Dear cleanroom user,

Hereby you receive our first newsletter of 2023. A lot of exiting things are about to happen. We spend a lot of time collecting all relevant information and data for the new cleanroom @South and we are busy with tendering, ordering and installing new equipment both in Kavli and EKL. Quite some holidays are upcoming. We wish you a nice holiday period! *The Kavli team*

Holiday period

During the following days the cleanroom is available under "outside working hours regime":

Friday April 7th : Good Friday
April 10th : Easter Monday
April 27th : Kings day
May 5th : Liberation day
May 18th and May 19th: Ascension day and connected scheduled day off.
Monday May 29th : Pentecost.

The cleanroom will be open from 10:00 -17:00 hr these days and high risk work is not allowed. Medium risk work is allowed with a buddy, see the safety and behaviour rules on our website.

At April 20th we will have our Technologist/technician day. All staff members of Kavli will meet cleanroom staff members of other cleanrooms in the Netherlands. Due to this, no Kavli staff members will be in Delft that day. In principle TNO is taking care of the safety in VLL. We try to avoid "out of office regime" during that day. We will follow up on this.

At 25 and 26 April, there will be 6 tours with students of the nanotechnology course, so at specific time slots it can be busy in the gowning room.

Our Kavli Nanolab is (part of) one of the largest nanotechnology research facilities in Europe. It is unique in size, and collaborations, to create the extraordinary. With a relatively low access threshold to boot. It requires a lot of effort, to provide and maintain, the high level of quality, to enable this feat. One of the activities to do this, is regular maintenance on the facility (the infamous maintenance weeks). Week 26 will be the first maintenance week of this year.

Nanotechnology practicum

Srijit Goswami and Richard Norte are taking care of the TUDelft Nanotechnology course. Part of this course are three –four hour long- fabrication sessions in the Kavli Lab. Almost all Kavli staff members are involved in the guidance of the 30 students attending this course with their fabrication project.

These sessions will happen in the period May 16th till June 6th. During this period, some of our wet benches will be allocated only for nanotechnology lab work under the supervision of Eugene and Brian.

New Kavli member: flex Delft logistic assistant

Hi everyone, I am Mädchen, a chemical engineering student at the TU Delft. Last year I finished the Bachelor Molecular Science and Technology in Leiden and Delft, where I chose the chemical technology track. I am originally from Amsterdam but moved to Delft a couple of months ago. A very big difference, but I like that Delft is very small. It is very cosy and I enjoy walking through the city.

After working at Ikea for 5 years, I thought it was time for a change and wanted to work at a lab. When I am not at work or studying I play field hockey and like to meet up with friends to have a drink or play games.

Can't wait to learn new things, as one of the student assistants, in the lab and see you all around.

Groetjes,

Mädchen Wolff

Safety adaptions Wet bench

A while ago, we had some issues with closing distance of the glass window. Due to the small gab between glass and wet bench surface, your arm could get stuck.

We increased the glass window standby position and we also extended the safety extension protection parts which are the rigid end points in case a glass window is falling down or in case a window exceeds its standby point accidentally.

We also investigated the possibility to stop the descend of the window by pushing the knob, but this cannot be adapted due to limitations of the PLC unit.

Once the window sensor sees no movement in front of the wet bench for a certain amount of time, the window will start to descend and this cannot be stopped. To inform you about the upcoming descent of the window we've added a flashing LED in the wetbench, see picture. Once this LED starts flashing, you have to wait for the window to fully lower before you can use the bench again. With these three adaptions we have increased the safety level of our benches.
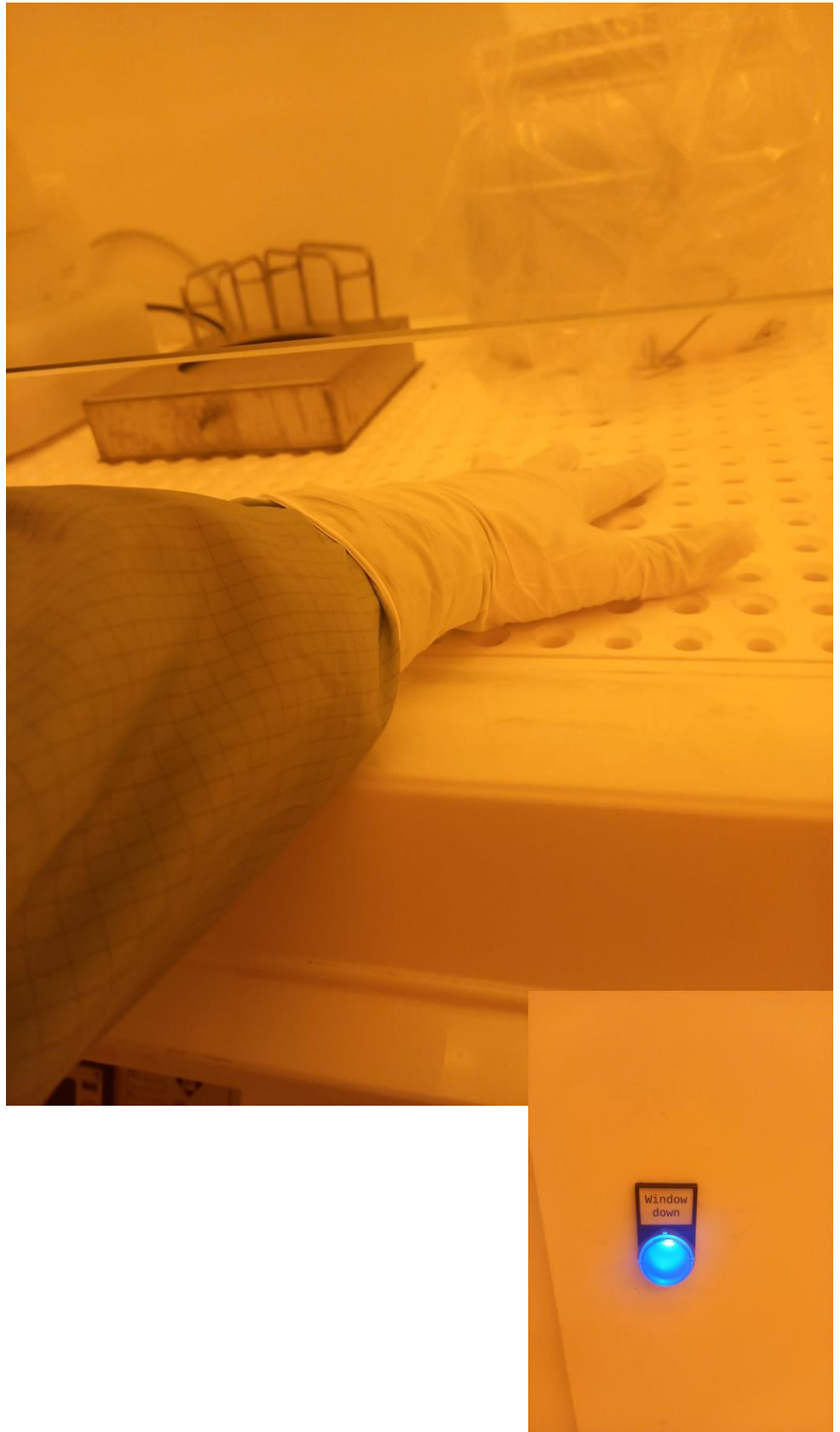
Replacement FFU units

After >10 years of continuous filtering the cleanroom air, the filter fan units (FFU) are at the end of their life span. This year they will be replaced. Koninklijke Kuijpers, an external company, will perform this work (under the supervision of TNO and Kavli).

This work is quite labour-intensive. Quality check on forehand and commission afterwards needs to be done. For example particle measurement, humidity en temperature regulation, noise levels before and after, pressure and vibration checks are all part of the commissioning. The replacement of the FFU units is done in small quantities. The related area in the cleanroom will be fully closed by a temporary enclosure. During the replacement of the FFU units, this part of the module cannot be entered for almost a week. The replacement is done via the cleanroom plenum, on a few locations in the corridors of the cleanroom we will have access holes to the plenum and elevators for lifting the FFU units onto the plenum. The order in which the FFU units are being replaced (and thus which equipment or benches are not available during that period) are under investigation. As soon as the schedule is known, we will communicate this. Minor adjustments (of a few days) are possible.

The work will start in the TNO part of the cleanroom. After the Summer (August) we expect nuisance in the TUDelft cleanroom area due to the replacement there.

We are aware that this will have quite some impact on your fabrication work. We will try to cause you as little inconvenience as possible. During the replacement period you can always contact the Kavli staff members for additional information. We have a direct line with the project manager of Kuijpers to discuss the possible issues with them.

Bruker White Light interferometer

The WLI Bruker has finally arrived and is operational for use. The WLI Bruker is capable with the help of interference patterns to make height profiles of your sample till the sub nm range. The height resolution that you can get out of it is dependent on which setting is used: PSI ~ 0.1nm, USI ~ 1nm, VSI ~ 5nm. As an idea on which setting you need to use for what sample, PSI is used when measuring samples that have a height range of 800nm or lower and VSI on samples that are higher than 800nm. If you want an resolution higher than the VSI setting but your sample is
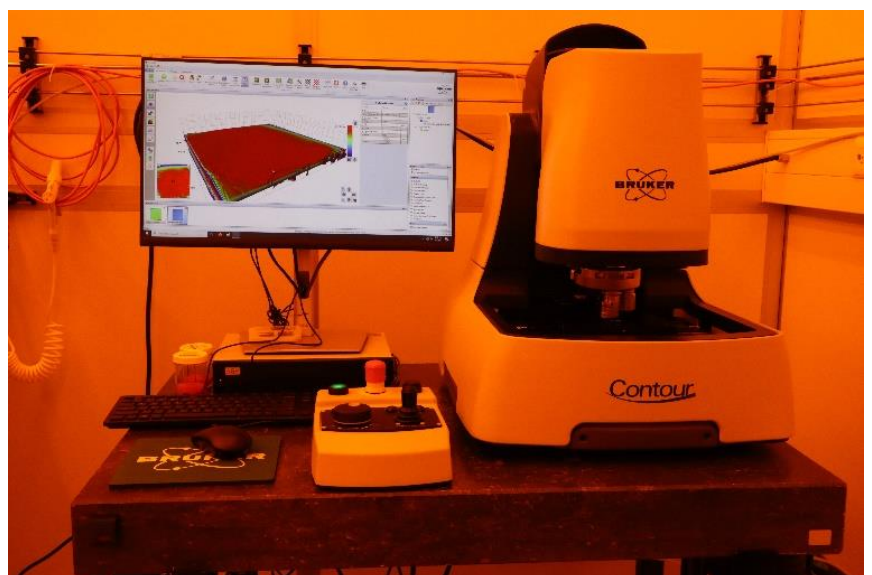
higher than 800nm then USI is a good setting to use. USI is capable of determining if the VIS or the PSI setting is better to use during the measurement. Because of that USI is able to create a very wide height
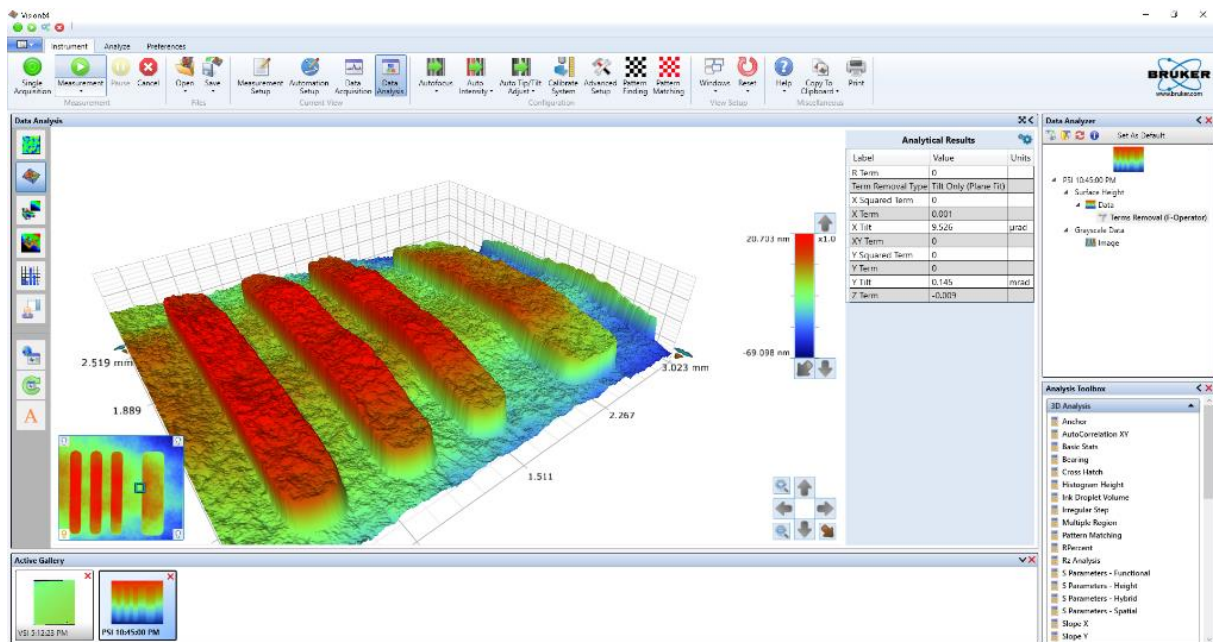
range with a high resolution. WLI is a much faster than AFM. It even has a higher possible height resolution that our AFM (0.1 nm vs 0.3 nm), But WLI has a spatial resolution defined by the microscope objective used. The highest spatial distance in our case is 0.55 um. Also the highest measurable Ra ~ 6nm due to this combination. WLI is very useful for flakes, trenches (broader than ~0.55 um), resist or metal film height measurements. It can also be used to measure the top and bottom side of transparent materials such as diamond. For now the maximum sample height is 3.0 mm. If you have higher samples (or parts close to the sample which are higher) this will also be possible in the future, but we need to discuss a procedure/strategy to change the hardware safety limit which is not available yet. So please inform the system owners if you would want that, then we'll start working on that.
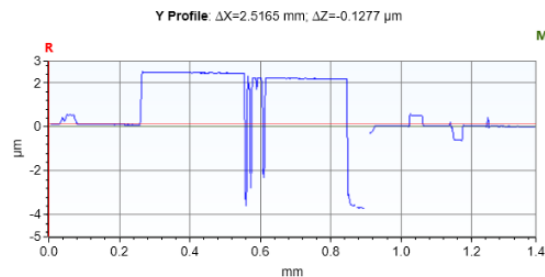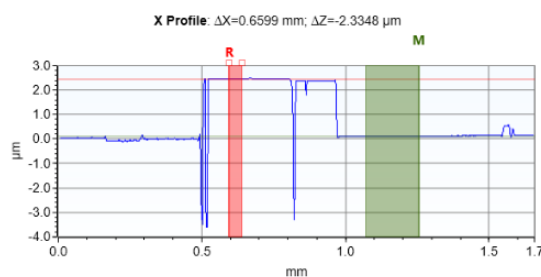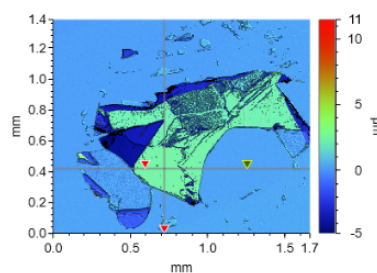
NANO🦁LAB**NL**

Welcome to the NanoLabNL Information System!

NIS Documentation

In any NIS screen, clicking the question mark button on the top right will open the specific help page (if any) for that page, or open the general starting page where you can choose a help topic from the navigation bar on the left.

The NIS Documentation can also be accessed directly via: https://nis-docs.nanolabnl.nl/

Additional NIS questionnaires

As you know we use our NIS questionnaires currently to test your knowledge on General Safety and Wet Bench Safety and Behaviour. These are yearly tests which need to be done by all cleanroom users. Starting today (when we have the next Intake new users) we will add two additional questionnaires to NIS: one about the Safety and Behaviour rules and one about Simple Inspection.

Both these self-examination Questionnaires will be tested once when starting the use of the cleanroom, so most of the existing users will not have to make them (unless your corresponding Course has expired ;-).

After attending the General Intake new users should read the latest version of the Safety & Behaviour rules (Safety (tudelft.nl)) and take the 'Course 1a. General Intake' questionnaire. This questionnaire needs to be passed by every new cleanroom user.

After receiving and watching the Simple Inspection self-study material new users should take the 'Course 5a. Simple Inspection Intro' questionnaire. This questionnaire needs to be passed before applying for the Wet Bench Test.

Course	Initial validity before renewal by questionnaire	Validity after passing the self-examination questionnaire
1a. General Intake	15 days	10 years
4. Safety	3 months	1 year
5. Simple Inspection Intro	15 days	6 years
10. Wet Bench Test	1 year	1 year

In NIS under 'Personal – My courses' you can check the validity of your Courses. One month before expiring you receive an email notification to inform you about this. After expiry you lose certain capabilities like reserving equipment that is linked to the Course. If any of the Courses mentioned above is not listed, it could already be expired, and it can be found by toggling the switch *'Show invalid, revoked and/or expired results'* in the bottom right.

A questionnaire can already be taken during the last month of validity of the Course, so new users can start the new questionnaires as soon as their initial result of 15 days has been granted.

After clicking on one of the Courses, you can click +Apply for course, after which you can start the self-examination.

Apply for course ✕

This course offers the possibility to take a self-examination! Do you want to start the self-examination now? Don't worry, we will first show you more details before you actually start with the exam.

✕ No, I want to register for normal examination instead

✕ Cancel   ✔ Open self-examination

1a. General Intake   ✕

+ Apply for course

| General information | Related equipment and locations | Documents | Your previous results |

Contamination control plasma etchers

To avoid sample contamination and etch rate/profile fluctuations we decided to keep the **new cobra system for diamond processing only**. **No III/V materials are allowed in this system**. Decisions regarding the change of addition of allowed processes is done in user committees (organized around a specific system) or in the general cleanroom user meeting (CRUM).

Just to summarize, we currently have the following ICP etch systems @Kavli:

1) Cobra system (equipped with 400 degree Celcius chuck) Diamond only.

Available gases: BCl3/Cl2/CH4/H2/HBr N2/SF6/Ar/O2

2) Estrellas. high quality Si etching (shallow oxide etching <500nm)) and cryo etching of silicon.

Available gases: SF6/C4F8/CHF3/Ar/O2/He

3) AMS bosch: Si etching and currently oxide etching. Around June we will have a new dedicated oxide etcher (see 4), so oxide etching is extended to higher speed on the new system.

Available gases: SF6/C4F8/CHF3/CH4/Ar/O2

4) New clean Oxide/nitride etcher (will be installed in EKL around June, available for both Kavli and EKL users).

5)AMS cryo etcher. Mainly nitride etching and silicon etching.

Available gases: SF6/C4F8/CHF3/Cl2/Ar/O2

6)Plasmalab system100 Cl2 etcher, etching of Diamond Si Ti Al2O3 table temperature 0-65 deg C

Available gases: BCl3/Cl2/HBr N2/SF6/O2/N2/Ar/He

Calibration of inspection equipment

All our inspection equipment, that provide the user with absolute measurements (as opposed to reference or derived measurements) are meticulously calibrated, at least once a year.

For Kavli Nanolab these are (but not limited to):
5x Olympus BX-series, optical microscopes (OM1 t/m OM5)
2x Bruker DektakXT, profilers (one manually operated and one motorized)
1x Bruker Dimension Fastscan, Atomic Force Microscope (AFM)
1x Woollam M-2000 ellipsometer

The AFM is calibrated by our Bruker service engineer, it is not easy to accidentally change the calibration settings in the Bruker NanoScope software. However, it **IS** easy to change the calibration settings in the Bruker Vision64 software for the DektakXT profilers. And it **IS** easy to change calibration settings in the Olympus Stream Essentials software for the optical microscopes.

Kavli staff members find that, several times a year, calibration settings (or machine config files) have been altered. This means that, all researchers that depend on these measurements, are now unwittingly introducing errors into their research work. Avoidable errors. Lowering the average quality of our lab tremendously.

We believe our lab's high quality level demands this:
If you ever come across any software button, that carries the words 'calibration', **please do not use it**. If you accidentally did, please contact the machine owner, as soon as possible. If you use it on purpose, give yourself a red card immediately.

New chemical protective gloves

As communicated during the CRUM, we will start using a new type of gloves as a protection against exposure of inorganic chemicals (acid and alkalines). They will be a replacement of our well known Neoprene gloves.

Chemical breakthrough times of these Butoflex (Butyl rubber) are much better than the Neoprene gloves and they are convenient to wear. These two reasons are the main ones to step over to these Butoflex gloves.

Below you can find the breakthrough times of some of our used chemicals as an indication of the protection level of these gloves and a comparison with our current neoprene gloves.

The exchange in the cleanroom will take place at April 4th.

Breakthrough times of gloves (EN374 and ASTM F739 ($))

Chemical protective gloves

	Vital 117/115/124 /185/186	AdvanTech 517/522	Ultranitril 472	AdvanTech 519 Ultranitril 487	Ultranitril 485	Ultranitril 454	Ultranitril 492/491	UltraNeo 401	UltraNeo 420/450	Butoflex 650/651
Range										
Gloves material	NATURAL LATEX	MIX	NITRILE	NITRILE	NITRILO	NITRILE / NEOPRENE	NITRILE	NEOPRENE / LATEX	NEOPRENE / LATEX	BUTYL
Interior finish	Flocked	Chlorinated	Coated	Chlorinated	Flock	Flocked	Flocked	Flocked	Flocked	Textile/Chlorinated
External finish	Grip waterdrop	Grip Z	Peebled	Grip diamond	Grip diamond	Grip reversed diamond	Grip diamond	Grip diamond	Grip diamond	Grip Z
Thickness (mm)	0,35	0,5	0,2	0,3	0,34	0,35	0,38	0,55	0,75	1,5/0,5
Lenght (cm)	30,5	36/61	31	32	31	31	32/37	31	31/41	35

Chemicals listed:
RCA-1
RCA-2
Hydrochloric acid (HCl)
Sulfuric acid (H2SO4)
Acetic Acid (CH3COOH)
Phosphoric acid (H3PO4)
Citric acid
KOH solution / NaOH
Ammonia
HF 7-40%
TMAH 25%
Fumic Nitric Acid (100% HNO3)
Piranha (H2O2/H2SO4)
Aqua Regia (HNO3/HCl)
Hydrogenperoxide (H2O2)
Perchloric acid (HClO4) 60%
Ammonium sulfide solution 20%

Legend:

| Niveau	Breakthrough time	Daily duration
0	0-10 minutes or <60 : not recommended, not tested	Splashes protection
1	10-30 minutes	Splashes protection
2	30-60 minutes	Medium use
3	60-120 minutes	Medium use
4	120-240 minutes	Medium use
5	240-480 minutes	1/2 day of work
6	>480 minutes	1 day of work

*in bold : cleanrooms gloves (ISO 5)

EBPG 5200 upcoming actions, EBPG performance tests

Together with the new EBPG5200Plus system, that should come by the end of this year, or early next year, we ordered two upgrades for the EBPG5200:

- MDP upgrade: New, more accurate and stable main deflection printed circuit boards. With this, main deflection field errors should be somewhat smaller, on the order of below 5 instead of below 10 nm.

- Firebird upgrade: The UPG (Universal Pattern Generator) board converts shape pattern data to actual main and subfield deflection signals and controls the beam blanker. Over time, the pattern generator board evolved from a board with a lot of fixed hardware and firmware to much more flexible microprocessor controlled boards with specific hardware. In the early days, the only generated shapes were trapezoids, horizontal lines with fixed beam step size being exposed at line-by-line increasing Y position. The later GPG (Generic Pattern Generator) we had in the past on the EBPG5000Plus supported sequences, user-defined paths the beam is stepped along, as single shape within a subfield. Our tool txl2gpf uses this to generate e.g. circles, but this can take a lot of calculation time. The UPG we nowadays have on both our EBPG systems supports complex shapes like circles, ellipses, rotated rectangles ("cubes") as primitive data and spiral fill-in of trapezoids. The sequences of these shapes are calculated on the UPG board and also can be quite time-consuming. With Firebird, this time-consuming calculation is done on the multi-core processors of the Linux workstation, that also will be replaced. The recent versions of BEAMER can export EBPG pattern files using more and more of the advanced shapes.

The filament we currently have in our EBPG5200 was installed by the end of January 2019. Over time, the extractor current increased, and also there is more noise/fluctuation on both extractor current and measured beam current, as shown in the graphs of results of weekly performance and stability tests, that also are available online (http://epic-beta.kavli.tudelft.nl/pgdoc/perftestdata.html).
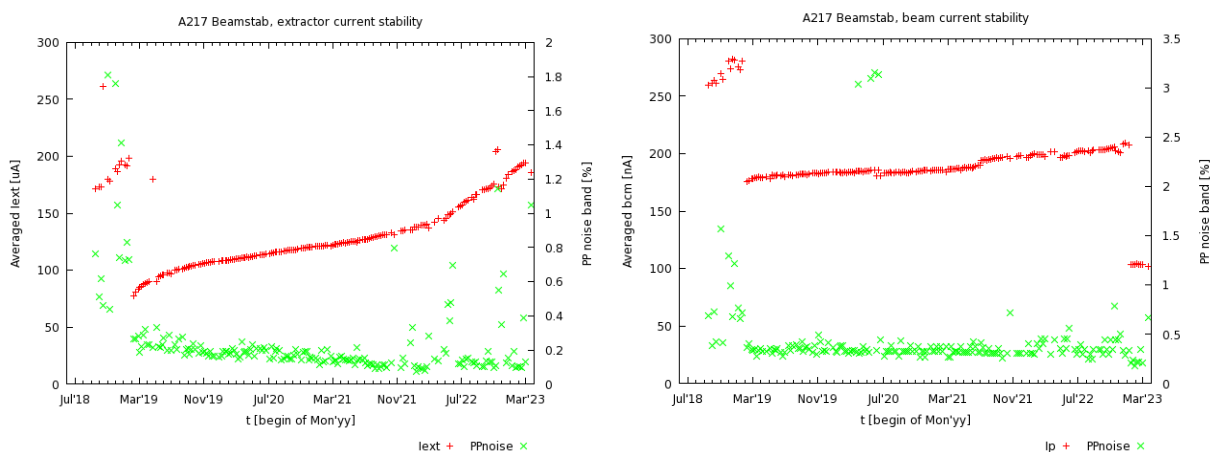
This increment in instability is a strong indication that the filament is approaching its end-of-life. Last November, I for the first time noticed the instability, but it recovered, and by then a new filament on the EBPG5000Plus seemed more necessary, which was installed in December.

Since two weeks, after switching off and running-up the filament again, the instability is back again and stronger than before.

This brings us to the following provisional planning of actions on the EBPG5200:

- **week 17 and 18 (starting 24 April), to be confirmed by Raith:**

    o **replacement of filament**

    o **preventive maintenance, instead of week 26**

    o **MDP upgrade, if possible**

- **Week 26 (26 - 30 June):**

    o **Firebird upgrade with new RH8 Linux workstation**

Also online available (http://epic-beta.kavli.tudelft.nl/pgdoc/opertimedata.html) are graphs of the used OPERator hours per month and per year, split in Staff and Users usage: