Muzzle Flash Measurement, Detection and Localization

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Army Proven
Battle Ready

Current Flash Data

3 Round Burst – Back and Side

20 Round Burst – Back and Side

Where we are going

- Direct measurement of the flash intensity and duration.
  - Relative to the response of the human eye.
- Direct comparison of any weapon system or ammunition.
  - Single shot, burst
  - Suppressed, unsuppressed
- Data that can be fed into a detection model.

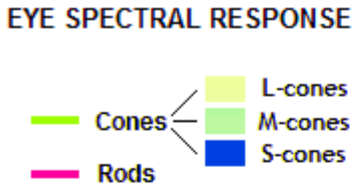
Typical Lux Values

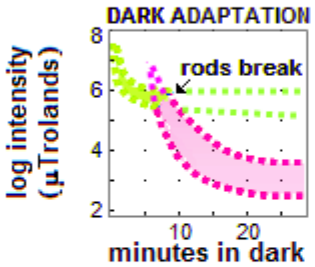
100000 Lux – Direct Sunlight
10000 Lux – Full Daylight
1000 Lux – Overcast Day
100 Lux – Dusk
1-10 Lux – Street lighting
0.1 Lux – Full moon
0.01 Lux – Quarter Moon
0.001 Lux – Clear night without moon
0.0001 Lux – Dark cloudy night

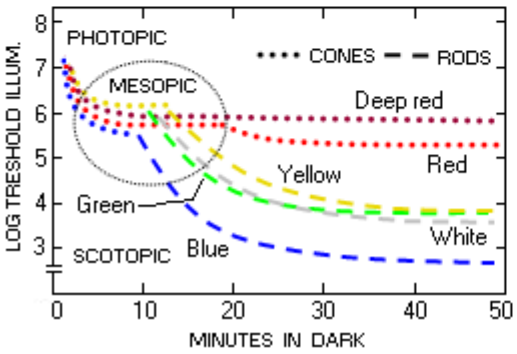
The Human Eye

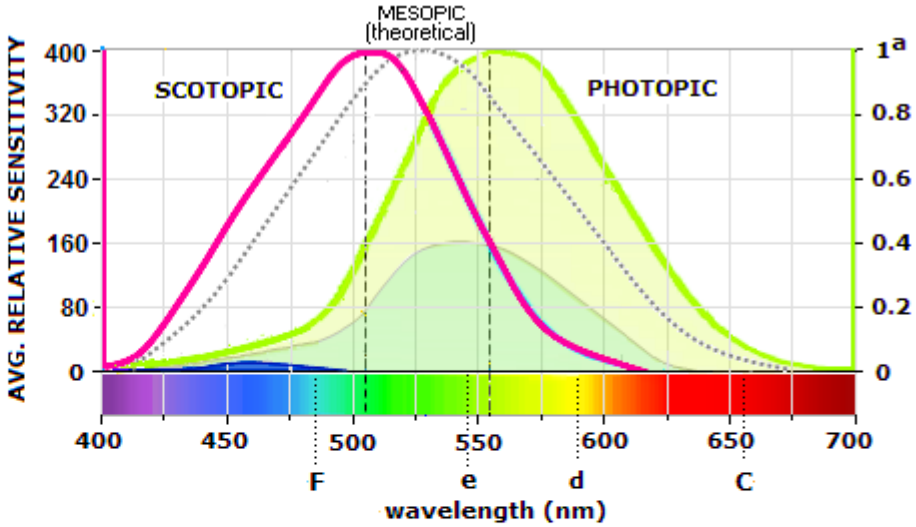
- Response determined by many factors.
  - Background Light
    - Daylight – Photopic Vision (Cones)
    - Dark adapted – Scotopic Vision (Rods)
  - Spectral Distribution
  - Shape of the flash.
    - Modified Allard Method
  - Orientation of the flash to the eye

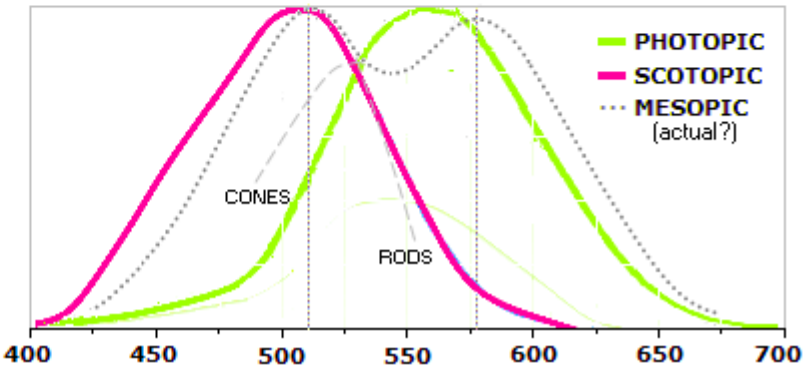
Spectral Response of the Eye



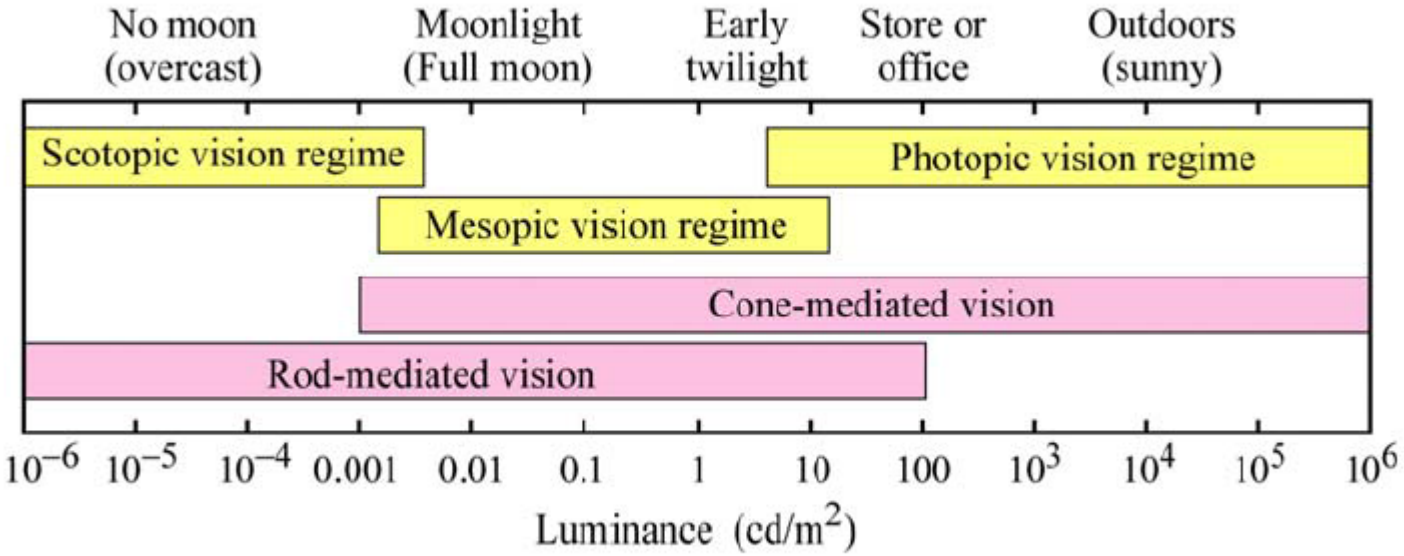




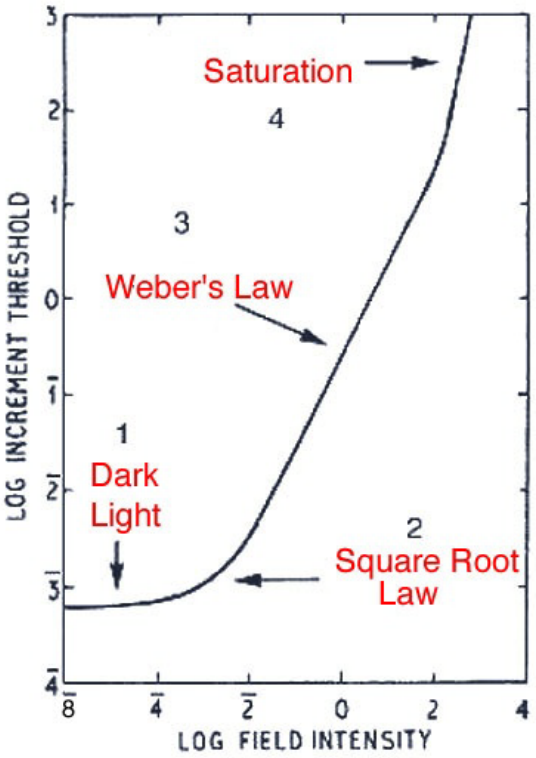


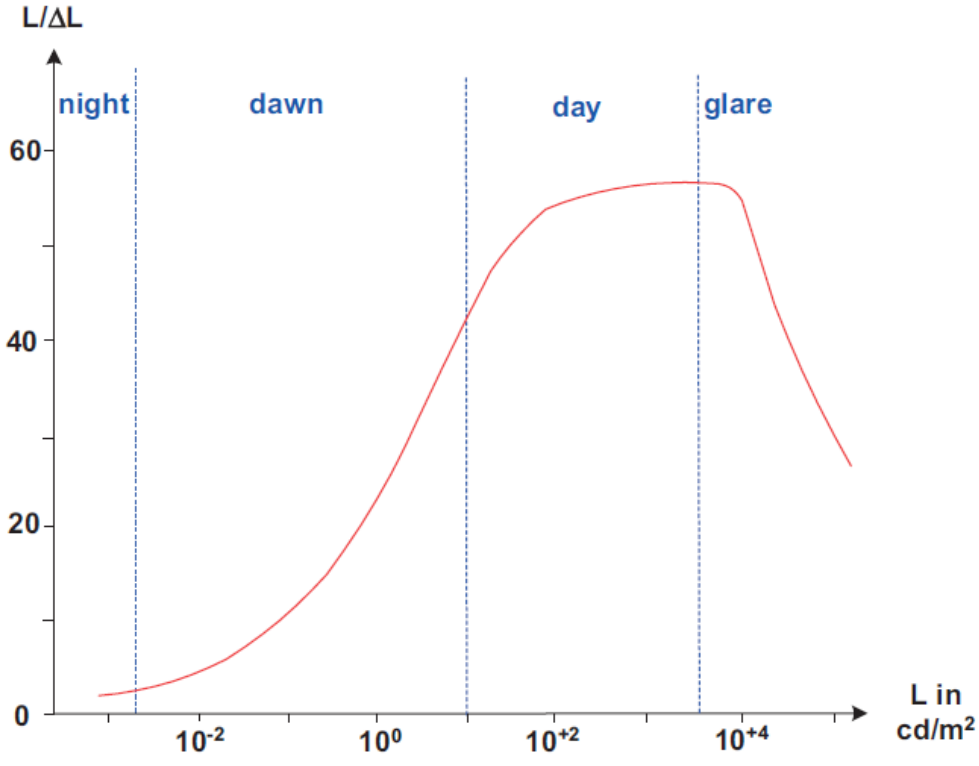


Ranges of Vision



Threshold Sensitivity

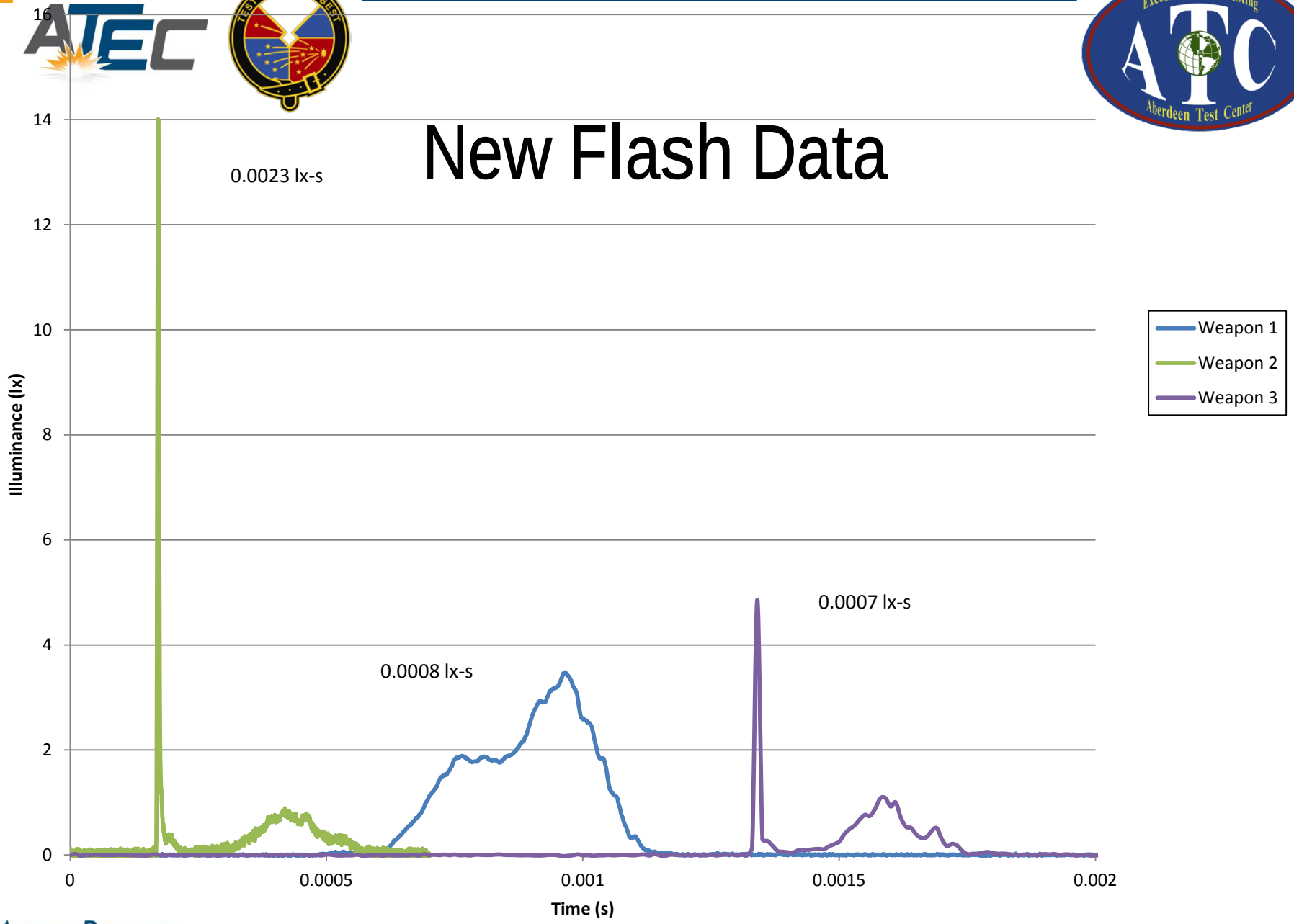




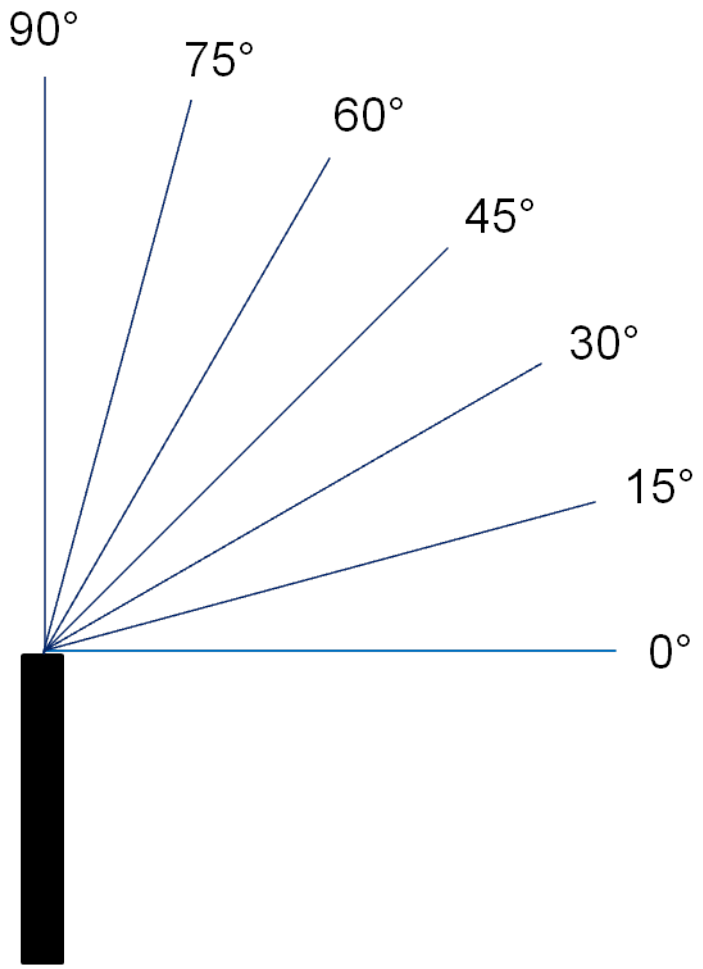
New Flash Measurement

- Optometer used to capture time history of the flash.
  - Gigahertz-Optik TC-9600
  - MD-37 Detector (Photopic and Scotopic Filters)
- Digital SLR used to capture size.
- Both single shot and burst data can be collected and analyzed.
- Data processed using Modified Allard which reults in apparent intensity (lx-s).

New Flash Data



Flash Measurement Angle



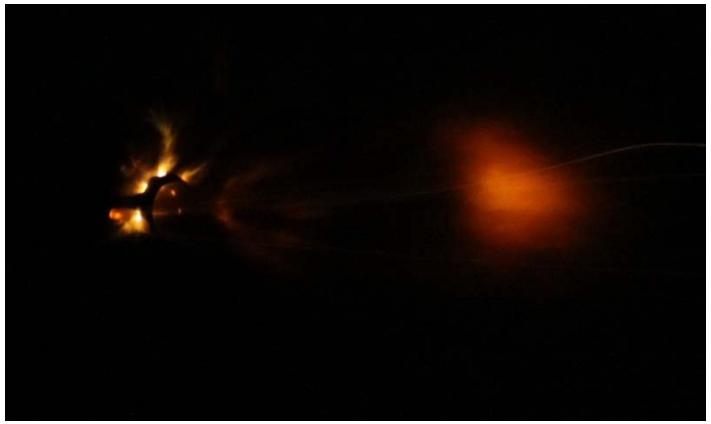
Flash Measurement Angle

0

15

30

Flash Measurement Angle



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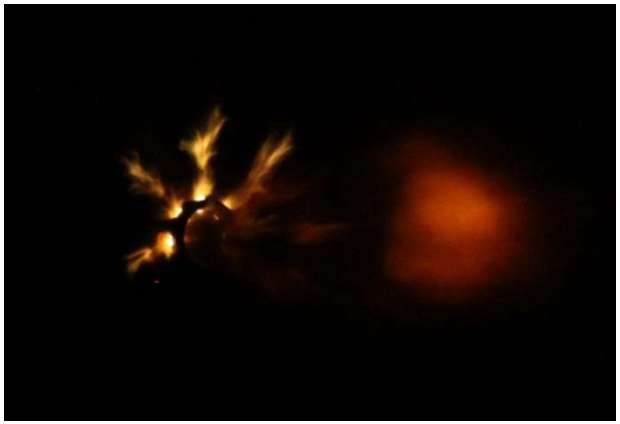

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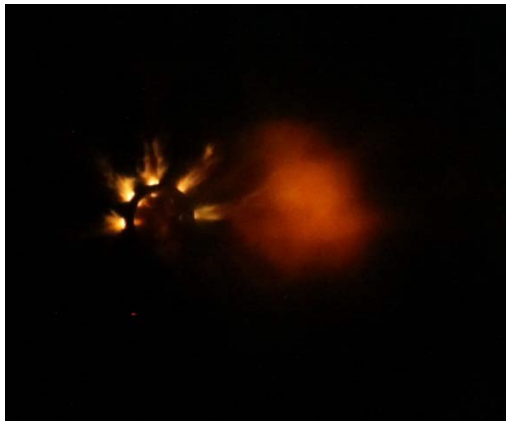

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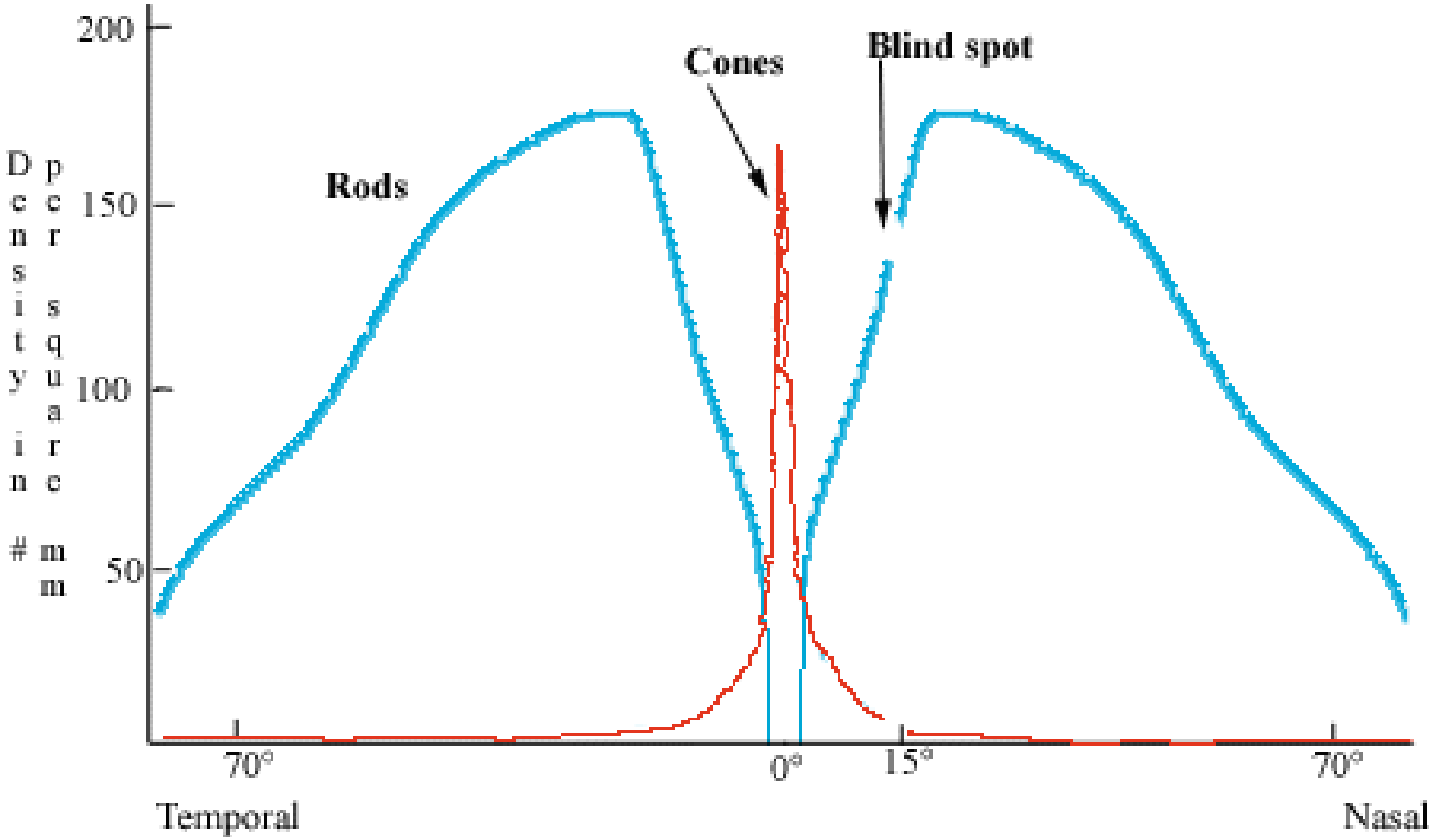
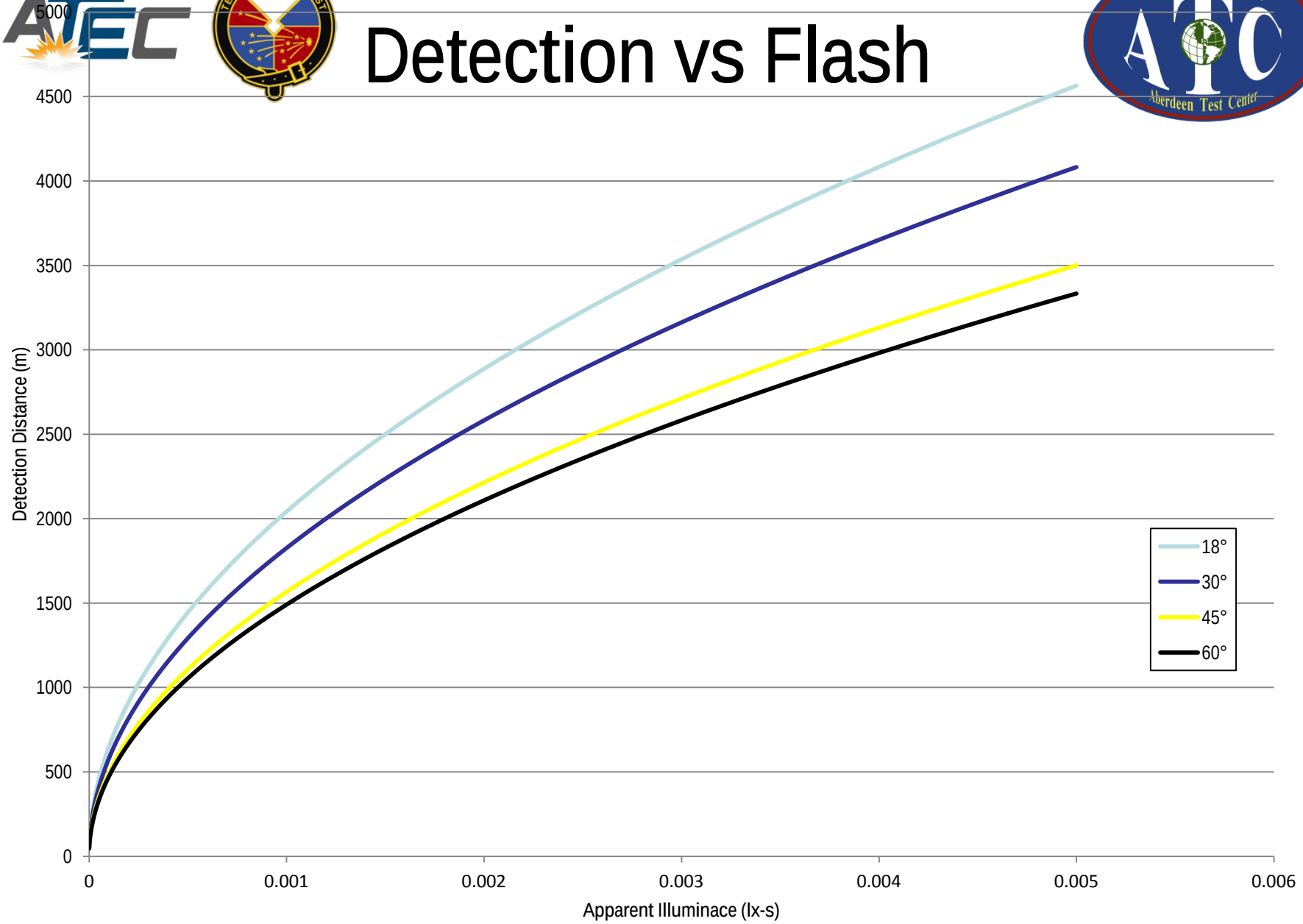
Simple Detection Model

- The time history of the muzzle flash is recorded.
- The flash profile is analyzed using the Modified Allard Method resulting in an apparent intensity. (Both single shot and burst can be analyzed.)
- Detection distance calculated based on:
  - minimum detectable level
  - background intensity
  - observation angle

Distribution of Rods and Cones



Detection vs Flash



The Next Step

- The detection model will be validated
  - Several flash levels
  - Range of background light
  - Standard observer
  - Live fire
- Localization
  - Testing at ARL and HRED

Questions?