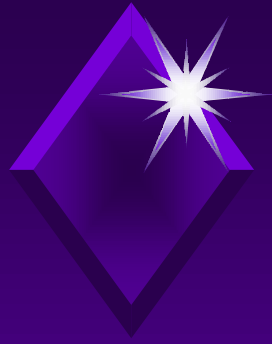


# *Speed Detection: LADAR*

*by : Eric Buchbinder*

EE 494 - Consumer Optoelectronics



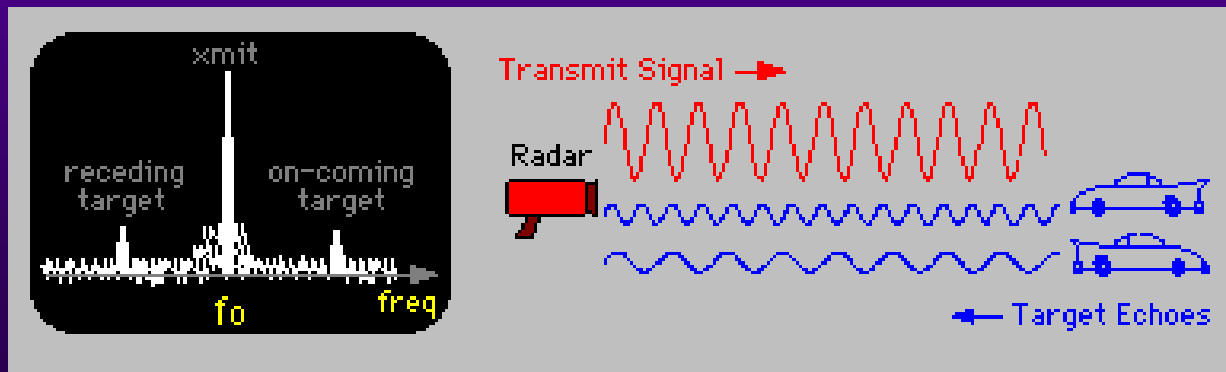
## *Outline - Speed Detection Systems*

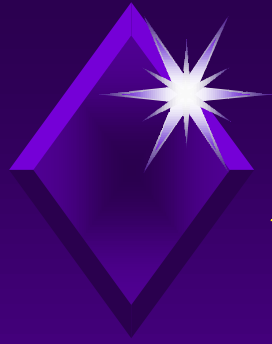
- ◆ Early Methods - Radar
  - \* Applications and Problems
- ◆ Modern Methods - Radar, Ladar
  - \* Applications and Problems
- ◆ Technology : Ladar
- ◆ Comparison - Radar vs. Ladar
  - \* Advantages and Disadvantages



# *Basic Radar Devices*

- ◆ RADAR - RAdio Detection And Ranging
- ◆ Radar measures reflected radio signals
- ◆ Uses Doppler Theory to detect frequency shift in reflected waves
- ◆ The greater the Doppler shift, the greater the speed





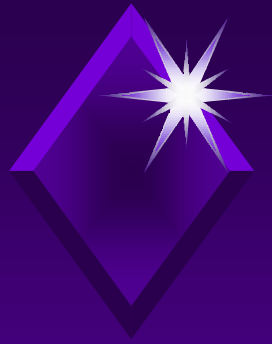
## *Early Radar Devices*

- ◆ S - Band Radar : operates at 2 - 4 GHz
  - \* Microwave ovens operate at 2.45 GHz
- ◆ X - Band Radar : operates at 10.50-10.55 GHz
  - \* Not accurate below 20 mph, has interference problems
- ◆ K - Band Radar : operates at 24.05-24.25 GHz
  - \* Water Vapor absorption band centered at 22.24 GHz



# *Modern Speed Detection*

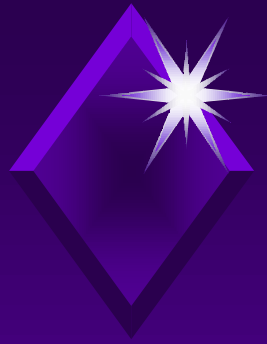
- ◆ Ka - Band : operates at 33.4 - 36.0 GHz
  - \* has 13 200-MHz channels, can operate in “hop” mode
- ◆ Ladar : uses light emitted at 904 nm (typical)
  - \* can use different wavelength, dependent upon material



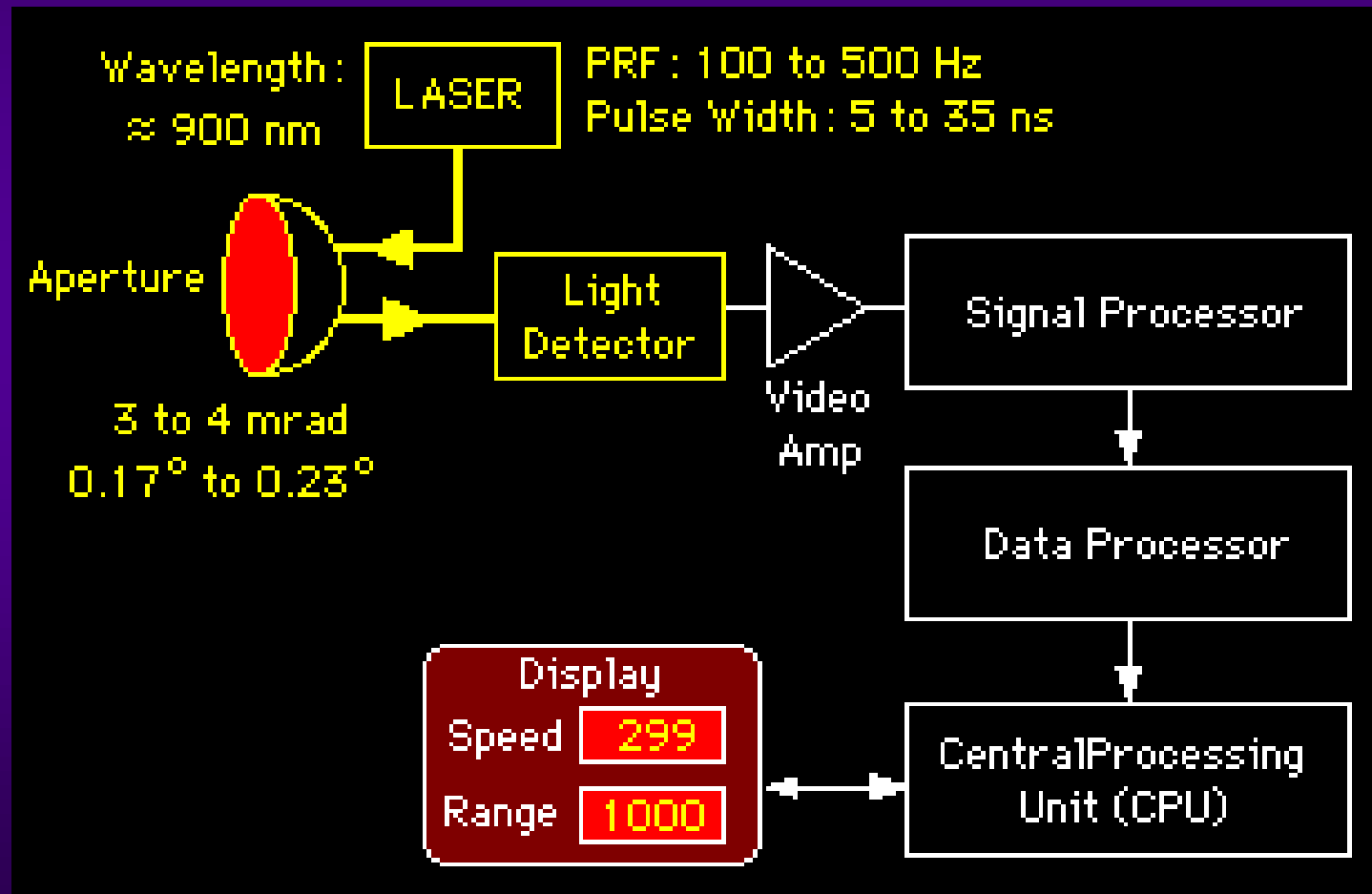
# *The Technology of Ladar*

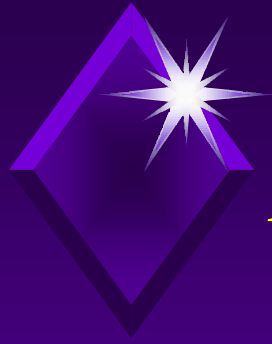
- ◆ Ladar uses 3 semiconductor diodes to generate laser light
- ◆ Uses light pulses to make 2 consecutive distance measurements, then divides by time
- ◆ Lenses are used to collimate light to narrow beam
- ◆ Typically use ANSI Class I laser devices





# *Ladar Technology*





## *Advantages of Radar*

- ◆ Very flexible - can be used in a number of ways
  - \* Stationary mode
  - \* Moving mode
  - \* Two Directional mode
- ◆ Beam spread can incorporate many targets
- ◆ Can often select fastest target, or best reflection
- ◆ Still very reliable





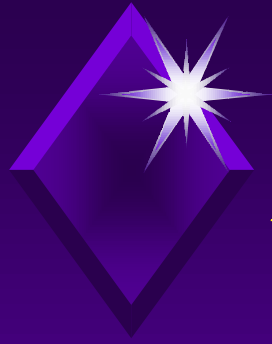
## *Radar Disadvantages*

- ◆ Time - Radar can take up to 2 seconds to lock on
- ◆ Radar has wide beam spread (50 ft diameter over 200 ft range)
- ◆ Cannot track if deceleration is greater than one mph/second
- ◆ Large targets close to radar can saturate receiver
- ◆ Hand-held modulation can falsify readings
- ◆ More interference sources



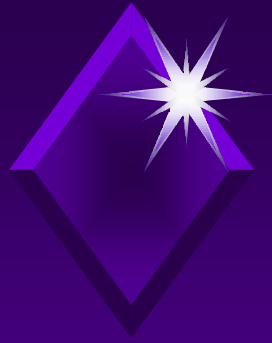
## *Ladar Advantages*

- ◆ Faster lock-on time ( less than 1/3 second)
- ◆ Very narrow beam spread ( less than 6 ft over 2000 ft range)
- ◆ Better ability to track decelerating targets
- ◆ Typically mounted, and aimed with optical targeting device
- ◆ Fewer sources of interference
- ◆ Much more difficult to detect



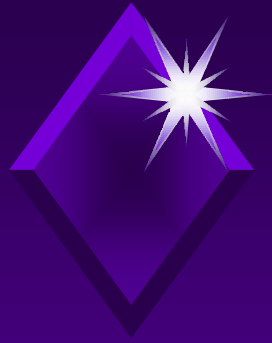
## *Problems with Ladar*

- ◆ Particles (dust, water) in air can limit range
- ◆ Rounded surfaces, the colors black, blue, and violet are poor reflectors
- ◆ Can be difficult to track target
- ◆ Alignment can cause severe error
- ◆ Extreme sunlight can be damaging



## *Conclusions*

- ◆ Ladar is, in the correct environment, better suited for speed detection
- ◆ Ladar is not perfect, however
- ◆ There is still room for Radar patrolling
- ◆ Both could be used in concert to achieve maximum detection capabilities



# *Sources of Information*

- ◆ <http://members.aol.com/copradaar/index.html>
- ◆ [www.motorists.org](http://www.motorists.org)
- ◆ [www.dot.gov](http://www.dot.gov)
- ◆ [www.fhwa.gov](http://www.fhwa.gov)
- ◆ [www.nhtsa.dot.gov](http://www.nhtsa.dot.gov)