Reflective Laser Protective Eyewear

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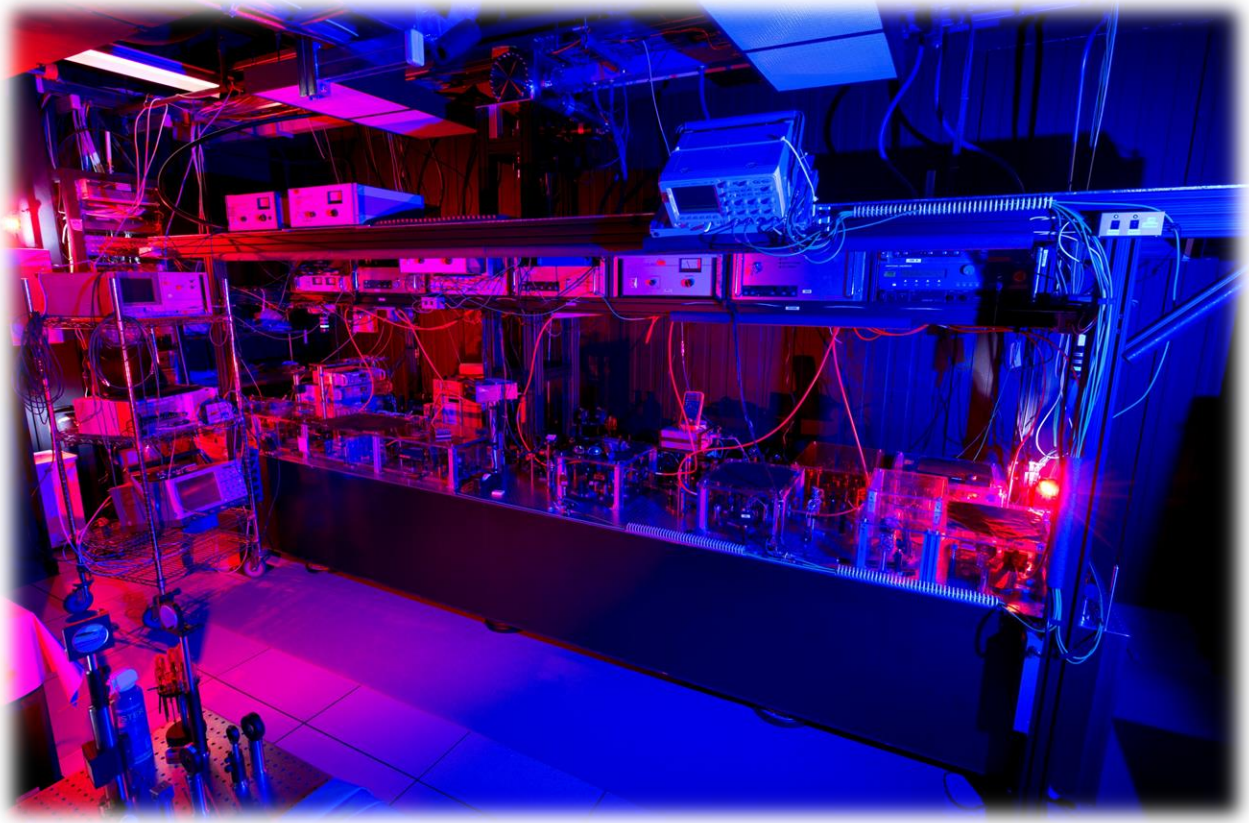
Laser Familiarity

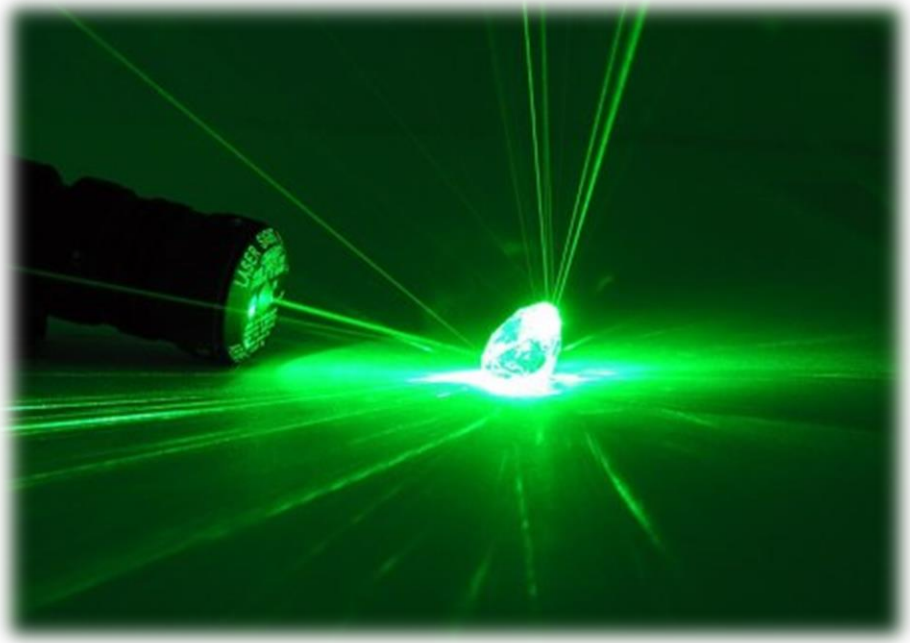
- I am not a safety professional, I am a customer
- I have been working with high-powered lasers for over 20 years
- and I have noticed a few things over the years



"The majority of accidences result from carelessness that accompanies familiarity." –Ken Barat, LBNL.

Reflective Best Practices

- As an experimenter and a laser operator (LO), I understand the importance of knowing where the beam is and being aware of all stray reflections
- I know how to mitigate stray reflections by;
  - keeping the beam in one horizontal plane
  - using beam blocks & dumps
  - removing watches, jewelry, ID badges
  - being careful with tools near the beam



Reflections

- Being a safe LO I am aware that transmitting optics can also **reflect** & reflecting optics can also **transmit**

- But usually LOs do not think about the reflections of the **LPE** (Laser Protective Eyewear) on their face

Reflections

- Most laser eye accidents involve a **specular reflection**
  - e.g. April 2003, UC Berkeley campus, During alignment of the laser's Nd:YAG beam, a graduate student was struck in the eye by a specular reflection (a stray beam)

- **Reflective LPE, by design, reflects in a specular way!**

Reflective LPE

- With more and more labs using **multiple wavelengths**, Reflective LPE is here to stay
- Reflective LPE have become very useful for users that want to be protected from multiple wavelengths yet still benefit from **high VLT**

- Reflective LPE are great, but we must be cautious

Reflective LPE

e.g. October 2012, LANL, Through the C505C reflective LPE center field of view, Laser worker observed a diffused reflection of a green 527nm beam during laser Installation.

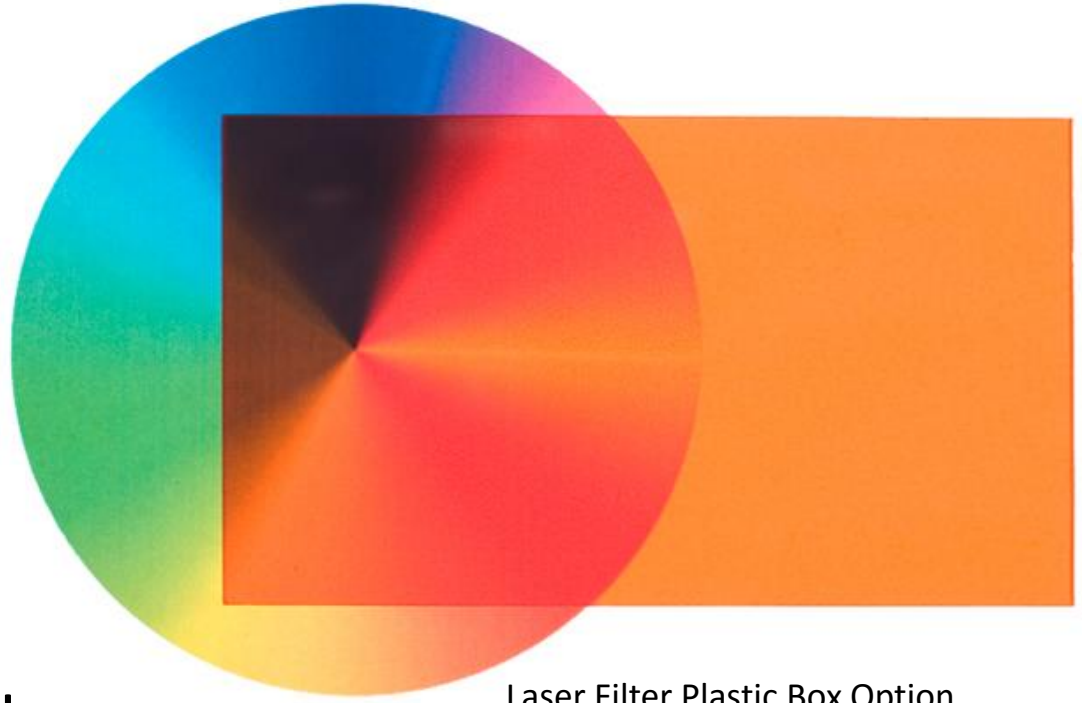
- The worker's LPE was thought to be defective and taken out of service.
- But in fact LPE were perfectly fine and performed as engineered.
- The C505C filters in the above example were designed to protect against Nd:YAG (1064nm) and it's 2HG (532nm) and 4HG (266nm).
- The above laser system was Nd:YLF (1053nm), 2HG = 527nm.

How Reflective LPE works

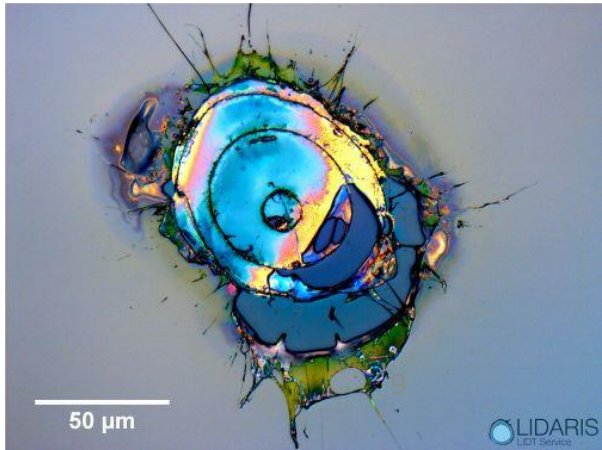
- R-LPE have absorptive as well as reflective elements
- They use absorptive filters for wide BW coverage of IR and of UV
- To filter out the 2HG green while still providing high VLT they use a notch filter at that exact wavelength.
- The notch filters are deposited dielectric coatings
  - **the <u>same</u> way laser HR mirrors are made**

Reflective LPE

- Two main issues;
  - Specular reflection from R-LPE
  - Dielectric coating has narrow BW
    - make sure your wavelength is covered.
- Use opaque box to enclose non-covered wavelength.
  - Available from many laser safety vendors.
- Damage to dielectric coating is undetectable
  - some have hard protective coatings on outside

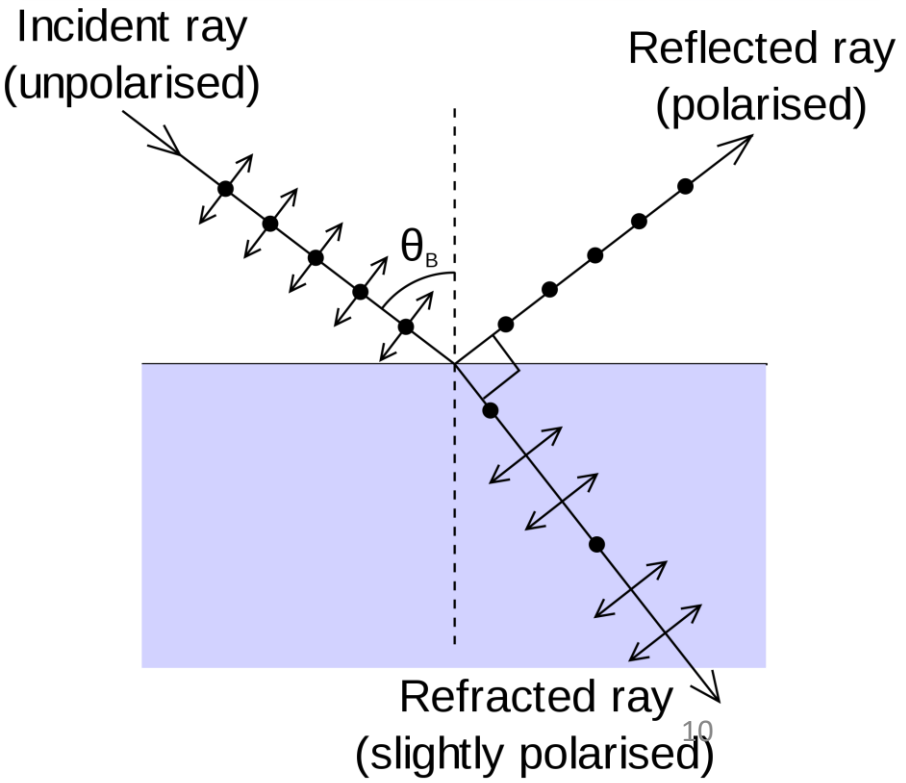


Laser Filter Plastic Box Option
OD 5+ @UV, OD 4+ @Green, ~30% VLT



Reflective LPE

- Even absorptive glass of traditional LPE produces **5% reflection** from front surface
  - (back surface has 2X the rated OD in reduction).
- Under certain conditions **all** of the light is reflected from traditional glass LPE
  - At Brewster's angle all of the light reflected
- Typical Q-switched Nd:YAG laser is >1J
  - 50mJ is 5% of 1J
  - 50mJ is Nd:YAG MPE



Reflective LPE Guidance Document

- DOE Energy Facility Contractors Group (EFCOG) Laser Safety Task Group (**LSTG**) is currently producing a **guidance document** on reflective laser protective eyewear (R-LPE).
- The LSTG is looking for safety community input on this document.
- If you would like to comment or advise on this subject, please contact Jamie Santucci santcci@fnal.gov or Jamie King king75@llnl.gov or through the DOE/EFCOG/LSTG website

http://efcog.org/safety/worker-safety-health-subgroup/laser-safety-task-group/

Questions or Comments?

If there are no questions or comments I will fill the rest of my time slot with a dry reading from ANSI Z136 which I will call…

"Safety First, Safety Always"