



# MagneDyn Beamline safety instructions

**Process membership: PRSI - Procedere in sicurezza**

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## 1 Purpose

This document contains information on the main scientific and technical activities carried out at the "MagneDyn" beamline at Elettra - Sincrotrone Trieste S.C.p.A. (hereafter "Elettra Sincrotrone Trieste" or "Company") and a set of *Operating Instructions* necessary to perform these activities safely.

This document is directly downloadable from the beamline website:

<https://www.elettra.eu/lightsources/fermi/fermi-beamlines/magnedyn/safety.html>

For anything not expressly considered in the following, reference is made to current laws and regulations, and in particular to [LEGISLATIVE DECREE No. 81 of April 9, 2008](#).

## 2 Security managers

Responsibility for the safety of workers and female workers operating at the beamline rests with the following individuals:

- *Beamline safety officers*. They are the *beamline coordinator*, i.e., the person in charge of the activity, *beamline scientists* and, in some cases, *postdocs*. The supervisors oversee the various activities conducted on the beamline, ensuring the implementation of the employer's directives and giving instructions for their proper execution. The list of the Company's safety supervisors can be downloaded from the following link:

[https://vuo.elettra.trieste.it/pls/vuo/amm\\_people.safety\\_org\\_chart\\_printout](https://vuo.elettra.trieste.it/pls/vuo/amm_people.safety_org_chart_printout)

- *Safety Managers*, in the persons of the *Group Coordinators* of the SPEED and IDEAS beamlines, who organize the work activity of each Group and supervise its proper implementation, with particular attention to prevention and protection measures. Their names can be found on the web page:

<https://www.elettra.eu/it/about/contatti-dei-coordinatori-di-gruppo.html>

### 2.1 Duties of beamline safety officers

The beamline or laboratory safety officer must ensure that workers (including users, co-workers, students, trainees, etc.) use the prescribed protective equipment and follow all the prescribed safety provisions.

*In the absence of the supervisor, this responsibility is discharged by the supervisor through the prior information and training of workers and the provision of safety procedures and instructions.*

## 3 Beamline staff

The names and contact information of the personnel appointed by the Company can be found on the following webpage:

<https://www.elettra.eu/lightsources/fermi/fermi-beamlines/magnedyn/contacts.html>



## 3.1 Job Categories.

After appropriate training, the following categories of workers/laborers are authorized to work at the experimental stations and other parts of the beamline:

- beamline research staff, i.e., *beamline coordinator (or beamline manager), beamline scientists on both fixed-term and permanent contracts;*
- photon transport support research personnel (PADReS group).
- Laser support research personnel (Laser group).
- external research personnel, and in particular academic or industrial users (*users*), collaborators, fellows from other institutions, doctoral students, graduate students and trainees;
- technical beamline staff;
- Maintainers: electrical-electronic technical personnel, computer-design personnel, mechanical-fluid technical personnel; technical personnel of the Mechanical, Vacuum and Optical group.
- movers.

Each worker/employee is responsible for taking care of his or her own health and safety and that of other persons in the workplace, on whom the effects of his or her actions or omissions fall, in accordance with his or her training, instructions and means provided by the employer.

## 3.2 General safety requirements and training

Each job category is required to complete the prescribed training courses for the specific activities of the assignment, made available through the *Virtual Unified Office (VUO)* system.

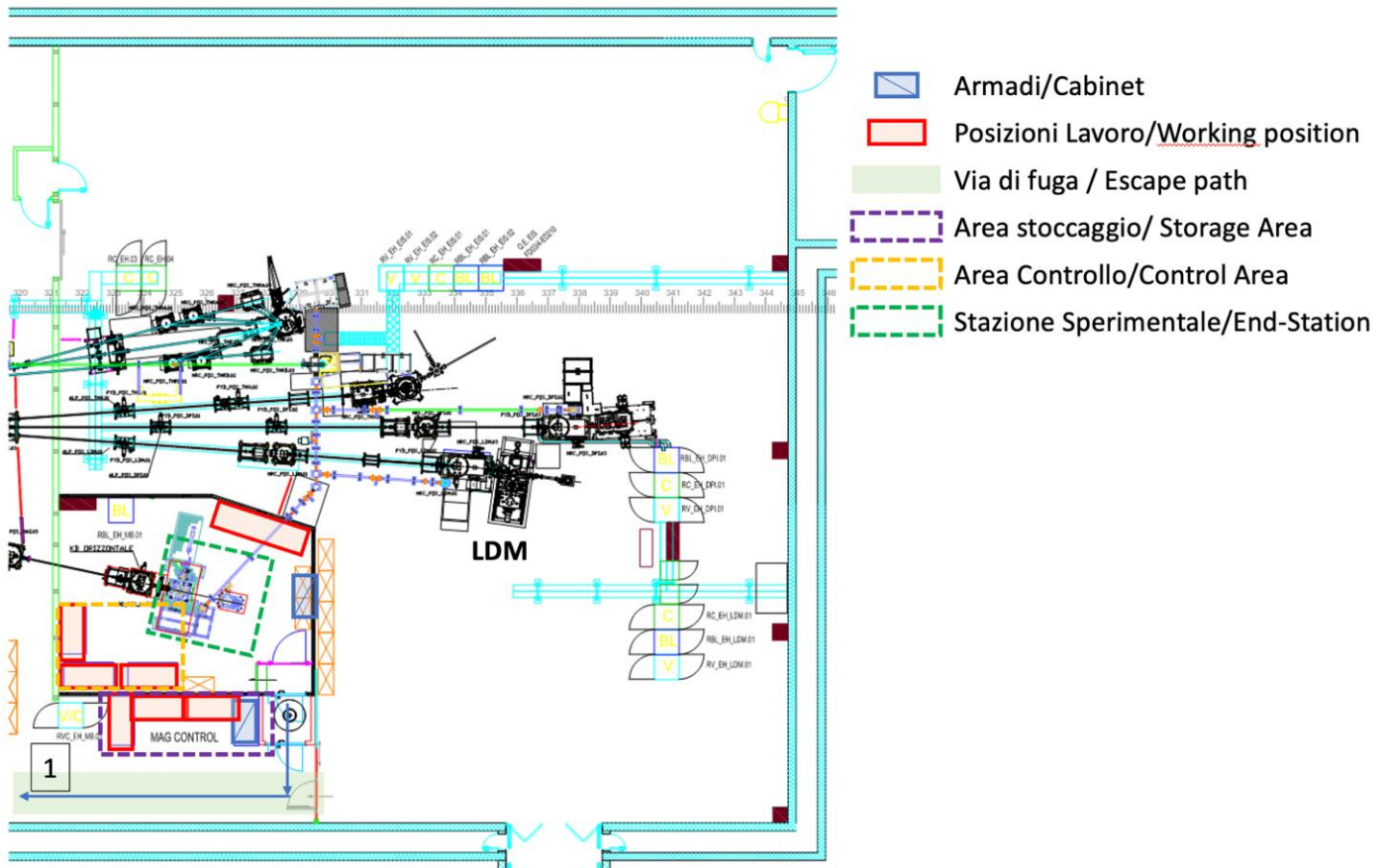
All are encouraged to consult **Elettra's Risk Assessment Document** (document code: **PVAR-MAN-01**). In addition, electrical maintenance personnel should review the recommendations in document **PVAR-SCH-07**, electrical-electronic technicians those in document **PVAR-SCH-16**, and fluidistic-mechanical maintenance personnel those in documents **PVAR-SCH-09** and **PVAR-SCH-19**. IT-design staff should view document **PVAR-SCH-03**, research and laser support staff of those in documents **PVAR-SCH-7 0**

**Please note:** It is *beyond the scope of this document to report in detail the safety requirements of electrical maintenance workers called upon to perform routine and extraordinary maintenance operations on electrical distribution panels, or repair work on electrical switchboards or similar devices, since there are already risk assessment documents and specific safety requirements related to their tasks. Likewise, please note that it is absolutely forbidden for the scientific and technical staff of the beamline and external researchers to perform any work on the electrical systems.*

## 4 The "MagneDyn" beamline.

### 4.1 Description of the work area

The "MagneDyn" beamline (see **Figure 1**) is located inside the "EHF" building at the south side position in the FERMI experimental room floor plan. The beamline is equipped with a hutch. Beamline 1, is highlighted in green in **Figure 1**.



**Figure 1:** Plan of the "MagneDyn" beamline.

Referring to **Figure 1**, the areas marked by the **yellow** (A) and **magenta** (B) outline correspond, respectively, to the area reserved for instrument control during the data acquisition phase and the area designated for storage of beamline instrumentation and/or *online* data analysis by instrument users.

The areas delineated by **green** dashed stripes (in **Figure 1**) are the areas reserved for access and placement of instrumentation that can be used during *beamtimes*, i.e., the periods of activity when experiments approved by FERMI's *Proposal Review Panels* are performed.

The "MagneDyn" experimental station has an adequate number of workstations at which data acquisition and analysis activities can be carried out during experiments. Each workstation is equipped with a desk and one or more ergonomic chairs.

### 4.2 Scientific activity of the beamline

The "MagneDyn" beamline operates in the spectral range of 40 to 300 eV and is used by a scientific community active in the fields of solid-state physics, particularly magnetism.

The "MagneDyn" beamline experimental station houses two experimental chambers. The first





experimental chamber called the magnetic chamber is dedicated to resonant polarimetry and resonant magnetic scattering in reflection or absorption. The experimental setup was designed and built through an international collaboration involving Elettra Sincrotrone Trieste, the Advanced Light Source Berkeley (California USA), and CNR-IOM. The second experimental chamber, developed through collaboration with CNR-IOM, the University of Hamburg, and FEL Flash (Germany) is dedicated to resonant X-ray emission/EUV spectroscopy

The first experimental setup allows the following types of measurements to be performed with magnetic sensitivity:

- Time-resolved spectroscopy techniques using beams in the extreme ultraviolet (*XUV*) or *soft X-rays* (*soft X-rays*) as a probe, either in transmission or reflection:
  - *Time resolved EUV-magneto optical Kerr/Faraday effect polarimetry*
  - *Time-resolved X-ray Absorption Spectroscopy* (tr-XAS)
  - *Time Resolved X-ray Magnetic Circular Dichroism* (tr- XMCD)

The second experimental setup allows the following types of measurements to be made

- *Time resolved resonant x-ray emission and inelastic spectroscopies*

### 4.3 Instrumentation available

A list of the main equipment used is provided in this section (the **CE** symbol indicates the particular marking required for marketing products within the European Community).

#### 4.3.1 User and instruction manuals

Manuals for the instrumentation available at the experimental station are kept in the "MagneDyn 06" armand located outside the beamline hutch. PDF versions of the manuals, can also be downloaded from:

<https://drive.elettra.eu/d/01bb171f40a44634be00/>

#### 4.3.2 Experimental station instrumentation

While they may vary in configuration depending on the specific needs of the particular experiment, the main components that make up the measurement system of the "MagneDyn" experimental station are listed below:

- Instrumentation experimental stations:
  - 1.5 Tesla electromagnet GMWassociate (CE)
  - ARS 4k Cryostat (CE)
  - ARS Cryostat Compressor (CE)
  - 4-Axis Manipulator VG-Scienta
  - EUV Polarimeter TONIX
  - XES Scienta Spectrometer
  - 1x Smaract filter wheel (CE)
  - 4x MCP Hamamatsu F1094-011F
  - 1x MCP Hamamatsu phosphorous screen
  - various Smaract translators (EC)
  - Vacuum pressure measurement system in chamber
    - IONIVAC Pressure Readers (EC)
    - Pfeiffer Pressure Readers
  - Pumping system
    - 5x Pfeiffer HiPace400 pump and related accessories (CE)



- 3x Edwards Xds 10i scroll pump (CE)
- Additional instrumentation on board experimental chamber
  - Infinity Telemicroscope (CE)
  - 2x Basler chambers aCa 780-75gm
  - 3x Basler chambers aCa 1300-75gm
  - 1x Model HD8096 Teledyne LeCroy Inc. oscilloscope (CE)
  - 2x stepper motor controllers model 8SMC5-RS232 manufactured by Standa
  - 3x Smaract motor controllers
  - 3x PI piezo controllers
  - 4x stepper motor controllers Mclennan manipulator VG (CE)
  - 5x high voltage FLEX modules Elettra Sincrotrone Trieste (CE)
  - 2x Custom made Elettra central power distribution and signal trigger rooms Basler (CE)
  - 1x Custom made Elettra tip-tilt controller SLU piezoelectric
  - 1x Laser Power Meter model S-Link manufactured by Gentec. (CE)
  - 1x LakeShore temperature controller model 336
  - 1x LakeShore temperature controller model 335
  - 1x LakeShore magnetic field reader
  - 6x LED lamps room lighting
  - 1x VME CAEN
  - 2x CAEN digitizer V1761
  - 2x Custom made Elettra trigger signal distribution
  - 3x Custom made Elettra distribution network
  - 2x helium cylinders 35 liters, high pressure 200 bat
  - Elettra custom made system for pressure reduction and helium gas distribution for cryostat

### 4.3.3 Experiment station control instrumentation

- Rack RBL\_EH\_MAG\_01
  - 1x Switched Rack AP7922 PDU APC
  - 1x Elettra YAMS controller
  - 3x Leybold pressure reader controllers
  - 5x Pfeiffer DCU turbo pump controllers
  - 1x MOXA N-port 5650-8. (CE)
  - GMW 231HC bipolar current amplifier (CE)
  - 
  - 1x Keithley 2410 1100V SourceMeter (CE)
- Rack RC\_EH\_MAG\_01
  - 2x DiskLess PCs.
  - 3x Experiment station control server.
  - 3x Ethernet switches for data traffic.

## 4.4 Beamline access

External research personnel wishing to perform experiments at the "MagneDyn" beamline must fill out an appropriate request for access to the Elettra Sincrotrone Trieste site on the VUO portal and pass the required security tests. Access to the line takes place in a very specific manner, which depends on the category and professional status of the applicant, see **Figure 2**:



### Access requests to the laboratory (ONLY FOR USERS)

This link for the [access requests](#) to the laboratory is **ONLY FOR USERS**.

### Access requests to the laboratory (NOT FOR USERS)

This link for the [access requests](#) to the Elettra laboratory is **NOT FOR USERS**, but only for:

- Student final-year@UNI (from Italy),
- PhD student (from Italy),
- Post-doc@UNI (from Italy),
- Student for training,
- Fellowship holder,
- School attendee,
- Attending at Conferences/Lecturer,
- Elettra partner,
- Collaborator,
- Commercial user

**Figure 2:** Types of access requests and categories of applicants

The main types of access requests are described below:

- **Academic users (panel-approved proposal):** submission on the VUO portal of a request for access to Elettra's "MagneDyn" beamline Sincrotrone Trieste following approval of a scientific proposal for *beamtime* by FERMI's *Proposal Review Panel*.
- **Academic users (in-house proposal):** submission on the VUO portal of a request for access to Elettra's "MagneDyn" beamline as a *participant* in an in-house research *proposal*, i.e., an "*in-house*" *proposal*. This request is taken up and approved by the *Users Office* of Elettra Sincrotrone Trieste.
- **Industrial users:** submission on the VUO portal of a request for access to the "MagneDyn" beamline as a participant in an industrial research proposal managed through the Company's Industrial Liaison Office (ILO). The access request is handled by the ILO.
- **Collaborators and partners:** submission on the VUO portal of a request for access to Elettra Sincrotrone Trieste's "MagneDyn" beamline as a *collaborator* or *partner*. This request is approved by an internal "*tutor*," i.e., a member of the beamline *staff* and then by the *Users Office* of Elettra Sincrotrone Trieste.
- **Students and trainees, external fellows, doctoral students:** submission on the VUO portal of a request for access to Elettra Sincrotrone Trieste's "MagneDyn" beamline as a *student*, *trainee*, *external fellow*, or *doctoral student*. An agreement (e.g., a *Memorandum of Understanding/Convention*) between Elettra Sincrotrone Trieste and the institution with which the student/fellow is affiliated must be in place at the time of the request. The request for access is approved by the Human Resources Activity and an internal "*mentor*," in this case a member of the beamline *staff*.
- **Outside firms:** sending a request to the Prevention and Protection Service (PPS), for example by e-mail, to perform installations or provide services at the "MagneDyn" beamline following a procurement request and corresponding order. The contractor is required to provide and update the list of names of personnel who will be going to the Company's site. Entry will be authorized by the SPP Activity, after sending the names of the personnel involved and the license plate of the vehicle with which access to the site will take place. According to current occupational safety regulations (Legislative Decree 81/2008, as amended), any activity entrusted to the contractor must be preceded by a mutual exchange of safety documents, see:

<https://www.elettra.eu/activities/spp/information-for-external-firms.html>



## 5 Safety operating instructions

This section lists safety operating instructions related to the main scientific and technical activities performed at the "MagneDyn" beamline and related experimental stations. These instructions are based on the following documents available in the corporate documental.

- **MagneDyn beamline risk assessment summary document (document code: ?)**
- **Worker risk assessment sheet at the MagneDyn beamline (Document code: ?)**

All members of the beamline *staff* are responsible for ensuring that the activities outlined here are carried out in accordance with current regulations and according to the directives given by the Activity Manager, i.e., the *beamline coordinator*, and the *group coordinator*. Of particular relevance are the provisions regarding the use of Personal Protective Equipment (PPE) described below.

Regarding the Protection and Safety Regulations governing the activities in FERMI's Experimental Hall, we invite you to take a look at the document "Radiological Risk in FERMI's Experimental Hall" (document code: **RPFO-SCH-06**), and regarding the regulations for laser sources the document "Instructions for the Use of Seed Laser Users (SLU) in Experimental Hall" (document code: **PRSI-IOP-07**).

### 5.1 Special health conditions of the worker/employee

The performance of some work activities described below may be incompatible with special physical or medical conditions. Please notify the beamline coordinator or supervisor in a timely manner of any limitations that may result.

In the special case of pregnancy conditions, it is recommended that only activities that can be assimilated to office work (described in Section 5.2), i.e., activities at the video display screen and in particular data acquisition or analysis operations, be performed. Particular attention should be paid to the observance of breaks.

Pregnant or post-partum workers must absolutely refrain from performing activities on the line that expose them to electrical, chemical or radiological hazards or involve the risk of injury or the performance of physical exertion. Please refer to the procedure "**Pregnant and Postpartum Workers. Protection from health risks in the workplace**" (document code: **PVAR-IOP-01**).

### 5.2 Video terminal activities (data acquisition and analysis, etc.)

*Task Description:* all work activities that require the use of *personal computers* or *workstations*, and in particular:

- data acquisition;
- data analysis;
- *software* development;
- Document preparation, e.g. scientific articles, *email* correspondence, etc.

*Associated risks:*

- demand for special visual attention in carrying out the operation;
  - no PPE is provided; current regulations require a break of 15 minutes for every 120 minutes of continuous activity;
  - Appropriate training must be provided;
- Repetitive movements, fixed postures, uncomfortable positions. Skeletal-muscular damage is possible. It is required to:
  - Maintain an ergonomically correct posture;
- During data acquisition activities at night and on weekends, conditions may arise for beamline



research personnel that can be attributed to an "isolated worker" situation, with an inability or limited ability to alert possible help. It is therefore requested that:

- Notify the FERMI Control Room (phone int. 8800) of solo operations.
- Activate with the FERMI Control room a contact by video terminal through the "Zoom" application, *which is present on the workstations of the experimental stations*, using the following link (<https://zoom.us/j/7260842412?pwd=ZGVrL2U4OFVNeGxUbK5zbzVjb3NPQT09>),
- In the case of independent management of the experiment and data acquisition by external research personnel only (i.e., external users, collaborators, fellows, trainees), the minimum number of personnel required for independent management of the instrumentation after appropriate training is two (2).

Video display screen activity may be conducted by the following work categories:

- beamline research staff;
- photon transport support research personnel (PADReS group).
- Laser support research personnel (Laser group).
- External research staff;
- technical staff on the beamline.

Please note:

- *users, collaborators, fellows, students, and trainees may conduct data acquisition activities (i.e., active and independent use of the experiment station instrumentation) only after appropriate training by the beamline staff. Damage to the instrumentation and thus a negative impact on the outcome of the ongoing experiment are possible. The Company reserves the right to claim compensation for damages incurred in case of negligent or irresponsible conduct.*
- *the activity of data acquisition should not be confused with that of manual operation of the experimental apparatus, which requires more training and experience and may pose risks to the operator. As stated in section (5.2), users, collaborators, fellows, students and trainees **may not** independently act on the optical tables of the experimental station, **may not** independently **remove** any covers, window caps and laser protection fabric covers of the experimental station when the laser shutter of the SLU is open.*

### 5.3 Installation, alignment and removal of laser optical set-ups on the optical table of the experimental station

*Task Description:* work activities involving the installation, alignment and removal of laser optical set-ups for time-resolved experiments on the optical table of the experimental station, these may be for example:

- Installations of nonlinear higher harmonic generation systems, e.g. second or third harmonic, of the radiation of the SLU laser fundamental.
- Installations of temporary diagnostics of spectral and pulse duration properties of optical laser.
- Installation of nonlinear parametric amplifiers aimed at generating by nonlinear optical processes wavelengths in the mid-infrared to ultraviolet range.
- Alignment of optical *set-ups* within the optical tables and/or experimental chamber.

*Associated risks:* Exposure to non-ionizing radiation from FERMI's SLU laser. Reflected light from the laser can be accidentally focused on the retina. The following requirements should be followed:

- The guidelines on laser operators (**PRSI-LNG-02**) and the provisions for putting the



FERMI experimental room into "Laser Maintenance" mode (**PRSI-IOP-06**) should be strictly adhered to;

- the use of laser protective goggles appropriate to the wavelength of radiation being used is mandatory for everyone in the experimental room. Such PPE can be found in the cabinet-schedario located at the access to the laser controlled area in the FERMI experimental room;
- for those working on the table is optical it is recommended to take an elevated position relative to the height of the laser beam, using the special platform attached to the long side of the optical table.
- for those working on the optical table, removal from hands, arms and forearms of potential reflecting surfaces such as, for example, watches, rings, bracelets, pendants is recommended.
- if necessary, arrange screens and veils to mitigate the risk of beam leakage to the outside.
- once the intervention is over verified the integrity of the protective casing and the restoration of safe conditions.

The activity can be conducted by the following labor categories:

- Laser support research personnel (Laser group).
- beamline research personnel qualified for "Laser Maintenance"-the list of qualified personnel can be found in the following company document (**PRSI-SCH-17**);

Please note:

- *Users, collaborators, fellows, students and trainees **ARE NOT AUTHORIZED** to carry out this type of activity.*

### **5.4 Use of laser optical set-ups on the optical table of the experimental station for time-resolved measurements**

*Task description:* work activities involving the use by beamline research staff, users, collaborators, fellows, students and trainees of a laser optical set-up for time-resolved experiments with confined equipment in a class 1 laser-emitting segregated enclosure.

Under these conditions there are no special individual laser protections to be taken, we refer to the general precautions given in the following guidelines:

- Guidelines for laser users (**PRSI-LNG-03**).
- Instructions for the use of Seed Laser Users (SLU) in Experimental Hall (**PRSI-IOP-07**).

In particular, it is recalled:

- Prior to the start of an experimental activity and/or after a Laser Maintenance activity, the Operator or Person in Charge is required to verify the integrity of non-interlocked optical confinement devices (with particular attention to caps on viewports, movable screens, and fabric guards).
- In case of short temporary absence from the experimental station, those who leave the laser confined within the hermetically sealed optical tables should make sure that there are no precursors of damage in the experiment (e.g., of combustion, spillage of materials or liquids, inadequate cables, uncertain mountings...) and that the equipment guards are closed by verifying the absence of free beams.
- In the case of an unattended operation, to enable the conduct of experiments in remote mode, or the acquisition of long scans, during which the physical presence of the Operator or Preposto is not necessary, before leaving the experimental station with an experiment with SLU in progress, the Operator or Preposto send an email to the lists [fermi-laser-maintenance@elettra.eu](mailto:fermi-laser-maintenance@elettra.eu) and for information to [operatori@elettra.eu](mailto:operatori@elettra.eu) reporting the situation. The affected experimental station must be indicated. An email to the same lists at the end of the unattended operation signals the end of this mode.





- Removing/tampering with the integrity of laser safety guards especially for non-interlocked optical confinement devices (with special attention to caps on viewports, moving screens and fabric guards) is prohibited.
- visual inspection of the specimen holder area by removing the protective caps on the viewports of the experimental station without first closing the laser safety shutter of the beamline is prohibited.

The activity can be conducted by the following labor categories:

- beamline research staff;
- photon transport support research personnel (PADReS group).
- Laser support research personnel (Laser group).
- External research staff;

Please note:

- *Users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline staff in charge of safety. Instructions received must be followed scrupulously.*

### 5.5 Installation, use, and removal of high-voltage instrumentation

*Task description:* work activities involving the installation and use of scientific instrumentation whose internal parts can reach voltages of more than 500 volts up to several thousand volts, for example:

- Penning-type pressure sensors;
- XES spectrometer;
- Micro Channel Plate (MCP) detectors;

*Associated risks:* electrocution. The following requirements should be followed:

- consult the manuals and strictly follow the installation instructions, paying special attention to the type of connection;
- Check the integrity of the controller-instrument wiring before installation;
- Do not exceed the maximum allowable curvature of power cables;
- Connect and disconnect the instrument only when the power supply is off;
- Follow the instructions for proper grounding of the instrument and its controller.

The activities described above can be carried out by the following labor categories:

- beamline research staff;
- External research staff;
- technical staff on the beamline;
- maintenance workers (electrical, electronic, computer, and vacuum technicians).

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline staff in charge of safety. Instructions received must be followed scrupulously.*

### 5.6 Installation, use, and removal of low voltage instrumentation

*Task description:* installation, use and removal of scientific instrumentation operating at low voltage (< 50 V). High currents (\*), up to 10 A, may be present in some cases. Some examples follow:

- capacitive pressure sensors;
- Pirani-type pressure sensors;



- Bipolar power supplies for electromagnets;
- Stepper and/or piezoelectric motors;
- inspection cameras;
- CCD and/or CMOS detectors;
- Oscilloscopes, picoamperometers, low-voltage waveform generators;

*Associated hazards:* burns. Possible burst due to the electric arc formed as a result of accidental interruption of the continuity of the electric circuit. The following requirements should be followed:

- consult the manuals and strictly follow the installation instructions, paying special attention to the type of connection;
- Check the integrity of the controller-instrument wiring before installation;
- connect and disconnect the instrument only when the power supply is off, being sure that no current is flowing through the cable connecting the controller to the instrument;
- Pay special attention to connections between laboratory cables with banana plugs.

The activities described above can be carried out by the following labor categories:

- beamline research staff;
- photon transport support research personnel (PADReS group).
- Laser support research personnel (Laser group).
- technical staff on the beamline;
- Maintenance workers (electrical, electronic, computer and vacuum technicians)

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving appropriate training and authorization from the beamline staff in charge of safety. Instructions received must be followed scrupulously.*

### 5.7 Small repairs of electronic instrumentation

*Task description:* replacement of damaged electronic components, such as fuses or capacitors, or replacement of entire electronic boards:

*Associated risks:* electrocution. The following requirements should be followed:

- Before carrying out the repair, consult the manuals and strictly follow the instructions therein. Contact the manufacturer if in doubt;
- Always disconnect the apparatus from the power supply before operating on it;
- Always pay attention to the residual charge of the capacitors, since it persists even after the instrument is turned off. Wait sufficient time for the capacitors to discharge completely;
- in case of using the tinsmith, choose a suitable workstation. There is a fire hazard from using the tinsmith. Remove flammable objects from the work table. Turn off the tinner immediately after completing the repair;
- after completing the repair, inform the beamline coordinator and agree on the tests to be performed.

Electronic instrumentation repair activities can be performed by the following labor categories:

- beamline research staff;
- photon transport support research personnel (PADReS group);





- Laser support research personnel (Laser group);
- technical staff on the beamline;
- maintenance workers (electrical, electronic, computer, and vacuum technicians).

Please note:

- *Users, collaborators, fellows, students and trainees **ARE NOT AUTHORIZED** to carry out this type of activity.*

### 5.8 Routine or extraordinary maintenance work in the racks end-station control

*Task description:* this is repair/replacement of instruments (e.g., controllers and power supplies) installed in the control racks of the beamline or experimental station, or repair/replacement of signal or serial/ethernet communication cables.

*Associated risks:* electrocution. The following requirements should be followed:

- Strictly comply with electrical safety regulations
- Take into account what is stated in Sections 5.5, 5.6 and 5.7.
- Before installing or repairing any equipment, consult the manuals and strictly follow the instructions therein. Contact the manufacturer if in doubt;
- Always disconnect the apparatus from the power supply before operating on it; if necessary, remove power from the rack;
- Always pay attention to the residual charge of the capacitors, since it persists even after the instrument is turned off. Wait sufficient time for the capacitors to discharge completely;
- be careful not to damage the cables of other instruments, especially those carrying high voltage (pressure sensors, ion pump power supply); if necessary, turn off these instruments and move or remove their cables;
- after completing the repair, inform the beamline coordinator and agree on the tests to be performed.

Electronic instrumentation repair activities can be performed by the following labor categories:

- beamline research staff;
- photon transport support research personnel (PADReS group);
- Laser support research personnel (Laser group);
- technical staff on the beamline;
- maintenance workers (electrical, electronic, computer, and vacuum technicians).

Please note:

- *users, collaborators, fellows, students and trainees **ARE NOT AUTHORIZED** to carry out this type of activity.*

### 5.9 Routine and extraordinary electrical maintenance work

*Task description:* routine maintenance operations at the beamline, for example:

- Electrical repairs in racks or on electrical distribution boards;
- Installation/repair of electrical outlets or receptacles;
- Maintenance of electrical panels, testing of proper operation of circuit breakers.



*Associated risk:* electrocution. The following requirements should be followed:

- Strictly observe electrical safety regulations;
- Take note of the recommendations given in document **PVAR-SCH-07**.

Maintenance activities can only be performed by the following labor categories:

- maintenance workers (electrical-electronic technicians in the Infrastructure Group);

Please note:

- *all other labor categories **ARE NOT AUTHORIZED** to perform this type of activity.*

## 5.10 Installation/removal of heavy or bulky instrumentation

*Description:* these are activities that must be carried out with the support of the handling personnel. Typically these are the transport, installation or removal of encumbered or heavy parts of the instrumentation of the beamlines or their experimental stations, for example:

- VACUUM CHAMBERS;
- manipulators;
- Scientific instruments of relevant weight and size;
- Ionic or turbo-molecular pumps of significant weight and size;

*Associated hazards:* manual handling of loads, shock, impact. The following requirements should be followed:

- Agree with the beamline coordinator on a plan for safe assembly/disassembly;
- Request the intervention of handling personnel;
- Always make use of the overhead crane for lifting rooms and heavy objects. Where it is not possible to intervene with the overhead crane, use a "goat" type lift;
- work in pairs to reduce the load and corresponding strain;
- Always wear the prescribed PPE:
- Protective gloves, for example leather gloves or cut-resistant gloves;
- safety shoes;
- Protective helmet (only in case of overhead crane use).

The work activities described in this section can be conducted by the following work categories:

- beamline research staff;
- photon transport support research personnel (PADReS group);
- technical staff on the beamline;
- movers.

Please note:

- *users, collaborators, fellows, students and trainees **ARE NOT AUTHORIZED** to carry out this type of activity.*

## 5.11 Installation/removal of vacuum equipment and instrumentation

*Task description:* installation or removal of parts of the instrumentation of the beamlines or corresponding experimental stations, without use of the overhead crane and without support from handling personnel. By way of example, this involves performing the following tasks:



- Installation or removal of scientific instruments (weighing up to 20 kg), ionic or turbo-molecular pumps, diaphragm or diaphragm pumps;
- Installation or removal of small to medium-sized vacuum instrumentation (weighing up to 20 kg);
- Assembly or disassembly of various instrumentation, e.g., manipulators (weighing up to 20 kg);
- Assembly or disassembly of motorized translators and/or CCD and CMOS detectors (weighing up to 20 kg);
- Installation or removal of instrumentation in *racks* (weighing up to 20 kg);

### Associated risk:

- Manual handling of loads. The following requirements should be followed:
  - work in pairs to reduce the load and corresponding strain;
- shocks, blows, impacts. We recommend:
  - Wear the following PPE: protective gloves, for example, leather gloves or cut-resistant gloves.
- Slips, level falls, tripping. It is recommended to:
  - Keep the floor free from sharp objects, highlight any obstacles.

### Precautions:

- When wiring motorized shifters and/or detectors, it is recommended that the operation be carried out by turning off the power supply and/or controller of the instrument.

### These work activities can be performed by the following labor categories:

- beamline research staff;
- photon transport support research personnel (PADReS group).
- External research staff;
- technical staff on the beamline;
- Maintenance workers (electrical, electronic, computer and vacuum technicians)

### Please note:

- users, co-workers, fellows, students and trainees may conduct this type of activity *only after receiving proper training and authorization from the beamline staff in charge of safety.* Instructions received must be followed strictly.

## 5.12 Minor maintenance work on vacuum chambers

*Task Description:* routine maintenance operations of vacuum chambers and/or their vacuum components, for example:

- installation/removal or assembly/disassembly of instrumentation or parts and components of vacuum systems, e.g., *gate-valves, leak valves*, linear manipulators (*z-translators*), pressure sensors, vacuum motors;
- opening/closing flanges to allow repairs and routine maintenance operations inside in the vacuum systems of the beamline or experimental stations;

### Associated risk:

- shocks, blows, impacts;
  - there are no prescriptions or use of PPE
- Slips, level falls, tripping. It is recommended to:



- Keep the floor free from sharp objects, highlight any obstacles.

Maintenance activities can be performed by the following labor categories:

- beamline research staff;
- External research staff;
- technical staff on the beamline;

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving proper training and authorization from the beamline staff in charge of safety. Instructions received must be followed strictly.*

### 5.13 Minor fluid-mechanical maintenance work

*Task description:* plumbing installations or repairs, for example:

- repairs of water leaks;
- Installation or replacement of faucets, rigid pipes, hoses, and flow switches.

*Associated risk:* shocks, blows, impacts.

- Take note of the recommendations in documents **PVAR-SCH-09** and **PVAR-SCH-19**.

*Associated risk:* electrical hazard, electrocution.

- Take note of the recommendations in document **PVAR-SCH-07** and in **Section 6.3**.

Maintenance activities can be performed by the following labor categories:

- Maintenance workers (mechanical-fluid technicians in the Infrastructure group)

Please note: *All other labor categories **ARE NOT ALLOWED** to perform this type of activity.*

### 5.14 Elevation work on channel or vacuum chambers

*Task description:* operations performed in elevation on ladders or scaffolds, such as:

- Laying or removing cables on canal;
- Maintenance operations of the internal or external parts (e.g., manipulators) of the vacuum chambers of the beamline.

*Associated risk:* slip or fall from elevated positions. The following requirements should be followed:

- if possible, always use a harness and make sure to solid supports;
- Work in pairs; one of the two must hold the ladder firmly.

Activities related to elevation work can be conducted by the following labor categories:

- technical staff on the beamline.
- Maintenance workers (electrical, electronic, computer technicians)

Please note:

- *beamline research staff, users, collaborators, fellows, students and trainees ARE NOT AUTHORIZED to perform this type of activity. Beamline staff may assist technical staff.*



## 5.15 Cleaning of components and vacuum tools

*Task description:* these are operations carried out in the course of routine or extraordinary maintenance of vacuum chambers and/or their parts and components:

- cleaning of small metal parts, such as parts of specimen holders, manipulators, and sensors. Cleaning is done by immersion in ethyl alcohol or acetone;
- Cleaning of tools used for assembly/disassembly of parts in ultra-high vacuum;
- material removal operations using filings or sandpaper, resulting in the formation of metal dust.

Associated *risks*:

- Inhalation of gases or vapors. The following requirements should be followed:
  - Avoid prolonged exposure to acetone vapors; if so, work under a fume hood;
  - wear latex gloves;
- Inhalation of dust or fibers. The following requirements should be followed:
  - working under a hood;
  - Wear latex gloves and lab coat;
  - Wear FFP2 or FFP3 mask during all material removal operations.

Activities related to the cleaning of components and parts for use in ultra-high vacuum can be conducted by the following labor categories:

- beamline research staff;
- photon transport support research personnel (PADReS group).
- External research staff;
- technical staff on the beamline.

Please note:

- users, co-workers, fellows, students and trainees may conduct this type of activity *only after receiving proper training and authorization from the beamline staff in charge of safety.* Instructions received must be followed strictly.

## 5.16 Maintenance of primary pumps

*Task description:* this is a routine maintenance operation, typically to be carried out once every one to two years, necessary to restore the pumping capacity of *scroll*, diaphragm, or diaphragm pumps. Seals/membranes are changed and mechanical cleaning is carried out using brushes, vacuum cleaners, and wet rags.

*Associated risks:* inhalation of dust. The following requirements should be followed:

- Refer to the manual provided with the pump maintenance kit. Follow the manufacturer's recommended instructions;
- Working under a hood or outdoors;
- wear latex gloves;
- Wear FFP2 or FFP3 mask during the entire duration of cleaning operations.

The work activity related to the cleaning of primary pumps can be performed by the following labor categories:



- technical staff on the beamline;
- technical vacuum maintainers;

Please note:

- *Beamline research staff may assist technical staff. Users, collaborators, fellows, students and trainees **ARE NOT AUTHORIZED** to perform this type of activity.*

### 5.17 Sample preparation with powders

*Task description:* powders or nanoparticles are deposited on metallic or semiconductor samples for example by *spin coating* technique, or by fixing them under pressure.

*Associated hazards:* inhalation of dust and/or fibers. The following requirements should be followed:

- Refer to the User Support Laboratory Security Procedure (**GSLA-PRO-03**);
- Consult the substance's chemical risk sheet and take necessary precautions;
- carry out the preparations in the Support Laboratory, always working under a fume hood ;
- Wear prescribed PPE: chemistry lab coat, latex gloves, goggles, FFP2 or FFP3 mask during the entire duration of preparation operations.

Sample preparation with powders can be carried out by the following.

labor categories:

- beamline research staff;

Please note:

- *users, co-workers, fellows, students and trainees may conduct this type of activity only after receiving proper training and authorization from the beamline staff in charge of safety. Instructions received should be followed scrupulously.*

### 5.18 Mounting and specimen insertion in the experimental chamber and in experiments using FERMI's laser-optical unit (SLU)

*Task description:* mounting samples in chamber for experiments involving time-resolved measurements and the use of FERMI's laser optical unit (SLU).

*Associated risks:*

- Inhalation of dust, fibers. The following requirements should be followed:
  - Consult the chemical risk sheet of the substance(s) making up / composing the sample and take necessary precautions;
  - Use latex gloves; wear an FFP2 or FFP3 mask if necessary;
- repetitive movements, uncomfortable postures. Temporary incongruous postures can cause musculoskeletal disorders.
- Exposure to non-ionizing radiation from FERMI's SLU laser. Reflected light from the laser can be accidentally focused on the retina, it is mandatory to wear the following PPE: LASER safety glasses.

The following requirements should be followed:

- Before sample replacement and removal of the opaque screens placed on the experimental chamber windows, make sure that the SLU laser transport shutter is in the closed position, inhibiting laser transport on the optical coupling table of the experimental station.
- During the pumping phase of the experimental station, before rehabilitating the transport of





the SLU laser on the optical table of the experimental station, make sure that the opaque laser protection screens have been repositioned on the windows of the experimental chamber.

Sample assembly activity can be conducted by the following labor categories:

- beamline research staff;

Please note:

- *External research staff, i.e., users, collaborators, fellows, students and trainees **ARE NOT AUTHORIZED** to carry out this type of activity.*
- *Laser safety glasses are placed at the filing cabinet located near the entrance compass to the controlled access area. Copies of the keys for opening the filing cabinet are kept in the key box of the experimental station at position No. 12.*

### 5.19 Mounting and insertion of samples into the experimental chamber in experiments that do **NOT** involve the use of FERMI laser optics (SLU)

*Task description:* mounting samples in the chamber for experiments **not** involving FERMI laser optics (SLU).

*Associated risks:*

- Inhalation of dust, fibers. The following requirements should be followed:
  - Consult the chemical risk sheet of the substance(s) making up / composing the sample and take necessary precautions;
  - Use latex gloves; wear an FFP2 or FFP3 mask if necessary;
- repetitive movements, uncomfortable postures. Temporary incongruous postures may cause musculoskeletal disorders. There are no special prescriptions.

*Precautions:*

- It is recommended that in case of prolonged absence from the FERMI experimental room, for example, during the pumping phase after sample replacement and/or for automated acquisitions during nights, to inform the FERMI Control Room (phone int. 8800).

Sample assembly activity can be conducted by the following labor categories:

- beamline research staff;
- External research staff.

Please note:

- *External research personnel, i.e., users, collaborators, fellows, students and trainees may assemble and insert samples into the experimental chambers only after receiving appropriate training and clearance from the safety officer. Instructions received must be followed scrupulously. Significant damage to the instrumentation caused by unintentional re-entry of the experimental apparatus into the air is possible. The Company reserves the right to claim compensation for damages incurred in case of negligent or irresponsible conduct.*

## 6 Electrical Safety Standards

Electrical and electronic equipment in operation at the experimental beamline stations expose operators to electrical hazards. This risk is reduced by complying with current regulations and following the guidelines and prohibitions below:



## 6.1 Recommended electrical safety guidelines

- Comply with safety signs and related regulations.
- Ensure that the electrical system or equipment has the necessary approvals and certifications, if necessary contacting the appropriate personnel.
- Be sure of the location of the electrical panel supplying power to the area in which you are working so that you can promptly de-energize the system if necessary.
- Use electrical systems in accordance with their intended use and respective operating manuals.
- Ensure that power cords of electrical equipment are adequately protected from mechanical (passing people, sharp objects, etc.), thermal (heat sources) or chemical (corrosive substances) actions.
- Make sure the power has been turned off before performing any simple operation on the facilities (including changing a bulb) or equipment.
- Always make sure the electrical system is disconnected (after operating the appropriate switch) before unplugging.
- Disconnect the equipment from the power source before starting periodic cleaning.
- Plug the equipment into the nearest outlet, avoiding the use of extension cords as much as possible.
- Do not overload outlets with too many electrical consumers, always checking that the total current load intensity does not exceed the limits of the outlet itself.
- The multiple adapters allowed by the standards are those with only two side sockets. The other type, with a third socket parallel to the plugs, is considered dangerous because it allows multiple sockets to be chained together.
- German-type (Schuko) plugs can be inserted into Italian-type sockets only by means of an adapter that transfers the ground connection made via the side plates to a central plug. It is absolutely forbidden to forcibly insert Schuko plugs into Italian sockets.
- Avoid subjecting all parts of electrical systems to mechanical or impact actions (passing trolleys, etc.).
- When using roller extensions, they must be fully unwound to avoid overheating. In fact, the capacity of the coiled cable is reduced. The capacity of the cable, which must be indicated, must always be respected.
- Do not pull the power cord to disconnect an electrical appliance from the outlet, but use the plug.
- Do not tamper with electrical equipment (qualified personnel must be requested for any need in accordance with company procedures).

## 6.2 Prohibitions

- Prohibition of tampering with electrical appliances.
- Prohibition to install or use private electrical equipment or materials.
- Prohibition to intervene in case of failure on switchboards or electrical panels.
- Prohibition of covering or concealing the controls and electrical panels with cabinets or other furnishings (allow inspection and timely intervention in case of anomalies).





- Prohibition of removing the protective channels of electric cables.
- Prohibition of overloading outlets with too many electrical appliances, using adapters or multiple outlets.
- Prohibition of depositing flammable substances in the vicinity of equipment.
- Prohibition of depositing containers filled with liquids on the devices.
- Prohibition of exposing equipment to excessive radiation or heat sources.
- Prohibition of preventing proper ventilation of equipment by covering ventilation openings.
- Prohibition of touching facilities and/or equipment if you have wet hands or shoes.
- Prohibition on the use of water for extinguishing fires of electrical origin.

### **6.3 Behavior to be followed in case of water leakage**

The turbomolecular pumps in use at the experimental station require cooling water. Such water is demineralized, and therefore non-conductive.

Given the presence of high voltage in many pieces of equipment, the risk of electrocution cannot be completely ruled out. Therefore, it is important to avoid putting yourself or others in a dangerous condition. The following recommendations should be followed:

1. Consult the beamline safety prespect, if in place.
2. Don't get caught up in the rush or panic.
3. Avoid stepping on wet areas.
4. Avoid touching wet areas with your hands.
5. Prevent flooding by immediately closing the cooling circuit subject to leakage.
6. DO NOT dry wet areas with paper or rags unless you have completely turned off power to all racks and utilities. Cordon off the area so as to prevent third parties from accessing it.



## 7 Emergency management

Various and of different severity are the emergencies that can happen on the beamline. They must be handled according to the company's Emergency Plan (see procedure GEEM-PRO-02-rev03IT).

