



AdV INJ status

Virgo week November 2015

Eric Genin on behalf of the INJ Team
European Gravitational Observatory

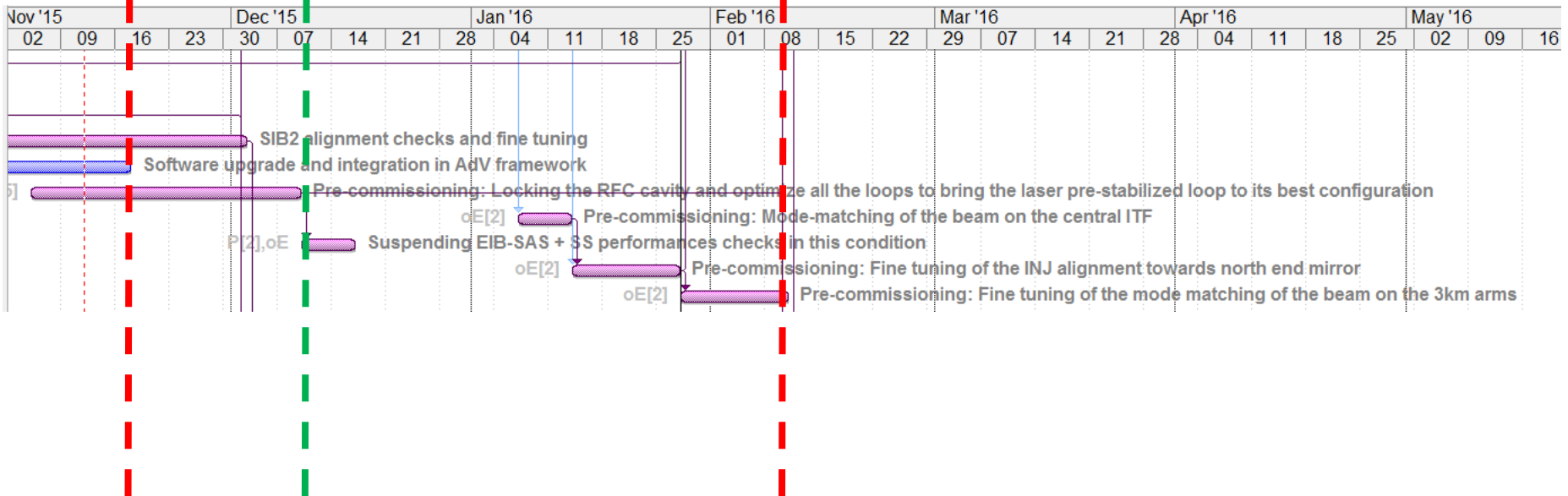


- ❑ Activities around INJ since Last Virgo week (July 2015)
 - ❑ Overview of the planning
 - ❑ Last months activities
 - ❑ What is missing to complete the SS integration/pre-commissioning?
 - ❑ the main issues found so far:
 - ❑ IMC instabilities, PSL/INJ locking electronics, IMC end mirror payload and IMC extra losses, extra modulation phase noise due to GPS.
- ❑ Conclusion and next steps

Today

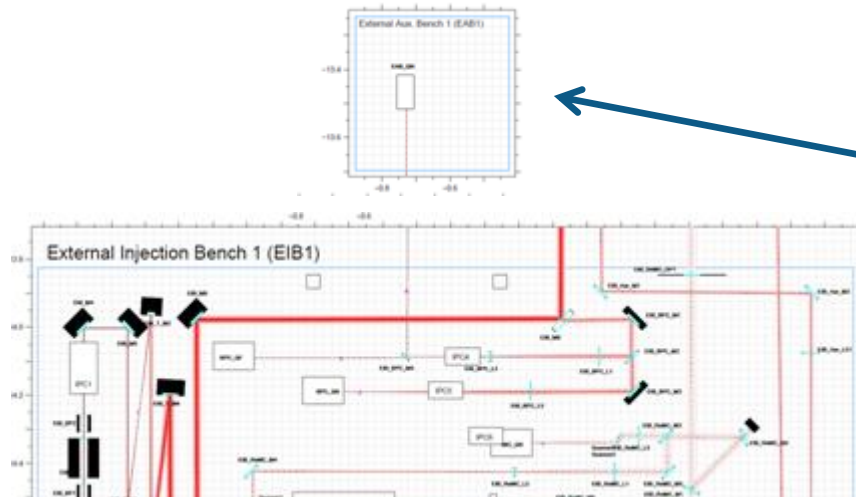
End of
INJ commissioning

Beam available for CITF

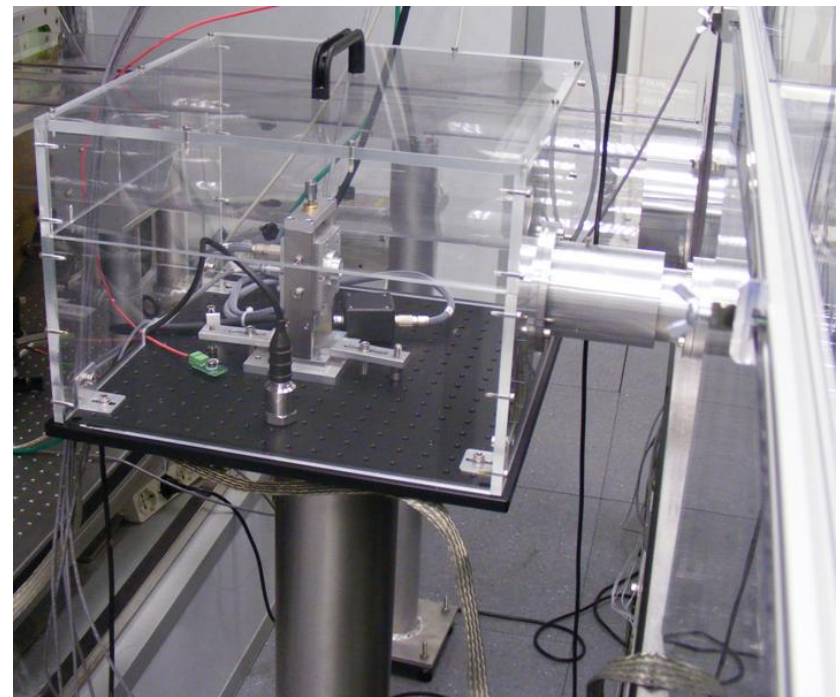


Installation of Input Beam Monitoring system quadrant

- Input Beam Jitter Monitoring quadrant installation (see logentry # [32494](#))



INJ layout snapshot with IBJM quadrant location



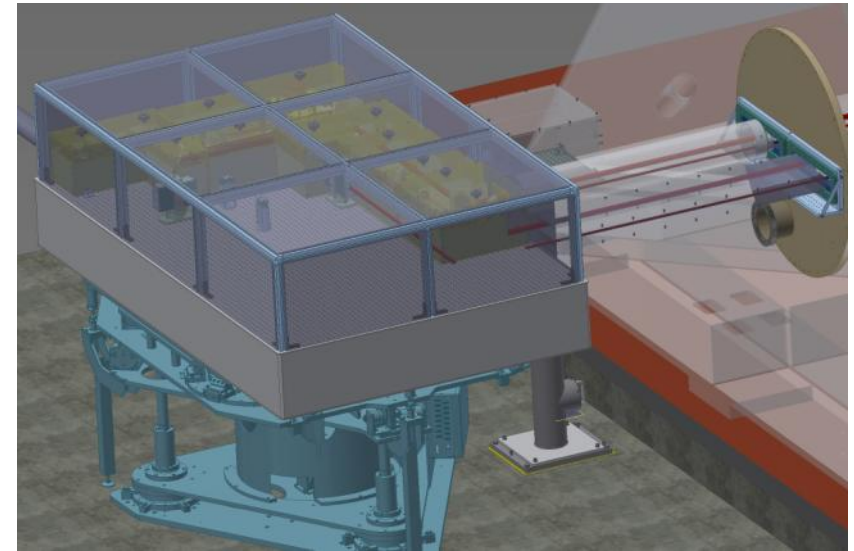
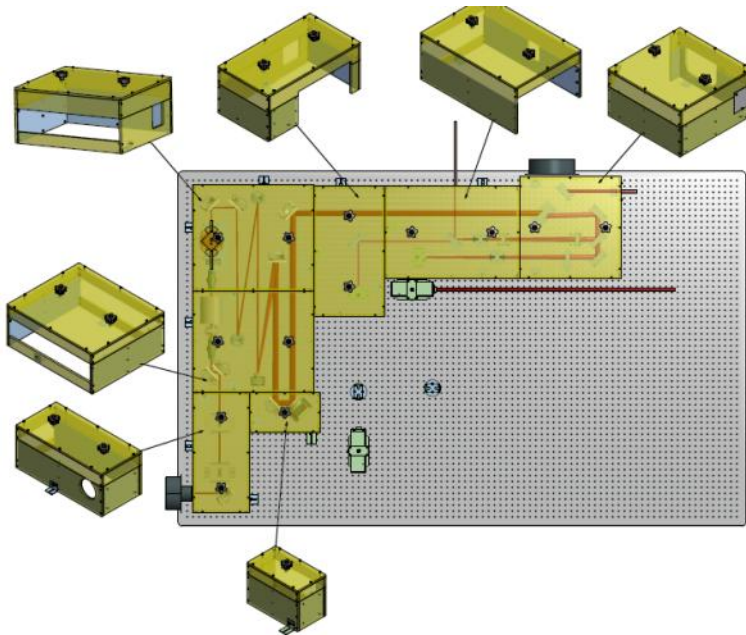
→ This quadrant is useful to have an out of loop measurement of input beam jitter and monitor possible drifts of the EIB.

Main contributors: B. Montanari, M. Mantovani, E. Genin

EIB weight optimization: redoing EIB external and internal enclosures

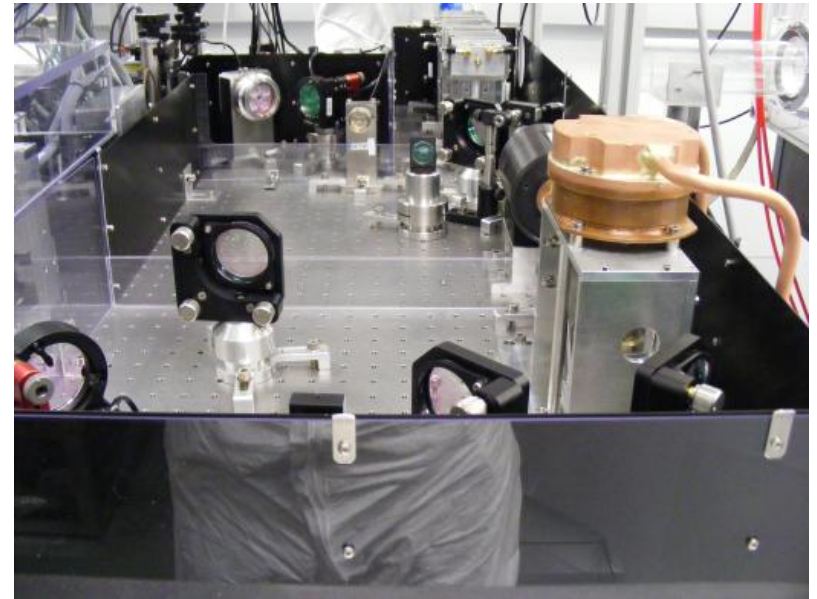
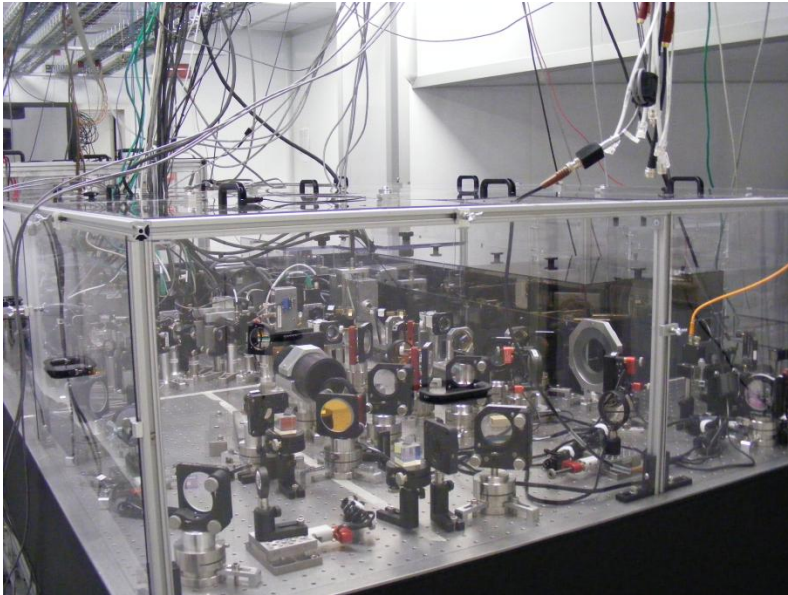
Slide from INJ status presentation at last Virgo week

- ❑ The design of the new enclosure (lighter one) has been completed.
- ❑ The inner boxes are produced at Nikhef
- ❑ The external enclosure is produced to EGO
→ everything should be ready for installation in a few weeks.



Main contributors: T. Zelenova, A Bertolini, E. Genin

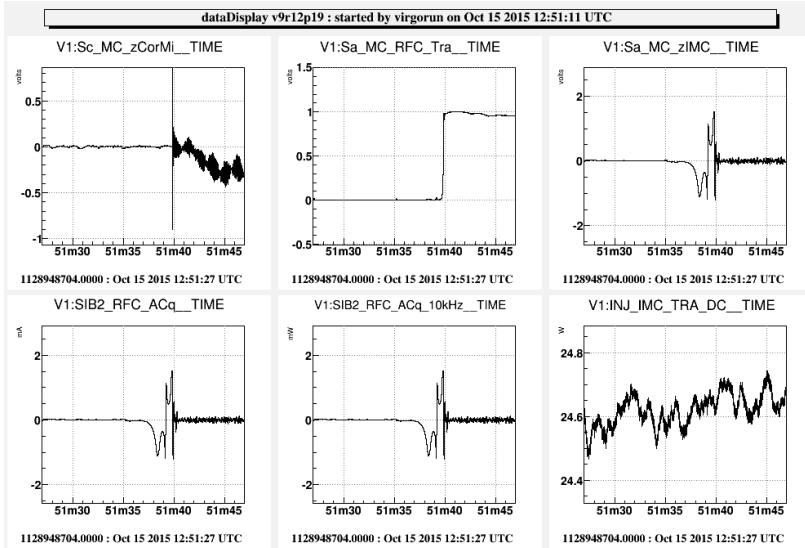
❑ The EIB new inner plexiglas enclosure has been installed at the beginning of September (see logentries #[32599](#) and #[32612](#))



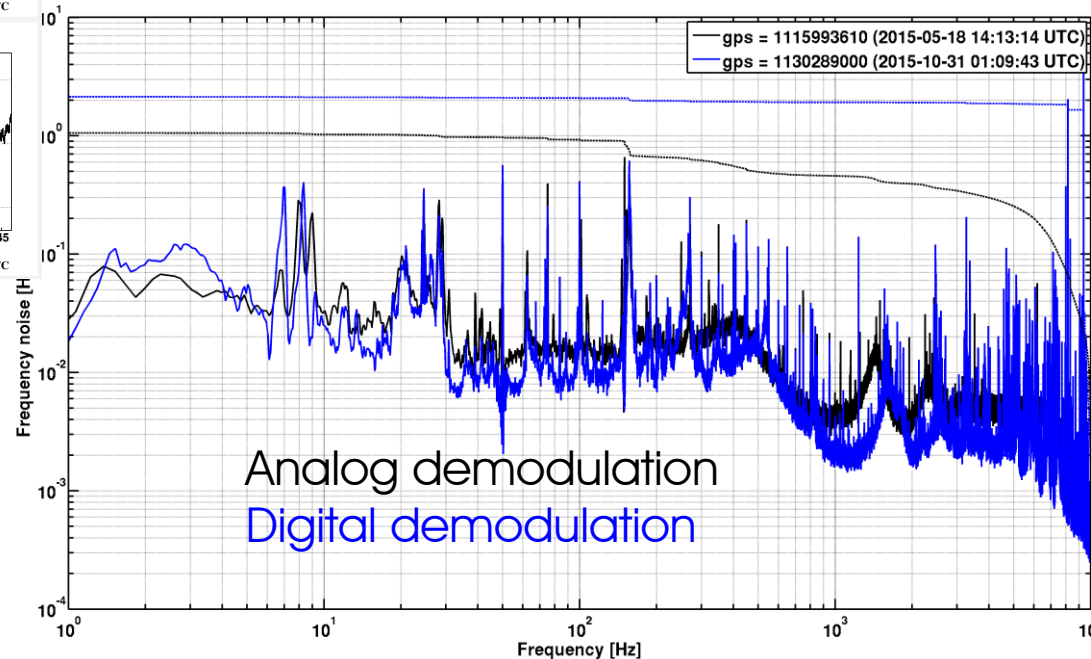
❑ The EIB new external enclosure installation carried out at the beginning of October (see logentries #[32694](#), #[32711](#))

→ The overall weight has been decreased a lot. The EIB-SAS team had to add more than 70 kg below the bench to balance it (see entry #[32824](#))
Final works on EIB-SAS foreseen this week (more time might be needed).

□ The RFC has been relocked on the 15th of October (logbook entry # 32728).

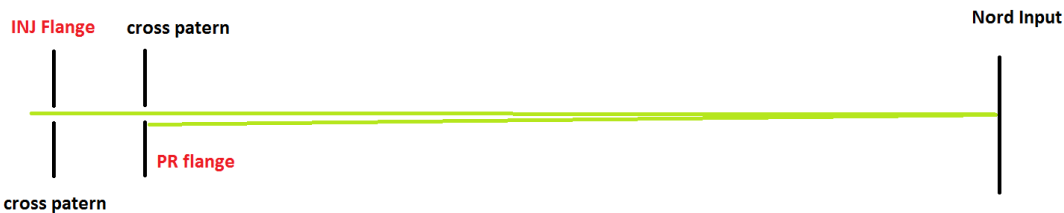
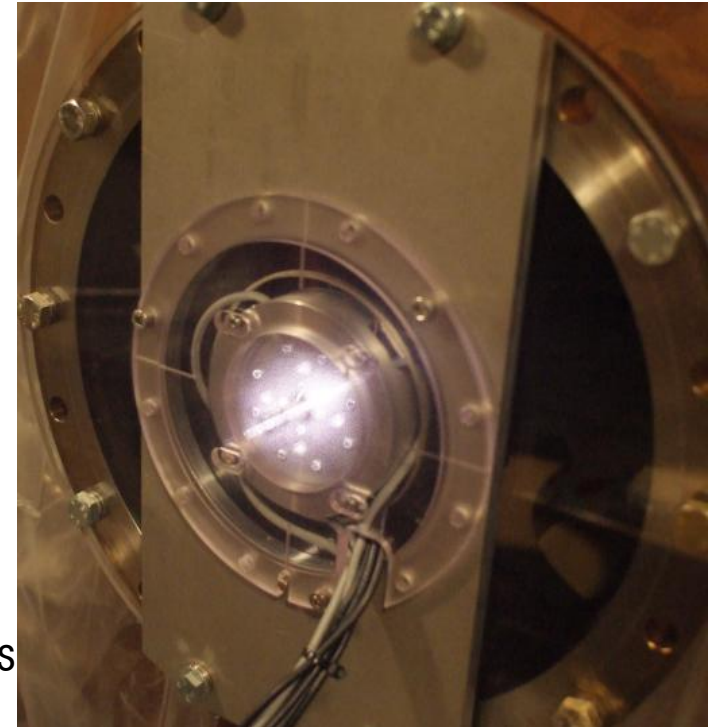


Noise budget not performed yet
But we have a first comparison
with old RFC error signal



MAIN CONTRIBUTORS: D. ANDRUS, E. GENIN, M. MATHIOU, D. SWINERS

- ❑ INJ output beam alignment check and adjustment with “big quadrant” (see logentry #[32648](#)).
- ❑ Several adjustments have been carried out to get the beam going straight towards NI (see logentries #[32664](#) and #[32776](#)).



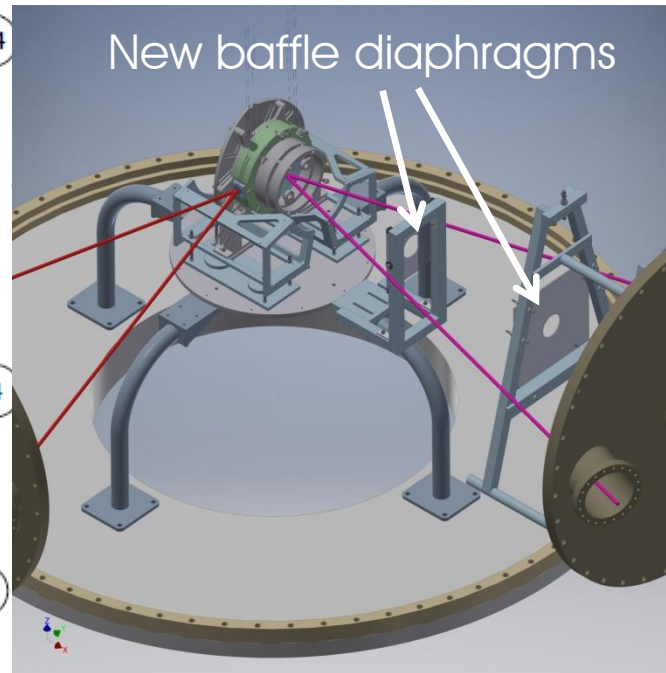
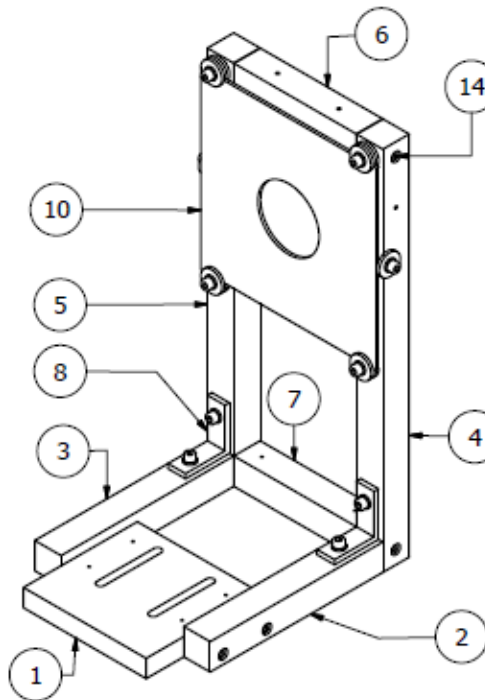
→ We could estimate that SIB1 was tilted by approximately 1 ± 0.5 mrad around the vertical axis
 → to recover the tilt without losing too much time

We have shifted the beam on the Meniscus lens using SIB1_M7 mirror and compensate the tilt by shifting transversally to the beam direction the meniscus lens (about 5 mm towards West) (see VIR-0475A-15 and entry #[32776](#) for more details).

→ This configuration is ok for the CITF but we will have to recover SIB1 tilt to guarantee a good beam coupling in the arm cavities (5 days required)

Main contributors: E. Genin, A. Magazzu, G. Pillant, P. Ruggi, F. Sorrentino

□ Some time ago, we have indentified some problems coming from MC tower scattered light (see entry #[32100](#)). We are not limited by this noise for the moment, but we prefer to stay on the safe side and we have prepared some baffles to be installed behind the IMC end mirror.



→ Baffles have already been cut out of the usual absorbing glass (SILO), following the design made by R. Day. Due clearance is granted to the existing viewports, while blocking most of the stray-light scattered off the end mirror. The baffles will be delivered on site during next days. → The holders are being produced.

What is missing to complete the SS integration/pre-commissioning?

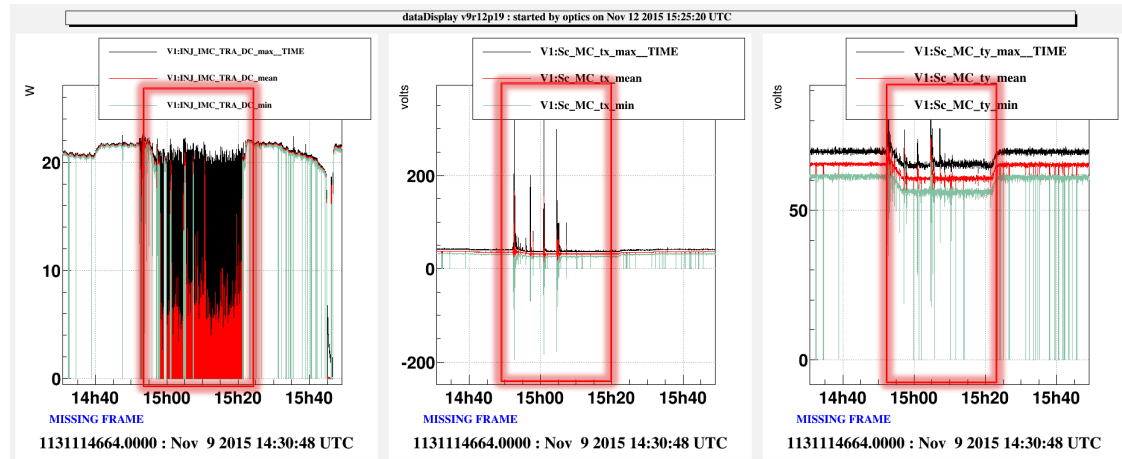
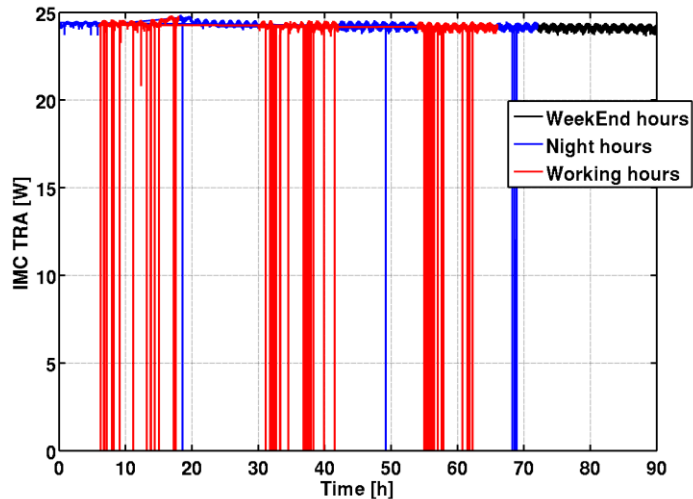
❑ Main tasks remaining to complete the installation and commissioning of INJ subsystem:

- ❑ EIB-SAS final commissioning: 16/11 to 18/11 by SBE and INJ teams (more time might be needed (see logentry #[32836](#))).
- ❑ RFC locking: complete the loop optimization work to achieve the frequency noise specs of the Pre-stabilized laser (noise budget). Work in collaboration with DET and DAQ subsystems.
- ❑ Suspending EIB-SAS and close all the loops to check the performance of INJ in this condition: 1 week
- ❑ Install the mini-links between IB tower and SIB2 minitower → profit of this to install also the IB tower cryo-link valve (might be necessary to make a useful tuning of the INJ telescope).
- ❑ ITF MMT pre-tuning (CITF): we might work in 2 shifts during that time to optimize the work (TBC). Probably not before January 2016 (last week, INJ meeting on this topic to discuss and prepare this activity).
- ❑ INJ beam alignment towards north end (1 week): as soon as north arm line of sight is available.
- ❑ ITF MMT final tuning: mode matching optimization on arm cavities (North and West arm required).

→ Beam ready for CITF commissioning as soon as IB cryolink is installed and under vacuum (VAC), PR mirror is available and we auto-collimated the beam coming from PR mirror on the EIB.

Lower priority: install the MC tower baffles.

- During the week-end and nights the stability is quite good.
- The system has been found quite unstable during the working hours .






Two people inside the MC building
 No heavy works

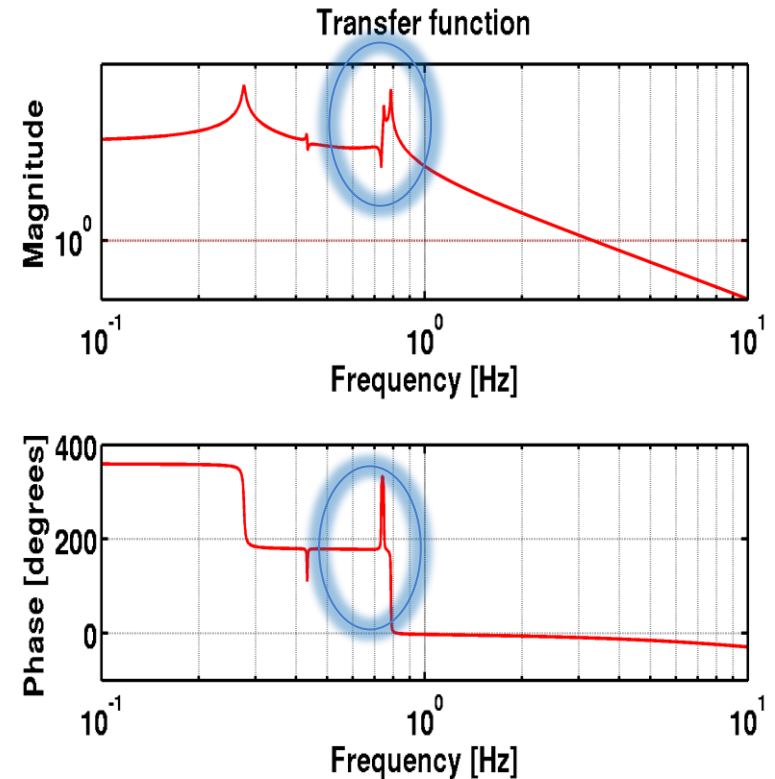
→ In general, the unlocks are “fast unlocks”. Might be also related to INJ/PSL electronics.

- ❑ The initial phase of Adv required reinstalling back the old Virgo+ Laser with its control electronics as well (Photodiodes, Rampeautos –PDH electronics–, PStab...). The Adv PSL is part of what was known as ISYS in Virgo.
- ❑ Limits and shortcomings of this solutions have been known for a long time, but there was no option. Since it looks likely this transitional solution is... semi-permanent (in the O2 scope), an operative decision to re-engineer the most critical pieces of electronics has been made and it is currently underway.
- ❑ A plan has been drafted to complete the operation in time for O2. Currently the analog servo electronics (Rampeautos) is under review. Other parts will follow.

NB: Work carried out by the EGO electronics group in collaboration with Artemis group (J-P Coulon).

□ We are preparing a document to motivate the substitution of the IMC end mirror and payload (even if workable not optimally working).

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|  <p>AdV, DfJ: IMC end mirror change Date 25/08/2015 VIR-XXXXA-YY Page 1 of 8</p>  <p>AdV INJ: AdV IMC end mirror payload change.</p> <p>R. Day, E. Genin, M. Mantovani, G. Pillant and P. Ruggi</p> <p>25/08/2015 V1.0</p> |  <p>AdV, DfJ: IMC end mirror change Date 25/08/2015 VIR-XXXXA-YY Page 2 of 8</p> <p>Contents</p> <ul style="list-style-type: none"> 1. IMC end mirror optical quality 2 1.1. High reflectivity surface contamination 2 1.2. IMC cavity mirrors high reflectivity coating absorption 3 1.3. IMC throughput with respect to IMC losses 3 2. Payload mechanical actuation issues 7 2.1. Payload mechanical issues 7 2.2. Actuation limitation 7 3. Conclusion 8 <p>I</p> <p>The aim of this document is to explain why we should design and substitute the current IMC end mirror and its payload.</p> <p>1. IMC end mirror optical quality</p> <p>1.1. High reflectivity surface contamination</p> <p>Right after the coating procedure at LMA the first contact film has been deposited to protect the mirror from the contamination unfortunately something has been written and an arrow has been drawn on the protective layer as reported in logentry #31341 and shown on figure 1. Cleaning of the mirror has been performed in-situ (see logentry #31342) with a not completely satisfactory result.</p> |
|---|--|



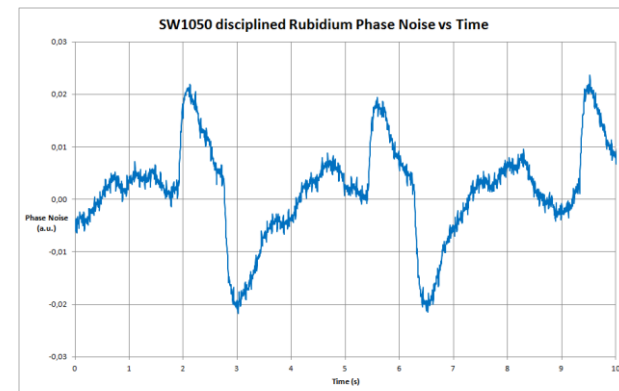
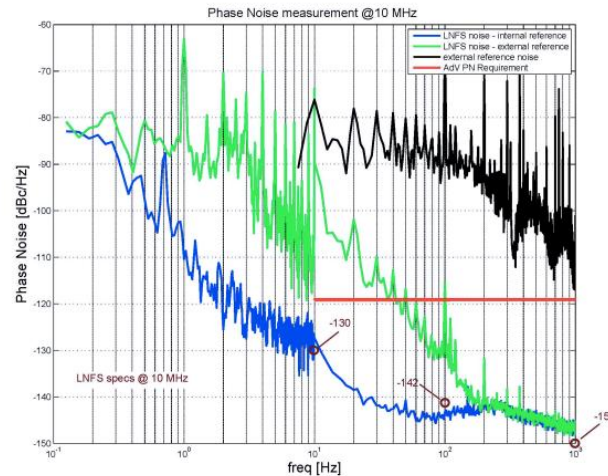
→ We expect to have the document ready in a couple of months.

MC tx: Critical zero/pole structure close to the UGF

Issues (ITF): RF Sidebands Phase Noise spoiled by external reference

- ❑ As per specifications given in the AdV TDR (see Table 4.3, pag. 105), we chose an RF source to modulate the beam having very low phase noise, the Spectradynamics' LNFS-100.
- ❑ This allows us to meet the specifications when running standalone. When instead we use as external reference the signal available either directly at the output of the "Virgo Clock" (Microsystems' SW1050-R, GPS synchronized generator with disciplined 10 MHz Rubidium oscillator) (see logbook entry #32552) or after its distribution after the Timing Box (see logbook entry #32536), this is no longer true.
- ❑ In addition to the specs, defined above 10 Hz, below this frequency large peaks in the spectrum (or large glitches in the time series) of the phase noise are clearly visible and audible, likely associated with the 1 PPS pulse.
- ❑ All these measurements need to be repeated to make sure this is not a serious issue.

→ this issue deserves more discussions with DAQ, DET and ISC (specs to be checked).



- The subsystem is fully compliant with the requirements in stand alone mode (Frequency pre-stabilization performance down to 1 Hz r.m.s)→ it has still to be confirmed with the new digital demodulation electronics.
- Complete SIB2 bench commissioning with DET, SBE and DAQ subsystems.
- Complete EIB-SAS commissioning (being done these days).
- Recover the horizontal beam pointing of SIB1 bench towards the ITF (around tz dof in VRS) (to be inserted in the commissioning activity).
→ we expect to have the subsystem ready for the interferometer commissioning very soon.
- Implement FmodErr (IMC length/modulation frequency) (first test presented in logentry #[32582](#)).

Longer term actions:

- Prepare a new webpage for the injection system (similar to the old one <https://www.virgo-gw.eu/ISYS/>).
- Add a few baffles in MC tower to reduce the scattered light problem coming from this tower.
- Complete the document to motivate the substitution of the IMC end mirror.
- Improve the reliability of INJ/PSL electronics (substitute old electronics,...)

All the benches are installed now

