# Laser Dazzler Effects and Applications

NATO Military Police Close Protection Forum 2023

17 May 2023

**Joint Intermediate Force Capabilities Office (JIFCO)**

**US Dept. of Defense**

# Agenda

- What are Laser Dazzlers?
  - General effects & applications
- Human Effects & Injury Risks
  - Effects: Hailing/Warning, Distraction, Visual Suppression
  - Conditions affecting performance
- Hardware
  - Power output, wavelengths, form factors
  - Engineering controls for effects and safety
- Policy & Regulatory Considerations
  - Safety standards, laser safety review boards

# What are Laser Dazzlers?

Low power visible laser devices intended to have reversible non-lethal effects

- Temporarily overwhelming an adversary's visual sense by emitting a credible glare source
- Providing an unequivocal, non-verbal warning
- Providing the target an opportunity to clarify intent

**Advantages:**

- Relatively low-cost
- Relatively small form factor
- Reliable effects, short & long range
- Low risk of injury

# General Applications & Effects

## Applications:

- Convey Protection
- Entry Control Points
- Urban Operations
- Long Range Vehicle & Vessel Hailing
- Dismounted Patrol

## Effects:

- Unambiguous Hailing/Warning
- Glare
- After Images
- Temporary Visual Suppression

# Example Vignette: Urban Operations

EoF CROWS

Solid-State Active Denial Technology

**MANEUVER TO OBJECTIVE:**

- Coalition forces conducting operations in megacity across the continuum.
- Joint Forces must maneuver through urban areas to reach objectives.
- Noncombatants number in the tens of thousands and attempt to lead normal lives.
- Civilian vehicle and foot traffic impede movement of friendly forces.

**INTERMEDIATE FORCE CAPABILITIES (IFCs):**

- **Dazzling Laser and Acoustic Hailing Device** mounted on **Escalation of Force (EOF) Common Remotely Operated Weapon Station (CROWS)** warns pedestrians/vehicle operators to give way.
- **Vehicle Mounted Solid-State Active Denial Technology (SS-ADT)** clears roads of non-compliant individuals.
- **Vehicle Mounted Radio Frequency Vehicle Stopper** protects friendly forces from vehicle-borne improvised explosive devices.

**OPERATIONAL IMPACT:**

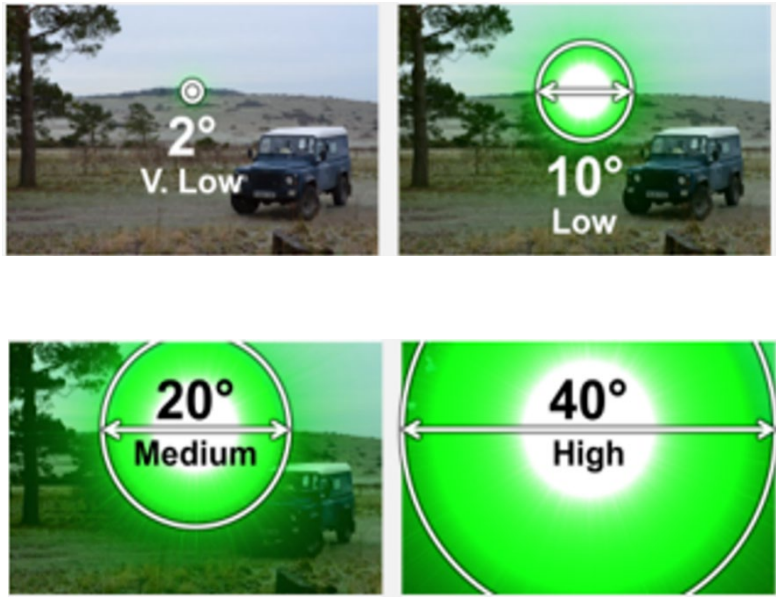
- Help to prevent unnecessary destruction and loss of life.
- Expand decision time and space in ambiguous situations.
- Enable proactive operations while reducing risk in information space.

# Human Effects

**Irradiance** $(\mu W/cm^2)$

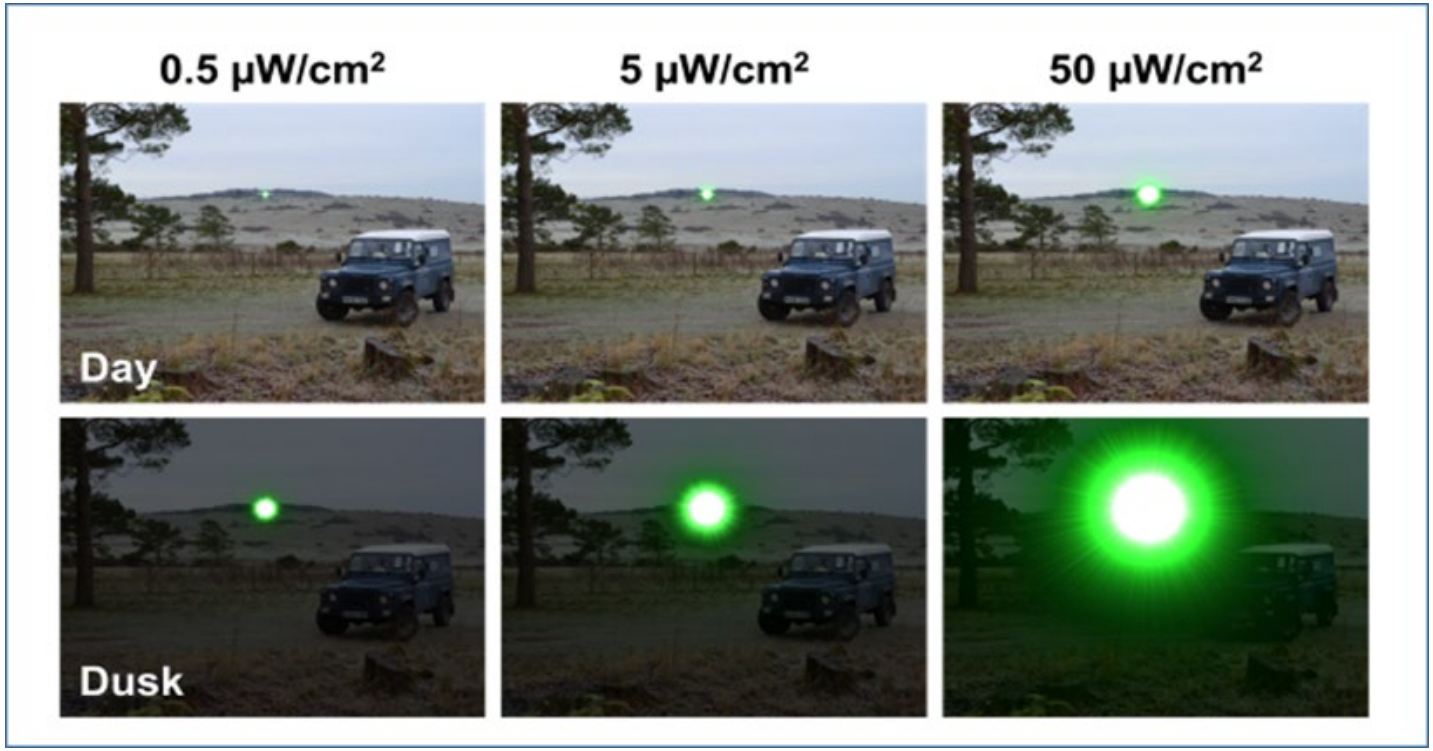
+ ⟶

Visible Detection ⟶ Unambiguous Warning ⟶ Visual Suppression

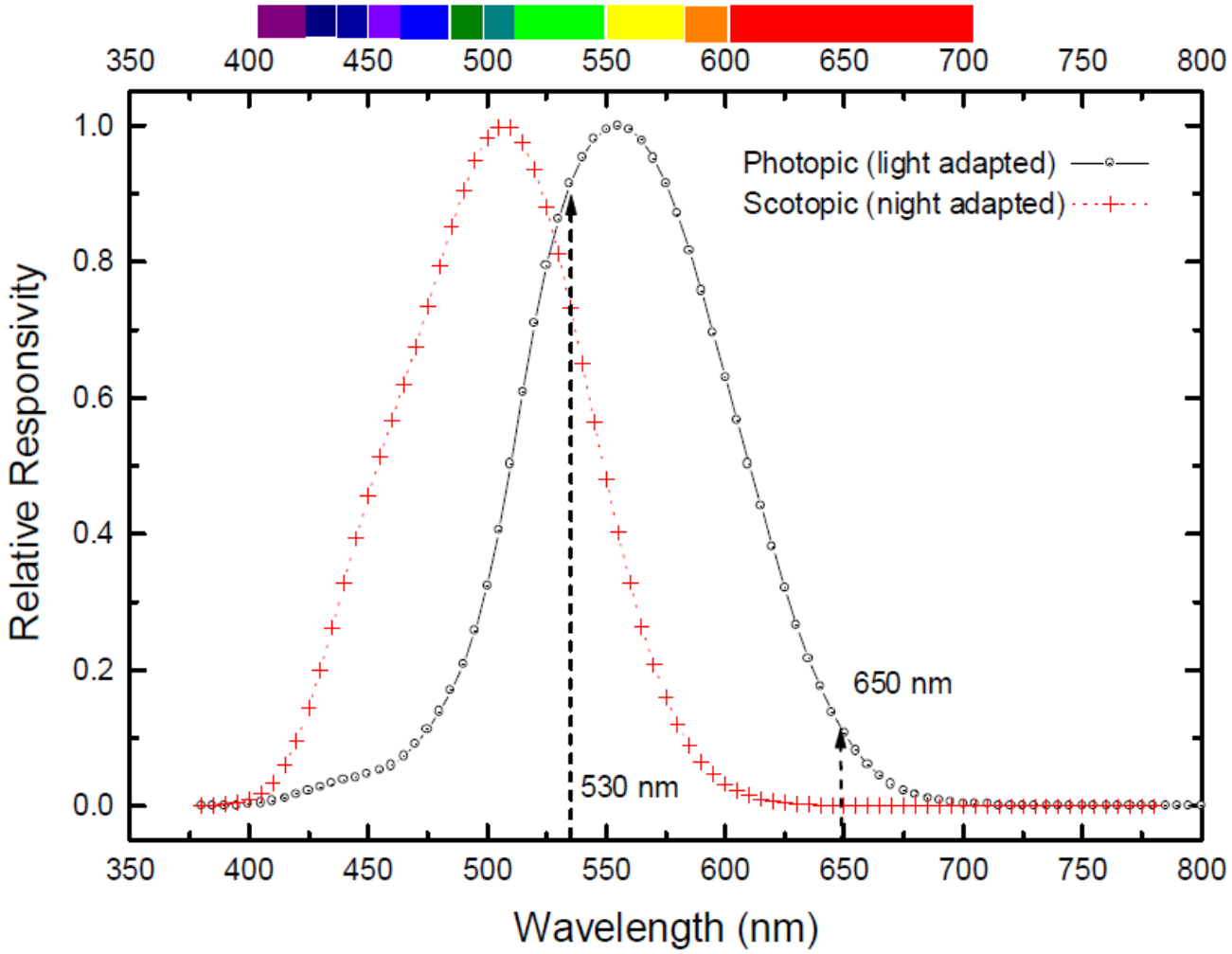



- Size of glare in visual fields increases as irradiance on target increases
- Glare effects often increased behind glass through scattering

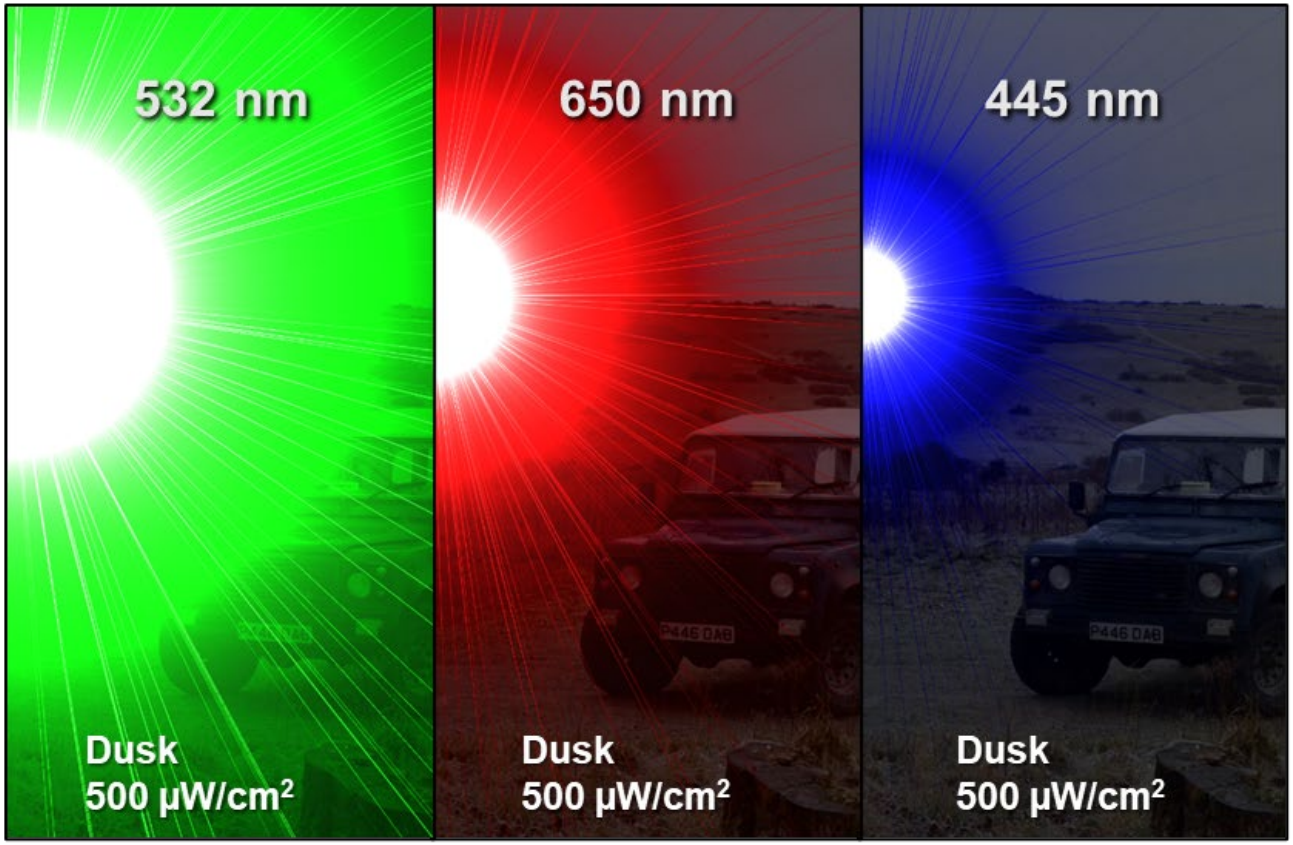
# Effects of Ambient Lighting



# Dazzler Wavelengths



# Dazzler Wavelengths




Williamson, C. A., McLin, L. N., Rickman, J. M., Manka, M. A., Garcia, P. V., Kinerk, W. T., & Smith, P. A. (2017). Wavelength and ambient luminance dependence of laser eye dazzle. Applied optics, 56(29), 8135-8147.

# Safety & Injury Risks

- Laser device can cause injuries to eyes and skin
- However, visible laser dazzlers do not pose any risk of skin injuries and eye injuries can be prevented with administrative (training, rules of engagement) and engineering controls
- Desired non-lethal effects can be achieved well below thresholds for injury and laser hazard standards
- US Department of Defense uses American National Standards Institute (ANSI) Z136.1
- Maximum permissible exposure (MPE) for ¼ second exposure
  - 2.5 $^{mW}/_{cm^2}$
  - 0% risk of injury when below MPE
- Nominal Ocular Hazard Distance is defined as distance from laser source where peak irradiance falls below MPE

# Laser Technology & Form Factor

## Laser Technology:

- Solid state, diode-pumped
- Output: mW to tens of Watts
- Wavelengths (i.e., colors):
  - A lot of options now: red, green, blue, etc.
  - Most common is a frequency doubled Nd:YAG (neodymium-doped yttrium aluminum garnet) – 532nm (green)

## Form Factors:

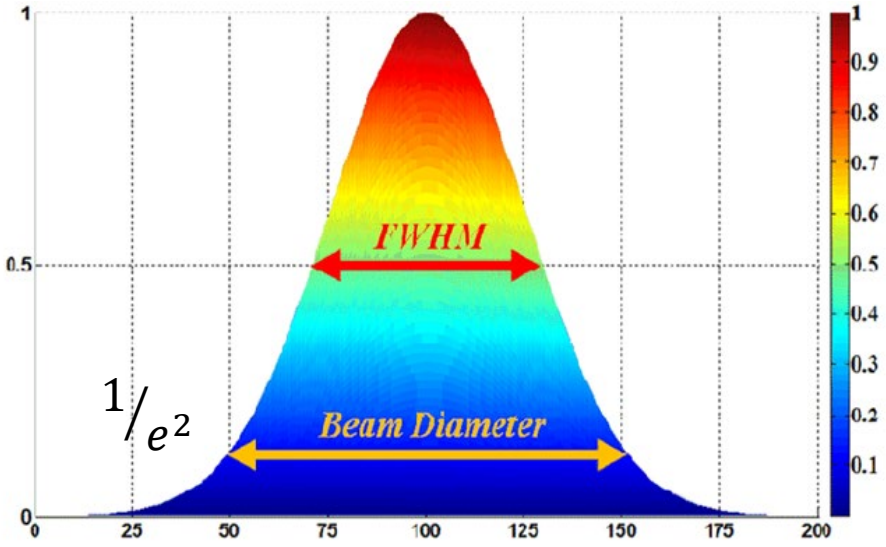
Handheld

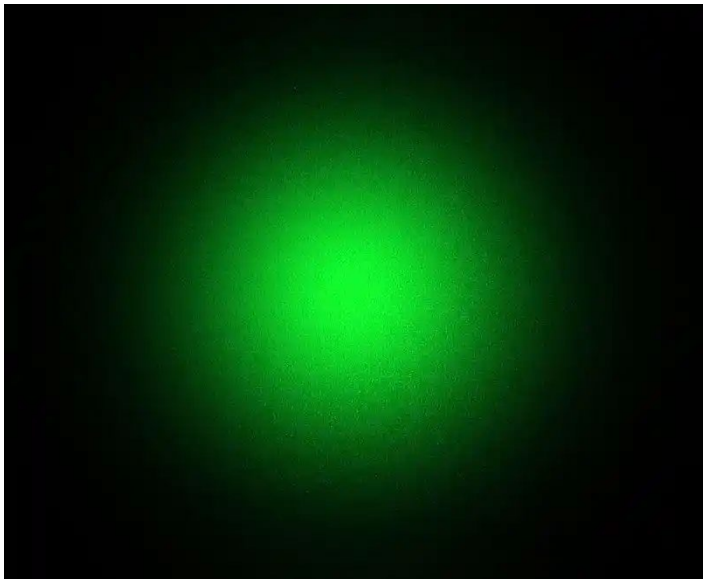
Weapon-mounted

Platform-mounted

# Laser Spot Size & Beam Profile

- Laser spots are not uniform in intensity
- Spot sizes can be defined by different conventions

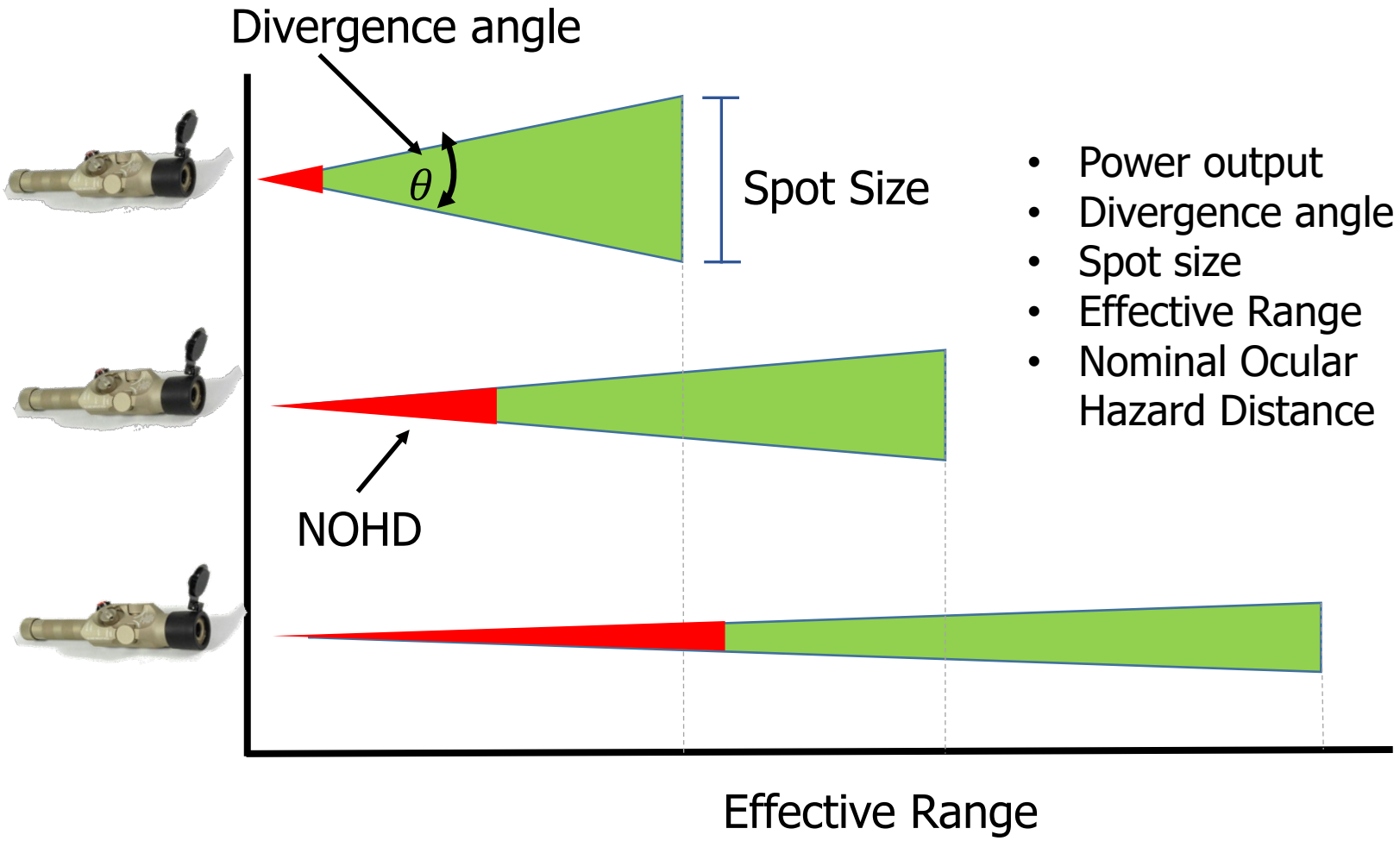


- You could also define an "effective spot size"

Images from: *https://en.wikipedia.org/wiki/Gaussian_beam*

# Hardware Trade Space

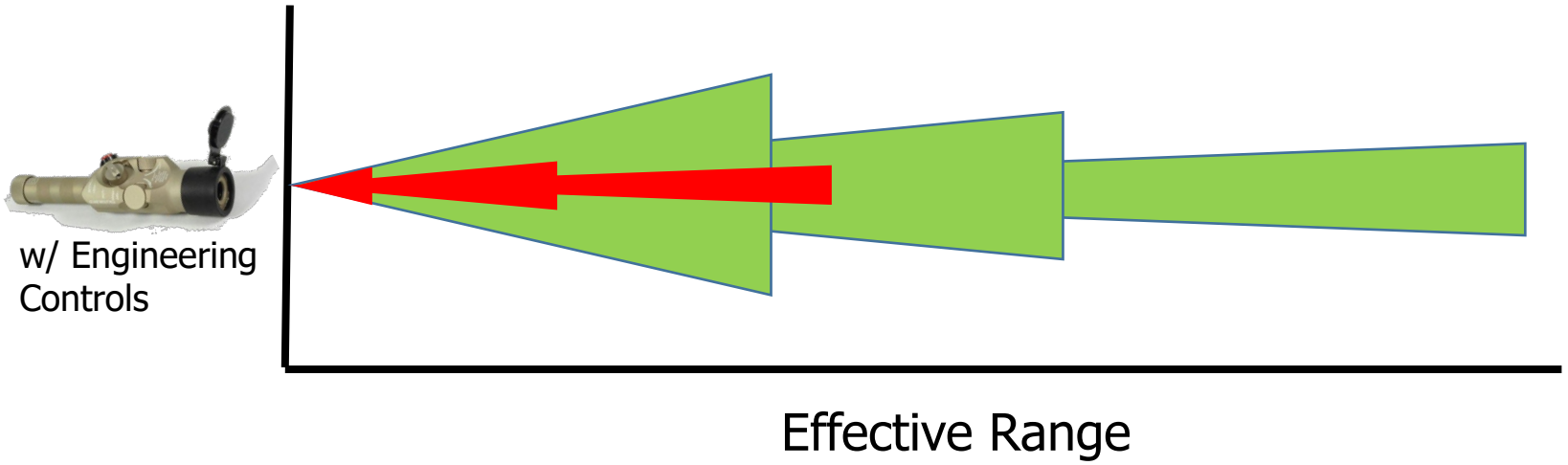



- Power output
- Divergence angle
- Spot size
- Effective Range
- Nominal Ocular Hazard Distance

# Engineering Controls

- Engineering controls can be utilized to maximize utility for a given laser source

- **Example:** Integrated laser range finder output used to automatically adjust laser divergence to maximize effect and minimize risk of injury based on range to target



# Fielded Systems

## US Navy:

- B. E. Meyers "GLARE" LA-9/P – 250mW output power includes a safety control module
- Long Range Ocular Interrupter (LROI): Green Dazzling Laser; Warning: 3000m; Suppression: 2000m
- Hailing Acoustic Laser and Light Tactical Systems (HALLTS): Integrates a BE Meyers LA/9-P with acoustic hailing
- Optical Dazzling Interdictor, Navy (ODIN) to disrupt unmanned aerial systems and other platforms

LA-9/P

LROI


## USMC:

- B.E. Meyers 532-VPS GLARE RECOIL

# Fielded Systems

## US Air Force:

- BE Meyers GLARE RECOIL

GLARE RECOIL

## US Army:

- Z-bolt Laser System Model MBP-5-ARMY; 3-5 mW output power
- Green Laser Interdiction Systems (GLIS) – B.E. Meyers GLARE MOUT; 250 mW output power

GLARE MOUT

Z-Bolt


## US Coast Guard:

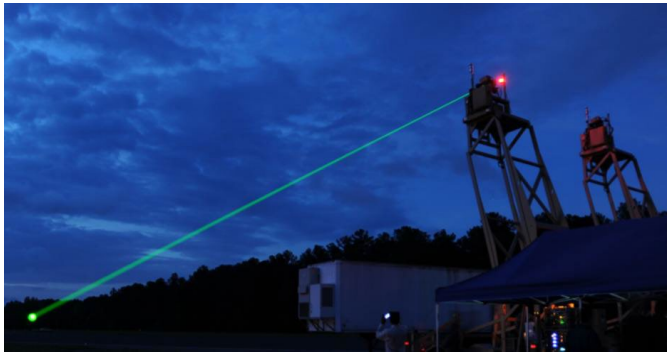
- LA-9/P
- CG-HALLTS

CG-HALLTS

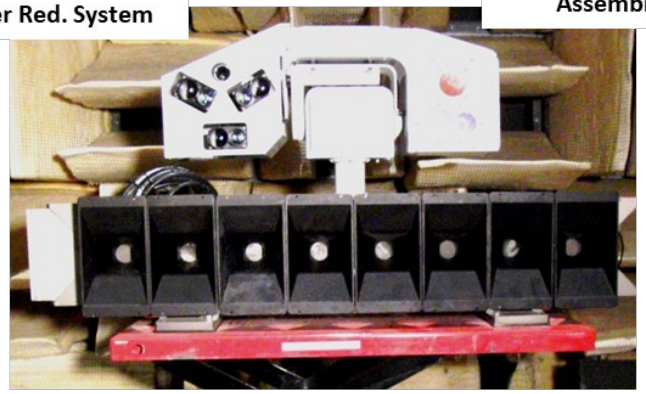
# JIFCO-developed Distributed Sound and Light Array (DSLA) Prototype

## Performance Specifications:

- Dazzling Laser Output Power:
  - 8 watts; Coherent TracER Green Forensic Laser System
    - Wavelength: 532 nm
    - Spot-Size: 3m
    - Cooling: Air-cooled
    - Weight: 10 lbs
- Acoustic Output:
  - 145 dB Acoustic Output with beamforming
- Bright White Light:
  - Maxa Beam Model MBS-430-AY; 12,000 candlepower; Range 3500m; $1^0$ spot; $40^0$ Flood; 3.2 lbs



Mini-DSLA mounted on a Tower




Enhanced Mini-DSLA System

# Regulatory & Policy Considerations

- Laser devices, as compared to other light-emitting devices, are subject to much more regulatory review, control, marking, & procedures
  - Hazards standards
  - Institutional laser safety review boards
- Regulatory compliance can sometimes be a hurdle to train, test, & employ with laser dazzlers
- Training and administrative & engineering safety controls are key to safe and effective use for both the operator and targeted individuals

# Regulatory & Policy Considerations

- 1995 United Nations Protocol on Blinding Laser Weapons
  - "It is prohibited to employ laser weapons specifically designed, as their sole combat function or as one of their combat functions, to cause permanent blindness to unenhanced vision…"
  - "…take all feasible precautions to avoid the incidence of permanent blindness to unenhanced vision. Such precautions shall include training of their armed forces and other practical measures."
- Non-lethal laser dazzlers are not prohibited by this protocol as they are intended to have non-injurious, temporary effects; however, each new device may have to be evaluated for compliance

# Questions?