

DTU DANCHIP

DTU Cen

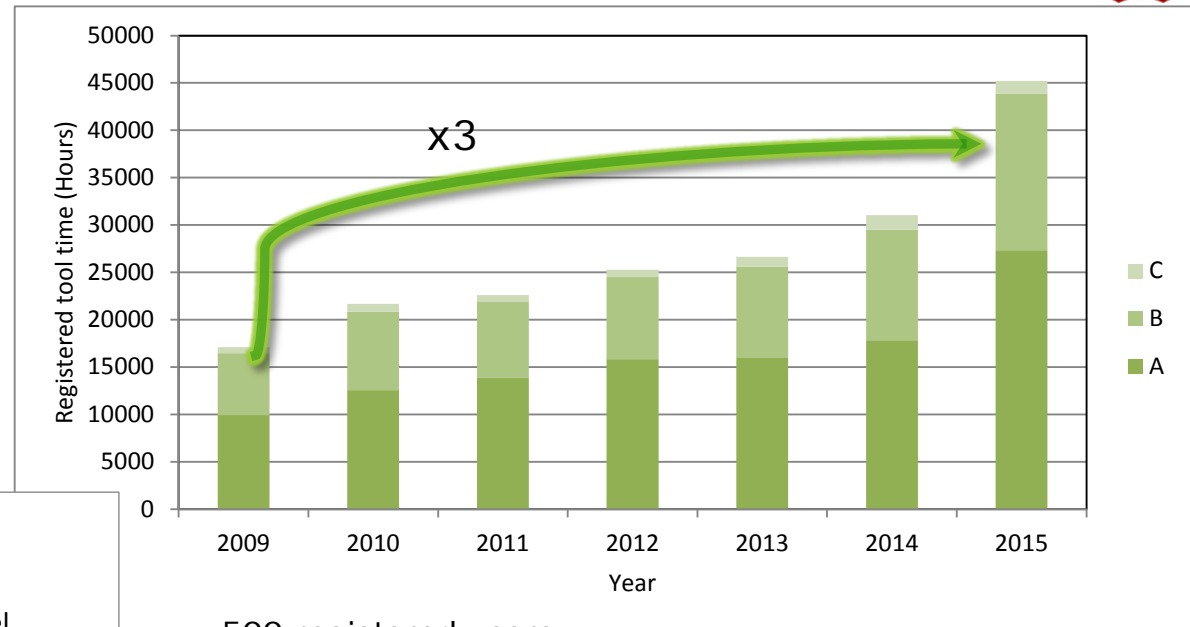
Tech Forum no.3 2016

← 346-347 DANCHIP



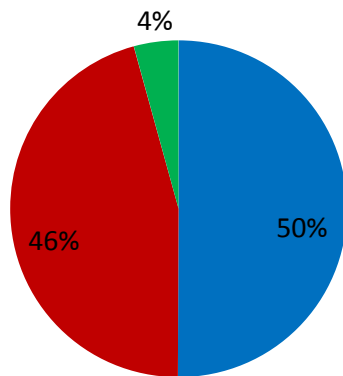
Facts and figures

Machine usage Danchip



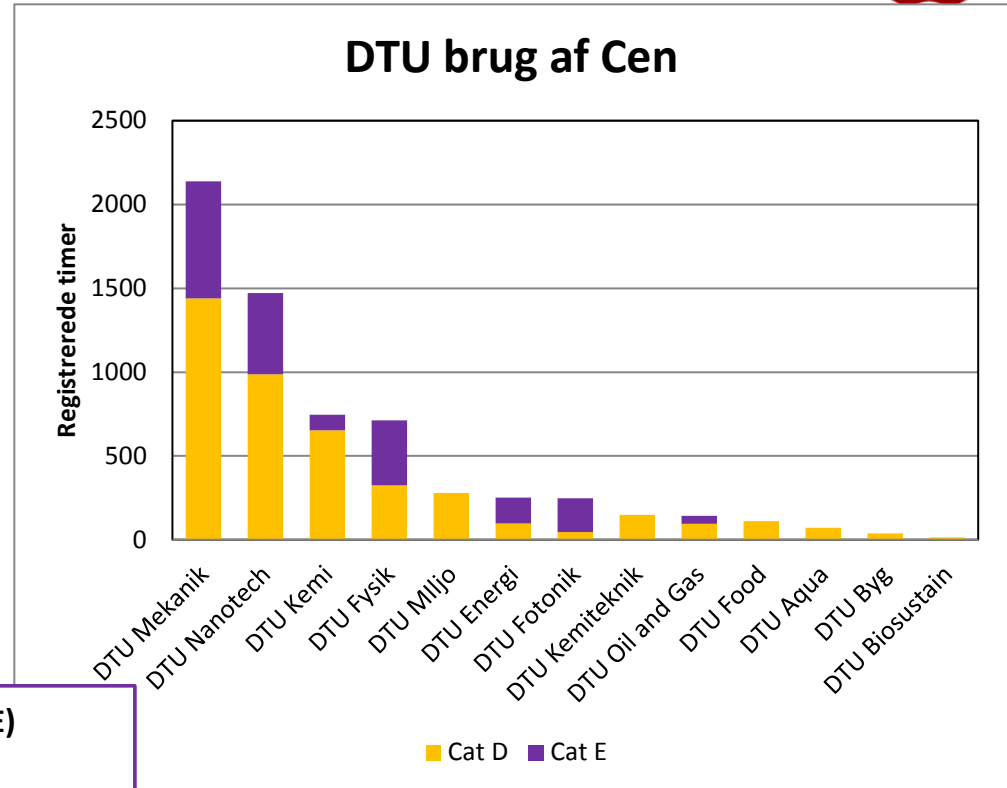
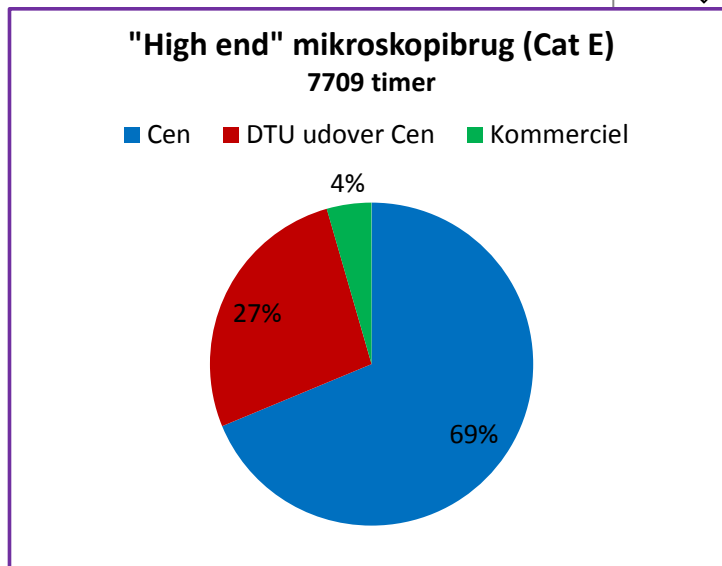
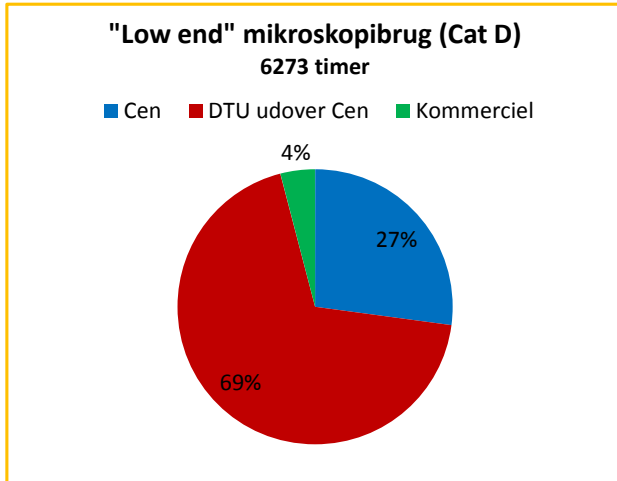
Total mikroskopibrug (Cat D+E) 13981 timer

■ Cen ■ DTU udover Cen ■ Kommerciel



- 500 registered users
- 70 total staff, 15 research staff, 7 PhD stud.
- 77 peer reviewed publications (2015) with DCH/CEN staff directly involved (authored/co-authored); 6 publications in Nature Publishing Group
- Used by 15 departments and 4 Centers of Excellence (Grundforskningscentre)
- 20 companies
- 170 ext. financed research projects with budgeted activities in Danchip/Cen last 5 years

Facts and figures



It is getting crowded.....

Increase throughput ---- increase efficiency

A lot has changed over the last years (equipment, resists, safety)

There are plenty of new technologies available (ALD, DUV, etc)

Get a Danchip co-supervisor

Get your processes flows checked and updated

It is much more efficient **for all** to update the process flow and plan training according to an updated flow instead asking for single tool training.

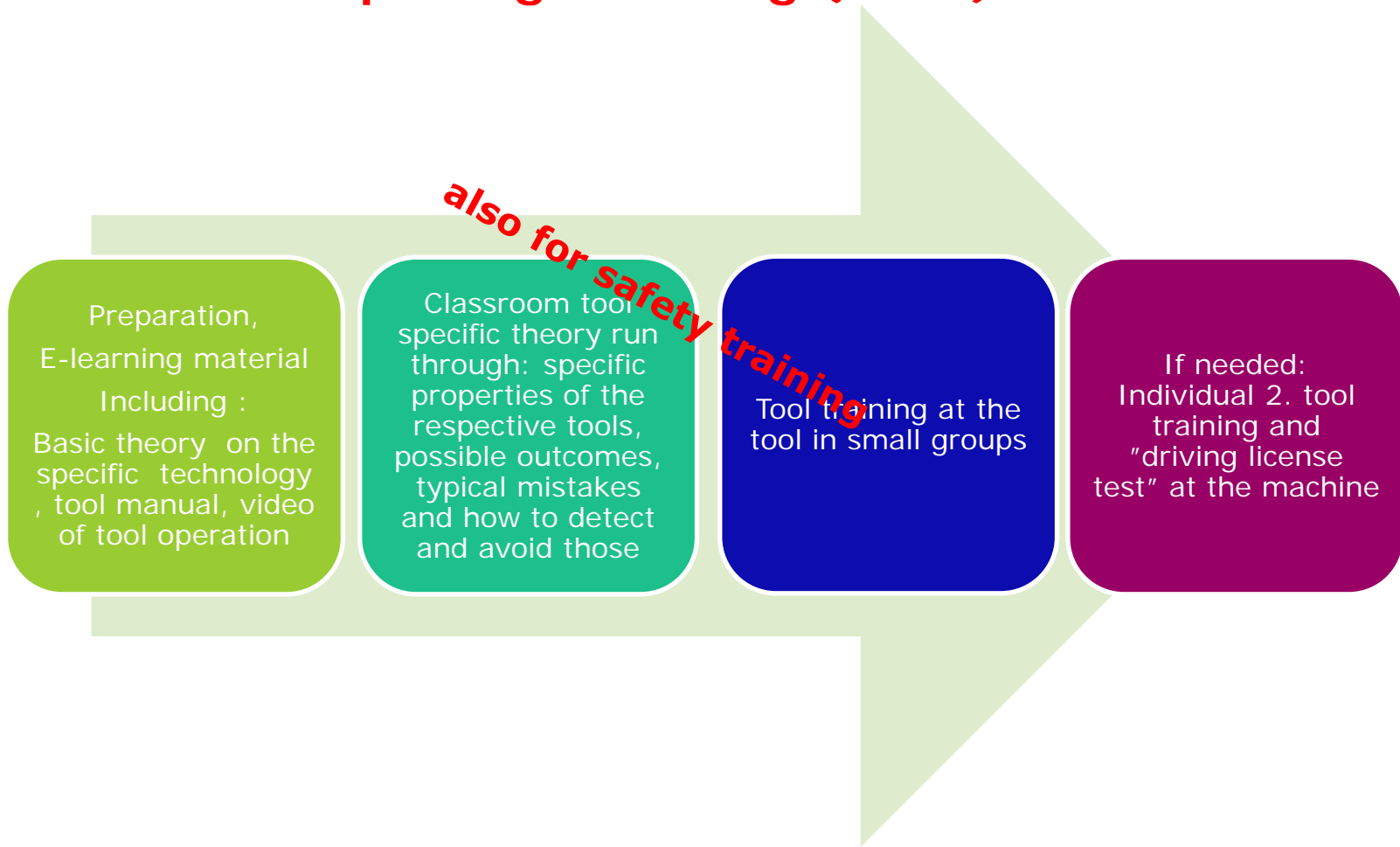
Prepare to process during fringe hours.

A more thorough introduction to cleanroom processing

Training engineers - not operators

Prevent downtime and accidents through understanding and insight

scheduled tool package training (STPT)



scheduled tool package training (STPT)



Status:

Lithography TPT in place v1.0 (3h theoretical, 2 (1) practical training session(s), monthly
aim for: more electronic material, 1h theoretical, 1 practical training session, bi-weekly

SEM training

from 1/11 : 2h theory 2h practical training at SEM basement 346

Mask design TPT

from 1/11: 6-8 participants, distributed course over 2 weeks, ~4h classroom in total

Safety course TPT

from 1/10: safety

Soon: process flow + cross contamination , Wet Chemistry TPT, Thin Film TPT, Etch TPT

New safety course, access procedure

Major changes:

- Runs once a week fixed day and time
- Max participants: 4 (extra courses if waiting list becomes too long)
- First come first serve
- Preparation with e-learning
- Passed online exam required to be admitted
- Safety course, ~3 hours including former hands-on in the cleanroom
- Second exam as last part of the course
- Talk processing approach, goals, process flow with Danchip and supervisor
- Get access to cleanroom and tool training (TPT)

New safety course, access procedure

Runs once a week fixed day and time

- **Once a week (if sufficient participants ≥ 3)**
 - faster "get going" in the cleanroom
 - limited number of participants to ensure interaction
 - fixed day and time easy to remember and plan

New safety course, access procedure

- **Preparation with e-learning**
- **Passed online exam required to be admitted**
 - Material (video, powerpoint, text) online available
 - Online "material consumed and understood" test

Sign up for safety course first and only possible after passed online exam !

New safety course, access procedure

- **Safety course, ~3 hours including former hands-on in the cleanroom**
- **Second exam as last part of the course**
 - Online exam at the end of course
 - Course requires personal laptop computer /tablet

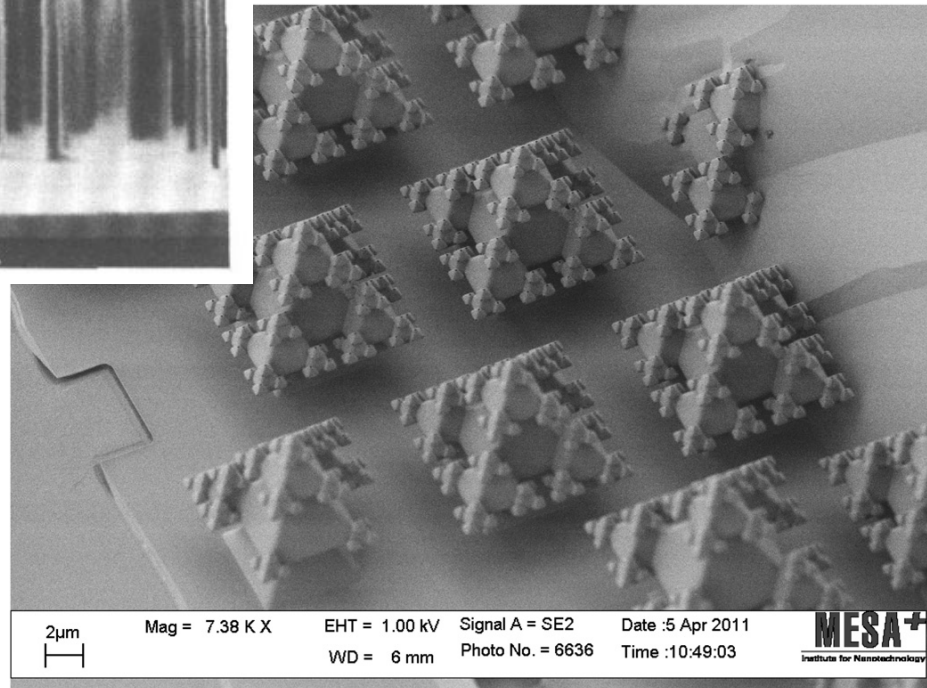
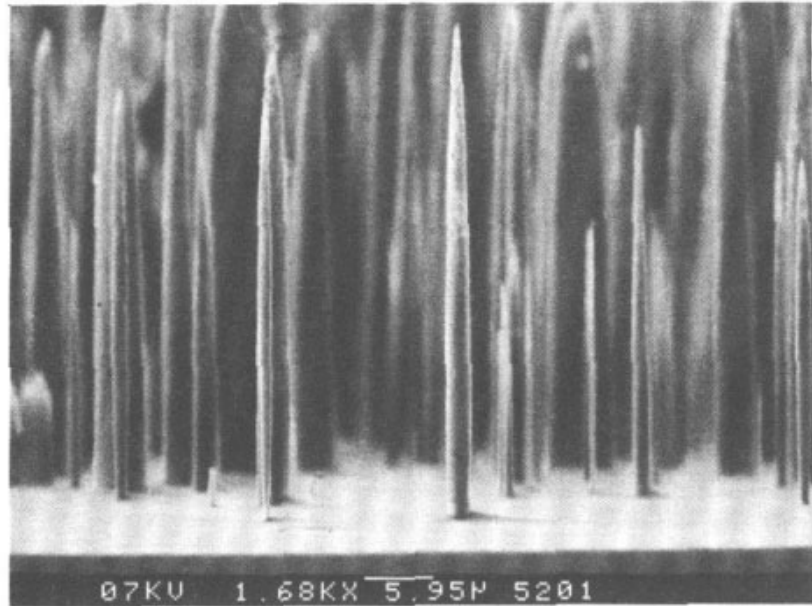
New safety course, access procedure

- **Talk processing approach, goals, process flow with Danchip and supervisor**
 - Update user and supervisor on latest developments
 - Guide the users to the new possibilities
 - Make sure cross contamination issues are taken care of
 - Make a time plan and training plan for the project

Get access to cleanroom and tool training

Professor in Silicon nanofabrication

Henri Jansen starting nov 2016



Soft matter electron microscopy

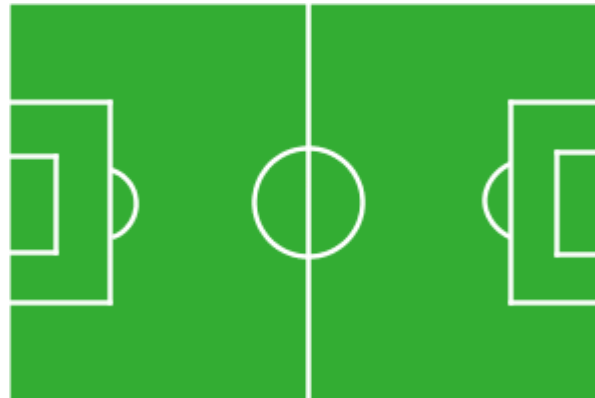


No professor this round.... find a senior associate professor

Strategic frame

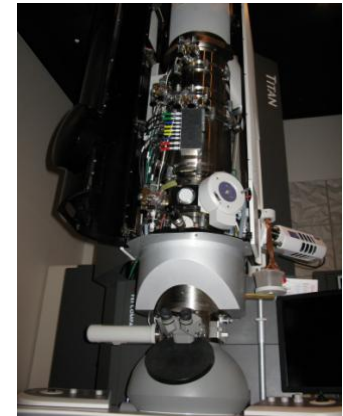
useful for the "wet" sciences

characterization
not just imaging



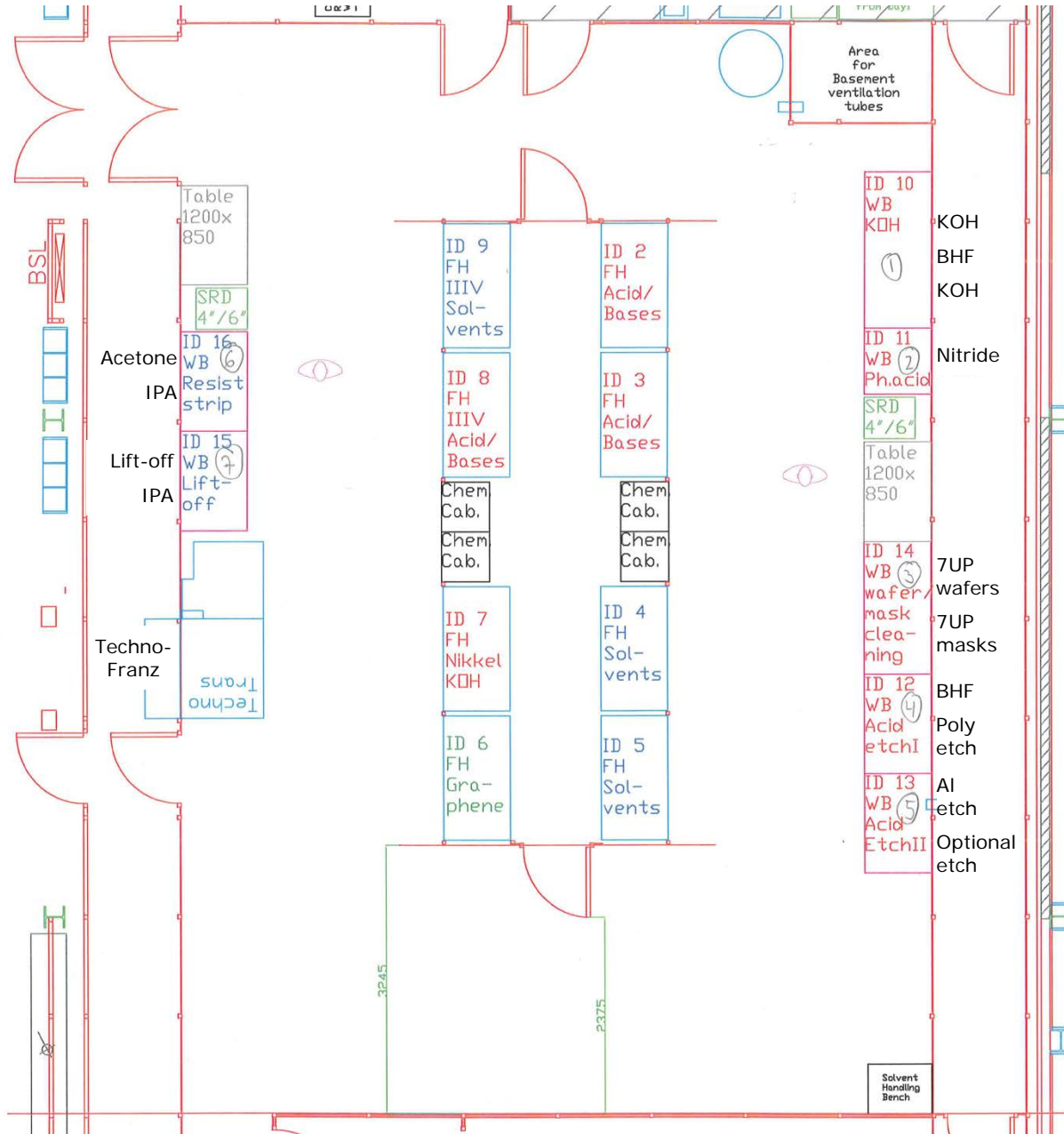
make use of the
existing toolpark
with few but significant
additions

try to exploit synergies with
possibilities at Danchip
(e.g. MEMS microfluidic sampleholder etc.)



NEW TOOLS & TOOLS LEAVING - LESJO

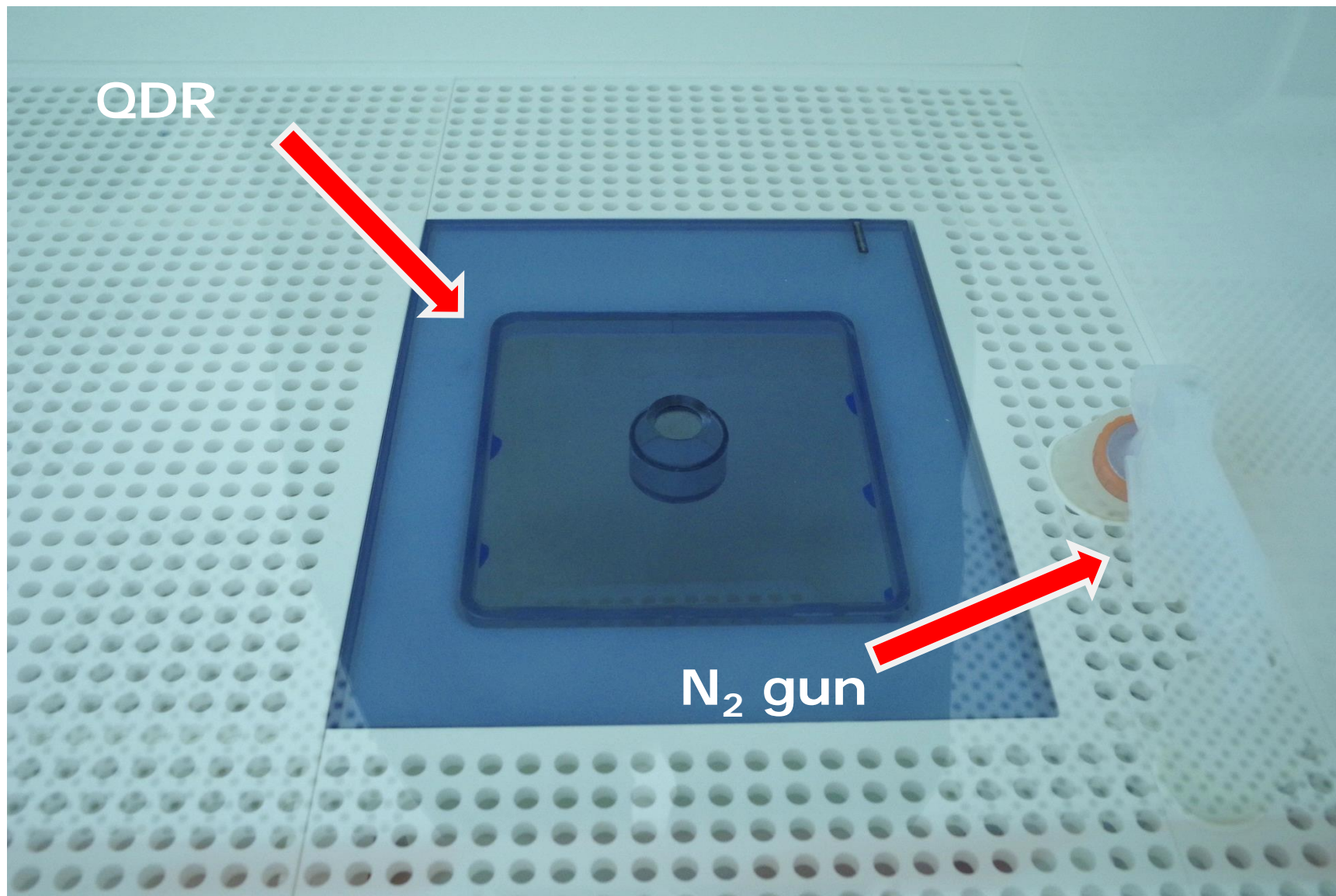
Ballroom with new fume hoods and wet benches



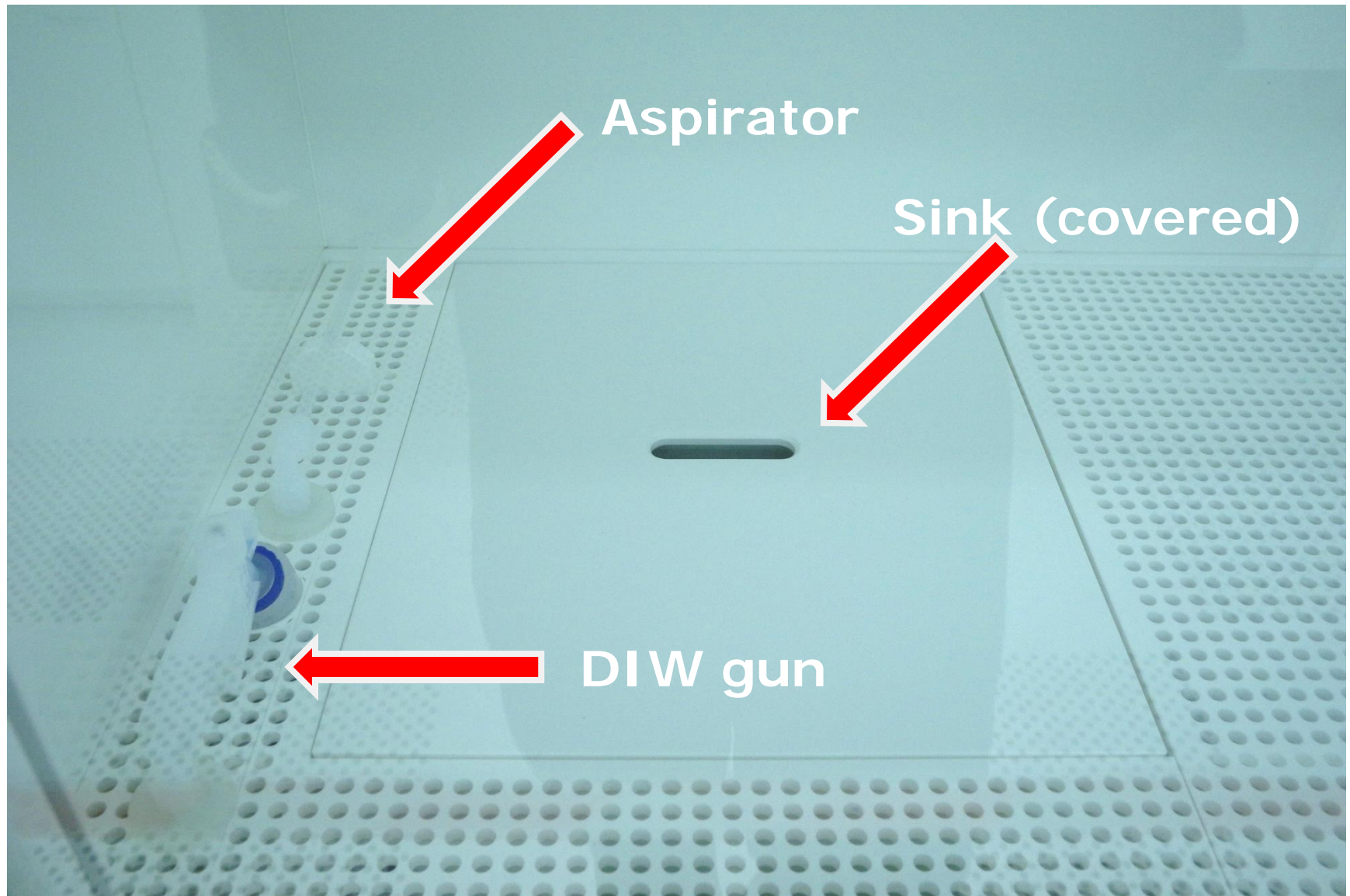
Brave new fume hood world



Quick dump rinse



What are you sinking ?



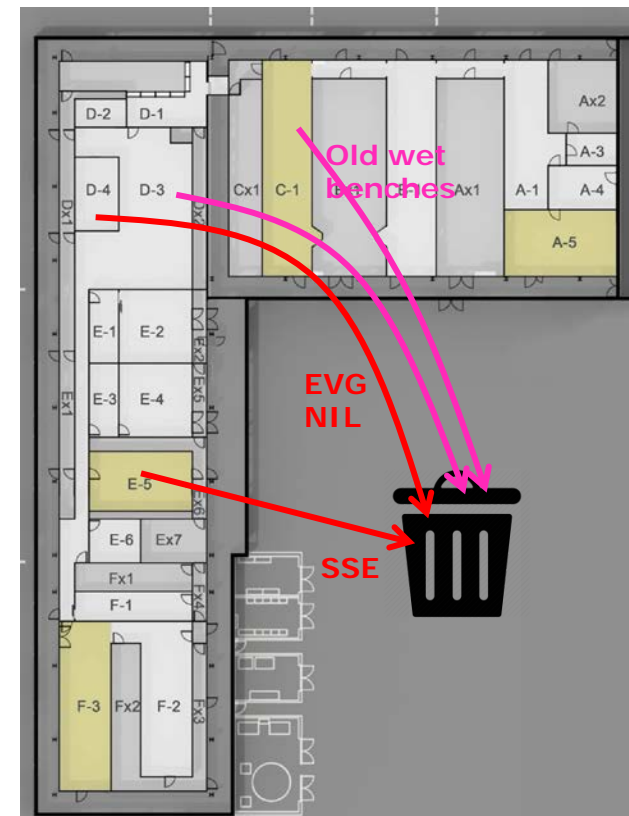


Time schedule for fume hoods and wet benches in Ballroom

- 8 fume hoods for ballroom
 - Delivery: August 2016
 - Expected release: December 2016
- 7 Wet benches for ballroom
 - Delivery: October and December 2016
 - Expected release: 2017Q1 and Q2
 - Old nitride etch will not be removed before new bench working
 - Use other KOH baths in transition period
- 2 spinner wet benches + 1 cleaning fume hood for E-5 (litho)
 - Delivery: January 2017
 - Expected release: 2017Q3

Equipment Tetris – moving stuff around and installing new things – plan per September 2016

Tool	Moves to	Date
EVG NIL 520	Trash	Week 38
EVG 510 align	Trash	Week 38
SSE spinner	Trash	Week 38
KOH3	Trash	Before October
2 old fume hoods	Trash/C-1	Before October
7-UP, Nitride etch, Poly etch, BHF, Al etch, strip and lift-off	Trash	Before December
Old nitride etch	Trash	When new nitride etch ready
New KOH, nitride etch, lift-off and resist strip benches	D-3	October
New Ox etch, poly etch, Al etch, BHF and 7UP	D-3	December
Old wet benches in C-1	Trash	Once new benches ready



X-Ray Diffractometer

- Background:
 - Complementary in-line material analysis (crystalline/ poly/nano-crystalline)
 - Co-funding (Danchip/Fotonik)
- Material properties:
 - crystal orientation
 - grain size
 - electron density
 - film thickness



Table-top Thermal Evaporation

- resistive heated boat (simple system)

- Background:
 - Heavy load on Wordentec
 - Improve flexibility/costs
- Simple (cheap) system:
 - low budget (ca. 30 kEuro)
 - table-top
 - single stage
 - 1-2 boats (resistive heated)



Pegasus 2

- Background:
 - Bottleneck situation on Pegasus
 - Plans for intensive research in silicon etching (a.o. nanoetch)
- Actively pursuing 2nd hand system
 - Roy goes to Morocco



plasma/thermal ALD from Picosun

Motivation

- High utilization, bottleneck tendency
- No in-house back-up
- Limited capacity for new precursors

Key features

- Highly flexible ALD system, thermal & plasma-ALD
- Stacked substrates (pieces – 8" wafers)
- "Work horse" as well as new capabilities
- New chemistries, e.g. for metals and metal nitrides
- Low temperature processes



Under installation – acceptance planned for 2016Q4

PECVD-4 – replacement of PECVD-1/2

- SiO / SiN / SiON / BPSG / (~~Ge-doped~~)
- Including stress-tuning capability
- Refurbished SPTS system (2011)

Installation “almost” done

- Initial functional tests
- Toxic lines need running in
- He line missing.



New bonder tool

- Pre-align in KS MA-6 aligner, then bond in KS bonder
- Released for use
- Standard processes established
- No user editing of recipes
- Transfer processes from EVG 520 NIL now – talk to Rune



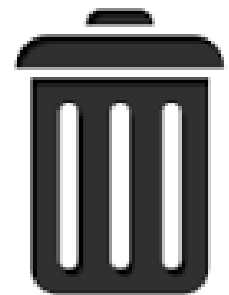
New imprint tool

- CNI 1.5 from NILT replaces NIL on the EVG 520
- Alignment not possible
- Heating up to 280 deg. C
- Later: Also a CNI 2.0



Tools leaving the cleanroom

- SSE Maximus. Will be shut down in 2-4 weeks
- EVG NIL 520 & aligner 510. Will be shut down in 2-4 weeks
- Nanoscribe 2 photon polymerization. Will be moved out of the cleanroom
- Old wet benches in Ballroom (replaced by new benches and fume hoods)
- Wet benches in C-1 (old yellow room)
 - Replaced by new wet benches in Ballroom
 - Will stay until new benches are ready
- SIMS (no replacement – use external services)
- PECVD-2 (replaced by PECVD-4)
- Cryofox
 - too unstable / too expensive (running costs)



MONEY ISSUES

Material changes 2017

- Cost of DUV resists is significant and will be added as a materials cost
 - DUV42S-6: €2040 for 4l: 3.80 kr/ml
 - KRF M35G: €1100 for 1 gallon: 2.17 kr/ml
 - KRF M230Y: €1100 for 1 gallon: 2.17 kr/ml

 - For 25 wafer with ~3 ml of BARC and resist: ~450 kr

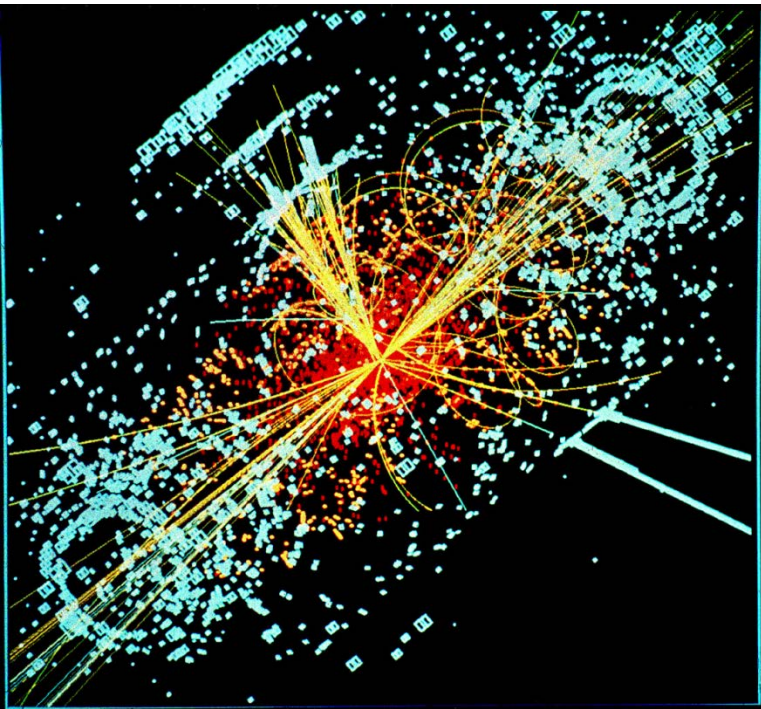
- Relative prices for noble metals have changed significantly:
 - Separate pricing for Gold, Platinum, Palladium
- Wish to automate registration:
 - Use machine readout - crystal information, internal gauges



Unified price model for Danchip/Cen

Complete overhaul including:

- Re-evaluate cost objects for UK95 (Academic) justification
- All registrations in "Anlægs kartotek" audited and corrected for funding agencies/infra-structure funding/private funding
- Capacity/actual hours puzzle solved for the categories
- We have been requested not to have a buffer for academic prices



Overall results

- Commercial pricing: No changes
- Academic pricing: Mainly increases
- H2020: No change

Prices – external commercial users (UK90)

Service from Danchip	New price 2017	Present price 2016	Unit
Cleanroom access (below cap) ^{a)}	800	800	kr/h
Danchip assistance	1250	1250	kr/h
Cleanroom area	1600	1600	kr/m ² /mo
Category A tools	370	370	kr/h
Category B tools	630	630	kr/h
Category C tools	3600	3600	kr/h
Category D tools	1200	1200	kr/h
Category E tools	1700	1700	kr/h
Category F tools ^{b)}	0	0	kr/h

a) Cleanroom access above cap of 20 hours is 0 kr/h

Early warning for costs – external funded projects and users (UK95, other universities: UK10)

+ overhead

Service from Danchip	Expected cost 2017	Present cost 2016	
Cleanroom access (below cap) ^{a)}	550	350	kr/h
Danchip assistance	550	450	kr/h
Cleanroom area	(500)	(200)	kr/m ² /mo
Category A tools	170	160	kr/h
Category B tools	400	300	kr/h
Category C tools	2100	1800	kr/h
Category D tools	550	800	kr/h
Category E tools	1300	1200	kr/h
Category F tools ^{b)}	0	0	kr/h

a) Cleanroom access above cap of 20 hours is 0 kr/h

Subject to auditor approval.

3 TO TAKE HOME

- **Changes in access and safety course**
- **8 new fumehoods ready for use 1/12**
- **Significant changes in bonding and NIL tools**