Auburn University
Plasma Sciences Laboratory

General Safety Procedures

Version 1.0

Applicable to the following Leach Science Center rooms:

ALEXIS Lab: 208/208A
PSL Main lab: 209/209A
PSL Undergraduate lab: 215
Microgravity lab: 157

PSL Magnet Lab area:
Development Lab - 163 / 163A
Control Room / MDPX Main Cell / Utility Rooms - 169 Suite

Table of Contents

1 Introductory information

This document will present safety hazards and precautions for the Auburn University Plasma Sciences Laboratory (AUPSL). Maintaining the safety of personnel and equipment is the responsibility of all persons working in the laboratory. Our most important rule:

If you do not know how to perform a particular task – do NOT proceed!
ASK A QUESTION!

Questions are always acceptable. Injured personnel or damaged equipment are not.

The primary points of contact for the laboratory are:

Mr. Darrick Artis, Laboratory Technician	(doa0003@auburn.edu)
Prof. Edward Thomas, Jr., Principal Investigator	(etjr@auburn.edu)
Assoc. Prof. Uwe Konopka, Co-Principal Investigator	(uzk0003@auburn.edu)

An active list of AUPSL personnel that will be cleared to operate specific experiments, hardware, or diagnostic systems will be maintained on the lab website at: http://psl.physics.auburn.edu/

1.1 Plasmas

Plasmas are ionized gases consisting of electrons, ions, and neutral atoms that represent a "fourth state of matter" beyond solids, liquids, and gases. While plasmas are often uncommon in terrestrial environments (except under certain conditions), in the space environment, over 90% of the visible universe is composed of plasmas.

Plasmas are created by "heating" gases to the point where ionization occurs. The heating mechanisms often involve the use of radio frequency, microwave, or high voltages in order to ionize the gas. Additionally, because plasmas are ionized, they can be manipulated using externally applied electric and magnetic fields.

1.2 Auburn University Plasma Sciences Laboratory

The Auburn University Plasma Sciences Laboratory (AUPSL) conducts basic and applied experimental research in the area of plasma physics. This work ranges from the study of laboratory studies of space-relevant phenomena to fusion energy related research. The AUPSL is currently involved in several major experiments:

ALEXIS – a linear, magnetized plasma column experiment (Leach 208)
Dusty Plasmas – studies of microparticle dynamics in a plasma environment (Leach 209, 215)

Magnetized Dusty Plasmas – studies of strongly magnetized dusty plasma environments using a superconducting, high magnetic field (B ≥ 4 Tesla) system (Leach Annex 169 suite)

1.3 Overview of safety issues

In the AUPSL, the study of plasmas often requires the formation of an ionized gas in a low neutral pressure environment. The resulting plasma is heated and probed with a variety of remote sensing (primarily, optical) diagnostic tools and in-situ probes. The properties of the plasma are modified and controlled using applied dc and time varying currents, voltages, electric fields and magnetic fields. As a result, there are a number of potential hazards that faculty, students, and visitors to the AUPSL must be aware of in order to carry out research activities. Among them are:

a. DC electrical - high currents, high voltages
b. AC electrical – electrical outlets, radio frequency radiation, microwave radiation
c. Pressurized gas cylinders –providing process gases to the plasma experiments
d. Chemical hazards – cleaning chemical used by the AUPSL
e. Vacuum chambers – chambers maintained at pressures of 10^{-6} Torr or lower
f. Lasers – continuous and pulsed lasers used as diagnostics
g. Magnetic fields – static DC magnetic fields from 0 to >40000 Gauss (4 Tesla)

1.4 Organization of this document

Because of the common hazards across the different lab facilities, for items (a) through (f) listed in Sec. 1.3, each hazard will be summarized, a remedy presented, and the location in each laboratory of the hazard will be identified as part of a table. For item (g) the magnetic fields in the ALEXIS lab (Leach 208) and the Magnet Lab (Leach 169 suite) will be discussed. Due to the large magnetic fields that may be present in the Magnet Lab, special precautions are needed and these will be addressed in a separate section.

1.5 Safety standards

This document is based upon established safety standards from the Occupational Health and Safety Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). Additional standards for magnetic fields will be based upon safety standards used by the National High Magnetic Field Laboratory (Florida State University, Tallahassee, FL) and the Auburn University Magnetic Resonance Imaging (AUMRI) Center.

NHMFL safety documents: http://www.magnet.fsu.edu/usershub/safety/
OSHA safety documents: http://www.osha.gov/SLTC/elfradiation/
NIOSH safety documents: http://www.cdc.gov/niosh/docs/98-154/
AUMRI link: http://www.eng.auburn.edu/research/centers/mri/educational.html

2 DC electrical hazards

DC (direct current) electrical hazards refer to non-oscillatory (i.e., steady state) currents and voltages applied to or delivered from electrical equipment such as power supplies.

HAZARDS: Known hazards from DC electrical hazards are listed below in Table 2.1

Table 2.1: DC electrical hazards from OSHA:
http://www.osha.gov/SLTC/etools/construction/electrical_incidents/eleccurrent.html

Current level (Milliamperes)	**Probable Effect on Human Body**
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions.
5mA	Slight shock felt; not painful but disturbing. Average individual can let go. However, strong involuntary reactions to shocks in this range may lead to injuries.
6mA - 16mA	Painful shock, begin to lose muscular control. Commonly referred to as the freezing current or "let-go" range.
17mA - 99mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go. Death is possible.
100mA - 2000mA	Ventricular fibrillation (uneven, uncoordinated pumping of the heart.) Muscular contraction and nerve damage begins to occur. Death is likely.
> 2,000mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable.

PRECAUTIONS: Before energizing any dc power supply, make sure that all control knobs are turned to their minimum values. Make sure to turn off and properly de-energize all dc power supplies prior to working on electrical equipment in the laboratory. If you do not know the status of a piece of equipment in the laboratory – ASSUME IT IS ENERGIZED AND SEEK ASSISTANCE.

Table 2.2: Location of DC electrical hazards

Room	Equipment	Comments
208	Magnet power supplies (PowerTen) Filament power supplies (Xantrex, HP) Probe power supplies (Xantrex, HP, Kepco)	
209	Glassman high voltage (5 kV, 30 mA) Probe power supplies (Xantrex, HP, Kepco)	
215	Glassman high voltage (5 kV, 30 mA) Probe power supplies (Xantrex, HP, Topward)	
157	TBD	
169 suite	TBD	

3 AC electrical hazards

AC (alternating current) electrical hazards refer to oscillatory (i.e., time varying) currents and voltages applied to or delivered from electrical equipment such as power supplies. In the AUPSL, the two possible AC hazards arise from radiofrequency (RF) or microwave (MW) electromagnetic sources.

OSHA defines Radiofrequency (RF) and microwave (MW) radiation as electromagnetic radiation in the frequency ranges 3 kilohertz (kHz) - 300 Megahertz (MHz), and 300 MHz - 300 gigahertz (GHz), respectively.

HAZARDS:

a) When electrical equipment is energized, RF and/or MW radiation may be present in the laboratory.
b) **According to OSHA**: "There are no specific standards for radiofrequency and microwave radiation issues."

PRECAUTIONS: Before energizing any ac power supply, make sure that all control knobs are turned to their minimum values. Make sure to turn off and properly de-energize all ac power supplies prior to working on electrical equipment in the laboratory. If you do not know the status of a piece of equipment in the laboratory – ASSUME IT IS ENERGIZED AND SEEK ASSISTANCE.

However, OSHA and NIOSH each maintain a substantial record of information about RF and MW radiation on their websites.

OSHA: http://www.osha.gov/SLTC/radiofrequencyradiation/index.html
NIOSH: http://www.cdc.gov/niosh/topics/emf/

Table 3.1: Location of AC electrical hazards

Room	Equipment	Comments
208	13.56 MHz, 500 W, Kurt Lesker, RF generator	Primary RF plasma source for ALEXIS experiment
209	N/A	
215	N/A	
157	Custom RF generators (up to 10 W)	
169 suite	13.56 MHz, 100 W, RF VII, RF generator	Primary RF plasma source for MDPX experiment

4 Pressurized gas cylinders

The AUPSL makes use of pressurized gas cylinders for supplying process gases to experiments. Presently, for all AUPSL experiments, only non-reactive gases are used: argon, nitrogen, helium, neon, and krypton.

HAZARDS:

a) Explosion hazard due to high pressures in containers.
b) Low oxygen hazard if process gases are released into an enclosed space.

PRECAUTIONS:

a) All gas cylinders must be properly secured.
b) Empty gas cylinders must be properly stored.
c) Gas lines must be clearly labeled and identified.
d) Only two-stage gas regulators may be used for the AUPSL.

Table 4.1: Location of pressurized gas cylinders

Room	Equipment	Comments
208	Gas cylinders of argon, helium, nitrogen and neon (Rm. 208A)	Process gases for ALEXIS experiment
209	Gas cylinder of argon (Rm. 209A)	Process gas for dusty plasma experiments.
215	Gas cylinder of argon	Process gas for dusty plasma experiments.
157	TBD	Process gas for microgravity experiments
169 suite	Gas cylinders of argon Storage tank for air compressor (air)	Process gas for MDPX Air used for pneumatic valves

5 Chemical hazards

The AUPSL makes only limited use of potentially hazardous chemicals. Some chemicals are used for preparing/cleaning items for use under vacuum conditions as well as maintaining vacuum conditions (items a through e, below). Others are used as active ingredients in parts of the laboratory.

HAZARDS:

a) Methanol, Ethanol – for cleaning parts that will be placed under vacuum conditions
b) Acetone – for cleaning parts that will be placed under vacuum conditions
c) TKO-19 – roughing pump oil
d) Dow Corning 705 (DC705) – diffusion pump oil
e) Cryogenic gases and liquids – typically liquid nitrogen and cryogenically-cooled helium gas
f) Rhodamine 6G (http://www.sciencelab.com/msds.php?msdsId=9927579) - used for dye laser
g) Ethylene glycol (http://www.sciencelab.com/msds.php?msdsId=9927167) - used to dissolve Rhodamine 6G, also may be used as active ingredient in cooling systems (e.g., antifreeze)

PRECAUTIONS:

All reserve stocks of chemicals will be stored in the yellow metallic "chemical safety cabinets" in Leach 215 or in Leach 163. All working supplies of chemicals will be placed in properly labeled dispenser bottles. Used pump oils will be disposed of in the oil storage container located in the Leach Annex high bay.

Location: These items are in general use throughout all of the facilities used by the AUPSL.

6 Vacuum Chambers

Vacuum chambers are operated by using a pump or a sequence of different pumping stages to remove the air from the interior of an enclosed chamber. Atmospheric pressure is defined as 1 atm = 760 Torr; typical vacuum conditions in AUPSL experiments range from 0.1 Torr (~10^{-4} atm) to 10^{-6} Torr (~10^{-9} atm).

All plasma experiments in the AUPSL makes use of either a single stage vacuum system (in which only a roughing pump is used) or a two-stage vacuum system (in which a combination of a roughing pump plus a high speed pump – e.g., diffusion pump, turbomolecular pump, etc.) to maintain vacuum conditions. All personnel working in the AUPSL must be training on the correct operation of vacuum systems.

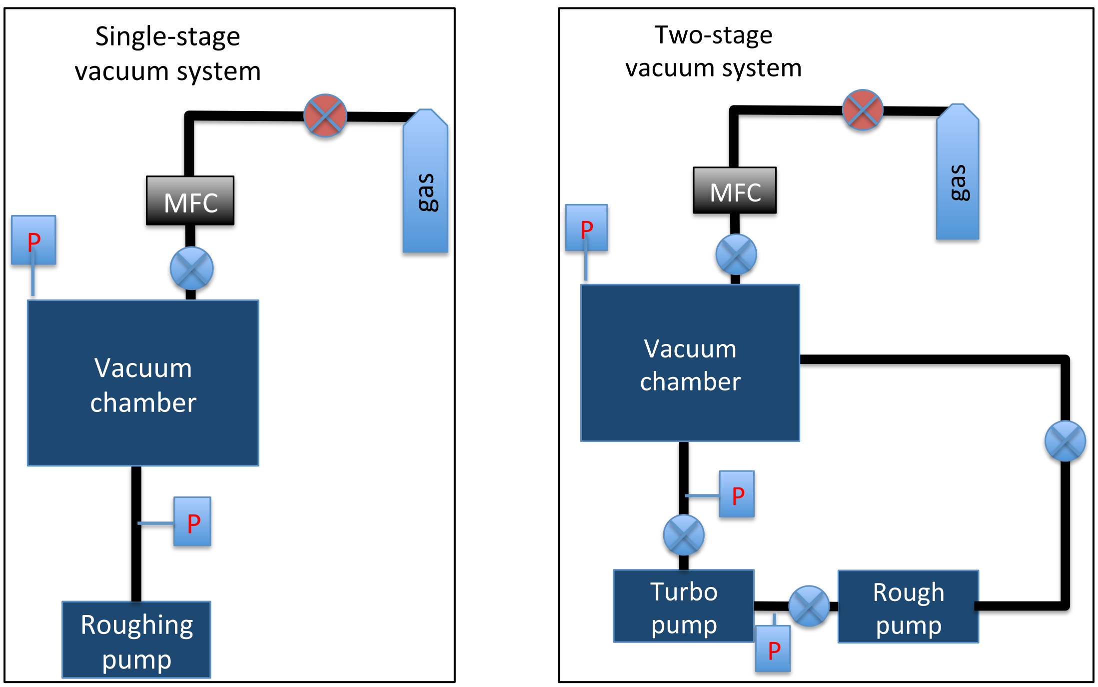


Fig. 6.1 – General schematic designs of a single-stage and a two-stage vacuum system. The symbol "P" indicates locations of pressure gauges. A "MFC" is a mass flow controller, which regulates the entry of the process gases into the vacuum chamber.

HAZARDS:

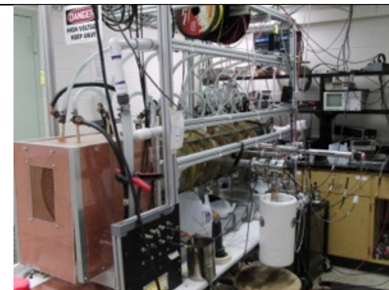
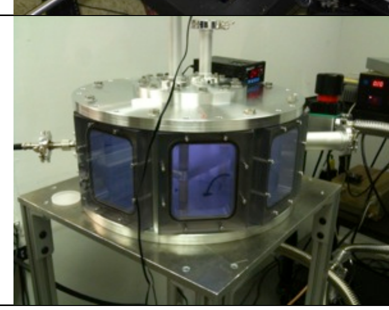
a) A vacuum system represents an implosion hazard due to the substantial pressure differential between the interior and exterior of the system.
b) A burn hazard may be present due to heating required for some types of vacuum pumps (e.g., diffusion pumps heat an oil to 200 ˚F; roughing pump oils may be heated to >120˚F)

PRECAUTIONS:

a) Adequate signage is required to indicate the presence of vacuum systems in each laboratory.
b) Warnings should be indicated on potentially hot surfaces.

c) AUPSL staff MUST receive vacuum hardware training prior to operating vacuum systems individually. Only approved personnel are allowed to make changes to vacuum systems.

Table 6.1: Location of AUPSL vacuum systems

Room	Equipment	Comments
208	ALEXIS experiment	
209	3DPX chamber	
215	DPX chamber, Plasma Demo	
169 suite	MDPX chamber, MDPX test stand, Plasma Demo	
157	Future system for microgravity experiment	
163	Future system for MDPX test stand	

7 Lasers

LASER is an acronym which stands for Light Amplification by Stimulated Emission of Radiation. The laser produces an intense, highly directional beam of light. The most common cause of laser-induced tissue damage is thermal in nature (i.e., burning), where the tissue proteins are denatured due to the temperature rise following absorption of laser energy. The AUPSL primarily uses lasers in two ways: to illuminate microparticles in dusty plasma experiments and to probe ion properties in laser induced fluorescence studies.

The hazards arising from lasers are dependent upon the laser Class. The four recognized laser classes and their biological impact are shown in the highlighted text and Table 7.1, below.

LASER HAZARD CLASSES (FROM: OSHA Technical Manual – Section III, Chapter 6).

1. Virtually all of the U.S. domestic as well as all international standards divide lasers into four major hazard categories called the laser hazard classifications. The classes are based upon a scheme of graded risk. They are based upon the ability of a beam to cause biological damage to the eye or skin. For visible and near infrared lasers, the limiting aperture is based upon the "worst-case" pupil opening and is a 7 mm circular opening.
2. Lasers and laser systems are assigned one of four broad Classes (I to IV) depending on the potential for causing biological damage. The biological basis of the hazard classes are summarized in Table 7.1

    a. **Class I**: cannot emit laser radiation at known hazard levels (typically continuous wave: cw 0.4 µW at visible wavelengths). Users of Class I laser products are generally exempt from radiation hazard controls during operation and maintenance (but not necessarily during service). Since lasers are not classified on beam access during service, most Class I industrial lasers will consist of a higher class (high power) laser enclosed in a properly interlocked and labeled protective enclosure. In some cases, the enclosure may be a room (walk-in protective housing) which requires a means to prevent operation when operators are inside the room.
    b. **Class I.A.**: a special designation that is based upon a 1000-second exposure and applies only to lasers that are "not intended for viewing" such as a supermarket laser scanner. The upper power limit of Class I.A. is 4.0 mW. The emission from a Class I.A. laser is defined such that the emission does not exceed the Class I limit for an emission duration of 1000 seconds.
    c. **Class II**: low-power visible lasers that emit above Class I levels but at a radiant power not above 1 mW. The concept is that the human aversion reaction to bright light will protect a person. Only limited controls are specified.
    d. **Class IIIA**: intermediate power lasers (cw: 1-5 mW). Only hazardous for intrabeam viewing. Some limited controls are usually recommended. **NOTE:** There are different logotype labeling requirements for Class IIIA lasers with a beam irradiance that does not exceed 2.5 mW/cm^2 (Caution logotype) and those where the beam irradiance does exceed 2.5 mW/cm^2 (Danger logotype).
    e. **Class IIIB**: moderate power lasers (cw: 5-500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit, whichever is lower). In general Class IIIB lasers will not be a fire hazard, nor are they generally capable of producing a hazardous diffuse reflection. Specific controls are recommended.
    f. **Class IV**: High power lasers (cw: 500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and a skin hazard. Significant controls are required of Class IV laser facilities.

Table 7.1 – Laser Hazards
From: http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_6.html

	Applies to --- wavelength ranges ---				------------ Hazards ------------		
Class	**UV**	**VIS**	**NIR**	**IR**	**Direct ocular**	**Diffuse ocular**	**Fire**
I	X	X	X	X	No	No	No
IA	--	X*	--	--	Only after 1000 sec	No	No
II	--	X	--	--	Only after 0.25 sec	No	No
IIIA	X	X**	X	X	Yes	No	No
IIIB	X	X	X	X	Yes	Only when laser output is near Class IIIB limit of 0.5 Watt	No
IV	X	X	X	X	Yes	Yes	Yes

Key: X = Indicates class applies in wavelength range.
* = Class **IA** applicable to lasers "not intended for viewing" *ONLY*.
** = CDRH Standard assigns Class **IIIA** to visible wavelengths *ONLY*. ANSI Z 136.1 assigns Class IIIA to all wavelength ranges.

HAZARDS:

a) The AUPSL uses lasers whose energies range from Class I to Class IV.
b) For all of the dusty plasma experiments, in particular, care must be taken to prevent excess scattering of laser light.

PRECAUTIONS:

a) All areas of the AUPSL in which laser light may be present MUST be clearly marked on EXTERIOR doors.
b) EXTREME CAUTION must be used in all areas where lasers are present. In all areas in which Class III or higher lasers are present, safety goggles MUST be available.
c) A Laser Safety Operational Procedures (LSOP) will be established for laser systems used in the AUPSL. The LSOPs will be an addendum to this document. Documents will cover:
    a. Stereoscopic particle image velocimetry (stereo-PIV) system
    b. Laser induced fluorescence (LIF) system
    c. Laser diode systems (for dusty plasma illumination)

Table 7.2: Location of laser hazards

Room	Equipment	Comments
208	Fiber optic lines for LIF on ALEXIS	
209	Laser diodes for dusty plasma experiments LIF laser system setup	
215	Laser diodes for dusty plasma experiments	
157	TBD	
163/163A	TBD	
169 suite	Laser diodes for dusty plasma experiments Stereo PIV system setup LIF laser system setup	

8 Magnetic fields

The AUPSL makes use of static magnetic fields in order to manipulate and control many aspects of our plasma physics experiments. Electromagnets are used for both the ALEXIS device (Leach 208) and the MDPX device (Leach Annex 169 suite).

Because of the use of electromagnets, it is possible to use a variety of static magnetic field configurations for these devices. While the strongest magnetic fields will typically be at the interior of the experimental devices, it is not possible to use compensating coils to suppress the effect of fringing magnetic fields. Depending upon the magnetic field configuration, these fringe fields could be *comparable in strength* to the experimental fields.

This is in contrast to magnetic resonance imaging / nuclear magnetic resonance (MRI / NMR) magnetic field systems which rely upon an "always on", fixed magnetic field configuration and a fringe field suppression system. In the AUPSL, magnetic field sources can be "on" or "off".

Because of the possibility of a large static magnetic field being present in the AUPSL Magnet Laboratory (Leach Annex 169 suite), this section of the safety manual is focused primarily on that area.

<u>For reference</u>: magnetic field strengths are measured in units of Gauss (G) or Tesla (T) [1 T = 10000 G]. The Earth's nominal magnetic field strength is ~0.5 G = 0.05 mT = 50 μT. [mT = milliTesla, μT = microTesla].

HAZARDS: (adapted from NHMFL document SP-19 and AU-MRI Center safety manual)

Magnetic fields attract tools to the magnet, may attract dust and particles that are magnetic, and will affect magnetic items such as credit cards, magnetic tapes, prosthetics, and implanted medical devices, metal plates, pins or staples, etc. These characteristics pose safety problems for personnel as well as creating the potential for physical damage to expensive and sensitive research equipment.

It is noted that OSHA maintains no specific regulations on biological exposure to static magnetic fields. All literature related to static magnetic field safety refers only to the effect on implanted medical instruments or magnetic objects (as noted above).

<u>Exposure limits:</u>

1. The consensus is that the operation of implanted medical instruments – particularly pacemakers and insulin pumps – may be adversely affected by exposure to magnetic fields strengths above 5 Gauss. [OSHA, NIOSH, AUMRI, and related reports]
2. The distance for the magnet that is safe for the general public and to use all objects and devices is denoted as the 10 Gauss (1.0 mT) line – except at noted in Line 1. [NHMFL]
3. Special precautions must be taken for any equipment that enters a region where the magnetic field could exceed 100 Gauss (10 mT). [AUMRI, NHMFL]

PRECAUTIONS: (adapted from NHMFL document SP-19 and AU-MRI Center safety manual)

General precautions that should be taken when working in and around high magnetic fields.

- Compressed gas cylinders in the vicinity of shall be secured at all times.
- Tools must be non-magnetic in nature if used within the 100 gauss lines of energized magnets.
- The 5, 10 and 100 Gauss lines will be clearly marked on the floor of each magnet field system that is capable of producing a magnetic field that exceeds 100 gauss (10 millitesla) on its exterior.
- Credit and ATM cards should be kept beyond the 10 G line. Steel, iron and other magnetic objects shall be secured and fastened down or kept behind the 100 G line.
- Personnel with implanted pacemakers, metal plates, pins or staples must inform the AUPSL staff prior to entering any region where high magnetic fields may be present.
- Footwear must provide secure footing, protection from spilled cryogenic liquids, and protection from falling objects. Bare feet and open toed shoes must not be worn when working in areas with potential foot hazards. Caution shall be taken when working around magnets if wearing steel-toed safety shoes.

Specific rules for AUPSL facilities:

ALEXIS device (Leach 208):

The calculated magnetic fringe field along the mid-plane for the magnets energized at a current of 200 Amps (approximately 2x the nominal operating conditions) is presented in Figure 8.1. This figure shows that the ALEXIS field will fall below the 5 Gauss limit approximately 20 cm (~8 inches) away from the centerline of the device. This is less than the extent of the support structure of ALEXIS. Therefore, with the exception of persons with implanted medical devices, there is a minimal magnetic field hazard in the ALEXIS laboratory and the general precautions described above are sufficient for ensuring the safe operation of the device.

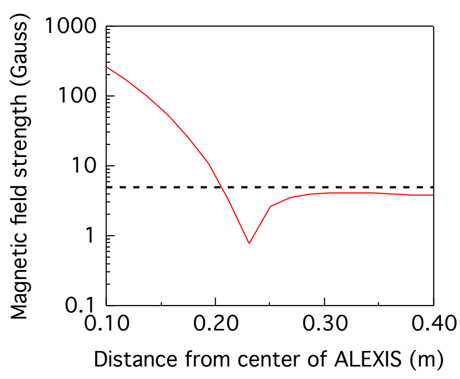


Figure 8.1: Model of ALEXIS fringe field. Black dashed line is the 5 Gauss limit. The red line is the magnitude of the magnetic field. The "dip" occurs due to the reversal of the fringe field direction outside of the main solenoid coils of ALEXIS.

AUPSL Magnet Laboratory and MDPX device (Leach Annex 169 suite):

The calculated magnetic field extent for the MDPX device operated at 125% of the nominal magnetic field (i.e., ~5 T on axis) and the safety zone for the Magnet Lab are shown in Figure 8.2.

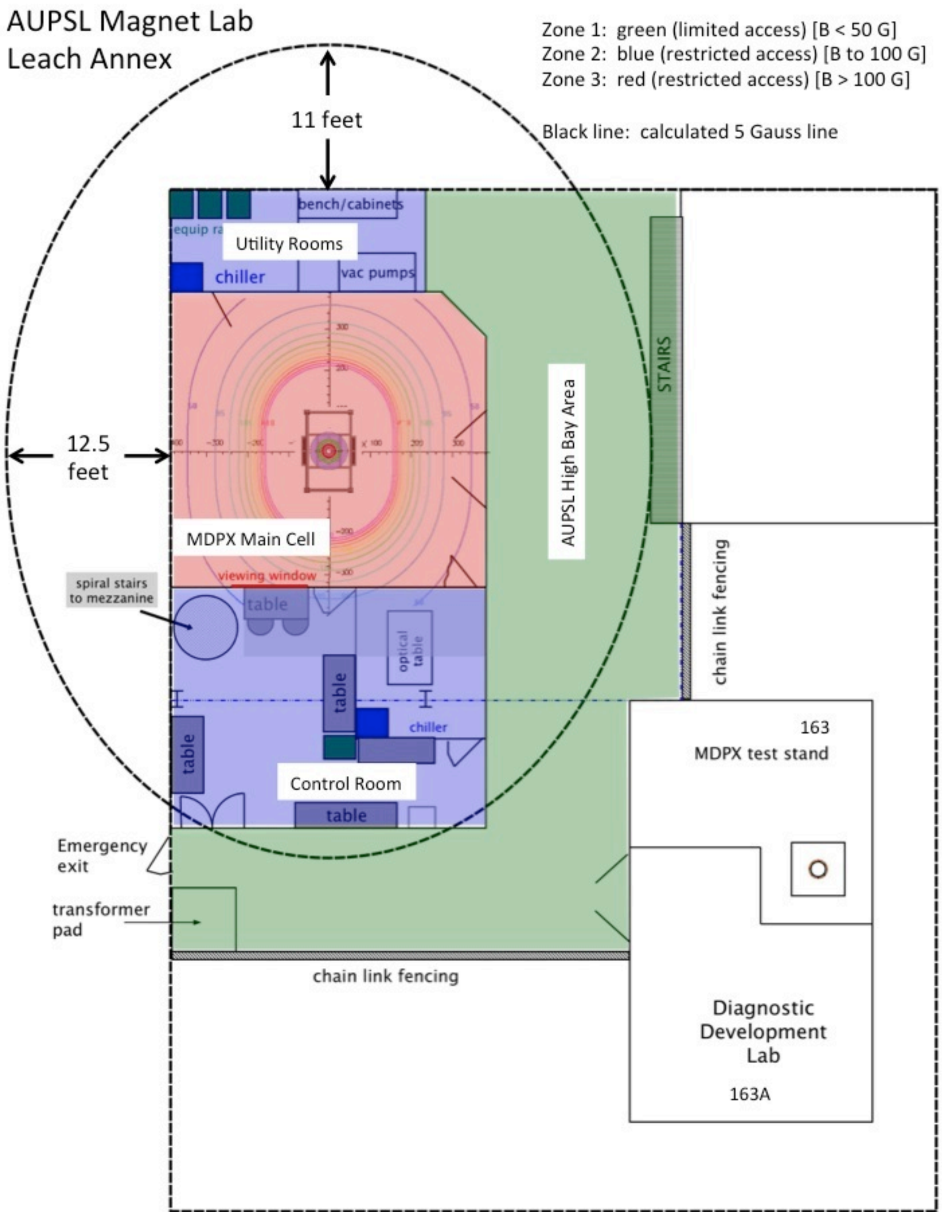


Figure 8.2: Model of MDPX fringe field and AUPSL magnet lab zones. The black dashed line is the calculated maximum extent of the 5 Gauss line. The green zone is a limited access region with magnetic field up to 50 Gauss present. The blue zone is a restricted access zone with magnetic field up to 100 Gauss present. The red zone is the main laboratory with magnetic fields up to 60000 Gauss present. Internal fencing is used to isolate the green zone. Key card and/or key access is required to access the blue or red zones. The area outside of the Leach Annex building that is within the 5 Gauss line will be secured by fencing and gates with appropriate signage to indicate entry into a region that may contain magnetic fields.

Magnet Lab Zones:

Zone 1 (Green) – Reduced/Limited access. This area includes all of the space that surrounds the control room and MDPX device. For regular access to this region, personnel MUST take the basic magnetic field safety course offered by the AU MRI center and have received approval from the AUPSL staff.

Zone 2: (Blue) – Restricted access. This area includes the MDPX Control Room and the MDPX Utility rooms adjacent to the MDPX main cell. Personnel without medical restrictions may enter this region ONLY when accompanied by AUPSL staff. For regular access to this region, personnel MUST take the basic magnetic field safety course offered by the AU MRI center and have received approval from the AUPSL staff.

Zone 3: (Red) – Highly Restricted access: Only authorized, trained AUPSL personnel are allowed to enter this region – the MDPX Main Cell – regardless of whether magnets are energized. When magnets are energized, individuals may NOT enter this area without another person present in the control room.

The AUPSL will maintain a current list on its website with persons approved to enter each zone of the Magnet Lab area.

Lab tours and visitors at AUPSL Magnet Lab:

Zones 1 and 2 may be accessible to visitors under strict conditions.

a) The AUPSL will NOT provide access to any persons who are unwilling to sign a consent form that acknowledges that they are free of any implanted medical instruments or any magnetic materials.
b) Tours of the MDPX facility MUST be arranged beforehand in order to ensure that the laboratory can be operated safely while visitors are present.
    a. For groups that will consist only of persons above the age of consent (i.e., above 18 years old) may entire Zones 1 and 2 provided the consent form is signed. The magnets *may be energized* when these groups are given tours.
    b. For groups that will consist of persons below the age of consent (e.g., student groups), PRIOR NOTICE IS ABOLUTELY required. During these tours, the MDPX magnets will not be energized. However, due to the presence of other magnetic field sources (e.g., permanent magnets), a signed parental / guardian consent forms will be required of all persons under the age of consent.
    c. The PSL will publish, on its website, a list of available dates/time when student and/or general groups may visit the Magnet Lab.
c) Visitors of the Magnet Lab refers to any persons that will be in the laboratory area for an extended period (several days to several weeks).
    a. Visitors must sign a consent form that acknowledges that they are free of any implanted medical instruments or any magnetic materials.

b. Visitors must receive a basic magnetic field safety overview, including review of the Magnet Standard Operating Procedure and Tool Control procedures from AUPSL staff in order to access the Control Room or Utility Room
c. Visitors will be required to take the magnetic field safety training course if they will be performing studies that require access to the MDPX Main Cell.

Additional safety considerations for AUPSL Magnet Laboratory

Firefighter, Police and Security Safety Considerations/Screening:

All fire-alarms, cardiac arrests, and any other emergent response calls originating from or located in the AUPSL Magnet Lab area shall be forwarded simultaneously to a specifically designated (with backup) individual from among the site's personnel. This person's duties will include being on site prior to arrival of emergency personnel and ensuring emergency personnel DO NOT have free access to Zone 3 due to the nature of the magnet and safety considerations. The local emergency response personnel shall be trained about the specific hazards associated with response to the AUPSL Magnet Lab. The Magnet Lab must have clearly marked and readily accessible Magnetic-field-safe fire fighting and extinguishing equipment stored in Zone 2.

In the event of a significant emergency, it may be necessary to execute a quench of the magnets. This is to be done only if it absolutely necessary for emergency personnel to have access to Zone 3 AND the magnets are energized. If a quench is deemed necessary, ALL personnel (including and especially emergency responders) must be restricted from Zone 3 until specially designated AUPSL personnel have ensured that the static magnetic field has sufficiently attenuated to no longer pose a potential hazard.

Magnet Lab personnel screening:

Any potential hire that works in the Magnet Lab facility must report any trauma, procedure, or surgery they have undergone during which any ferromagnetic metallic object or device may have become introduced within or on them.

Device and object screening:

All portable ferromagnetic objects are restricted from Zone 3. A strong (1,000 Gauss or greater) magnet will be on hand to test object/devices for ferromagnetic attractive forces. All portable metallic/partially metallic devices/objects are to be positively identified and marked as ferromagnetic or non-ferromagnetic prior to being permitted into Zone 3. Some metallic devices that are deemed ferromagnetic may, on a case-by-case basis and under specific circumstances be brought into Zone 3. If so, the device shall be under the control of specifically named AUPSL personnel, and shall be appropriately physically secured.

Table 8.1: Location of magnetic field hazards

Room	Equipment	Comments
208	ALEXIS device	
209	N/A	
215	N/A	
169 suite	MDPX device	

Document History

Version	Author	Date	Comment
1.0	E. Thomas, Jr.	5/28/2013	First complete version