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# Laser Incidents and Lessons Learned at DOE Labs since 2014

11<sup>th</sup> Annual DOE Laser Safety Officer Workshop  
Fermilab National Accelerator Laboratory



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September 27, 2016

# Laser Incidents without Injury at DOE Labs since 2014

- **January 2016 – SNL – Incorrect choice of laser eye protection**
- **January 2016 – SLAC – Configuration control error**
- **May 2016 – LLNL – Incorrect use of LOTO**
- **June 2016 – LLNL – Incorrect choice of laser eye protection**
- **July 2016 – LLNL – Reflection startles worker**



# Laser Accidents at DOE Labs since 2014

- 2015-NREL – Ti – Sapphire laser
- 2016- Sandia National Laboratory – LANL CINT employee working at SNL – ABQ



# Sandia National Laboratories – ABQ

**January 12, 2016**

- **Alignment of 800 nm laser**
- **800 nm laser light doubled to 400 nm**
- **Worker wearing LPE for 800 nm only**
- **LPE that covered 400 nm and 800 nm available in lab**
- **Alignment involved a vertical beam**
- **Beam block was present, but beam exceeded height of beam block**
- **When beam went vertical, worker experienced a flash in his eye**



# Sandia National Laboratories – ABQ, cont.

- **Worker secured the scene and reported the incident to lab owner**
- **Determined that LPE was inadequate**
- **Reported to management**
- **Worker taken to SNL medical facilities**
- **No injury detected**
- **DLSO determined that the worker was exposed to laser light above the MPE**



# SLAC National Accelerator Laboratory

**January 24, 2016**

- **Alignment with Class 3R laser**
- **Associated Class 4 laser was turned off**
- **Worker open a laser safety shutter without authorization**
- **Shutter was labeled “Laser Safety Device – Do Not Remove or Modify without SLSO Approval**
- **Approval must given before opening the shutter**
- **Opening the shutter tripped an interlock fault and an alarm sounded**
- **Following procedure, the laser system was secured by the SLSO**



# SLAC National Accelerator Laboratory, cont.

**January 25, 2016**

- **SLSO inspected the Laser Safety System**
- **Found the latched fault**
- **SLSO asked the worker about the shutter fault**
- **Worker stated he needed to have the open shutter to do the alignment with the Class 3R laser**
- **Worker did not think the shutter impacted safety**
- **Since the Class 4 laser was in “off” mode and shutters upstream prevented the laser from reaching the worker, there was no immediate safety hazard in that room**
- **If the Class 4 laser was on, then it could have exposed personnel to laser light above the MPE**

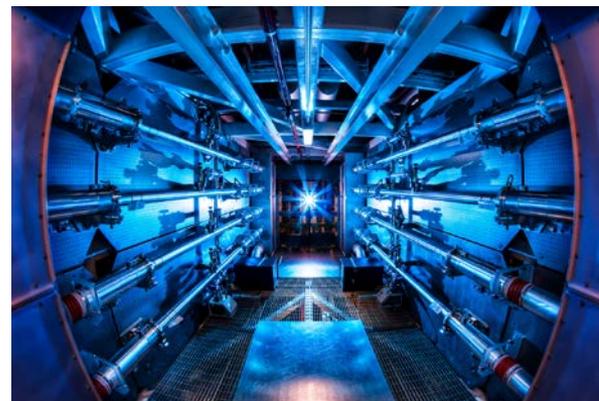
# Lawrence Livermore National Laboratory – NIF

**May 18, 2016**

- **VISAR safety gate valve improperly LOTO in open position**
- **Work paused**
- **LOTO properly applied**
- **No workers exposed to laser light**

## **Contributing Factors**

- **No policy defining when to use Energy Isolation Procedure**
- **Workers did not recall LOTO training**
- **Indicator slide was not clearly visible due to black background and limited lighting environment**



# LLNL – Jupiter Laser Facility

June 14, 2016

- Room was dark
- Visiting graduate student donned eyewear before laser was turned on
- Student picked up what he thought was LPE
- Saw a spot of green light for about 2 seconds
- Later while working on a computer, noticed that the computer screen was gray when it is normally orange
- Left the room
- Realized he was wearing a coworker's personal sunglasses



# LLNL – Jupiter Laser Facility, cont.

- **Notified other workers and reported the incident**
- **Seen by Occupational Medicine**
- **No injury detected**

## Recommend Actions

- **Signs posted indicating personal sunglasses should be kept away from LPE**
- **Personal reflective items must be securely stowed while working in target areas**



# Lawrence Livermore National Laboratory

**July 18, 2016**

- **Worker aligning a pulsed green laser (527 nm)**
- **Laser light reflected off a semiconductor wafer toward LPE**
- **Worker saw bright flashes across upper part of eyewear**
- **Worker reported incident**
- **Eye exam revealed no injury**

## **Further investigation**

- **Eyewear and similar eyewear with the YAG/KTP filter fluoresced when struck by a green laser beam.**
- **Other eyewear filters produced a dull spot**



# Lawrence Livermore National Laboratory, cont.

## Lessons Learned

- Practice good beam control during alignments
- Reduce laser output energy/power to as low as practical to perform the alignment.
- Do not move optics into or out of the beam path with laser(s) on.
- Ensure downstream beam is blocked while performing course adjustments.
- When using viewing cards, direct them down toward the table and not upward.
- Use cameras when possible to free up your hands.



# National Renewable Energy Laboratory

## May 5, 2015

- Worker aligning a Class 4 Ti-Sapphire (2.5W, 60 fs, 1kHz)
- Worker lowered his eyewear to better see the laser beam
- Turned his head and saw a flash of light
- Continued working
- Later that evening noticed a blind spot in right eye

## May 6, 2015

- Reported the incident to the LSS

## May 7, 2015

- Reported the incident to line management
- Evaluated by Occupational Health
- Confirmed injury to right eye



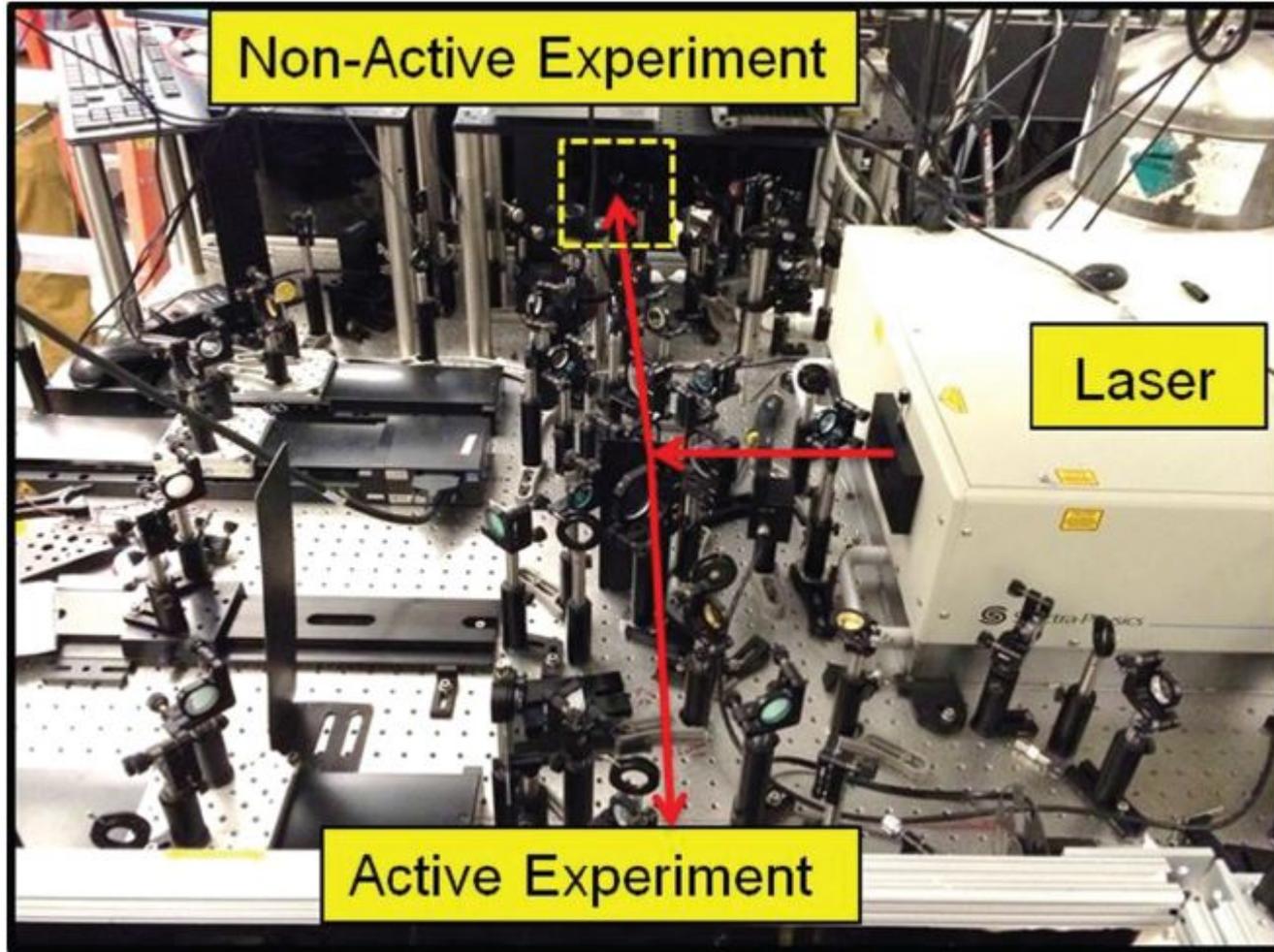
# Sandia National Laboratories – ABQ

**November 19, 2015**

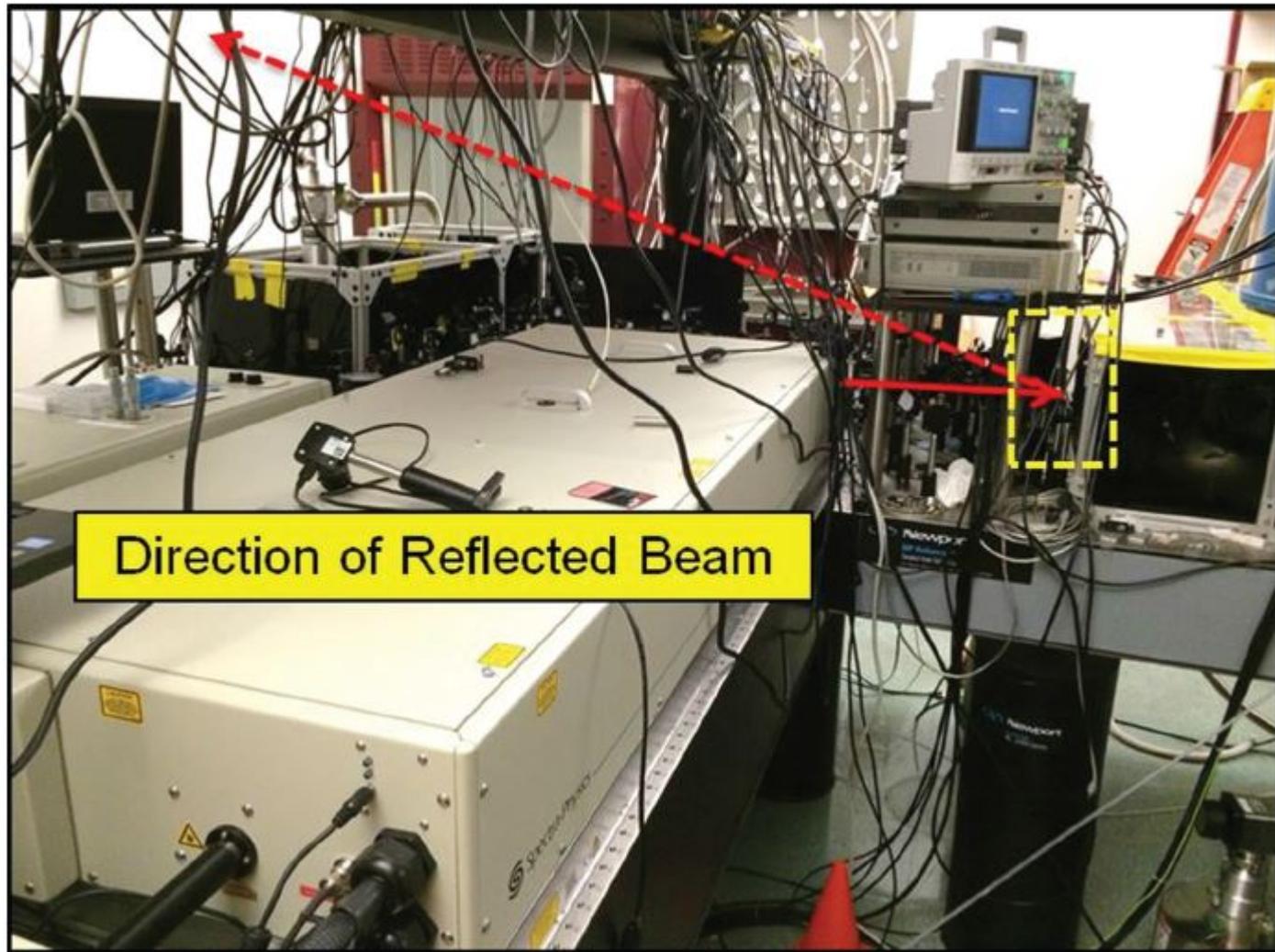
- **LANL worker at CINT core facility in ABQ**
- **Worker aligning a Class 4 pulsed Ti-Sapphire laser**
- **Laser beam was split for two separate experiments**
- **Only one experiment was active**
- **Worker stepped onto a step ladder to read a micrometer inside the laser enclosure**
- **Lifted his eyewear to read the micrometer and saw a flash of light**
- **Used infrared viewer to locate the stray reflection from the other experiment**
- **Reflection from an angled opaque material used as a beam stop**
- **Later worker noticed a blurry spot in his vision**



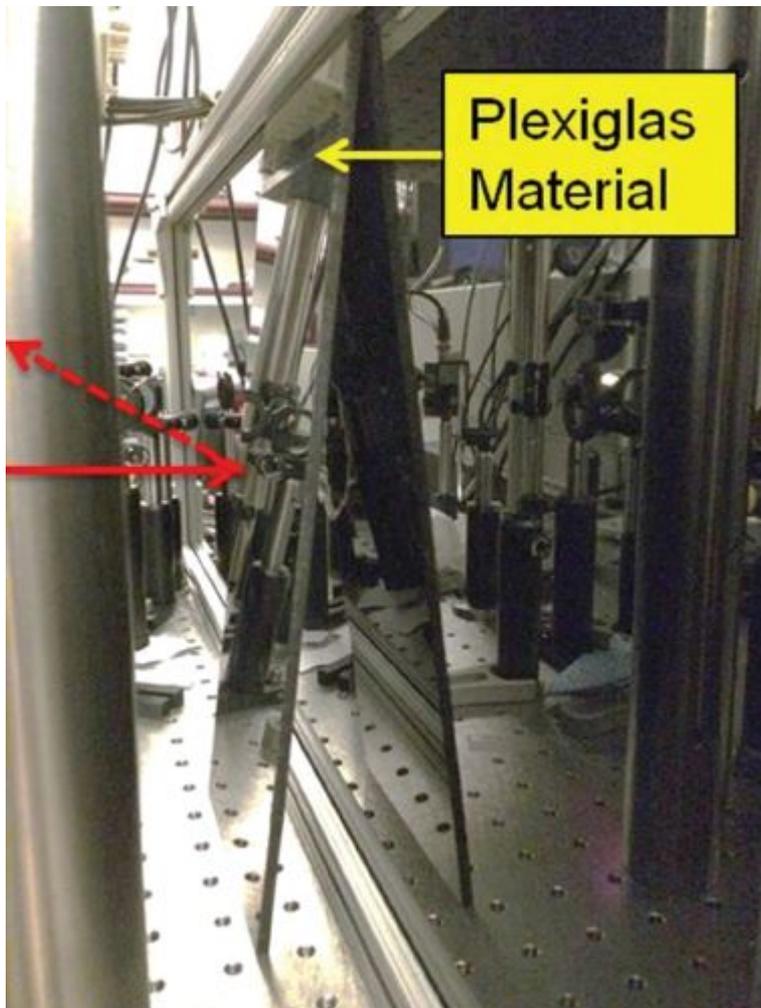
# Sandia National Laboratories – ABQ, cont.



# Sandia National Laboratories – ABQ, cont.



# Sandia National Laboratories – ABQ, cont.



# Sandia National Laboratories – ABQ, cont.

## November 20, 2015

- Reported incident to supervisor and CINT management
- Evaluated by SNL medical facility – no abnormalities noticed

## November 21 and 23, 2015

- Evaluated by ophthalmologist
- Small spot of inflammation found

# Sandia National Laboratories – ABQ, cont.

**November 23, 2015**

## **Critique performed**

- **Insufficient communication between users**
- **Second beam active when not in use**
- **Inappropriate material for beam block**
- **Stray reflections not blocked**
- **Insufficient lighting for reading micrometer**
- **Worker removed LPE**

# Sandia National Laboratories – ABQ, cont.

## Recommended Actions

- **Assess suitability of beam control devices currently used**
- **Improve communication between laser users on multiple systems in same laser lab**
- **Communicate special activities, e.g. laser alignment, “dark” measurements**
- **Use team meetings, email lists, white boards for communication**
- **Laser operator responsible for terminating unused beams and blocking stray reflections**
- **Use appropriate beam control devices (nonreflective, properly placed)**
- **Provide additional lighting for low visibility tasks**
- **Do not remove LPE**

# Summary

- **Laser accidents continue to happen at DOE Laboratories**
- **Recent accidents were due to workers not following established procedures**
- **Stray reflections must be looked for and blocked**
- **Eyewear lowered with a open Class 4 laser beam**
- **Medical attention not immediately sought**
- **Work not stopped**

