Minutes of the Laser CS Workshop

At the occasion of the EMIS Conference in CERN
21 September 2018

In attendance:

25 participants registered to the workshop.

More information and links to the presentations can be found at the following page: https://indico.cern.ch/event/756013/overview

Introduction:

Thomas Cocolios introduced the main idea behind the workshop, the existing and planned facilities worldwide for in-source laser ionisation (production / spectroscopy) based on an original slide by Sebastian Rothe, and created an equivalent for the collinear laser spectroscopy work.

He then reported on the outcome of the questionnaire that was distributed before the summer. From this questionnaire, two main aspects for this workshop were proposed:

- Wavelength measurement & control
- Laser control system

Wavelength measurement & control:

Four presentations were made to report on recent studies performed in our community about laser wavelength measurement, stability, and active control:

- *Frequency-comb based wavemeter calibration*, presented by Wilfried Nörterhäuser, on slides from Kristian König (*kkoenig@ikp.tu-darmstadt.de*); in this study, systematic shifts and non-linear behaviours were identified for a WSU2 wavemeter, as well as for WSU10 and WSU30 units. Follow-up work will be performed with the WSU2 to identify whether the systematic departures can be reproduced after long times (months) under the same circumstances.
- *Laser frequency determination and stabilisation at IGISOL*, by Sarina Geldhof; outputs from an FPI and from a WSU10 were compared. Large systematic effects were identified and some aspects (e.g. temperature stabilisation of the FPI) were addressed. More details in the slides.
- *Problems and solutions for accurate laser control at Helios and RILIS*, by Kristof Dockx (including material from Matthias Verlinde *matthias.verlinde@kuleuven.be*); comparison between a WS-7 and an FPI at HELIOS revealed discernible patterns in the response of the wavemeter. Exchanges with HighFinesse have revealed that this might due to a software problem with the imaging of the interferogram, but no immediate fix is proposed. New piezo-controlled optical mounts have been tested as candidate for accurate and reproducible wavelength control at RILIS with promising results.
- *Wavelength measurements with WS7 and ATOS wavemeters*, by Maxim Seliverstov; in the course of experiment IS608, many measurements have been performed on the hyperfine structure of ^{209}Bi, using 3 different wavemeters (2 WS-7 and 1 ATOS). Maxim reported on the first analysis of those results, showing the confidence one may have on the absolute and relative measurements from those units.

Those presentations triggered many reactions and quite some exchange between the participants. In particular, the question about **how the wavemeters are intrinsically made** became a subject of discussion. It was then mentioned that **HighFinesse** is quite open to inviting guests at their facility and provide informative trainings on their devices. This is something that should be considered in the near future, as well as **inviting them to join any future event** (e.g. PLATAN in Mainz) or even investigate how to better respond the needs of our community through **Joint Research Activities**.

For the groups who have to partially rely on the use of **HeNe lasers**, it was reminded that most of the devices available on the market are only valid **up to 0.001 nm absolute accuracy** and that

care should be taken that we do not expect more from our devices than what can actually be provided. Altogether, it seems that stabilising to HeNe lasers has not been successful for most of the setups. Check the manuals and apply caution.

The speakers involved in the presentations are preparing **joint or parallel publications** on the topic to fully report on their findings and the possible implications on the field of research. The timeline for these publications follows the EMIS Proceedings timeline (namely submission by the end of the year).

Laser control systems

Three speakers presented different approaches to control systems, and how they can be applied to laser systems and laser spectroscopy experiments:

- *Laser control system workshop @ EMIS: CS++ Add-On libraries for the NI Actor Framework*, by Holger Brand; the current concept of the Control System (known from the Penning trap community, but also used by the high-power laser system PHELIX) was introduced. The system is based on LabVIEw, but can interface with other platforms (such as EPICS). The advantage of this CS is that it is supported by a team of experts who optimise the code and provide feedback on development, upgrade, and maintenance. They also offer training in LabVIEW for whomever would become a Local Developer of the system, to also co-develop the system and be fully involved in the installation of the system at any facility. This can prove to be a great opportunity when developing a new platform for a new experiment. For more information, contact Holger Brand (*h.brand@gsi.de*) & Dennis Neidherr (*d.neidherr@gsi.de*).
- *FURIOS EPICS laser control system*, by Mikael Reponen; for better integration at Jyväskylä and to benefit from the existing developments at JYFLTRAP, the laser setup at IGISOL has recently migrated to EPICS. It also stemmed from a will to step away from LabVIEW. From those developments, numerous drivers are now available under EPICS. Note that interfacing with LabVIEW is still possible within their EPICS system. More information available from the slides.
- *CRIS daq: CRISTAL — CRIS Tuning, Acquisition and Logging*, by Ruben de Groote; a Python-based control system written by a PhD student on the fly. While its architecture is simple and at first sight elegant, the author himself regrets the high time investment in the process and the collaboration now dreads the departure of that one person. The main lesson is to rather invest in a proper professional system rather than waste large amount of student time.

Altogether, a consensus was reached that **the biggest problem in control systems is bad programming**, which is possible with any system (either LabVIEW, EPICS, or a self-written code). In particular, a lot of the bias against LabVIEW stems from its inherent accessibility, which may in turn bring poorly-written code. In that respect, it is also a general recommendation to **invest locally in a framework that is well supported**: CERN has a strong LabVIEW support group, that would make the use of the CS++ more accessible. Meanwhile, facilities like TRIUMF and GANIL have strong EPICS support groups, that justify their investment in such framework.

The current status of either framework allows as well **interfacing between the platforms**, so that it becomes less crucial nowadays to fully commit to either, and ensures that whichever direction is taken will not limit the exchange between groups.

A very supportive and positive note for the whole exchange is the willingness of any group to support the global effort, especially of **Holger and Dennis who are willing to train people from our community and co-develop the necessary tools** for laser control systems, and the openness of the IGISOL team on their existing material.

Conclusions and further action

The workshop was very lively and definitely of interest to the participants.

Besides the expected publications on the wavemeter work, further exchange between HighFinesse and the community will be discussed between now and the PLATAN conference in Mainz.

For the Laser Control Systems, each group will now reflect on what was presented to draw their own conclusions. It was felt by some people that a more decisive action should be taken, however there did not seem to be a consensus on the action to take. In particular, it was not clear whether the community wanted to commit to a single platform and neither how to jointly finance anyone to develop any specific control system.

In order to better address the possible **exchange of hardware and software**, it was suggested to make a **Wiki page** where people could provide the info about their own setups in a more detailed way, so that others may know whom to contact and what information is available. Such a page has now been made and is waiting for input from our community. Note that you need to register in order to gain access to implement modifications: https://iks32.fys.kuleuven.be/wiki/lasercs

We hope that this platform can be used as an exchange forum as well for ideas.

Before the PLATAN conference in the spring, the following points should be discussed on this forum:

- What are the questions that the community wishes to address?
- What are the requirements (precision/accuracy, …) to answer those questions?
- What are the devices required to reach the aforementioned aims?