



Hot Stuff!

Active Denial Technology Uses Millimeter Waves to Safely Keep People Away



Albuquerque, NM (Kirtland Air Force Base)—Active Denial Technology is being developed for use as a non-lethal directed energy weapon. Millimeter wave energy is harnessed and sent through a reflector which when aimed at a body, effects a burning sensation. These specific wavelengths can travel through air but cannot burrow deep enough into the body to actually harm tissue.

"It is very similar to if you were to reach out and touch a hot stove and jerk your hand back almost before you even think about it. It's an instinct." David Williams, lab mathematician

Framework

Middle School

Standards

- NSES - B.iii.1 ➤ Energy is associated with heat, light, and electricity.
- NSES - C.iii.3 ➤ Behavior is a response to an environmental stimulus.
- NSES - F.i.v.1 ➤ Risk analysis considers the type of hazard.
- STL - 3.D ➤ Technological systems often interact with one another.

Content Illustrated

- Animations compare the size and effects of different electromagnetic waves.



Content



Life Science

- Heating the skin near nerve endings causes an instinctual reaction to move away.
- The microwave used in the Active Denial (AD) weapon penetrates the skin 1/64th of an inch. It heats up the water just under the surface of the skin near nerve endings. This makes it feel as if your whole body is burning even though no actual tissue damage occurs.

Physical Science

- Electromagnetic waves, in order of wavelength from long to short, include radio waves (used in GPS), microwaves (used in radar), infrared, light, the visible spectrum (seen in a rainbow), ultraviolet light, X-rays, and gamma rays. Waves range in size from the length of a football field to the length of an atom.
- Millimeter waves are silent and invisible. The 95GHz millimeter-wave (a high-frequency microwave) generated by AD can travel through the air without losing much energy before reaching its target.

Technology

- AD is the longest range non-lethal weapon in existence. Its range is up to 500 meters. It is silent and invisible. Its effect is a strong heating sensation that washes over the whole body.
- AD is a portable technology which can be deployed from a Humvee.
- Energy from the battery is transformed in the gyrotron to millimeter waves, then projected from an aperture onto a large reflector and down to the target.

Engineering

- AD is designed to be a non-lethal weapon. It uses a high frequency microwave which is too short to penetrate the skin to the extent that it could cause damage.
- Microwaves used in ovens are longer and operate at a different frequency than the microwaves used in AD. Regular microwaves are designed to penetrate into food.

Guiding Questions

To think about as you watch:

- What are ways to get enemies to move without injuring them?

Suggested Activities

- Identify the wavelength at which a household microwave operates.

Keywords

aperture
electro magnetic waves
gamma ray
gyrotron
infrared
microwave
millimeter wave
radio waves
reflector
ultraviolet

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