

# Standard Operating Procedure

## Lambda LPX-300

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**All Emergencies:**

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This document also found at <http://cnam.umd.edu/LabSafety/>

## Introduction

Congratulations! By reading this you have taken the first step in becoming a competent user of the Lambda LPX-300 excimer laser. Though not particularly exciting, the LPX-300 is capable of doing some significant damage, and so this guide, besides being a user manual, is also a safety manual.

Throughout this guide you will read about how to safely use this laser, and the rules regarding the PLD lab in general. Please be sure to carefully read through the safety section, and be very familiar with the system before using it on your own. If you need assistance at any point in using the system call Arun Luykx (x53301) or R.D. Vispute (x55992) for help.

The LPX-300 is used for pulsed laser depositions, or PLDs. The workings and theory behind PLD are left for the user to look up. The laser is a KrF laser that operates at 248nm.

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1<sup>st</sup> Revision: August 2008 (Corrected laser procedure and formatting)

2<sup>nd</sup> Revision: September 2008 (Corrected refill procedure)

## Safety

If you are caught breaking any of the following rules your admission to the PLD lab will be suspended, and you could be severely hurt (not just by the laser).

- **Always wear UV-rated goggles** when in the PLD lab. Large concentrations of UV light are emitted from the laser. Though not always visible, you are very likely to be subjected to some amount of UV light. Your skin can take a certain amount of UV light, but your eyes a lot less, hence the necessity for goggles. Note that goggles will only protect you from a laser beam for about 2-3 seconds before the laser burns through. If you notice a beam hitting the goggles, or anywhere on your person, move immediately (to avoid skin cancer, terrible burns, or worse).
- **Do not service the laser.** Laser servicing should only be done by experienced personnel. The laser operates under high voltages (in the range of 26kV), and has very high current running through it. Furthermore this laser in particular is being meticulously monitored to ensure reliable operation. If you want to do anything to the laser contact Arun (x53301).
- **Do not mess with other people's optics.** Besides being plain obnoxious, other people don't expect their mirrors to have changed position. If they start running the laser with the optics in the wrong place, the laser may hit them or do other damage. Ask the user before removing his or her mirror.
- **Wear gloves.** Unless you want to have the skin of a chain-smoking 50 year old when you're 25, you should try to minimise your exposure to UV light as much as possible. Wearing long sleeves and long pants is not always practical, but you can certainly wear gloves when checking laser intensity and moving optics. It is not recommended, and I think even not allowed by DES, to make any changes to optics while the laser is running. Change gloves if the laser hits the glove anywhere.
- **All users must pass the laser safety training course.** Go to [www.des.umd.edu](http://www.des.umd.edu) to take the online and in-lab training session. Ask your PI for more information. There you will also learn about all other things than can go wrong with lasers.

## Comments On This Particular Laser

- **Logbook**: The performance of this laser is carefully monitored. Please make sure to make clear notes in the logbook as to when and how you used the laser. Note any and all errors or strange noises in the 'comments' section.
- **Warm Up Time**: Allow at least 5 minutes for the laser to warm up.
- **Gas Activation**: When the laser is first turned on the gas is not charged enough to produce a reliable output, and the user may notice a fluctuation in the energy levels of about 50mJ. Therefore it is recommended to run the laser for at least 3 minutes at 20kV, 10Hz, with the shutter closed to activate the gas.
- **HV/Energy Mode**: Although you have the option of using the 'Energy mode', where the software automatically adjusts the voltage to get a preset output energy, it is not recommended to use this mode. Often the software will overestimate the necessary voltage and cause a higher than necessary output energy, possibly resulting in bad films. Also, dust and other problems could interfere with the energy monitor, which would also change the voltage. Therefore it is recommended to use the HV mode.
- **Servicing**: Do **NOT**, at any point, service the laser on your own. This includes 'just opening it up to take a look'. Contact Arun Luykx (x53301) or R.D. Vispute (x55992) for help.
- **Known problems**:  
Please note all errors in the 'comments' section of the logbook, and email or call Arun at [aluykx@umd.edu](mailto:aluykx@umd.edu) or x53301.
  - Low Light: Either the gas needs to be refilled or the pulse signal is not getting through. Refill the laser if it hasn't been done recently, try using a higher operating voltage, wait 5 minutes for the laser to warm up, or call Arun (x53301).
  - Data Conflict: One of the three main control boards has detected an error and has shut down. Turn off the laser (first the key, then the red knob), and turn it back on after 5 minutes. If this doesn't resolve the problem call Arun (x53301).
  - Oil Flow: The cause of this error is still unknown, but we believe it is linked to a too short warm up time. Wait 5 minutes, and try again.

# Operating The Laser

## General use:

1. Make sure the shutter of the laser is closed.
2. Turn on the laser from the back by first turning the red knob, then the key.
3. Wait (at least) 5 minutes for the laser to warm up.
4. Start 'Laser Control' on the PC desktop.
5. Log in the logbook. For 'start count' use what the previous user put under 'Finish count' (Or go to Options → Reset Counter and read the current user count; DO NOT RESET THE USER).
6. Select Menu.
7. Under 'HV' (high voltage), set the preset to 20kV.
8. Under 'Rep. Rate' (the pulse rate), set preset to 5Hz.
9. Quit, and Start the laser.
10. Note the output energy, and adjust the voltage till you reach the output you want. It is recommended to let the laser run at this rate and voltage for 5 minutes to stabilise the output (if you are the first user of the day).  
NOTE: After a fresh refill the energy at 20kV should be around 1100mJ.
11. Stop the laser (space), open the shutter, and perform your run.
11. After you're done, stop the laser and closer the shutter.
12. Go to Options, select 'reset counter' and press enter
13. Note the current user count (the amount of pulses since the last refill). DO NOT RESET THE USER.
14. Quit the counter screen, quit the options menu.
15. If you are done for the day and nobody else is using the laser, exit the software and turn off the laser.

**NOTE: TURN OFF THE LASER WHEN NOT IN USE!!!** Certain parts are under a lot of strain in the system and to prolong their lifespan the laser should be turned off whenever possible.

## External Trigger:

In Menu, press 'T' to change the trigger to EXT (external). Remember to change back to INT (internal) after you're done. External trigger allows an external source such as a PC to run the laser.

### Changing Operating Mode:

When the laser is running, press left or right on the arrow pad to change from EGY CONST to HV CONST. It is recommended to only use HV CONST for a reliable laser output. See comments on page 4.

## Refilling The Laser

The laser should be refilled when one notices a lower power output than normal (500-600mJ at 19kV is a sign of this).

Refilling the laser is reasonably simple, but please ask for assistance if you're not comfortable in doing it (x53301). Similar instructions are located near the laser.

1. In the main laser control programme, go to Gas, then Gasflow.

### *Pumping out the remaining gas*

2. Make sure all gas cylinders (Fl, Ne, Kr) are closed.
3. Turn on the Pump (by pressing 'p').
4. Open the Vacuum valve (by pressing 'v').
5. Open Rare (This opens the valve, and then closes again automatically).
6. Open Rare again (all gas lines should be purged twice)
7. Open Buffer, and repeat as with rare.
8. Open Halogen
9. Let He in to the line (to clean the line). Do this by opening V4 (in the fume hood where the gasses are kept) for about 2 seconds, and then closing it again.
10. Open Halogen again
11. Close the Vacuum valve (by pressing 'v')
12. Turn off the Pump and Quit

## *Refilling*

13. Open the cylinders in this order: Krypton – Neon – Halogen
14. Select New Fill  
This starts refilling the laser automatically. It will first pump down the laser, then start refilling the gasses till about 3600 mBar. This will stop automatically.
15. Close all bottles.
16. Select Gas Flow

## *Clean Up*

17. Turn on the Pump, and open the Vacuum valve.
18. Wait about a minute. This removes any gasses left in the line.
19. We now need to flush the halogen line with helium (to remove the remaining and very harmful halogen gas). Open V2 in the fume hood for two seconds (this removes any remaining gas). Open V4 for 2 seconds to let He in. Open V2 to let the He out again, and then open V4 again. Finally open V2, and close after two seconds.
20. Record the remaining cylinder pressures and fill in all the details on the appropriate sheet. You should get about 1100mJ for 20kV at 5Hz.
21. Reset the user counts.