CARNEGIE SCIENCE | Geophysical Laboratory

(Room 129) (Transport Measurements and Raman Laboratory)

Principal Investigator:
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Secondary Contacts:
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Emergency Information:
Struzhkin: 240-8888132 (cell)
BBR (Gary Bors): 202-510-8577
All other emergencies: 911

Purpose:

This laboratory is used for transport measurements and Raman experiments with green (532 nm) and red (660 nm, 633nm) lasers. Transport measurements are performed in cryogenic environment in custom-made cryostat systems or using the standard Physical Propertie Measurements System (PPMS) from Quantum Design. Only trained personnel is allowed to handle cryogen loading/reloading procedures for PPMS with approval of the responsible staff member (Viktor Struzhkin). The handling of custom cryostat system also requires system-specific training and approval of the responsible staff member.

All laboratories and facilities on the Broad Branch Rd. campus are controlled areas. Specific training must be completed and documented before working in this laboratory / facility.
To be qualified as authorized laboratory user, one needs to be a qualified GL employee or a registered GL visitor, complete GL safety training, complete lab-specific user orientation and sign user agreement form. No food or drinks are allowed in the lab space.

(**Laboratory-specific information**)

Cryogenic and magnetic field safety.

Before further reading, please make yourself familiar with the Geophysical Laboratory general rules on handling cryogenic liquids (Nitrogen and Helium). R.129 has specific equipment, which uses both Liquid Nitrogen (LN) and and Liquid He (LHe). The Physical Properties Measurements System (PPMS) located near the first optical table, has a superconducting magnet, which is immersed into LHe bath, and is surrounded by a LN–filled jacket. The PPMS consumption of LHe is managed by a closed-system reliquifier, and needs only occasional refills when LHe level drops down below 66 % for magnet operation, or below 50% for general use without the magnetic field.

The LN-jacket needs to be refilled every week during the PPMS operation. Both LHe and LN refilling procedures should be performed only by trained users, after approval from the responsible staff member (Viktor Struzhkin). The vacuum jacket is connected to a turbo pump which needs to be periodically operated to improve the vacuum condition in the PPMS, and should be operated also only by trained users.

The magnetic field inside the PPMS may be a hazard for people with magnetic implants (cardio or similar). The use of the facility for such users could be allowed only under direct supervision of the responsible staff member, when the magnetic field in the PPMS system is set to zero.

The laboratory has two cryostats, which can be used with LN or LHe in the regime with the cryogen flowing trough the cryostat and driven by the pump. The operations involve the use of the transport dewar, the transfer line and the regulated pump line, and could be performed only after training and authorization from the responsible staff member.

Laser safety.

Only authorized laser users are allowed to and to operate/use High-Pressure Group's class 3B laser systems in Room 129:

(a) 532 nm and 660 nm P<100mV (typical P~30 mV) DPSS lasers in the Raman systems on the middle optical table.

(b) Neon ion 633 nm P<40 mV (typical P~30 mV) laser on the north end (first) optical table.

The biological effects of non-ionizing radiation in this Lab include the action of visible radiation upon tissues. Generally, radiation in the visible region can induce thermal effects. Damage can occur when a radiation encounters tissue**,** depending on the combined characteristics of both the incident source (wavelength, power) and the properties of the tissue involved. The thre lasers (532 nm, 632 nm, and 660 nm) present the greatest hazards.

Key safety factors are:

- Laser wavelength, power density, exposure time.
- Tissue propensity to reflect, transmit, or selectively absorb the laser radiation

Laser effects on the eye

The unprotected human eye is extremely sensitive to laser radiation and can be permanently damaged from direct or reflected beams. Due to tissue characteristics, the area of the eye damaged by laser energy is dependent upon the wavelength of the incident laser beam. The retina, cornea, and lens are the areas most commonly damaged.

- Retina: Laser light in the visible to near infrared spectrum can cause damage to the retina. These wavelengths are also know as the "retinal hazard region."
    - Visible and near infrared (400 – 1400 nanometer or nm) laser light pose a critical hazard on the retina. Since the tissue structures of the retina are unable to undergo any repair, lesions caused by the focusing of visible or near-infrared light on the retina may be permanent. The most critical area of the retina is the central portion, the macula, and the fovea.

Laser effects on the skin

Thermal (burn) injury is the most common cause of laser induced skin damage. Thermal damage is generally associated with lasers operating at exposure times greater than 10 microseconds and in the wavelength region from the near ultraviolet to the far infrared.

- The principal thermal effects of laser exposure depend on:
    - The absorption and scattering coefficients of the tissues at the laser wavelength
    - Irradiance or radiant exposure of the laser beam
    - Duration of the exposure and pulse repetition characteristics, where applicable
    - Extent of the local vascular flow
    - Size of the area irradiated

Safety glasses and laser classes

This spectroscopy lab contains class 3B laser systems. Laser safety glasses are provided for eye safety. Select the appropriate safety eyewear for the specific instrument depending on laser pulse length, wavelength and energy. Glasses are stamped with safety information that specifies eyewear protection against laser radiation using a glass or plastic material. The value of the OD number

increases in attenuation magnitude as factors of 10. OD2 safety spectacles have ten times the attenuation of OD1 spectacles. They will withstand 10 times the power density or energy density. The minimum Optical Density of the eyewear is equal to the OD number specified. For example, a rating of OD2 means that the OD is > 2. The maximum power or energy density that the eyewear will withstand has a more complicated relationship to the Optical Density.

Laser Radiation Symbol *– Be aware! This symbol indicates the presence of laser radiation.*

Thorlabs has a good overview of safety glasses and laser classes.
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=762
Click on the "Laser Safety" tab.

ANSI Z136 laser glasses standards can be found at the LIA website:
https://www.lia.org/resources/laser-safety-information/laser-safety-standards/ansi-z136-standards

Instrument safety instructions

All users must obtain instrument-specific training in order to operate lab equipment. There are tutorials and manuals for each instrument. Before you start your experiment, you must spend time to read them for your safety. **All users must first become "authorized users" to be able to operate the instrument independently.**

For all instruments:

1. Know the expected path and energy/power of all lasers and light sources. Keep all body parts outside of this path, especially your eyes!

2. Take care of your eyes! Never look directly into the laser beam / light source. Select appropriate safety eyewear based on the specific instrument.

3. Understand all warning symbols and instrument lights.

4. Use the minimum laser power needed for your experiment.

5. Understand all safety interlock systems and emergency shutdown procedures. You may not, under any circumstance, override any of the safety interlock features on safety enclosures, lasers and shutters.

6. Do not disrupt instrumental alignments without first consulting the PI.

7. Some of the Raman detectors require liquid nitrogen. Always follow proper cryogenic safety procedures and use appropriate PPE.

8. Always use the instrument log book and keep detailed notes. Is the instrument calibrated?

9. Inform the PI immediately of any problems or safety incidents.

10. All users must consult with PI prior to working alone / after hours in the laboratory.

Users agree to follow the following major rules:
(a) Wear safety glasses where it's required and when the laser(s) are on (see the warning signs).
(b) Do not modify or remove any component of the laser systems or laser safety components without approval of the responsible staff member.
(c) Use minimum laser power to reduce any potential hazard.
(d) Comply with GL-wide laser safety policies and procedures.
(e) Report any laser safety accidents to Viktor Struzhkin (202-478-8952) or Alexander Goncharov (202-478-8947) immediately.

- There are no specific operation manuals for high-pressure experiments using transport or Raman measurements. The users will perform the high-pressure work after appropriate training and authorization from the responsible staff member. The operation of the PPMS, the cryostats, and related electronics is covered in the available manuals for the corresponding equipment.

- All operations in the Lab require specific training from the responsible staff member. The training required depends on the experience of the potential user. The operations using the specific method/technique are allowed only after appropriate training and approval by the responsible staff member (Viktor Struzhkin).

- The storage of hazardous materials is not allowed in the lab area. The use of hazardous materials in experiments should be approved by the supervising GL staff member (PI) and approved by the responsible staff member (Viktor Struzhkin).

- Fire extinguishers are located near the laboratory door and in the hallway

- The emergency eyewash is located at the sink in R108a. The emergency chemical shower is located in R109.

Laboratory User

I agree that I have thoroughly read and understood this laboratory safety document. I have access to this safety information at all times when I am working. I have been trained to be able to identify the hazards to which I may be exposed and to follow the work practices and procedures discussed in this document. I certify that I will conduct my research work safely and that I will be responsible for following stated safety policies.

_____	_____	_____
User Name (Print)	User Signature	Date

Principal Investigator

I certify that the information presented in this safety document is accurate and complete. I agree to comply with all safety procedures and to fully train and supervise all researchers under my direction.

_____	_____
PI Signature	Date