

Rules, policies and procedures specifically related with work in the ICTS' NANOLITHOGRAPHY Area

Note GICORG: **10-1**
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Acknowledge of Junta Instituto:
Difusion: Internal within IMB-CNM and
external to potencial users

*The rules and regulations contained in this Note was taken to the extent that no colliding
with the official rules and regulations of the CSIC affecting*

GIGORG 10 Notes from the ICTS “Sala Blanca Integrada de Micro y Nano fabricación”, gathers policies and procedures specifically related to each Process Area . Note GICORG 10-1 refers to the issues affecting the Nanolithography APUS (Nanolithography Process Area – Service UnitArea, shortly “Nano” Area)

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1. Policies and Procedures Highlights

- Check it on the instrument logsheet. Fill up all the information required (user, timing, type of samples and any extra information do you think is relevant)
- Remove your sample/sample holder from the instrument and clean up the place. Note any anomalies to the staff. Check out on the instrument log sheet.
- When working in the nano-area be quiet, avoid fast or noisy movements, don't move chairs around and talk as less and as low as possible. Some of the equipments can be running even if the operator is not in front of it, so it is important to do not disturb the other's work.
- **Storage** in the laboratory **is not permitted**. If you need to keep something on the clean-room (samples, resists...) please contact the lab-staff.
- DO NOT modify anything on the equipment itself. NO EXCEPTIONS!
- DO NOT install any software on any computers. NO EXCEPTIONS!
- Use the “*fixers*” website (cnm intranet) for taking out the images saved on the computer. **Pen drives are strictly forbidden**.
- Transfer your files after EACH session from the computers. Excess data storage on the computers is not permitted. They are NOT backup computers!. Every few months all files will be deleted without any warning.
- Use the appropriate holders and tweezers for each sample. If you are not sure, ask the lab-staff.
- If you make a mess, clean it up. Return everything to its original condition.
- Be aware of supplies (paper, IPA, Acetone, stubs,...). If quantities of stock appear to be low, report it to the lab-staff.
- Remember: you shouldn't introduce in the Clean-Room any chemical, material or tool not previously discussed and aproved by the Area Responsible and/or the Clean-Room Manager (as established in the *Protocolo 0* document) .

2. Introduction

The Nanolithography Process Area and Service Unit (Nano-APUS) is the area devoted to nanolithographic techniques of the IMB-CNM ICTS. The location is on the new area of ICTS Clean-Room (see the map), and the list of actual equipments available is the following¹:

	Equipment	USE	Comments
N8	Dimension 3100 + Nanoscope V controller	AFM measurements and lithography	There is another AFM outside the clean-room for surface characterization.
N6	LEO 1530 + Elphy Plus attachment	EBL (non stitching capabilities) SEM (ICTS processing samples) SEM for any sample	Priority is settled according the following: EBL & SEM (ICTS) / SEM (any)
N2	Raith 150TWO	EBL	
N7	Crossbeam 1560XB	Focused Ion Beam with multiple accessories.	
N4	Obducat 4inch	Thermal NanoImprint	
N3	Obducat 2inch	Thermal and UV NanoImprint	Belongs to a research group. Ask Lab-staff to use it.
N5	NPS300	UV and thermal step and repeat imprinting system	
N10	Fume-Hood (Quimipol) + Spinner (Laurell)	Fume-Hood with spinner for spin-coating resists, and a hot-plate for baking.	Located at the yellow area for general and UV-sensible resists.
Q17 & N11	Wet-Station with two integrated spinners	For spin-coat, cleaning and developing of samples/wafers in an automated mode. Attached to it there is a fume-hood with a hot-plate.	
U13	Glove Box (Quimipol)	Glove box with N2 blowing and vacuum for the deposition of anti-sticking layers.	Belongs to a research group. Ask staff to use it.
N9	Zeiss Axio Imager	Optical Microscope with integrated camera for optical inspection.	

All these equipments are operated in both service (“encomienda”) and qualified self-service mode, some with free access and others through a pre-booking calendar system. All of them require a training to get access in self-service mode. Self-service is strongly encouraged for the ph.D students, as they get very valuable knowledge and skills on

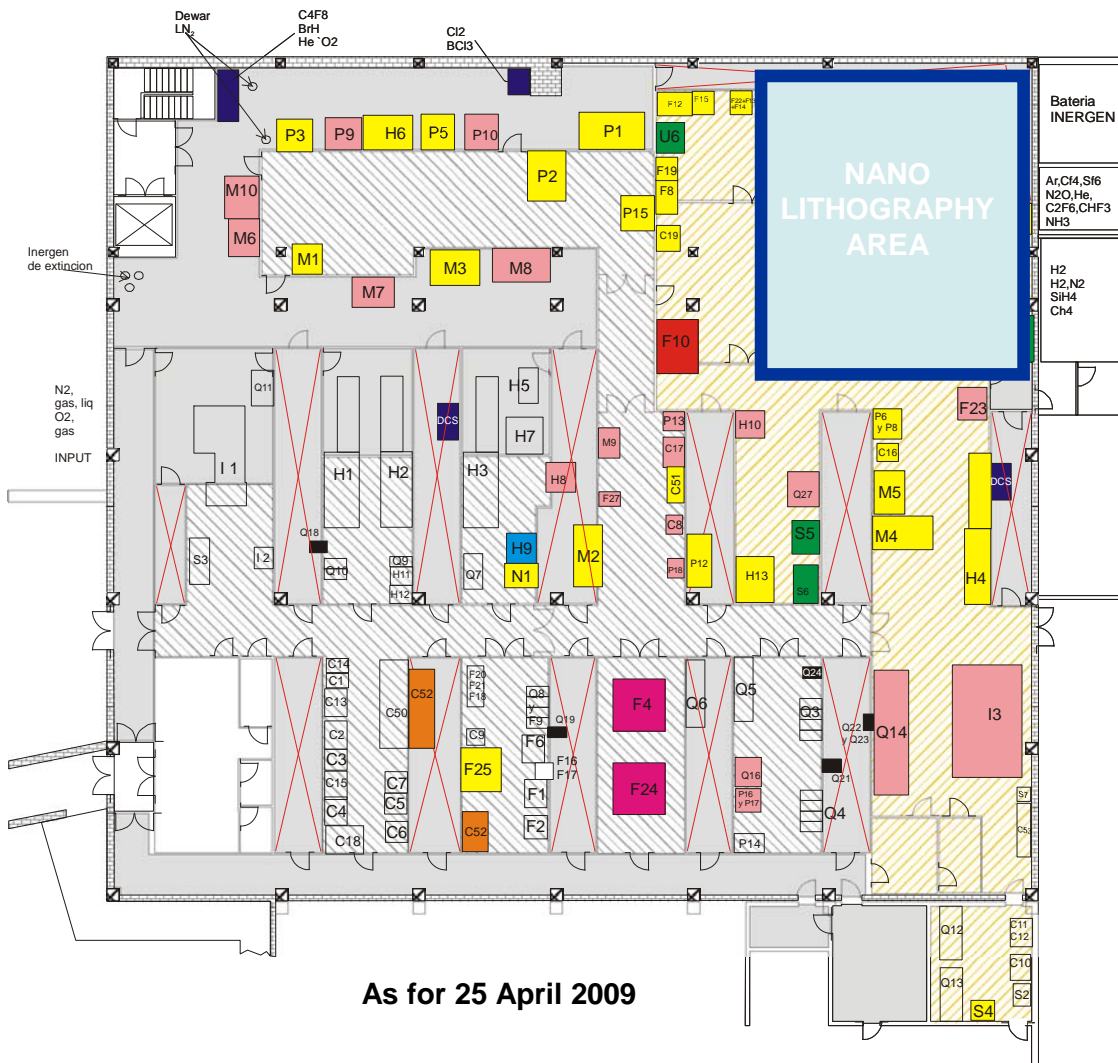
¹ For a brief presentation of the equipments see NANO-APUS.pdf (portal ICTS www.icts.cnm.es)

high-tech equipment. Accordingly it is expected the users to follow a good practice code according the rules and common sense.

When using any of the laboratory instruments, be aware of your knowledge/limitations. It is extremely important that you ask someone for help if you are unsure about the operation of this facility. You will not lose face. Instead, you will gain respect as one who realizes that a bit of blundering can cause a great deal of damage.

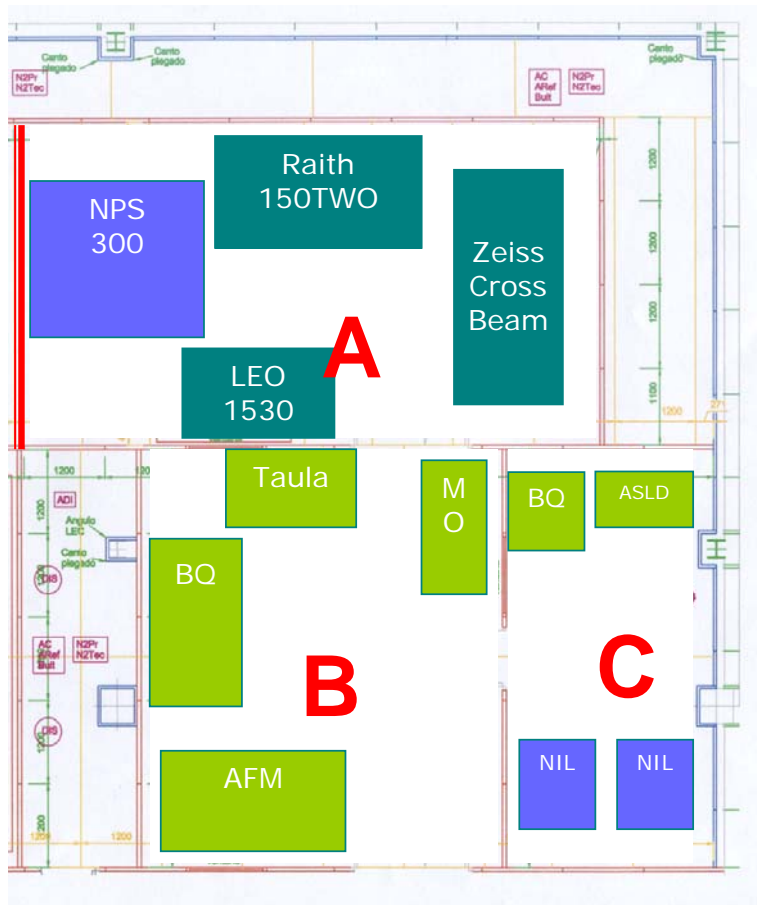
It is recognized that there will be many users with more projects and even more ideas for improvement. We appreciate any idea making the work safer and cleaner and more comfortable.

The procedures described here are intended to ensure the safety of the users, protect the very complex and expensive equipments in the laboratory and to create an environment in which many different research groups can co-exist peacefully. It is expected that the laboratory users will police themselves by encouraging and assisting one another in adhering to these policies. Flagrant or repeat offenders will be penalized, typically through suspension or expulsion from the laboratory.



3. Laboratory Description

The Area is divided in three laboratories. All laboratories are within a floating floor. Distribution of the equipments¹ in the different laboratories can be seen in the figure below.



The Laboratory A is on an anti-vibrations platform, in such a way that the more delicate equipments don't suffer from floor and walking vibrations.

The Laboratory C is in permanent yellow light to ensure the compatibility with UV-sensitive resists. The other laboratories work in white light, but both have a switch to change temporarily to yellow light, which is used for loading/unloading samples with photosensitive resists. If a user need to do so, please ask the staff of the laboratory to give you the proper instructions and/or assist you.

4. Users Policy

The access to the processes/equipments of the laboratory is divided into TWO main categories:

- SERVICE MODE: the equipments are operated by the laboratory staff, and the user can assist (if desired or necessary) the processes.
- SELF-SERVICE MODE: the equipments are operated by the users.

Service Mode (“Encomienda”)

The job must be ordered through BACO, as an step of a normal RUN, and by filling the form 3-170409-GO4-1² and send it to the laboratory staff. When the RUN/job arrives to the Nano-APUS to be performed, the lab-staff will contact the user in order to ensure/clarify the process and, if needed, the assistance of the user. If the user don't belong to CNM, then, before asking for any job is necessary the approval of the project to be done at the clean-room by the Clean-Room Director³

Self-Service Mode

This is when the user operates the equipment alone. For this, first, the equipment should be “open” to the self-service mode (it must be included in the so called LIDERAC – *Lista de equipos incluidos en el regimen de Autoservicio Cualificado*)⁴ and second, an application to the Clean-Room Director must be approved⁵, and after that a “hands-on-equipment” training is done by the laboratory staff. This is not a process training, but just a training on how to operate the equipment preserving: i) from damaging the equipment, ii) from damaging the general installations and iii) to preserve the integrity of the people in the laboratory (including the user)⁴.

There are different levels of users for the equipments of this process area operated in self-service mode.

SUPERUSER	Expert user with privileges for administrating the equipment. Basically restricted to the lab staff.
USER	User with a proven experience on using the equipment.
NEW USER	User with little experience. Basically this is for the new trained users.
LEARNING USER	User in selfservice training.
WAITING USER	User with the application for selfservice approved but waiting for the training.

² 3-170409-GO4-1 form can be found in Note GICORG 4 and download from intranet cnminfo.cnm.es/nanolab and / or IMB-CNM web and / or Portal ICTS

³ Refer to Note GICORG 4 for details

⁴ Refer to Note GICORG 3 for details

⁵ Application Form 6-150509-LUC-1 is in Note GICORG 3 and can be downloaded from intranet (cnminfo.cnm.es) and / or Portal ICTS and / or IMB-CNM web

The main difference between the “USER” and “NEW USER” is related to its proved ability in using the equipment. To upgrade from one level to the other is necessary a minimum of sessions on the system, according to the specific rules for every equipment, and on the staff criteria when observing the use of the equipment by the users.

When a “USER” is on absence or not using the equipment for certain time, varying from each equipment, the user will loose the level until the lab-staff certifies during the necessary sessions the ability to use the equipment again. A “NEW USER” who don’t use the equipment for certain time, will loose the level and will have to apply for selfservice again.

	LEO 1530 Dimension 3100 Obducat 4”	Crossbeam 1560XB Raith 150TWO
USER	1 session every 3 months	1 session every 2 months
NEW USER	1 session every month during 10 sessions.	1 session every month during 20 sessions

Minimum of sessions to keep in the category of user.

The sequence from applying for selfservice until becoming a “NEW USER” is as follows⁶:

- Approval from the DICTS (ICTS Director) of the application for self-service use for an specific equipment.
- The lab staff will contact the user to know about the experience of the user in the same/similar equipments and plan the training.
- The lab staff will give the user the necessary manuals to operate the equipment
- At this moment the user is a “WAITING USER”, time in which will read the manuals, and depending on the equipment availability and the workload of the laboratory/lab-staff, the waiting time can vary from one to another user⁷.
- An initial demo session on how-to-operate the equipment will be performed by the lab-staff, and the user become a “LEARNING USER”

⁶ Before applying is necessary that the user have access to the clean-room (Note GICORG 0 and Protocol_0)

⁷ A Training for self-service use will be considered as a service job, and treated accordingly (see next section).

- After the initial session the user will have to attend the necessary sessions (watching/hands-on) until the user “feels” prepared to work alone⁸.
- “Examination” by RAN (Responsible for the Nano-APUS) in order to certify that the user is able to operate the equipment alone following the booking system available for each equipment. The user become a “NEW USER”.
- To upgrade to “USER” a minimum of sessions will be necessary according the table.

As described in note GICORG 3, the training can be performed by another “USER”, when the RAN considere it convinient. The RAN will contact the “USER” who will do the training in this later case. The “LEARNING USER” can also assist sessions from the lab-staff to improve knowlegde/skills, and ask for specific training sessions with the lab-staff for hands-on to the equipment.

5. Laboratory Schedule Policy

The responsible to decide and distribute the access to the different equipments is the responsible of the Nano-APUS (RAN).

As most of the equipments are both for service and self-service is responsibility of the RAN to decide the time dedicated to each task for every equipment.

The general rule for giving access to the equipments is by “first come first”, and as the jobs are arriving to the Laboratory they will be performed, taking into account an estimation of the time to perform the job and to fit the job into the equipments schedules. A job performed in the Nano-APUS can be either i) a service job ii) a self-service job and iii) any session for training for self-service. As the number of equipments and running hours exceeds the capacity of the lab-staff, the self-service jobs will, in general, be performed before the service or training jobs.

Next page shows the detailed current table describing the accesability conditions and procedures for each equipment.

Some of the equipments are free to use after training, which means that no reservation is required. The rest operates under pre-booking of the equipment, by sending an e-mail to the responsible asking for certain slot time.

To avoid confusions or oversights, booking in advance is restricted to the next week. For special requirements out of this timing, ask the Nano-APUS responsible.

⁸ According to the Note GICORG 3

It is important to comply with the schedule. Many users want to access the instrument. Users who do not use their time slots will be penalized.

Equipment	Access	Comments
Optical Microscope	Free	
Fume-Hood & Spinner	Free	
Wet-Station	Lab-Staff only	It is on start-up process
Obducat 4"	Free	Ask lab-staff first.
Obducat 2"	Not Determined	Ask Lab-staff.
LEO 1530	Booking Webcalendar available	Mainly self-service. If necessary, priority will be for EBL and SEM Clean-Room related (characterization during a RUN, samples processed in the ICTS) upon others SEMs
AFM	Booking Webcalendar available	Mainly self-service. If necessary, priority for "special measurements" and lithography.
FIB 1560XB	Booking Webcalendar available	Both service and selfservice. Take special care on the time needed for the jobs, as they can vary a considerably.
Raith 150Two	Booking Webcalendar available	Both service and selfservice. Be aware of the time needed for large exposures (calculate approximate time in advance).
Glove Box	Free	Ask Lab staff first.
NPS300	Booking Webcalendar available	Ask lab- staff. In start-up process

6. Samples, sample holders and Tweezers

Equipments and Samples

According to section 3.2 of the Protocol_0 for accessing the clean-room, the ICTS Clean-Room runs a CMOS technology, which have practical consequences in order to guarantee its quality and continuity. Therefore it can be distinguished different types of equipments in the Clean-Room.

- a) **"Clean"** equipments: which can only process CMOS compatible samples.
- b) **MNC** equipments: which process any sample.

- c) **“Mixtos”** equipments; which depending on the accessories and/or protocols can process either Clean” samples and “Dirty” samples.

A confusion/mistake on holding the samples to the appropriate holder/equipment can suppose a major inconvenience in time to clean up holders/equipments, a big expenses in money (if cannot be cleaned and some part have to be replaced) or even a total disaster, in case that an equipment cannot be cleaned and has to change its condition for CMOS, which can be even **disable** the CMOS technology.

According to the above differentiation, the samples are defined as follows:

- a) **CMOS Samples:** samples of a CMOS RUN in process
- b) **“Clean” samples:** samples which cannot damage the CMOS technology **and** will be further processed in a CMOS-compatible equipment. This is basically samples without contaminating metals (Au, Pt, Pd, Ag,...) and/or Alkaline Ions (Na,K).
- c) **“Contaminated” samples:** all the rest

The equipments of the Nano-APUS area do not participate of the CMOS technology, but in some cases in-line characterization of CMOS or Clean samples, or even advanced design for devices processed in CMOS compatible equipments, one or several equipments of the nano-area can be used, therefore in the Nano-APUS the equipments and samples are also identified among the equipments and samples differentiation.

From all this description, the first rule regarding entering samples into the laboratory is to inform first the lab-staff about the kind of samples you want to process: materials in the sample, and the processes the sample got before. Remember, neither material nor any chemical should enter the clean-room without knowledge/approval of the RAN and/or Clean-Room Manager.

As the samples processed in the clean-room belong to the users, in the laboratory there is **no waste for samples**, so don't throw any sample of the normal waste, as the cleaning people could be injured when manipulating the waste.

Tweezers and Holders

According to the above explanations, we have divided the holders and tweezers following the classification shown in the table of next page .

It is not allowed the use of holders/tweezers different from the above specified. Special cases can be considered (special holders/ samples...), after the authorization from the Laboratory staff. In this cases all, the holders, the samples and the tweezers, will be considered contaminated.

It is important to fulfil the rules regarding samples, holders and tweezers, as the cross-contamination would depend on it, and improper use of them will be penalized accordingly.

Equipment	Type / USE	Tweezers/holders
Dimension 3100	Mixed	- Clean (samples & wafers) - Dirty (samples & wafers)
LEO 1530	Mixed	- Clean (samples & wafers) - Dirty (samples & wafers)
Raith 150TWO	Mixed	- Clean (samples & wafers) - Dirty (samples)
Crossbeam 1560XB	Contaminated.	- Dirty (samples & wafers)
Obducat 4inch	Contaminated	- Dirty (samples & wafers)
Obducat 2inch	Contaminated	- Dirty (samples & wafers)
NPS300	T.B.D.	
Fume-Hood + Spinner (Laurell)	Mixed	- Clean (samples & wafers) - Dirty (samples & wafers)
Wet-Station Laurell	Clean	- Clean (samples & wafers)
Glove Box	Mixed	- Clean (samples & wafers) - Dirty (samples & wafers)
Zeiss Axio Imager	Mixed	- Dirty (general holder) - Clean (adapted holder)

7. Chemicals

The Nano-APUS is a nanolithography laboratory, so it is necessary the use and handling of different chemicals to clean samples, and to spin-coat and develop the samples with resists/polymers for lithography within the equipments of the area.

The only chemicals accepted in the laboratory are the following:

- “DI water”
- Acetone
- Isopropanol
- Polymers for e-beam / NanoImprint (previously accepted)
- Anti-sticking coating in the Glove-Box (previously accepted)
- Developpers (previously accepted)

There **is not any other use accepted on the laboratory for chemicals.**

One of the spinners is for self-service use. **Before using any new product (polymer, developer...), it is necessary first the approval by the laboratory staff.** For this is necessary to present the MSDS of the product to be used. The laboratory staff will study

the convenience of using the product in the laboratory, and which precautions are necessary to take.

When using the chemicals there are few basic considerations to take into account.

- NEVER leave any recipient without labelling.
- When leaving something (recipients with samples for cleaning or developing) it is MANDATORY to label it, mainly for long processes where the user can be on absence for some time. Label it with NAME (user), DATE and PRODUCTS USED.
- **ACID-based** and **HALOGENATED** products are **STRICTLY FORBIDDEN**, as the laboratory does not fulfil the requirements for using such products.
- There is a recipient for the waste. It is **ONLY FOR SOLVENTS**. It is located beside the fume-hood.
- There are protective mask to be used when handling solvents/resists. It is highly recommended to use it.

8. Computer Handling

The computers in the laboratory are controlling highly sophisticated equipment, thus a major rule is to keep them as save as possible for optimum running conditions. From the practical point of view this applies in two rules: i) avoid viruses as much as we can and ii) avoid general software applications to avoid overloading the computer with non-necessary software. Most of computers are connected to internet and have an anti-virus software except the NIL 4" computer.

The practical procedures for file transferring and computer handling are:

- DO NOT modify anything on the equipment itself. NO EXCEPTIONS!
- DO NOT install any software on any computers. NO EXCEPTIONS!
- Use the "*fixers*" website (cnm intranet) for taking out the images saved on the computer. **Pen drives are strictly forbidden**. There is only one exception: The computer close to the Wet-Station, allowed for e-mail and web-calendars access. Also it can be used with a pen-drive to take out the images from "*fixers*" website (cnm intranet) if the user is from outside CNM.
- It is strictly forbidden to use the equipment computers to check e-mails or navigate through internet. The connection is only for transferring files purpose.
- Transfer your files after EACH session from the computers. Excess data storage on the computers is not permitted. They are NOT backup computers!. Every few months all files will be deleted without any warning.

- The users who don't respect the above rules will be penalized, with the risk to lose completely the access to the equipments if necessary.

Raith Lithography software

In our laboratory several equipments use Raith Software to create nanolithographic designs and control different equipments, summarized in the following table:

Equipment	Software	Off-line computers
LEO 1530	Elphy 4.0	Hardlock key needed
Crossbeam 1560XB	Elphy 4.0	Hardlock key needed
Raith 150TWO	Elphy 5.0	10 Web-license + off line hardlock keys

To prepare the designs several hardlock keys are available. Contact the Nano-APUS responsible for details.

It is important to remember that the hardlock keys are shared among different users, so ask for them when you are going to use it, not for store it "just in case".

As these keys are expensive, to get access to the key it will be necessary to sign a specific form⁹ to hire it, specifying the project for which the design is going to be used and, in case of losing the key, where it will be charged the acquisition of a new key. This form will be signed by the project responsible. After that, the user would be able to ask for a key when needed, not for store it as mentioned previously. After its use it will be returned again to the Nano-APUS responsible until it is necessary again. The way to get the key will be by e-mail petition and confirmation.

It is important to note that this software is a GDSII design software, so many other editors could be used. The main difference are some specific issues (circles, marks edition,...) which are specifically designed for e-beam in the Raith software.

9. Visitors

Permission is necessary. A NanoLab authorized user must escort them. Refer to the GICORC 0 and Protocolo-0 Acceso a SB notes for details (found at www.icts.cnm.es)

10. Loosing access to selfservice: penalties

Improper use of the any equipment or the laboratory, abuse of booking without using the time, long absences entering the laboratory, and any other "bad/impolite" behaviour will be penalized. The penalties will go from forbidding access for one week up to

⁹ The Form 08-150509-NL-2, "Raith_key_acces", is located at the CNM intranet (www.icts.cnm.es) and/or ICTS portal and /or IMB-CNM web. Pprovisionaly to be demanded to the RAN

loosing access to the equipments as a selfservice. This last item will means a new self-service qualification authorization.

11. Charging

Currently there are not fixed rates. They are under definition. Before start to applying the decided rates, the users will be informed.

12.Nano-APUS Staff

Here you find the phones and offices of the laboratory staff. Don't hesitate to contact them for any doubt, trouble, problem, or assistance you need to use the laboratory equipments.

		Phone (93 5947700)	E-mail	Office
Xavier Borrisé	Nano-APUS Responsible	Ext. 1104	Xavier.borrise@imb-cnm.csic.es	E0-13
Jordi Llobet	Process Engineer	Ext. 1119	Jordi.llobet@imb-cnm.csic.es	E0-14
Libertad Solé	Process Engineer	Ext. 1119	Libertad.sole@imb-cnm.csic.es	E0-14
	Nano-Area-Laboratory	Ext. 2309		
	Nano-Area-Laboratory	Ext. 1064		

13. Documents, templates and calendars

All documents cited in this document can be found at the portal ICTS and/or the IMB-CNM intranet and/or web site

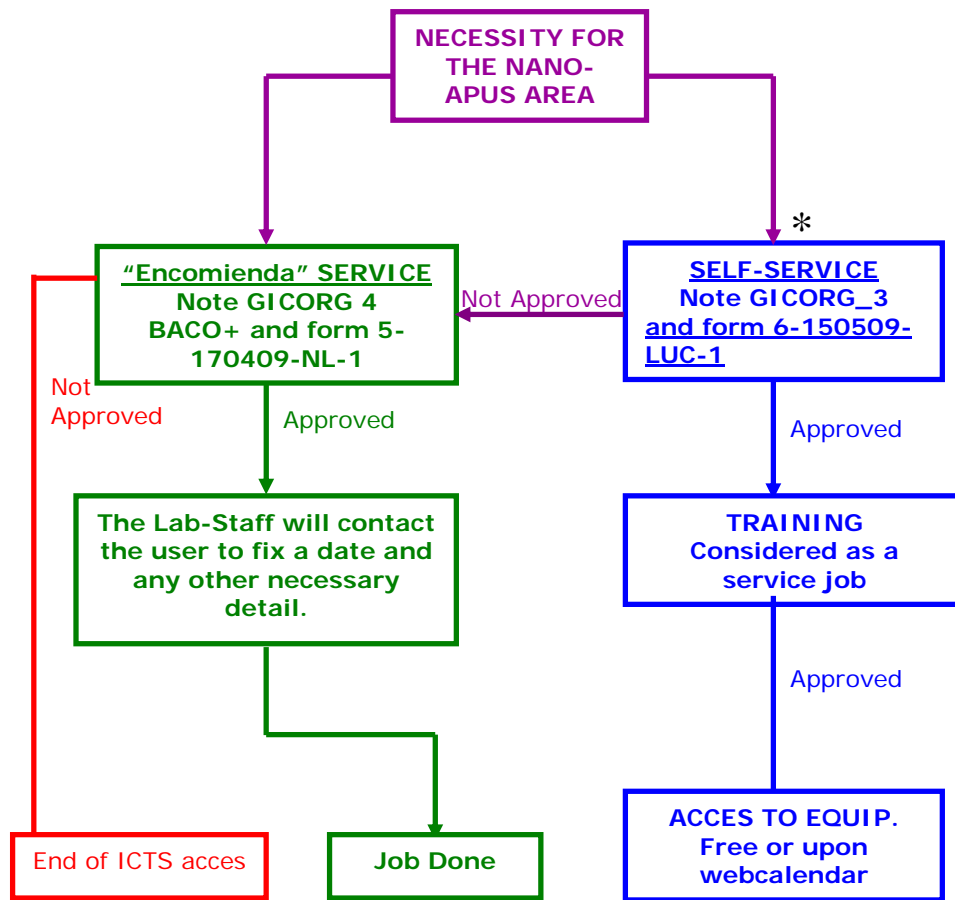
Document	Use
GICORG 0	Note describing how to get access to the Clean-Room of the ICTS
Protocol 0.1 Acceso SB	Manual of the Clean-Room (access, dressing, alarms...)
GICORG 3	Note describing how to get access to the equipments in self-service mode.
GICORG 4	Note describing how to apply for a job into the ICTS.
NANO-APUS.pdf	Summary of the equipments and capabilities of the Nano-APUS.
5-170409-NL-1	Form to apply for a job into the Nano-APUS (additional to BACO+)
6-150509-LUC-1	Form to apply for a self-service access for an specific equipment.
8-150509-NL-2	Form to get access to the hardlock key for Raith software equipment.
Procedures NanoAPUS (Note GICORG 10-1)	Specific manual related to the Nano_APUS protocols and procedures, i.e. this manual

WEBSITE	CALENDAR
http://www.google.com/calendar/embed?src=nanolabcnm%40gmail.com	Dimension 3100
http://www.google.com/calendar/embed?src=oda1uol5iu98l35otpjvn6jc6g%40group.calendar.google.com	LEO 1530
http://www.google.com/calendar/embed?src=58sevh7ki9d5g9ju5ltp3t0o%40group.calendar.google.com	Crosbeam 1560XB
http://www.google.com/calendar/embed?src=q1rtl7r0jrrpr8449k79vg6j5k%40group.calendar.google.com	RAITH 150TWO
http://www.google.com/calendar/embed?src=9jeheve66mrhj2sgqqol8l0bh4%40group.calendar.google.com&ctz=Europe/Andorra	NPS300

Con formato: Fuente: Negrita, Fuente de escritura compleja: Negrita

Together with all the above documents there are also manuals, specific procedures and descriptions for several of the equipments of the Nano-APUS. It's access will be given upon users necessities.

14. Summarized protocol



* Previously it is needed the access to the Clean-Room and have signed the *Protocolo 0.1* form (1-190309-PR-1) (see note GICORG_0, and *Protocolo 0.1* documents for details)