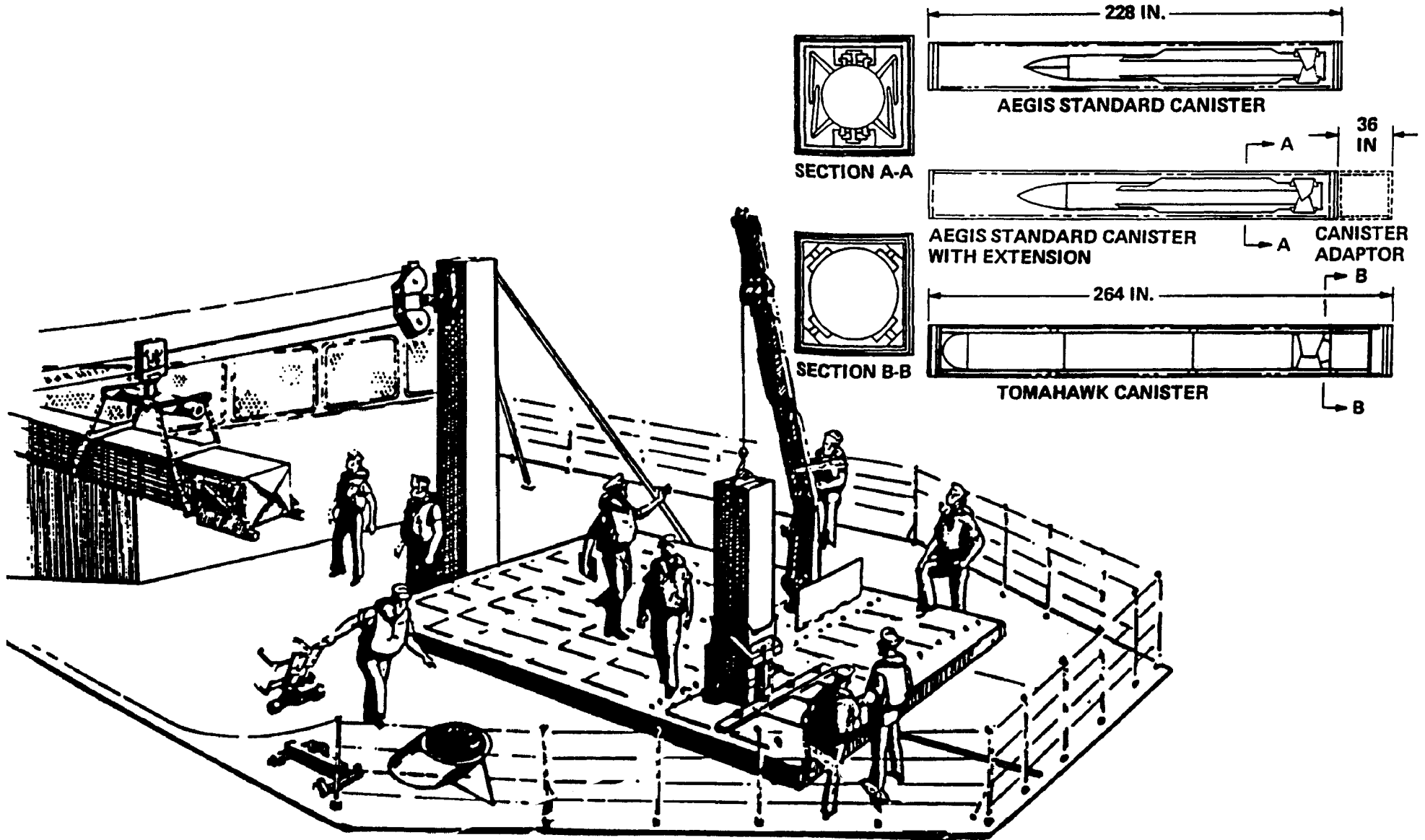
GBI Interceptor Weight = 30,000 –40,000 lbs

Size, Weight, Payload and Velocity Characteristics of Booster Variants Needed to Launch Kill Vehicles

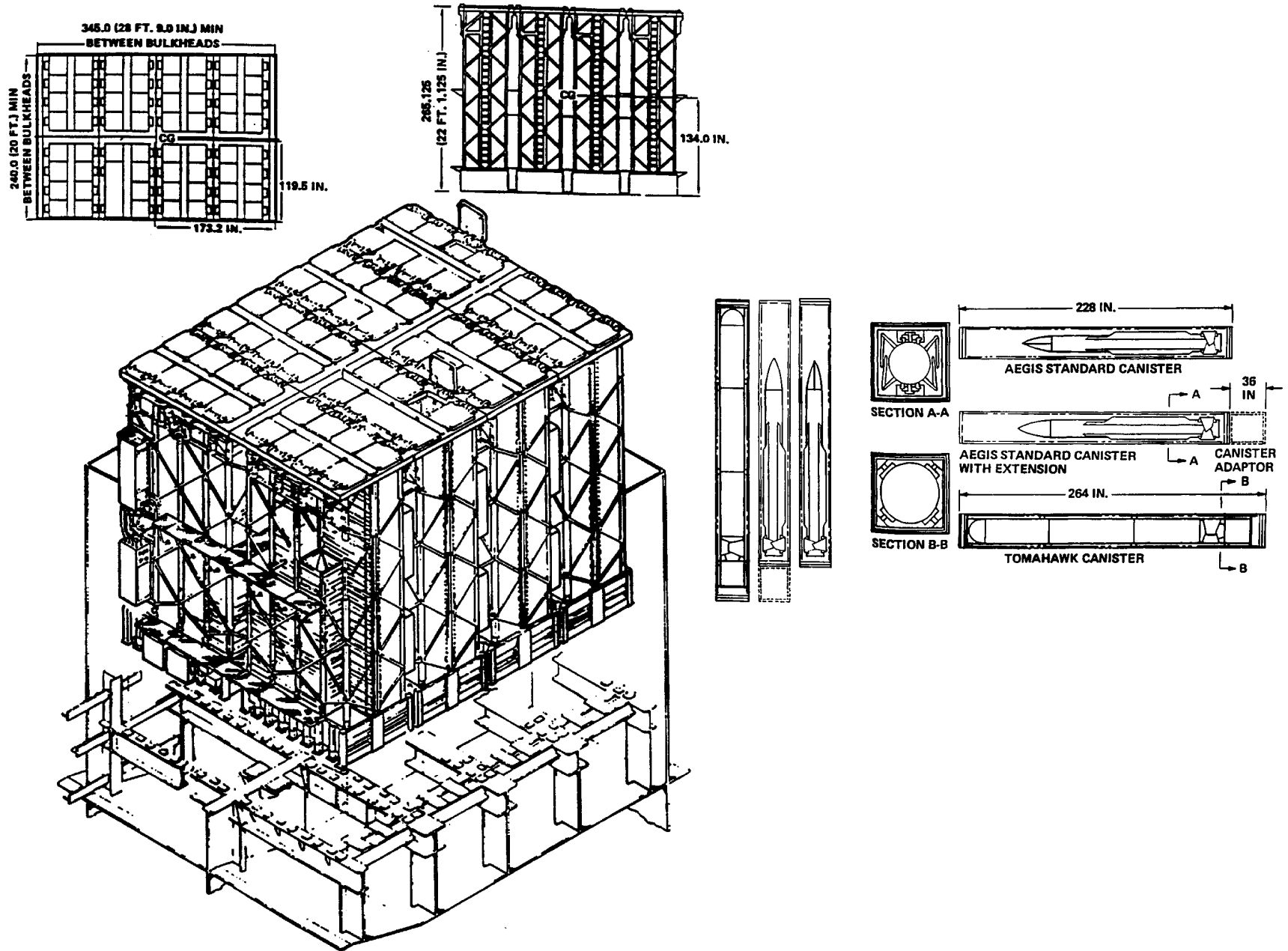
Mass Ratios for 70 Second Burn-Time Two and Three-Stage Boosters for Launch of Boost-Phase Kill Vehicles



Basic Dimensions of Vertical Launch System Components

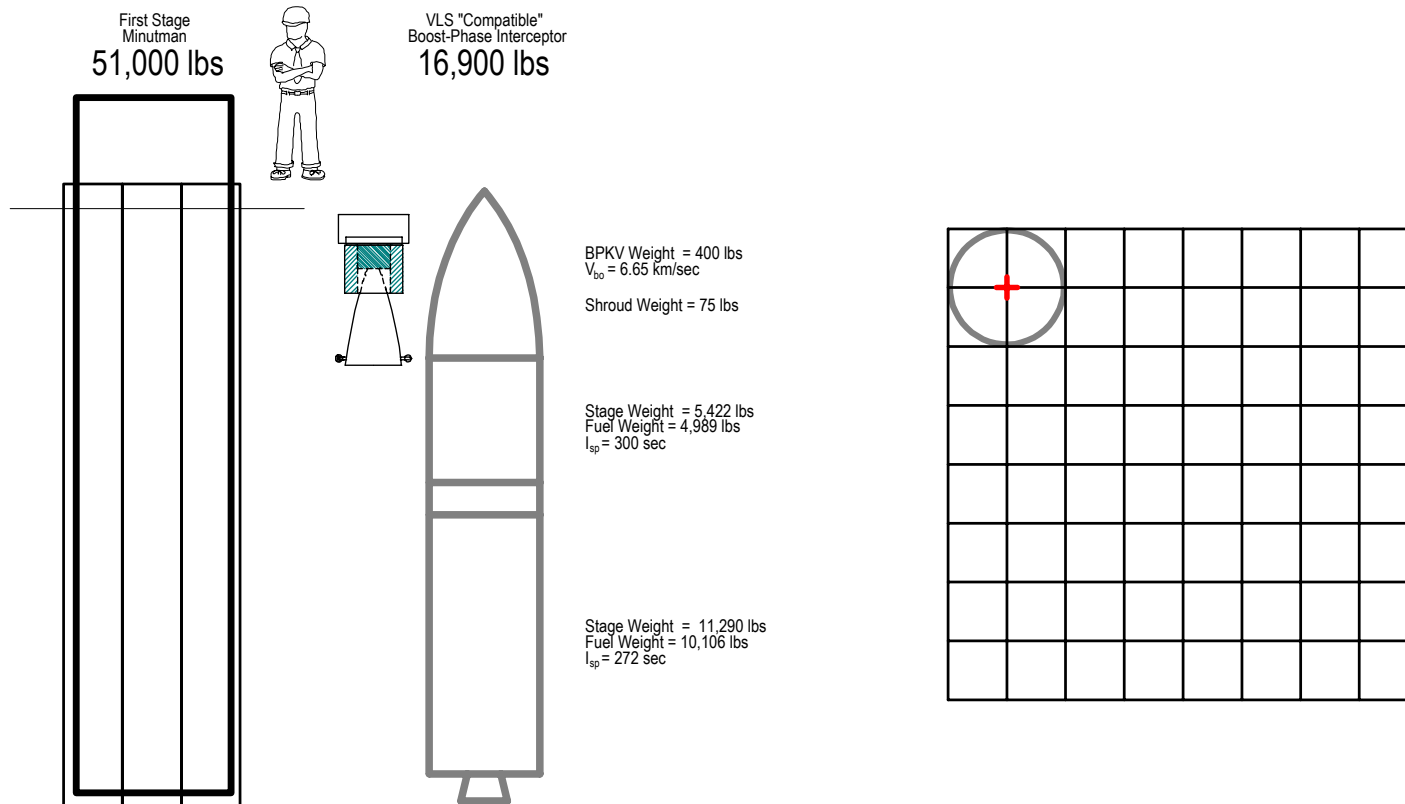


Basic Dimensions of Vertical Launch System Components

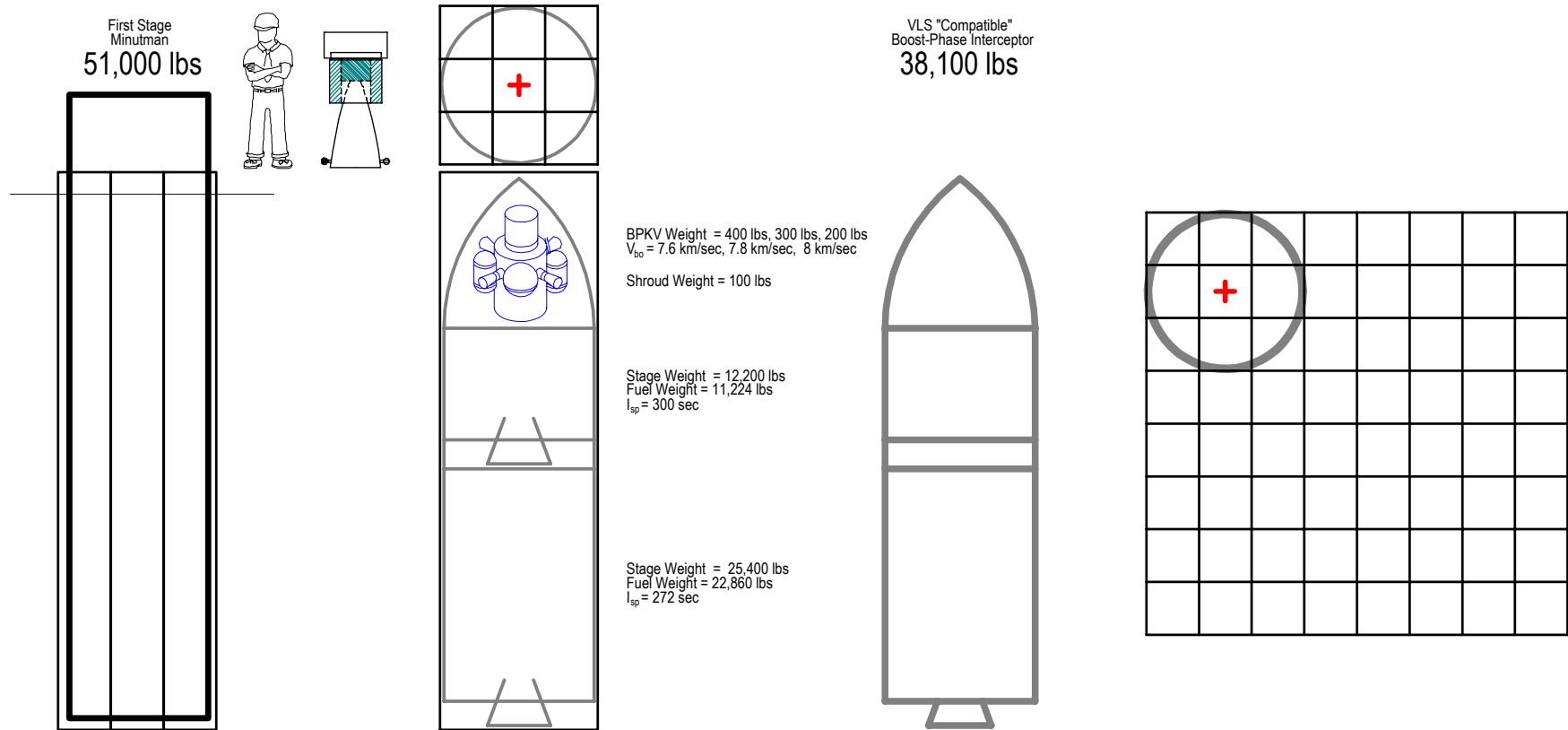


61-Missile Magazine

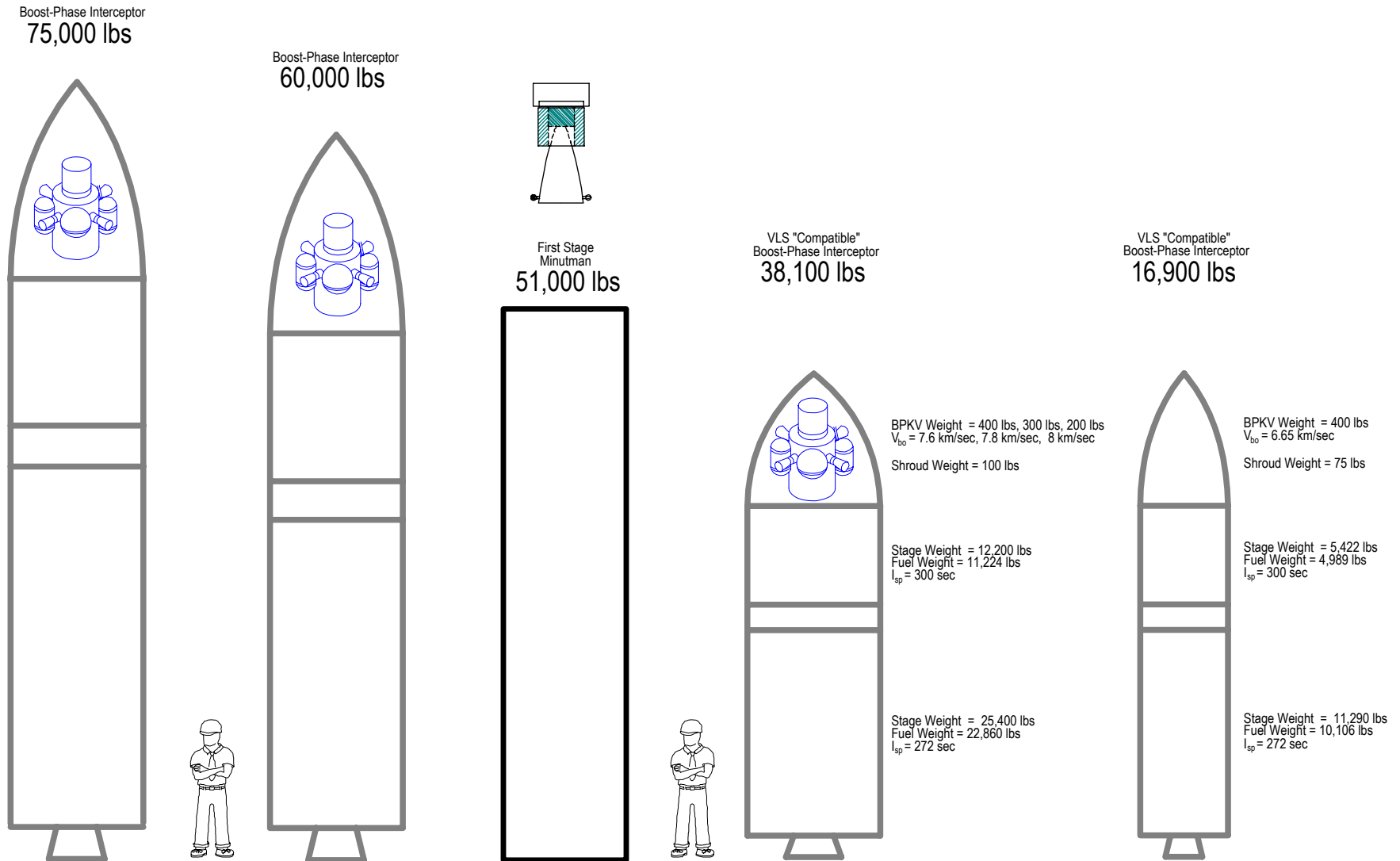
Vertical Launch System "Compatible" Variant of a Boost-Phase Two-Stage Navy Interceptor



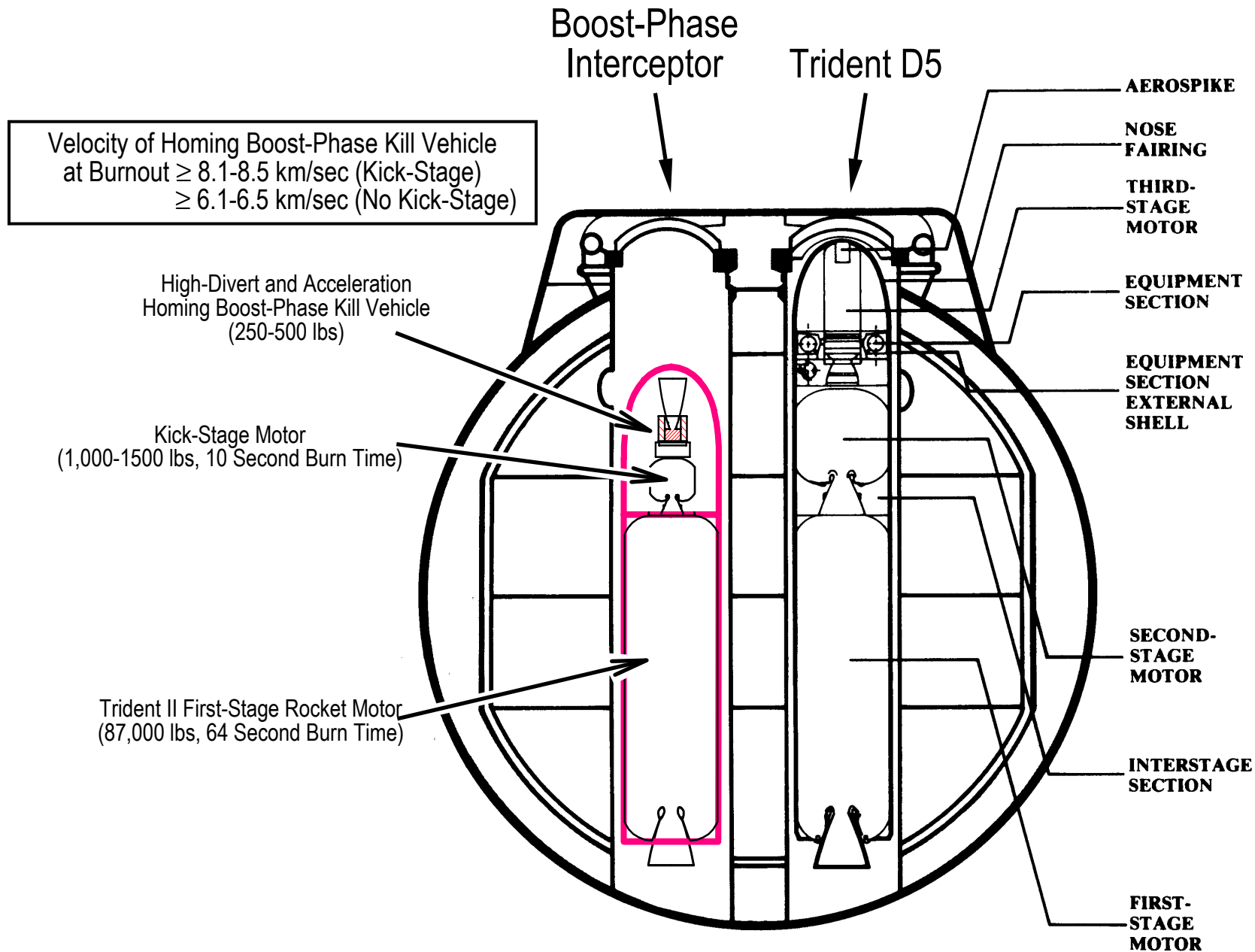
Vertical Launch System "Compatible" Variant of a Boost-Phase Two-Stage Navy Interceptor



Notional Two-Stage Boost-Phase Interceptors Relative to the First Stage of the Minuteman ICBM



Boost-Phase Interceptor Based on the Trident II First-Stage Rocket Motor



Appendix

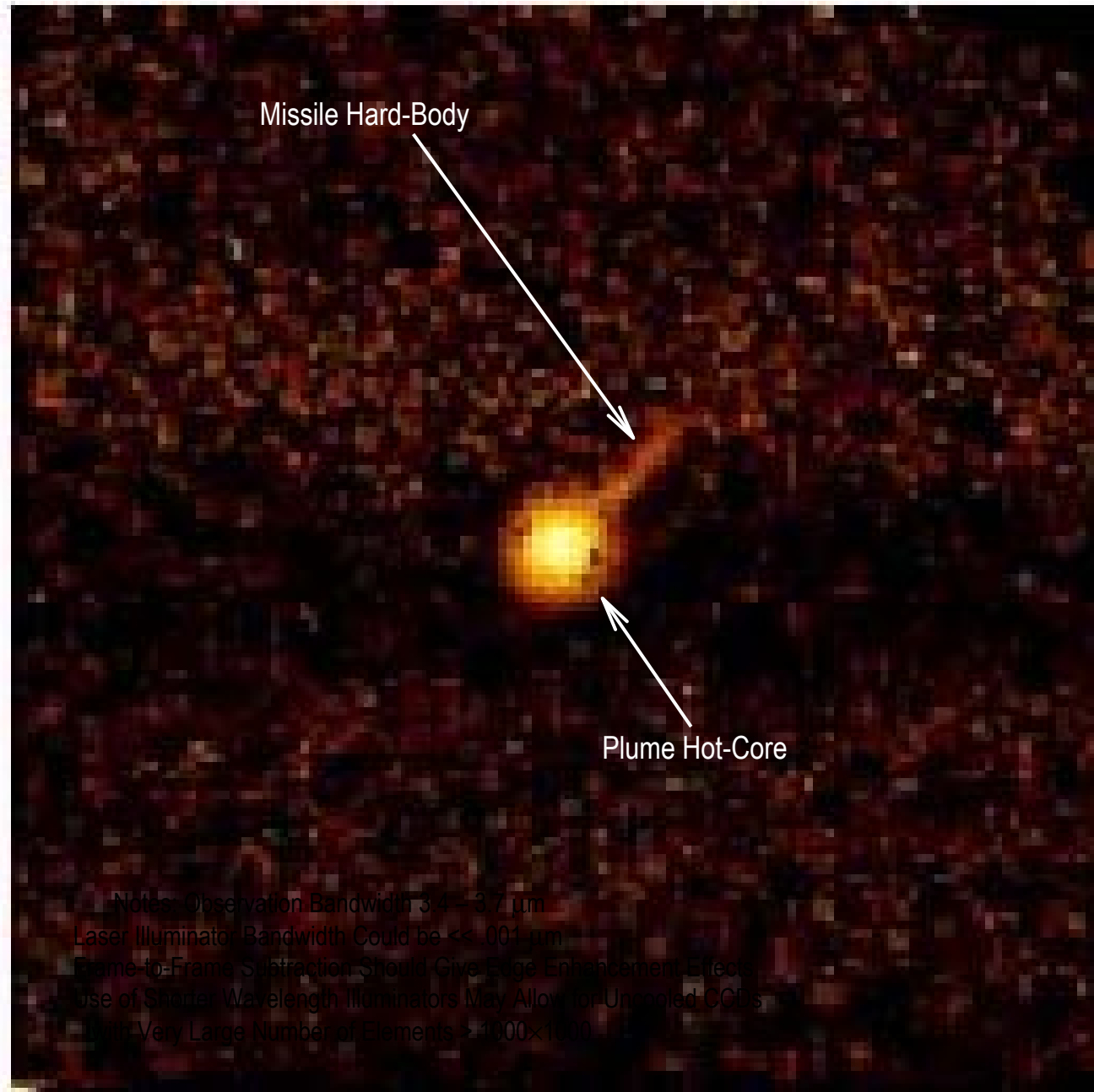
Ballistic Missile Plumes

Short and Medium Wavelength Missile Plume Characteristics Relevant to Hard-Body Homing

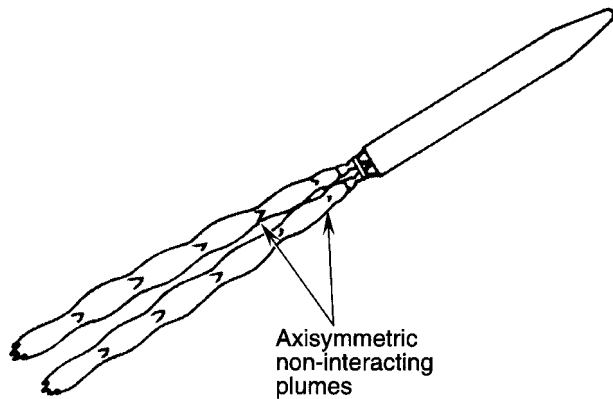
Ballistic Missile
Plume Radiance Characteristics
at Intermediate Altitudes
(50 to 90 Kilometers)



Narrow Band Infrared Target Measurements Combined with Frame-to-Frame Subtraction



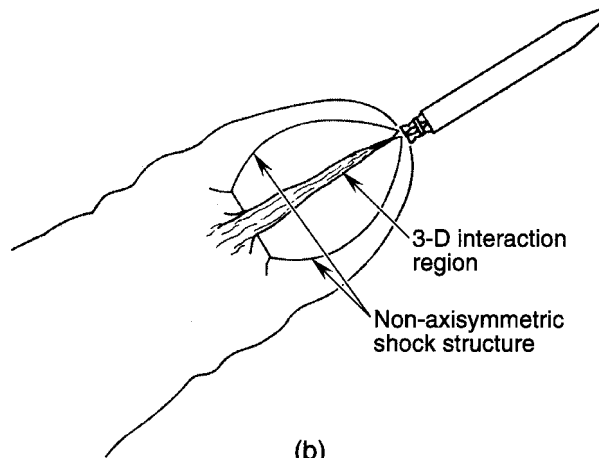
Shape and Radiance Characteristics of Ballistic Missile Exhaust Plumes at Different Altitudes



Axisymmetric
non-interacting
plumes

(a)

Low Altitudes

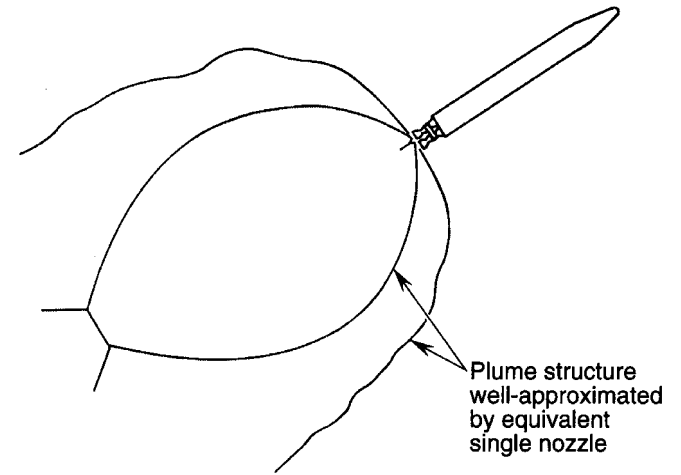


3-D interaction
region

Non-axisymmetric
shock structure

(b)

Intermediate Altitudes



Plume structure
well-approximated
by equivalent
single nozzle

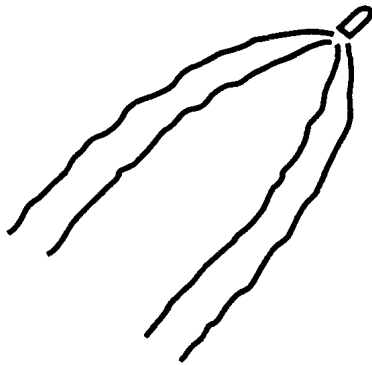
(c)

High Altitudes

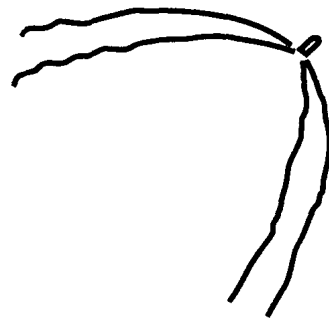
Variation of Apparent Ballistic Missile Exhaust Plume Intensities With Altitude

Enhancement

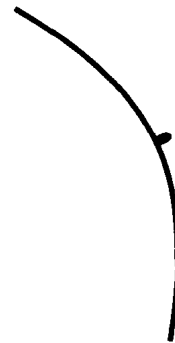
Afterburning,
 $D \sim 10\text{--}100\text{ m}$



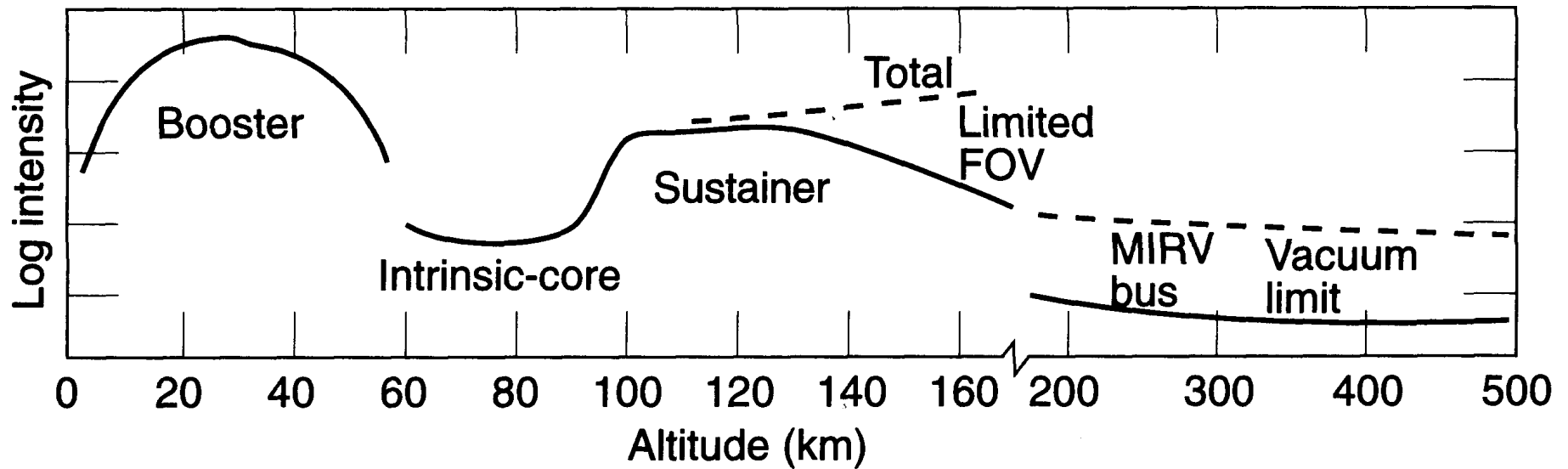
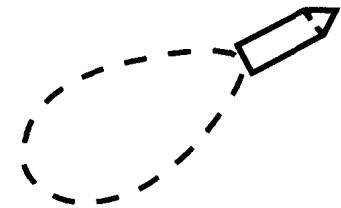
Continuum
flow regime,
 $D \sim 0.1\text{--}1\text{ km}$



Molecular
flow regime,
 $D \sim 1\text{--}10\text{ km}$



Vacuum limit,
 $D \sim 1\text{--}10\text{ m}$



Short and Medium Wavelength Radiance of the Titan IIB at 18 and 118 Kilometers Altitude

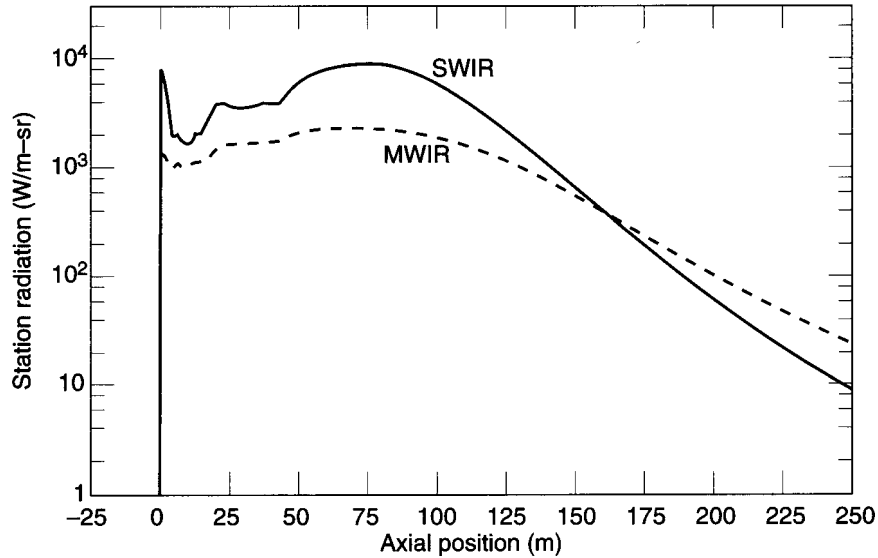


Fig. 5.5. SWIR and MWIR station radiances at 18 km.

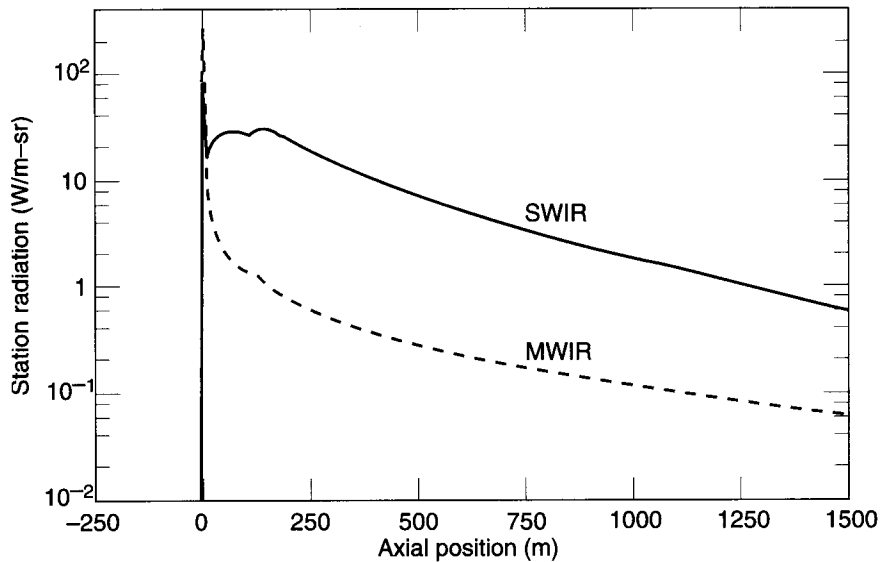


Fig. 5.6. SWIR and MWIR station radiances at 118 km.

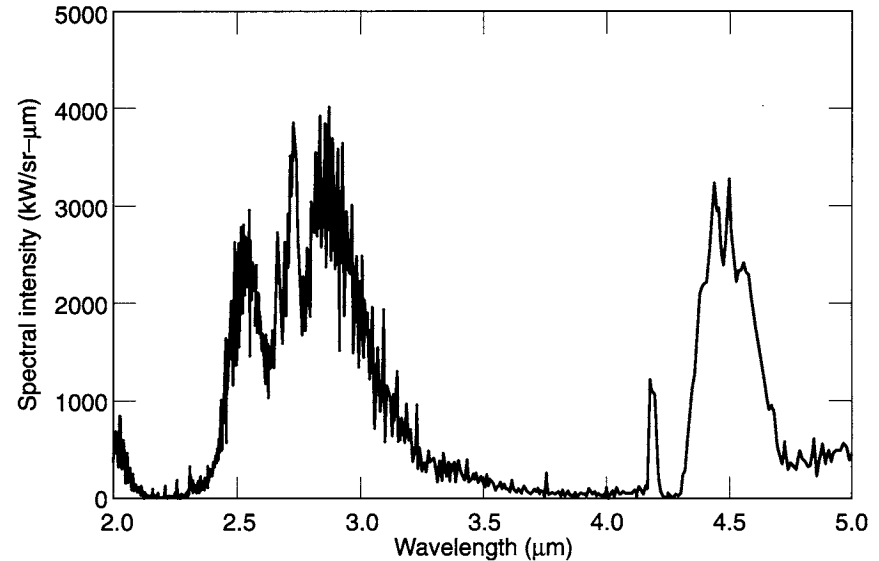


Fig. 5.3. Spectra of Titan IIB at 18 km and viewing aspect of 48 deg.

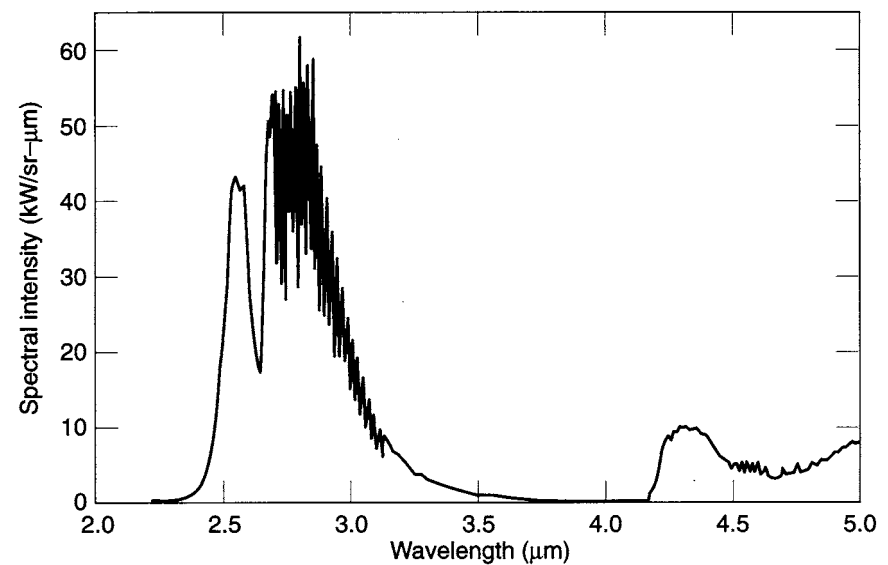


Fig. 5.4. Spectra of Titan IIB at 118 km and angle-of-attack of 7.4 deg.

Short and Medium Wavelength Radiance Maps of the Titan IIB at 18 and 118 Kilometers Altitude

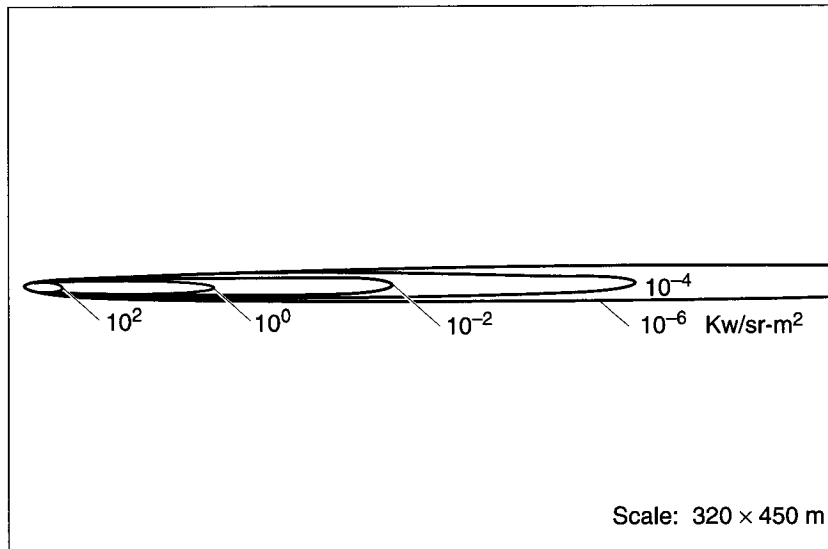


Fig. 5.7. SWIR radiance map at 18 km.

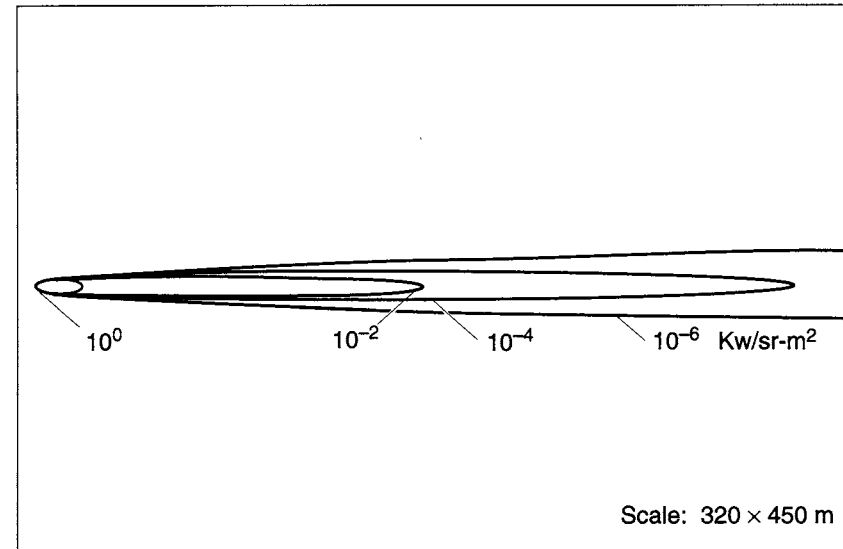


Fig. 5.8. MWIR radiance map at 18 km.

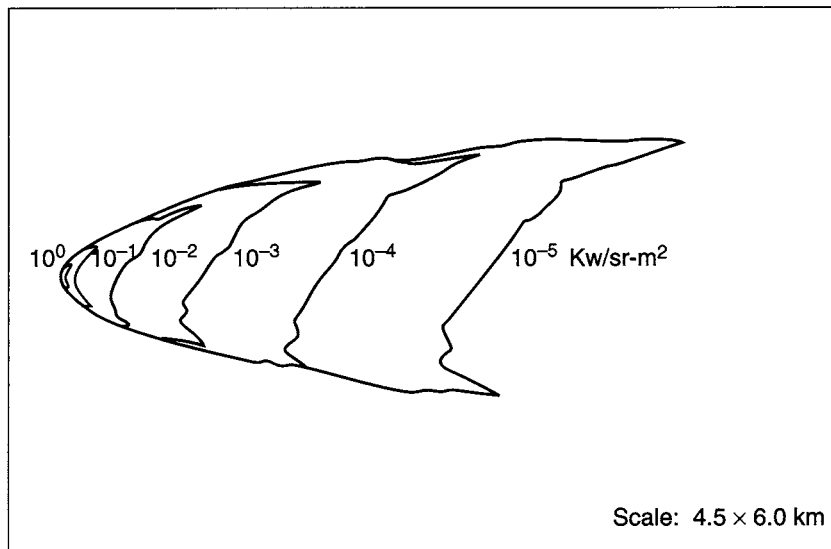


Fig. 5.9. SWIR radiance map at 118 km.

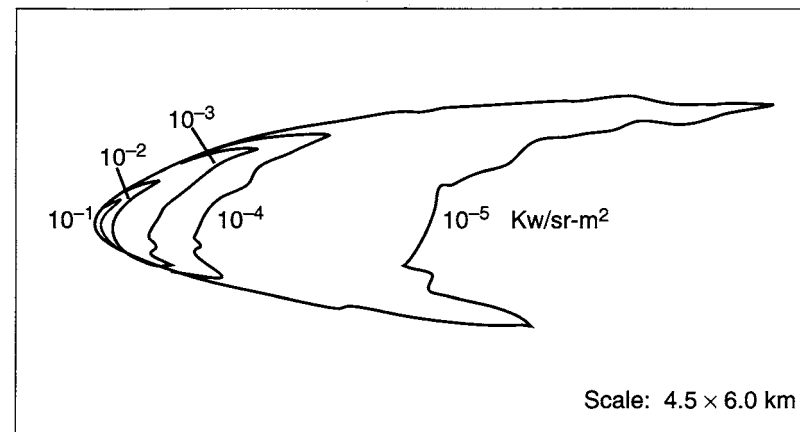


Fig. 5.10. MWIR radiance map at 118 km.

Flight Profile and Initial Plume Intensities of the Titan IIB

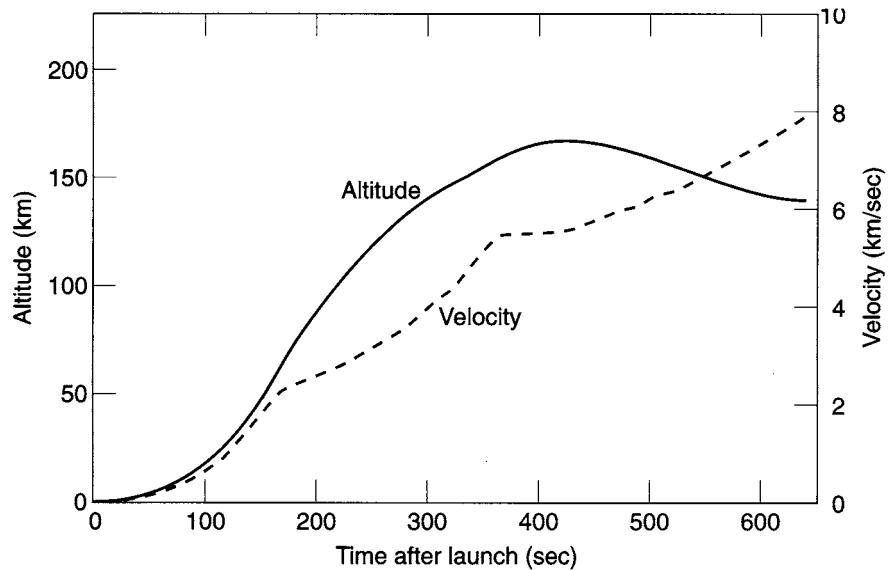


Fig. 5.11. Flight profile for Titan IIB.

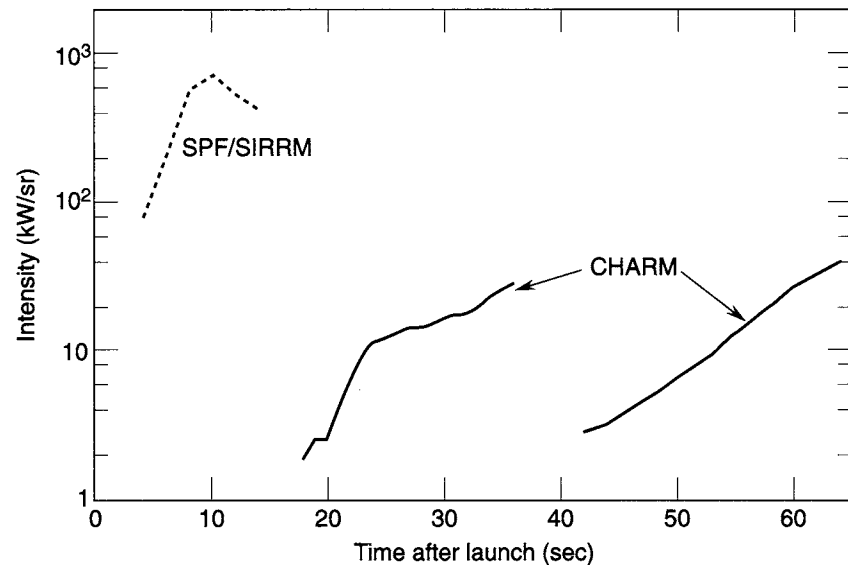


Fig. 5.2. Model calculations of the plume intensity of a Titan IIB.

Short and Medium Wavelength Radiance of the Titan IIB at 18 and 118 Kilometers Altitude

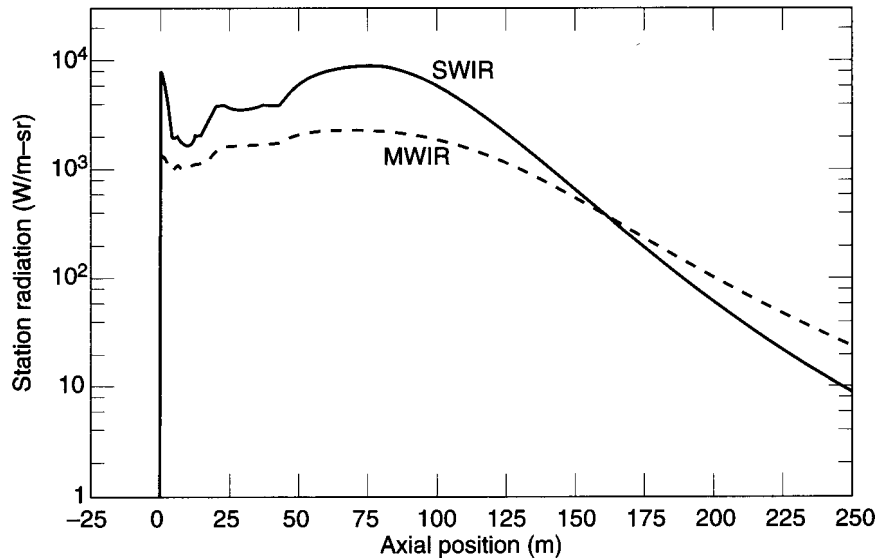


Fig. 5.5. SWIR and MWIR station radiances at 18 km.

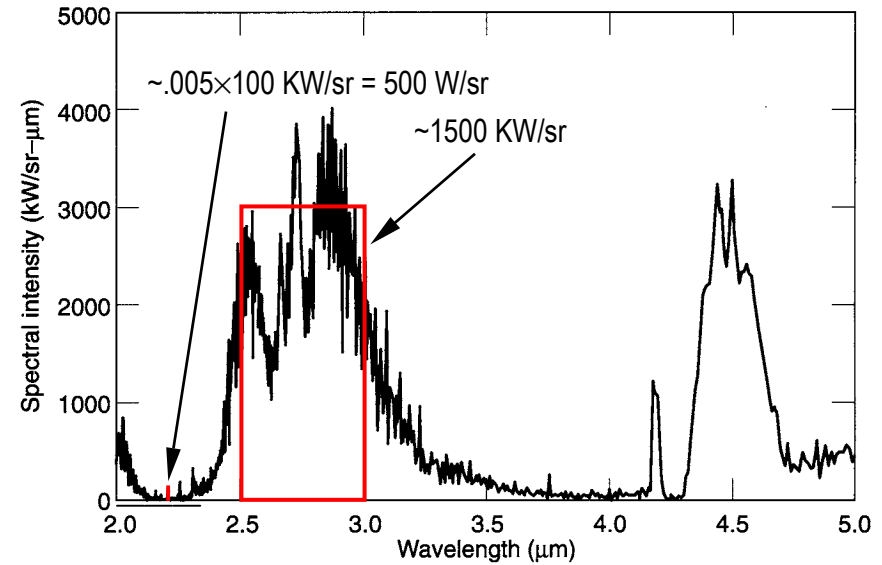


Fig. 5.3. Spectra of Titan IIB at 18 km and viewing aspect of 48 deg.

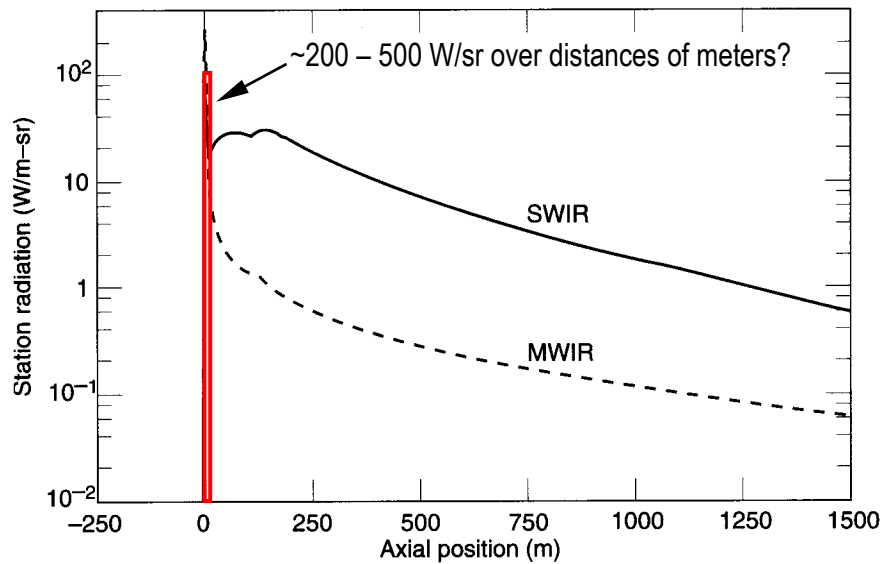


Fig. 5.6. SWIR and MWIR station radiances at 118 km.

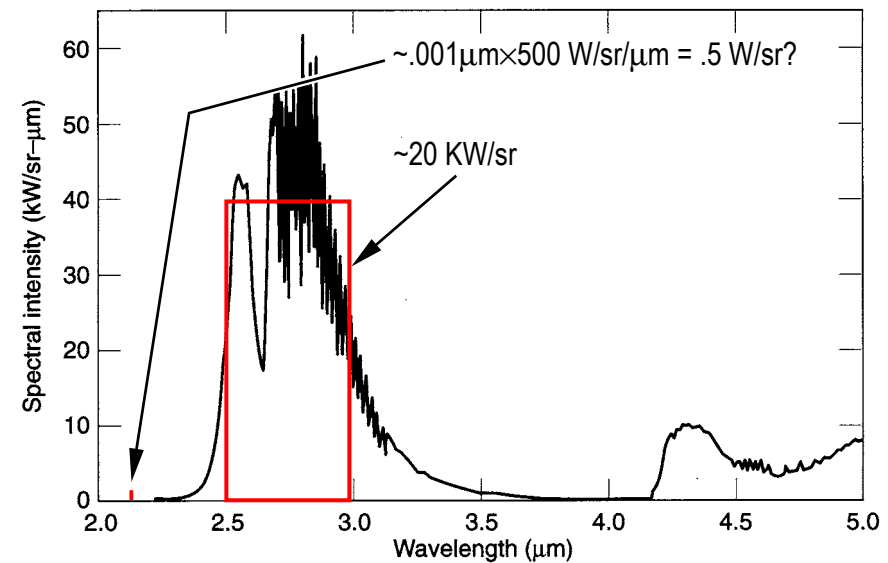


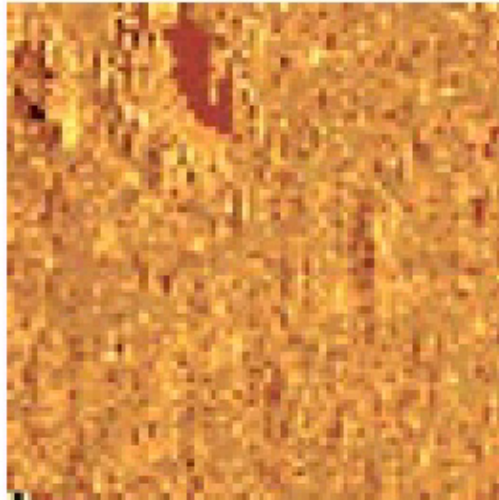
Fig. 5.4. Spectra of Titan IIB at 118 km and angle-of-attack of 7.4 deg.

Narrow Band Infrared Target Measurements Combined with Frame-to-Frame Subtraction

TUNDRA BACKGROUND

8-10 μm
64x64 8-BIT PIXELS
21 IMAGES

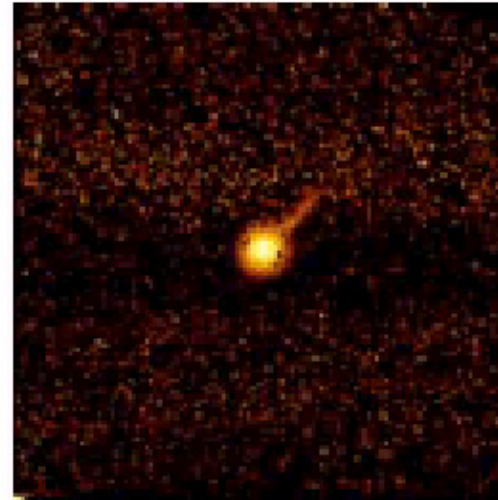
CAMERA ID - 00
8-BIT LINE NUMBER



HALO / IRIS SIMULATION SCENES

3.4-3.7 μm
128x128 12-BIT PIXELS
50 IMAGES

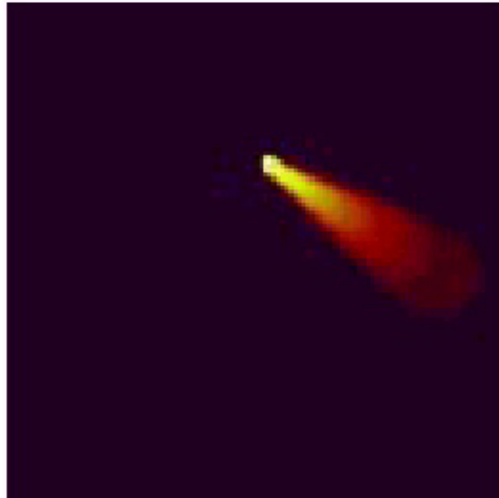
CAMERA ID - 10
8-BIT LINE NUMBER



TUNDRA BACKGROUND & SOLID BOOSTER

4.2-4.4 μm &
8.0-10.0 μm
256x256 10-BITS
101 IMAGES

CAMERA ID - 01
8-BIT LINE NUMBER



FOUR UNIFORM NOISE SETS

DATA RANGES:

- 0-255
 - 1792-2047
 - 3840-4095
 - 0-4095
- 1024x1024 12-BITS
40 IMAGES

CAMERA ID - 11
16-BIT LINE NUMBER



TABLE 19. TEST RESULTS SUMMARY

TEST SET	DESCRIPTION	COMPRESSION (Data Only)	COMPRESSION (With Header)
256 x 256 x 10	Boost vehicle against a tundra background. 4.2 - 4.4 μm	9.1:1	6.4:1
128 x 128 x 12	HALO/IRIS simulation scene. 3.4 - 3.7 μm	3.8:1	3.2:1
1024 x 1024 x 12	Noise uniformly distributed 0.255	1.4:1	1.4:1
1024 x 1024 x 12	Noise uniformly distributed 1792-2047	1.4:1	1.3:1
1024 x 1024 x 12	Noise uniformly distributed 3840-4095	1.4:1	1.4:1