Virgo change request

Title:

Laser Lab Electronics Relocation

Responsible:	Name:	Flavio Nocera
	Email	flavio.nocera@ego-gw.it
	Institution:	EGO

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Authors

Name	Institution	email
Flavio Nocera	EGO	nocera@ego-gw.it

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Abstract

Experience has shown that the temperature changes in the room commonly referred to as Laser Lab [LL] have a strong impact on our ability to lock reliably the injection system, and therefore the interferometer. To lower Virgo susceptibility to these variations we plan to move out of the LL as many power dissipating devices as possible, thus decreasing the thermal load to be dealt with.

Moving the electronics out of the room will not only ease this restriction but will also allow to get rid of the acoustic (VME crates fans) and seismic (vibration) coupling between the optical benches and the racks.

A suitable location for the electronics has been selected, the necessary infrastructure works have been planned, a strategy for a complete re-cabling of all pieces of equipment to be moved has been identified.

In addition, a new location for the laser chiller has been chosen.

Motivations

In the past year, every time it has been necessary to work in the LL, especially on the two optical benches (Laser Bench, External Injection Bench), we had to wait for several hours afterwards to gain back a stable temperature and, as a consequence, locking condition. Limiting as much as possible the temperature variations in the LL will allow to minimize this side effect. The relocation of (most of) the electronics currently in the room, commercial and custom, will help.

The electronics affected by this operation is both analog (in some cases RF) and digital. The two kinds live close to each other and no specific attention has been dedicated to the EMC/RFI aspects so far. The plan presented here does not aim to address this potential pitfall, but some reasonable engineering criteria, wherever applicable, and as far as convenient from the costs (economic and not only) point of view will be applied.

As new room dedicated to host the electronics, we choose to use the one on other side of north wall behind the racks' present position, known as DEPOSITO, where the laser chiller currently is, as visible in Fig 1. The chiller is right below the Mode Cleaner tube.

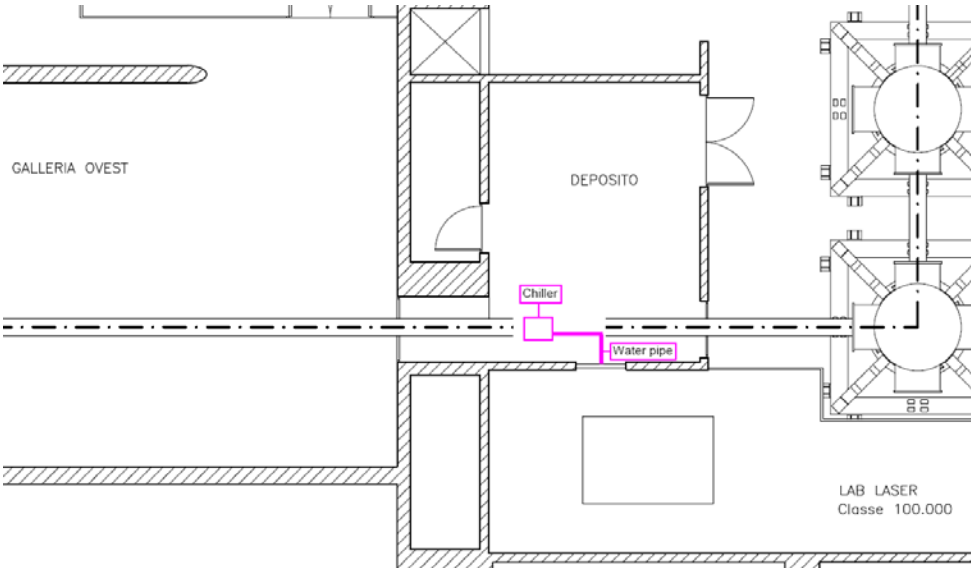

Fig. 1: Laser Lab and Deposito Room as they are today. The Laser Chiller is below the Mode Cleaner tube

Many different reasons pointed towards this solution, such as the following

- shortest possible addition to cable and water pipe lengths, that in some cases (fibers to the Slave Laser, for example) constitute a real constraint.
- possibility to use a separate room with real walls with a moderate amount of infrastructure work
- minimization of the possible acoustic and electromagnetic interference with either the instrument or the performance of the most delicate pieces of analog electronics, depending on the alternative solution considered (along the Mode Cleaner pipes or in DAQ respectively).

An additional critical point regarding the new electronics, taken into consideration in the this proposal, is the evaluation of its power consumption and, therefore, the possible need of air conditioning in the new destination, which would have either increased considerably the total cost of the work for the room preparation or ruled out this solution altogether, leaving us with a limited number of viable alternatives to choose from (among the few available conditioned rooms) not too far from the LL.

Our survey revealed that the total power absorption of the devices inside the LL today is slightly below 3kW. This is (just) twice as much as the (maximum) power needed to run the Laser Chiller to full power (1.5 kW), therefore given the total volume (over 100 m^3) of the room selected and its lack of thermal isolation due to the presence of the "storage room" nearby, there is no need for any forced cooling. If in the future the amount of heat we have to deal with will increase due to the addition of extra pieces of electronic equipment, even in the unlikely event we reach the point where we need to have some ventilation in the new room, it is possible to have some forced air circulation at almost no cost using the central building main air conditioning pipes running in the storage room mentioned above.

Technical description

A comprehensive list of all electronic devices currently in the LL, complete with their potential future location, is available in Annex 1. It is possible to find there also the legend used in the remainder of this document.

For technical reasons, not all electronic crates will be moved out of the room.

A request in this direction came from the groups responsible for the concerned subsystems, namely LAPP for rack LAS2 and Artemis/Nice for various crates in rack LAS3and LAS1 and some additional boxes. We also decided not to move farther away from the Laser Bench the Power Supply for the Master Laser due to the length of the cable going to the laser head (~ 2m) that cannot be made longer at a reasonable price.

Every piece of equipment we decided to move is going to be relocated, as specified earlier on, in the room indicated as DEPOSITO in Fig 2 and that from now on will be named EE Room (Electronic Equipment Room) (1).
This room hosts the chiller used to cool down Virgo Laser. This noisy machine will, in turn, be relocated elsewhere. The place selected is the one indicated as Chiller Room in Fig 2 (2).

To increase the level of acoustic isolation of the mode cleaner pipe, a wall will be built on its north side inside the EE Room (3).

The signal cabling going from the LL to the EE Room will go through two walls (the existing one and the one just described) in cable trays located about 2.3-2.5 meters above the LL access floor, in a solution similar to the one adopted in the DAQ Room. They will therefore go across the Mode Cleaner tube area staying above the tube itself (4).
Inside the EE Room, the cables will reach directly their “destination” crate. In the LL instead a different solution will be adopted, having a double goal in mind: easy maintainability and cost reduction.

All the existing cables will be as a matter of fact used as they are, i.e., they will not be removed; they will instead reach one or more patch panels located in a rack where the racks LAS1, LAS2 and LAS3 are now (see Annex 1). From the back side of these patch panels then they will be conveniently bundled and they will leave the LL inside the cable trays connecting the two rooms (5).

As for the Chiller, the water pipe going to the various loads on the optical benches in the Laser Lab will exit the New Chiller Room using one of the three already available openings in the south wall of the room and then, after going below the Mode Cleaner tube, running along the LL north wall they will reach the entrance point we are using today (6).

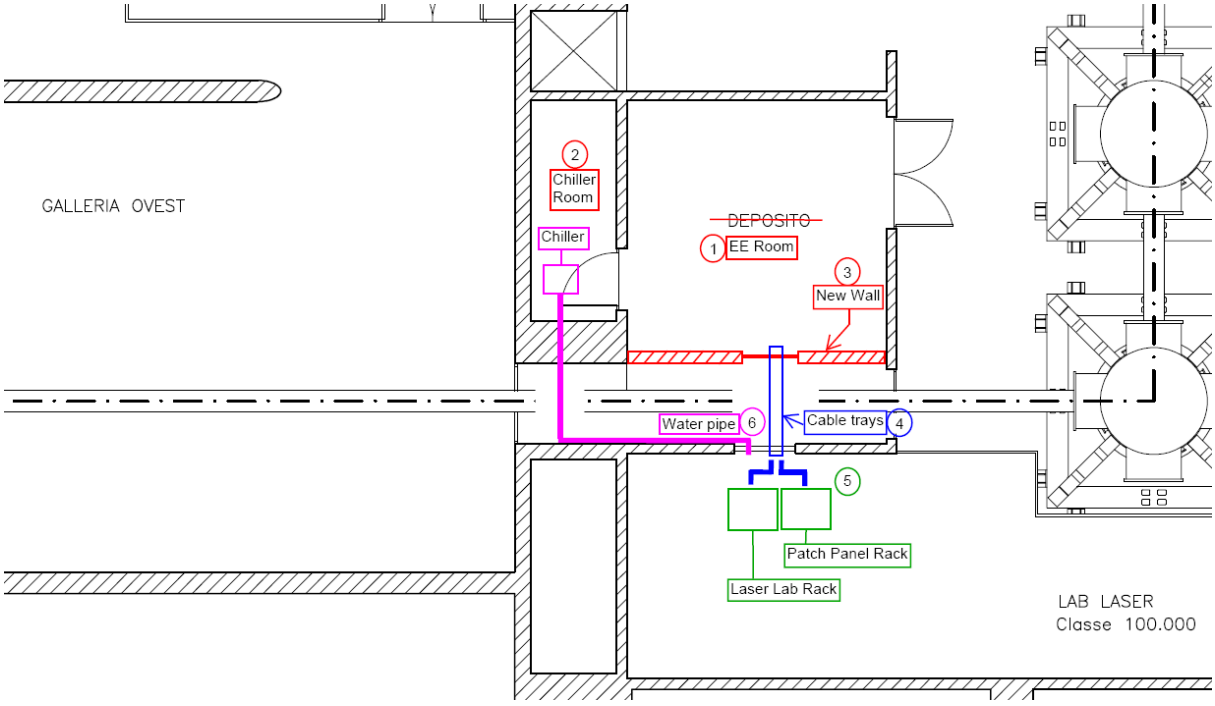

Fig. 2: Laser Lab, EE Room and Chiller Room

Task 1 EE Room preparation

The preliminary activity that should be completed before anything else is the preparation of the room where the electronics will be put in. This requires the two steps detailed below. The timing for this works will be agreed with the Commissioning Coordinator. According to the task's responsible, P.Popolizio, it requires 5 weeks of work (detailed later on in the planning)

Task 1a Infrastructure work

A new wall will be build as explained above. The solution agreed upon is to build a multi-layer wall which should guarantee the necessary acoustic isolation. This wall will go all the way up to the ceiling. In addition, the entrance door to the EE Room will be replaced with an acoustic isolating one. Due to its large size, the degree od isolation will not be better than 32 dB. It is then planned to improve passively the ventilation of the room linking the EE Room to the West Gallery through an air duct terminated with two vents.

The tunnels through it, to allow the cable trays penetration, shall be sealed. This of course will be the last step of the infrastructure work. That means that it will be done after the cable trays installation.

It is worth noticing that due to the addition of the Laser Power Amplifier on the Laser Bench and of its collateral optics and electronics, the workload on the Chiller will increase and it will be necessary to tap off part of the water to cool down the new Amplifer Power Supply, that will be installed in the EE Room (see Fig. 3). Experts showed that the Chiller currently used is sufficient to handle all the required cooling power. The pipes going in the EE Room to this Power Supply will in turn go through the wall to be build (again, see Fig.3) just above the height of the concrete floor (no digging required).

Task 1b Electrical Design

Two separate power lines are available in the LL at this time. One of them will be diverted to the EE Room, where a new UPS electrical panel shall be available. Each Rack shall have its own main switch in this panel. Each rack shall have a safety ground connection. To minimize costs (avoiding excavation), the power supply cables will reach the racks from above, as will do the signal cables, at slightly different heights so that they won't interfere with each other.

Some additional work is required to guarantee the Grounding of all racks, i.e., the connection to the buried grid that constitutes the reference potential (earth).

The power line feeding the laser chiller will remain, as it is now, a dedicated one, meaning it will not be shared with other pieces of electronics.

Task 2 Complete Re-cabling

This is the most crucial part of the work, because of its impact on the interferometer activities while underway (no laser) and its potential side effects.
Part of it can be completed in advance in a completely asynchronous way to the rest of the plan, while the remainder requires a complete stop of the detector/instrument.

Task 2a Patch panel and cable preparation

A series of rack-mount patch panels will be machined/designed. The different kind (connector type etc.) and total number is still under evaluation, but the philosophy adopted will be the one mentioned above: the existing cables will be kept as they are, brought to the patch panel(s) and terminated on their mating bulkhead connectors.

Task 2b Laser Lab and EE Room work

When all the preparatory work will be completed, the most invasive part of the job can start. It will consist in disconnecting all to-be-moved electronic devices, move them and their racks (that will be re-arranged) in EE Room, install and cable the patch panels on the LL side, lay the cables in their cable trays and pull them on the EE Room side, reconnect them to the proper pieces of equipment.

During this phase also the necessary network work will be completed; this translates in the installation in a rack (tbd) inside the EE Room of a Switch 3870 which will be connected to the already available Switch 5500 in the DAQ Room through the already existing cabling. This will not add any further cost for the Project completion since a spare switch 3870 is already available.

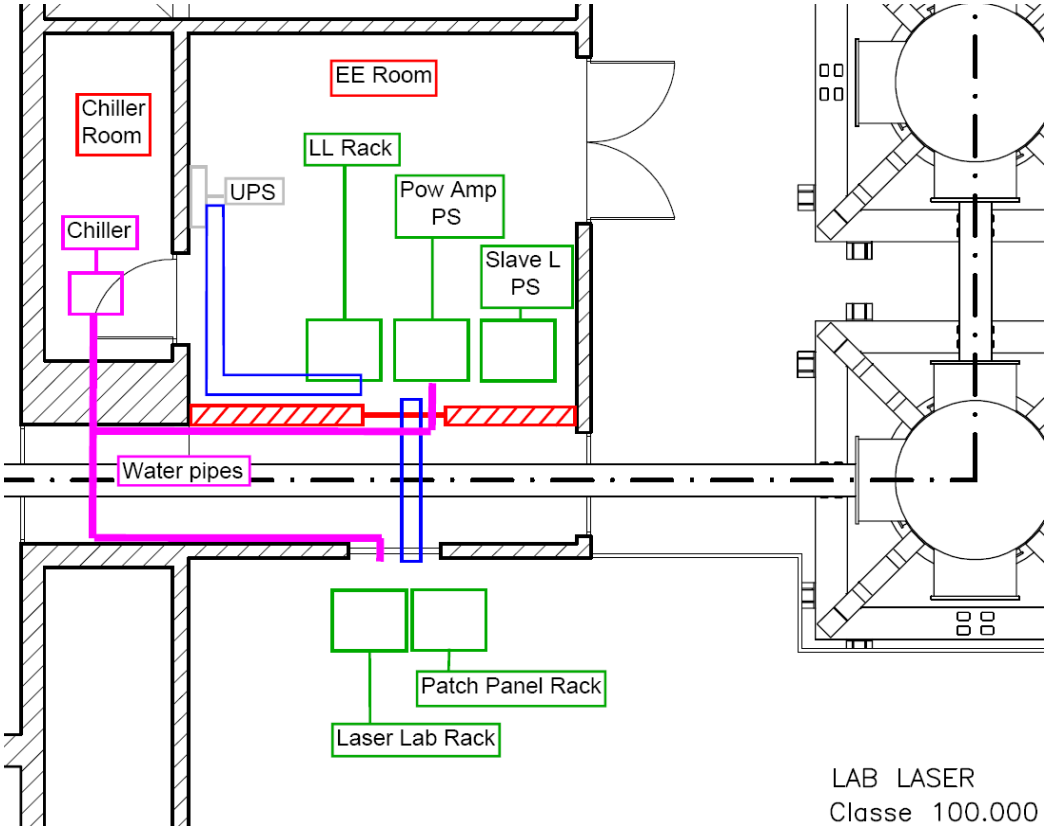

Fig. 3: Laser Lab, EE Room and Chiller Room when work completed

Involved Virgo sub-systems

Please, describe in the next table the subsystems that are involved in this change. Make the effort to put the sub-system in order of decreasing involvement (1 is the sub-system you want to modify) describing the type of consequence on each subsystem.

#	Subsystem Name	Description of the involvement
1	Injection System Electronics	no functional modification to the installed system

Involved EGO infrastructures

Please, describe the infrastructures of EGO you need (Clean rooms, workshop, Electronic support,…)

#	Infrastructure	Description of the involvement
	EGO ITF Dept. – Electronics Group	Electronics relocation and signal cabling
	EGO Infrastructure Dept.	Civil and Electrical work
	EGO Computing Dept.	Network connection

Planning

Describe the planning of the change. Define relative time needed and specify the milestones

Implementation Plan																
	June 2008				July 2008				August 2008				September 2008			
Tasks and Deliverables	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Tasks																
EE Room Preparation																
Infrastructure work																
Electrical work																
Complete re-cabling																
Patch Panel preparation																
Signal cabling																

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Budget

Short description

The amount of money needed to complete all the necessary modifications is mainly due to the addition of the new wall.

Detailed description of the requested items

#	Item	Contractor / supplier	Cost (€) (taxes included)	Charged to (EGO/Virgo lab)
	Civil work		6,610	
	Electrical work		2,000	
	Cabling and collateral		2,000	
	Optical Fibers		3,000	

Total cost (€): 13,610

Request to EGO (€): 13,610

Document/Procedure history

Date	Event	Comment
25/01/2008	Start of the procedure	
dd/mm/yyyy	Presentation to the detector meeting	
dd/mm/yyyy	New release of the document	
dd/mm/yyyy	Submission to the VSC	

Annexes

#	Description	Hyperlink
1	Present Laser Lab Electronics List	

Automatic information fields

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Description	**Value**
Last saved by:	
Last saved time:	01/01/1601 2.00
Automatic versioning	1
Automatic title	Virgo change request
Filename	Documento7

Annex 1 Laser Lab Electronics

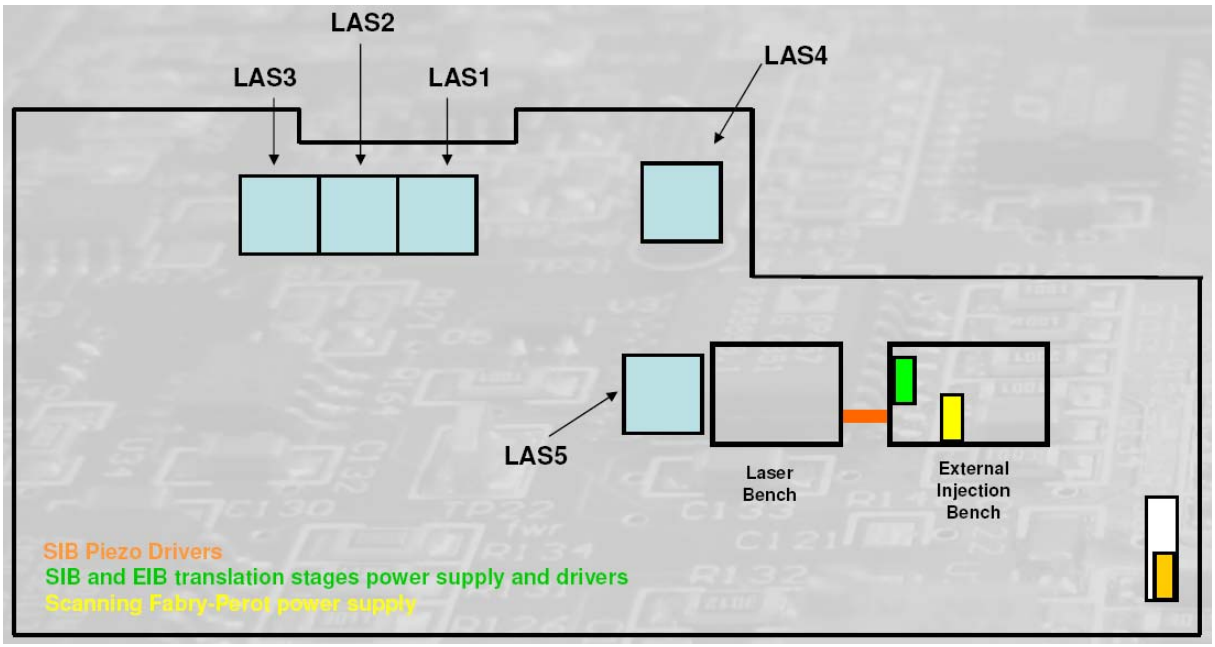

Fig. 2: Laser Lab layout: present electronic devices position

		Future location
LAS1 -- Slave Laser Power Supply Rack		
Crate LAS 1/C1	PID diode and Crystal temperatures	**Laser Lab**
Crate LAS 1/C2	PS1 --Diode1 High Current Supply	EE Room
Crate LAS 1/C3	PS2 --Diode1 High Current Supply	EE Room
Crate LAS 1/C4	Peltier Power Supply	EE Room
Crate LAS 1/C5	Diode1 Power Supply	EE Room
Crate LAS 1/C6	Diode2 Power Supply	EE Room
Crate LAS 1/C7	Power Stabilization crate	EE Room
LAS2 – LAPP's		
Crate LAS2/C1	Power Supply	EE Room
Crate C30	DAQ channels	EE Room
Crate C28	Photodiode Readout	EE Room
Crate LAS2/C4	Power Supply	**Laser Lab**
Crate LAS2/C5	Demod Boards...	**Laser Lab**
AA box		**Laser Lab**
LAS3 -- ISYS Servo Rack		
Crate LAS3/C1	RF Synthesizer	EE Room
Crate LAS3/C2	RF Distribution Crate	EE Room
Crate LAS3/C3	Mode Cleaner Rampeauto (Rampeauto Maitre)	**Laser Lab**
Crate LAS3/C4	qztsynth (w/ 22 MHz xtal) + ...	**Laser Lab**
Crate LAS3/C5	Injection Rampeauto (Injection locking)	**Laser Lab**
PI BMS Piezo Amplifiers		EE Room
Crate LAS3/C6	14 MHz xtal - dephaser crate	**Laser Lab**
Crate LAS3/C7	Power Supply1	**Laser Lab**
Crate LAS3/C8	Power Supply2	**Laser Lab**
LAS4 -- Patch Panel Rack		
Patch Panels to/from Laser Lab (DAQ, Det Lab)		EE Room
SIB PSDs Front-End electronics		EE Room
SIB and EIB picomotor power supplies and drivers		EE Room
J-P Coulon's Buffer		**Laser Lab**
Ampli IMCTra 6MHz		**Laser Lab (?)**
LAS5 – Short Rack		
Crate LAS5/C1	Master Laser Power Supply	**Laser Lab**
Crate LAS5/C2	RF Power Amplifier	EE Room
Crate LAS5/C3	Diode Box	EE Room
Other Devices		
Suspended Injection Bench Piezo Drivers		EE Room
SIB and EIB translation stages power supply and drivers		EE Room
Scanning Fabry-Perot power supply		EE Room