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In-Class Orientation

Quantum-Nano Fabrication and Characterization Facility (QNFCF)*

* Formerly *Quantum NanoFab*

Course Instructor: Nathan Nelson-Fitzpatrick

Last updated: September, 2020

Lecture Outline

1. Introduction
   - General information & resources
   - Lab layout, Hours of operation
2. Cleanroom Etiquette & Gowning
   - Sources of contamination, Keeping things clean
   - Gowning
   - Acceptable materials, In-cleanroom storage
   - Etiquette
3. Safety
   - General comments
   - Chemical safety
   - Emergency response plan
   - Specific hazards
4. *Badger* lab scheduler and file transfer mechanism
   - What is *Badger*, Getting started, How to use it

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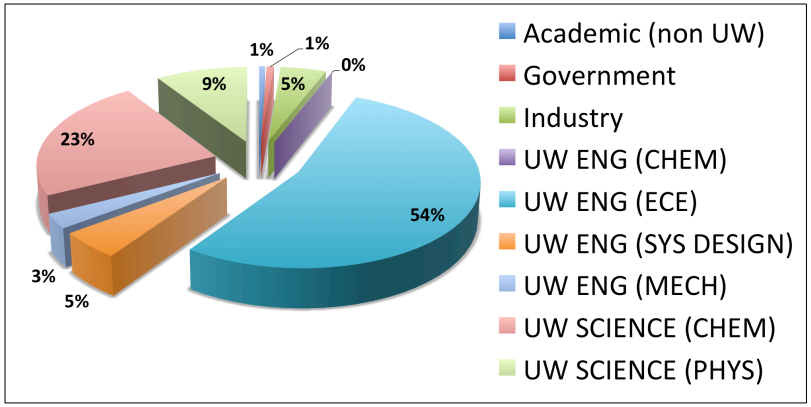
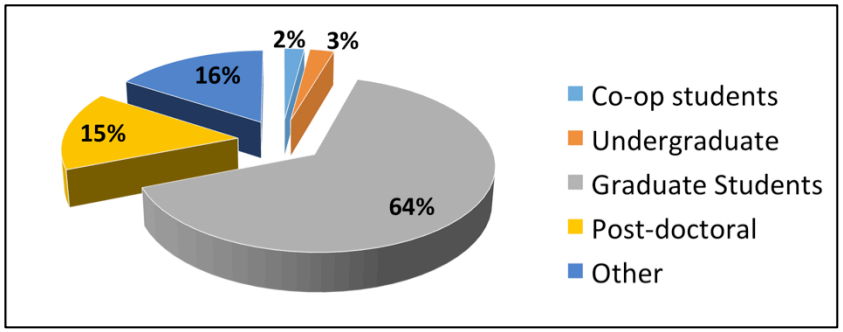
Welcome to our Community

QNFCF is a Core Facility used by a community of dedicated researchers

- Each of you is now a Member of this diverse community, not just a "User"
- You are encouraged to share your results & experiences with your peers
- Over 400 Members under 90+ Principal Investigators since September 2014





Fab Staff Team is part of this community and provides:

- Leadership
- Guidance to help you make best use of the facility
- Professional operations & consistent training across the entire membership

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Fab Staff Team

The Fab Team are here to support your work in the lab

- We are a group of support staff with a wide array of skills and experience
- We aim to be approachable and helpful

Who do I talk to about _____?

- Need to consult with someone about your process?
  - Contact the **Process Engineer**
- Have questions about lab billing or access?
  - Contact the **Finance and Administrative Coordinator**
- Have questions about specific equipment?
  - Contact the equipment's designated **trainer (listed on website)**

- **All contact info is available on the website:**
  - https://qnfcf.uwaterloo.ca/contacts

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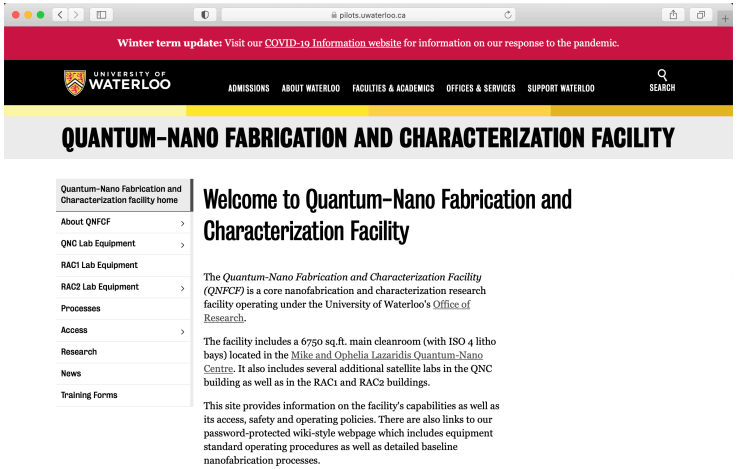
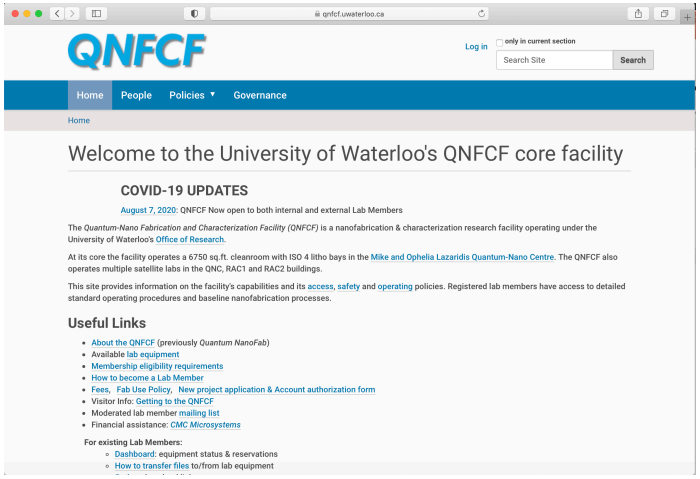
Available Resources: Website(s)

We have two websites:

- **WCMS website**
  - General info about equipment/lab
  - Staff contact info
  - Coming soon
- **Plone "Wiki style" website**
  - Detailed tool information
  - SOP manuals
  - Permitted materials
  - Characterized processes
  - https://qnfcf.uwaterloo.ca



Upper: WCMS website
Lower: Plone "wiki" website



Other resources for getting started

Useful insights on how to design your process & recipes:

Sami Franssilla - **Introduction to Microfabrication**
http://ca.wiley.com/WileyCDA/WileyTitle/productCd-0470749830.html

Marc J. Madou - **Fundamentals of Microfabrication and Nanotechnology**
https://marcmadou.com

Peter Van Zant - **Microchip Fabrication: A Practical Guide to Semiconductor Processing**
https://www.amazon.com/Microchip-Fabrication-Practical-Semiconductor-Processing/dp/0071821015

Multiple Authors - **QNFCF website process library**
https://qnfcf.uwaterloo.ca/process/process-library

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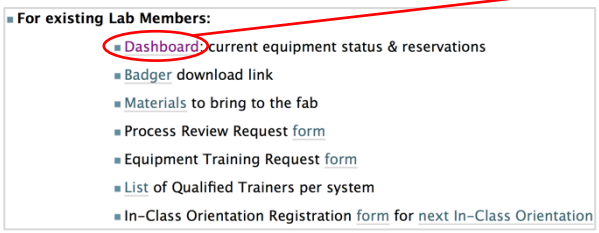
Staying in Touch: Dashboard & Mailing List

Dashboard: Real time snapshot of cleanroom operations

- What's in use
- Reservations
- Equipment issues

Link to dashboard on homepage

(no login required)



Member mailing list

- Best way of staying current with fab issues & announcements
- New members are automatically subscribed

qncfabmembers-subscribe@lists.uwaterloo.ca

http://uwaterloo.badgerlms.com/badger/DashboardQNCFAB-1.html

Badger Lab Management Systems Dashboard

Equipment In Use

OXFORD-cluster	rqsaland
RAITH-EBL	m3khoshn
HFACID	g2hollow
SUSS-align	kswillic

Recent Cancellations

cw4chang	11 Jan	10:30	11:30	YES-HMDS
m3khoshn	11 Jan	11:00	12:30	REYNOLDSTECH-twincoater
da2striakhilev	11 Jan	12:30	13:30	ACIDBASEnonHF
ralmaruf	11 Jan	12:00	13:30	RAITH-EBL
cearnest	11 Jan	11:00	13:30	DISCO-saw
ralmaruf	11 Jan	11:00	13:30	RAITH-EBL
jbflanne	11 Jan	10:00	13:30	RAITH-EBL
vlogiudi	11 Jan	8:00	20:30	OXFORD-cluster
m33scott	11 Jan	14:30	23:15	SRD-PIRANHA
m33scott	11 Jan	14:00	0:00	REYNOLDSTECH-bulkSi
m33scott	11 Jan	14:00	0:00	RCACLEAN

Today's Reservations

cw4chang	9:00	9:30	YES-ash
cw4chang	9:15	10:00	SOLVENT1
cw4chang	10:00	10:30	YES-ash
da2striakhilev	12:00	12:30	OLYMPUS-scope2
kswillic	12:30	12:45	SOLVENT2
kswillic	12:45	13:00	SOLVENT1
kswillic	12:45	13:00	YES-ash
cw4chang	12:30	13:30	REYNOLDSTECH-twincoater
kswillic	13:00	13:30	YES-HMDS
g2hollow	13:30	14:00	HFACID
kswillic	13:30	14:00	REYNOLDSTECH-twincoater
apetruk	14:00	14:30	REYNOLDSTECH-twincoater
kswillic	14:00	15:00	SUSS-align
kswillic	14:30	15:15	DEVELOPUV
liyunhan88	14:30	15:30	REYNOLDSTECH-twincoater
g2hollow	14:00	15:30	HFACID
cw4chang	15:00	16:00	SUSS-align
m3khoshn	13:30	16:00	RAITH-EBL
cw4chang	16:00	16:30	DEVELOPUV
cw4chang	16:00	16:30	SUSS-align
m3khoshn	16:00	16:30	RAITH-EBL
apetruk	16:30	17:00	OXFORD-metalRIE
apetruk	16:30	17:00	SUSS-align
apetruk	17:00	18:00	OXFORD-metalRIE
jbflanne	16:30	19:00	RAITH-EBL

Reservations for Tomorrow

m33scott	7:00	10:00	RAITH-EBL
ikhodada	9:00	10:00	REYNOLDSTECH-twincoater
kswillic	9:30	10:30	YES-HMDS
kswillic	10:30	11:00	DEVELOPUV
kswillic	10:30	11:00	SUSS-align
s535wang	10:00	12:00	HFACID
ikhodada	10:00	14:30	RAITH-EBL
y31liu	14:30	15:30	RAITH-EBL
cw4chang	13:00	16:00	INTLVAC-Ebeam
m3khoshn	13:30	16:30	OXFORD-SiRIE
cw4chang	16:00	17:30	SOLVENT1
sburzhue	15:30	18:30	RAITH-EBL
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m33scott	14:00	0:00	RCACLEAN

Problems and Shutdowns

Problem	8 Sep	OLYMPUS-scope1	DIC mode is currently not functional due to communications problem from PC to filter wheels. Bright Field and Dark Field modes still functional.	nnelsonf
Problem	16 Nov	OXFORD-cluster	A large amount of contamination appears in the chamber, and it seems to get worse than last time.	s535wang
Problem	18 Dec	OXFORD-cluster	Teos process is not showing any deposition.	nnelsonf
Problem	6 Jan	PLASSYS-sputter	Sample pallet locking pin is actuating correctly, but not being sensed correctly (pin actuates, computer thinks it has not moved). As a result automatic loading and unloading is not functional. Deposition is still possible, but must be accomplished manually.	nnelsonf
Shutdown	27 Aug	BREWER-UVspinbake	UV spinner offline pending exhaust modification and SOP generation.	nnelsonf
Shutdown	27 Aug	BREWER-Ebeamspinbake	E-beam spinner offline for troubleshooting of hotplate module.	nnelsonf

Orientation: Lab locations

Main lab in QNC building:

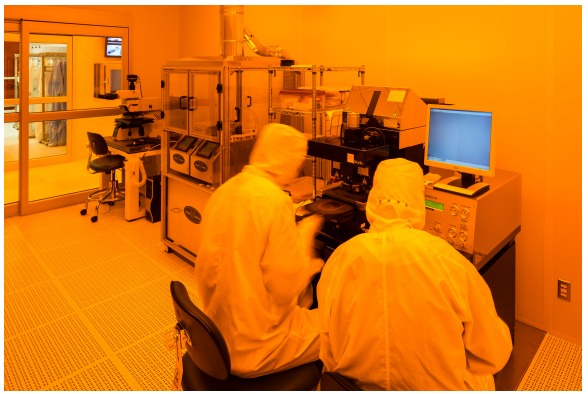
- Cleanroom lab (1701)
  - Semiconductor fabrication and characterization

QNC satellite labs:

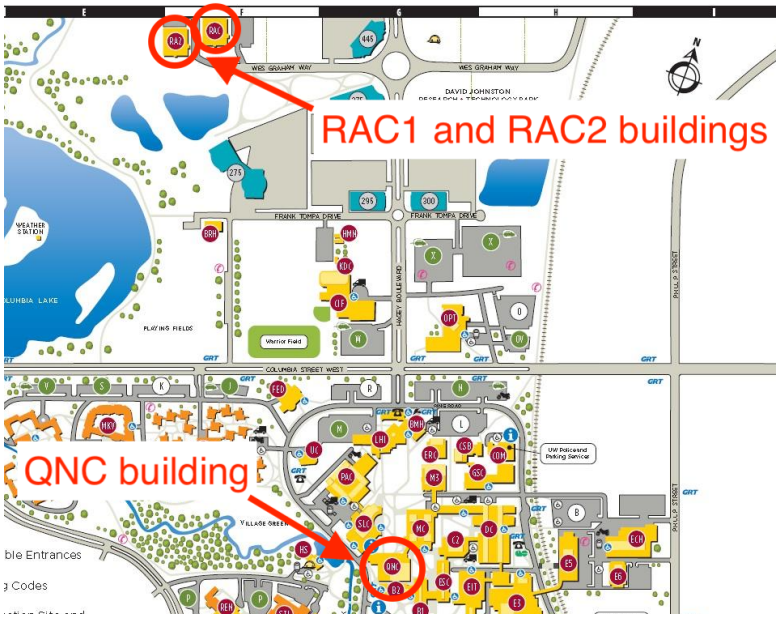
- Packaging lab (1706)
  - Dicing, wirebonding, flip-chip etc…
- Sample prep lab (1508)
- Software lab (B211)
  - CAD for fabrication
- Metrology suite (B703, B709, B711)
  - FIB/SEM, TEM sample prep

RAC1/RAC2 building labs:

- RAC1 clean assembly lab (1013)
- RAC2 (various)
  - Specialty deposition and characterization tools



QNC cleanroom lab



QNFCF labs across campus

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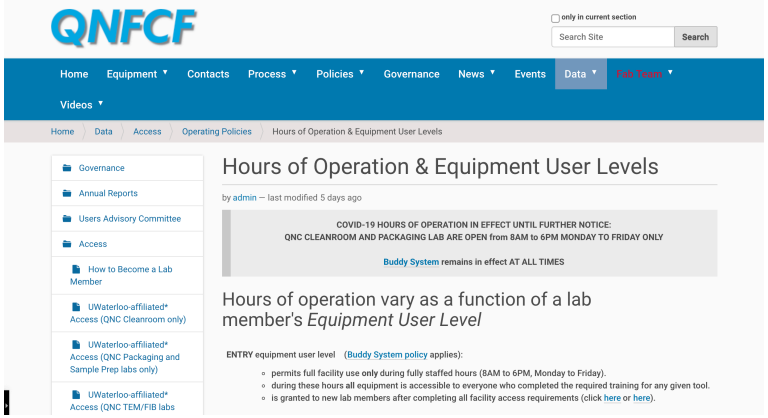
QNC Cleanroom & Satellite Labs

- Cleanroom “Bay and Chase” type layout
- Six modules joined by central aisle + Characterization module (1707)
- Class 10, 100 and 1000 mixed
- ***Chase areas are off limits (with 2 exceptions as shown)***
- Strict environmental hygiene protocols to maintain clean environment
- *Sample Prep* (1508) and *Packaging* (1706) labs are accessible from outside cleanroom
- Lockers available (1504) to store coats/jackets/outdoor shoes & boots (lockers are **day use only**)

Hours of operation and access

- QNFCF labs open 24/7
- Labs staffed 8:00 AM to 6:00 PM M-F
- 3 Access levels
  - **Entry level**: Facility use during staffed hours (M-F: 8:00AM – 6:00PM)
  - **Advanced level**: Facility use 7 days/week: 8:00AM – 10:00PM
    - Must have 150 hrs of equipment use over last 12 months.
    - Extra permission to use some tools 24 hours/day.
  - **Super user level**: Advanced level permissions plus permission to use EBL tools 24/7
    - Case by case basis depending on EBL experience

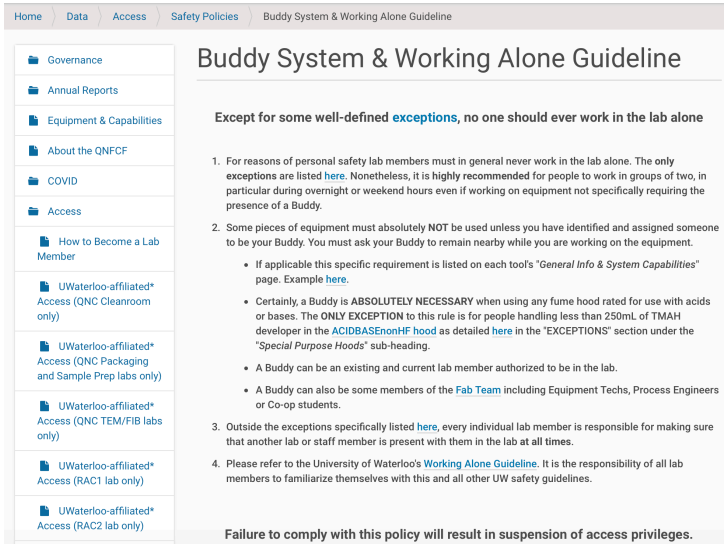


Check website for more details

https://qnfcf.uwaterloo.ca/data/access/operating-policies/hours-of-operation-equipment-user-levels

Buddy system

- Generally not permitted to work alone
- Some exceptions to this rule enumerated in “Hours of operation” policy
- Definition of buddy:
  - Any current lab member or staff who is authorized to be in lab
- **Suggestion 1**: Working with dangerous chemicals? Get a buddy who is familiar with the risks.
- **Suggestion 2:** Pay special attention to presence of others during unstaffed hours.



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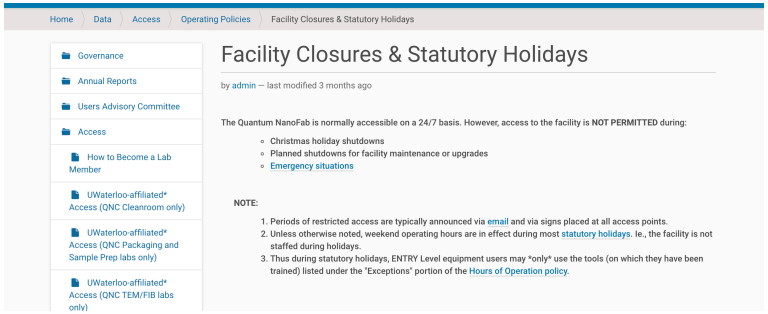
Facility closures

- Absolutely no work permitted when facility is deemed "**closed**"
- Examples of facility closures:
  - Yearly Christmas holiday shutdown
  - Planned shutdowns for facility maintenance or upgrades
  - Shutdowns for emergency situations
- Closures are announced via mailing list and signs posted at entrances
- FYI: Stat holidays are treated as a weekend day



Check website for more details

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Part 2

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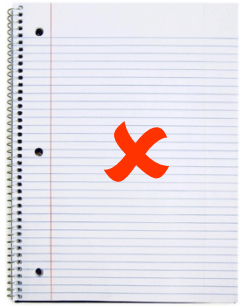
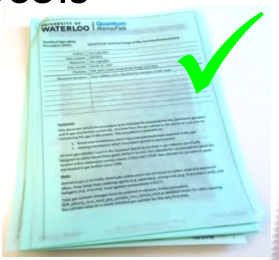
Where do contaminants come from?

1. People

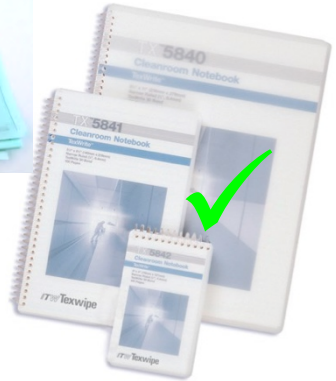
- People constantly shed hair and skin
- People sweat and leave oils on things they touch
- People who do not follow gowning & behaviour protocols

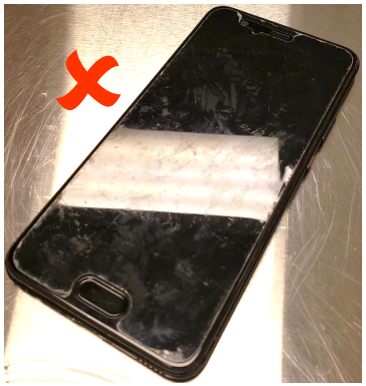




2. Regular paper, pencils, dirty items, etc.

- Cleanroom-rated paper & notebooks **must** be used
- IPA and cleanroom wipes **must** be used to clean materials **before** bringing them into the cleanroom





Phone not cleaned properly!

How do we keep the cleanroom . . . clean?

1. Constant air recirculation & filtration

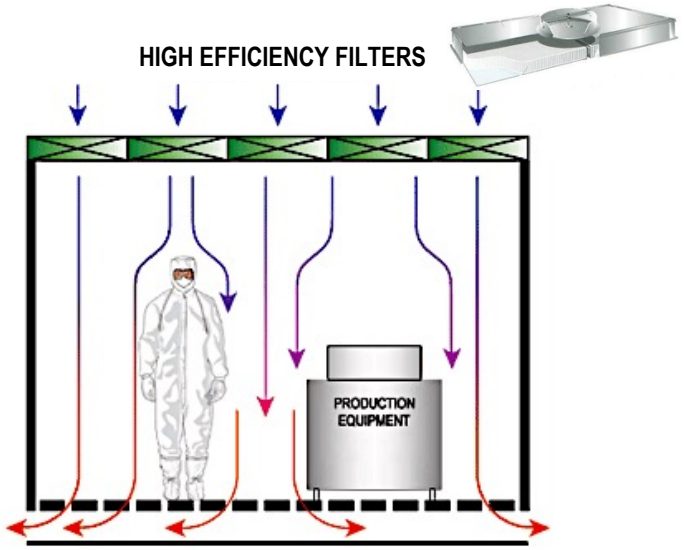
- *Class 1,000*: air filtered once every 90 sec
- *Class 100*: once every 20-30 sec
- Laminar air flow minimizes turbulence

2. Ongoing cleaning

- Monthly schedule for cleaning all surfaces

3. Personal hygiene

- Showering daily
- Wearing clean clothing
- Avoiding colognes, perfumes & smoking
- Correctly wearing cleanroom gowning apparel



Cleanroom airflow

Recall from video training module:

- Cleanrooms classified as a function of # particles ≥0.3um per ft^3 of air
- Typical office space has ≥100,000 particles/ft^3 (ie.: class 100,000)
- QNC cleanroom: class 100 & class 10 modules (ie.: less than 100 and 10, respectively, particles/ft^3)

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Before entering the cleanroom

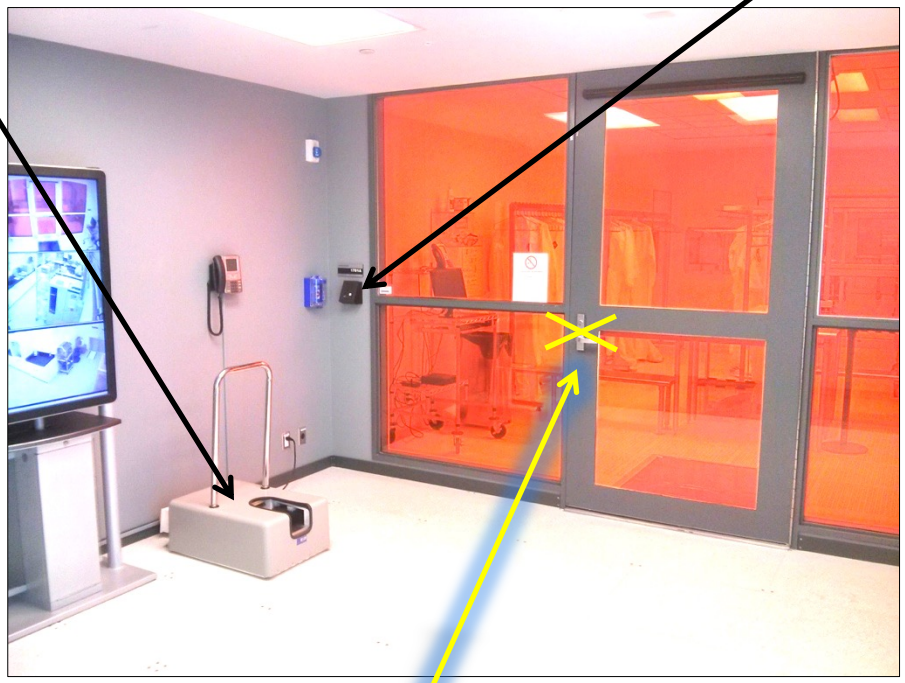
DO:

- Wear clean, closed shoes that are **worn indoors <u>only</u>**
- Arrive with clean apparel (full length pants ONLY)

DO NOT:

- Wear sandals, *Crocs*™ or dirty shoes/boots
- Bring unnecessary items

1. Shoe cleaner
   - Use before entering
   - Do **NOT** use to clean dirty shoes worn outdoors!



2. Use your FOB & PIN #
   - Each person must use their own access ID to enter
   - Do **NOT** enter behind someone else!
   - When leaving use your FOB to open door

Sample FOB ID card:

- You need your own FOB & PIN # to enter
- Do **NOT** share these with anyone!

3. Enter gowning room via automated door

Do not pull on door

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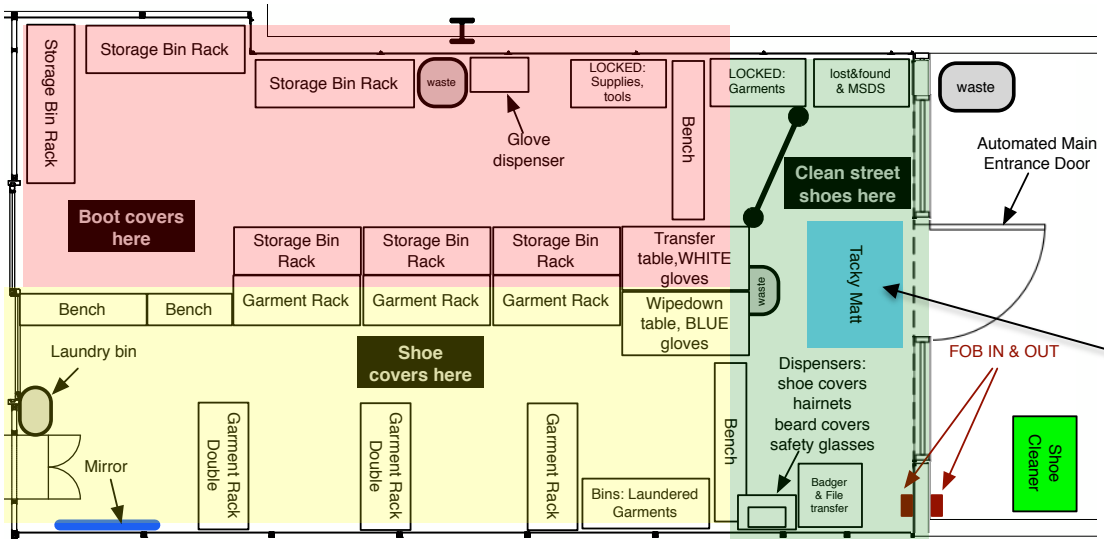
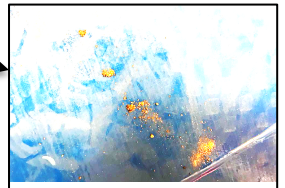
Entering the cleanroom: Gowning room

Gowning room is separated into three zones:



1. **Green zone**:
   - Wear clean indoor shoes here
   - Put on shoe covers, safety glasses, face mask, hair net



Dirt on tacky mat: BAD!

2. **Yellow zone**:
   - Shoe covers must be worn here
   - Clean your items on “wipedown table”:
     - Wear blue disposable gloves
     - Move cleaned items to “transfer table”
   - Put on cleanroom garments in yellow zone
   - ID Badge MUST be worn when in the cleanroom

3. **Red zone**:
   - Must be fully gowned here!
     - Boot covers must be worn
   - Put on white cleanroom gloves here
   - Retrieve your samples from storage racks
   - Proceed into cleanroom

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Proper Gowning Procedure

STEP 1
Shoe Covers

STEP 2
Safety Glasses

STEP 3
Face Mask

STEP 4
Hair Net

STEP 5
Hood

STEP 6
Coveralls (don't touch floor!)

STEP 7
Boot Covers

STEP 8
White Gloves

REMOVAL: Proceed in reverse order and hang your boot covers, hood and coveralls as instructed

IMPORTANT: Cleanroom apparel offers **NO** protection against chemical exposure

Acceptable materials: What can I bring with me?

- Keep bare minimum needed for your process in the cleanroom
- Bring only materials that are cleanroom compatible
- Remove your personal items if:
  - Your work is complete
  - You will be away for more than 2-3 months

Ok to bring:

- Tools (stainless, plastic)
- Samples, wafers
- Cleanroom notebooks
- Cleanroom paper notes

OK but minimize:

- Tablets
- Laptops
- Phones

Absolutely never!

- Tools (wooden)
- Items with soft fabrics
- Regular paper
- Books
- Graphite pencils
- Chemicals
- Items that can't be wiped (tin foil wrapped)

In-cleanroom storage

Cleanroom space is limited:

- Only “in process” items should be kept inside

All active members receive (no charge):

- One 16 qt. “sample” bin:
  - Stores multiple wafer cassette boxes
  - For your tools, reticles, samples, notebooks, wafers
- One per member only
- To be kept in cleanroom while member is active
- **NOTE:** Bins are removed after 6 months of absence

Two “beaker kits” (left) & one “sample bin” (right)

Members may additionally purchase:

- Up to 2 “beaker kits”
- **NOTE:** Kits are removed after 6 months of absence

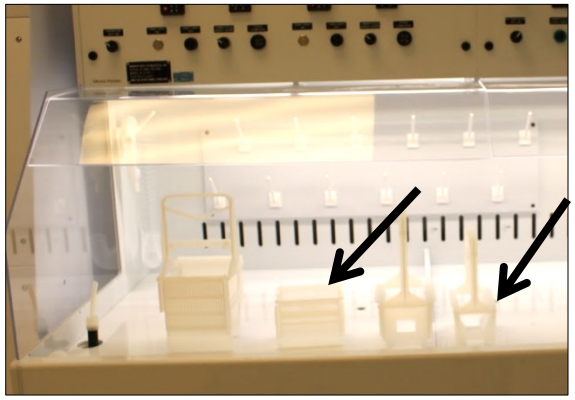
Only these containers are allowed. Please:

- No “loose” wafer cassette boxes
- No “odd size” boxes
- Please return 16 qt. bin once your work in the fab is completed

Minimizing cross contamination

Facility supports many chemical, high vacuum & high temperature processes

- Thus, cross contamination risks are magnified
- These risks are minimized by:
  - ✓ Using dedicated hardware available at each work station & keeping these items at their assigned station
  - ✓ Following all steps & recommendations listed in SOP's
  - ✓ Never touching your substrates with your gloved hands

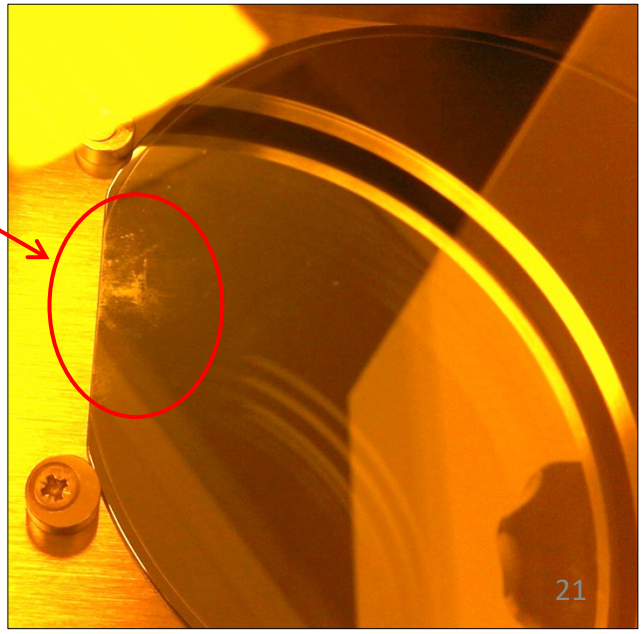


Wet bench: dedicated cassettes

Workstations have dedicated hardware

- Tweezers
- Wafer cassettes & handles
- Glassware (in some cases)

"Chamber Cleaning" wafer handled with gloved hand in reactive ion etcher (RIE) resulting in contamination. **Tweezers ONLY!**



Remember: Hardware marked for a given workstation must stay there!

Additional important points

- Wear cleanroom garments properly (close all snaps and zippers)
- *Reserve equipment ahead of time* & enable these when working

  NOTE: If you don't reserve but just enable a tool a person with a reservation has the right to bump you off the tool

- Do not touch or otherwise interfere with other people's work
- Always label beakers with their contents, your name and the date
- Always clean up thoroughly at the end of your session

When you leave: workstation should be safe, clean and ready for the next user

Part 3

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Safety is everyone's responsibility

QNFCF cleanroom and its satellite labs allow for well-defined and controlled use of many hazardous materials.

When using the facility:

- You are responsible for **your safety** and the **safety of others.** Please:
  - Know hazards that could be present in the lab and how to protect yourself
  - Know hazards of your process so you can protect yourself & others from it
- Understand and follow all Safety Policies: https://qnfcf.uwaterloo.ca/policies/safety-policies
- Do **not** work with chemicals & gases unless you **understand the risks**
- Think about & if possible **simplify** your process if it can be made safer

If unsure about anything ask a member of the Fab Team for help

Safe handling of chemicals

① **ALWAYS** apply SDS guidelines for safe handling of chemicals you plan to use

② **ALWAYS** read SOP and obtain hands-on training before using any hood

③ **ALWAYS** work in the assigned wetbench (fume hood) for chemicals you plan to use

④ **ALWAYS** wear all required *Personal Protective Equipment* (PPE) and safety glasses

⑤ **ALWAYS** use the correct solid waste bins for contaminated wipes, etc.

⑥ **ALWAYS** plan your work flow before pouring your chemicals

⑦ **ALWAYS** clean up after yourself

① **NEVER** expose yourself & others to fumes or vapours

② **NEVER** flush solvents or HF solutions down any drain

③ **NEVER** mix solvents with Acids or Bases

④ **NEVER** rush or work in the facility if you are tired/sick

Personal Protective Equipment (PPE)

- When working with solvents & photoresists:

White nitrile cleanroom gloves*

+

Face shield

*Note: second pair of grey nitrile gloves used to prevent contaminating primary gloves on spinners

- When working with acids or bases:

Tychem Apron

+

Face shield

+

Green nitrile gloves on top of white gloves

Consequences of poor behavior and cross contamination

- All chemicals pose a risk of cross contamination

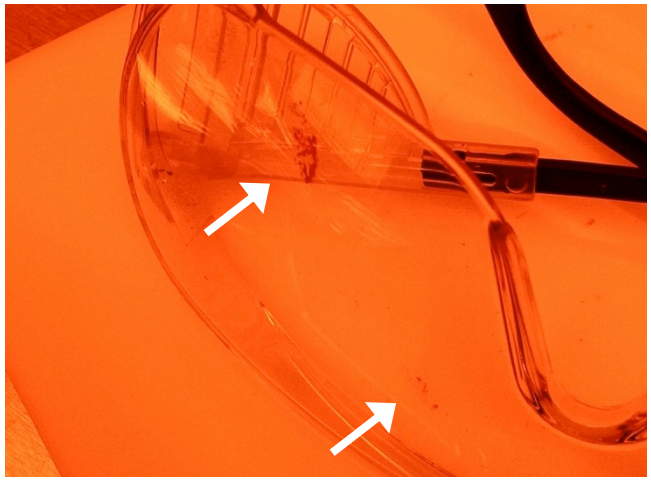
- Even small amounts can be dangerous:
  - **NEVER** wear PPE away from workstation
  - **NEVER** carry dedicated tools / beakers away from workstation
  - **ALWAYS** assume the worst if you find trace contamination at any workstation

What's wrong with this picture?

Unacceptable conduct

Photoresist on empty bottles cart

Photoresist on acetone bottle in ReynoldsTech spin coating hood

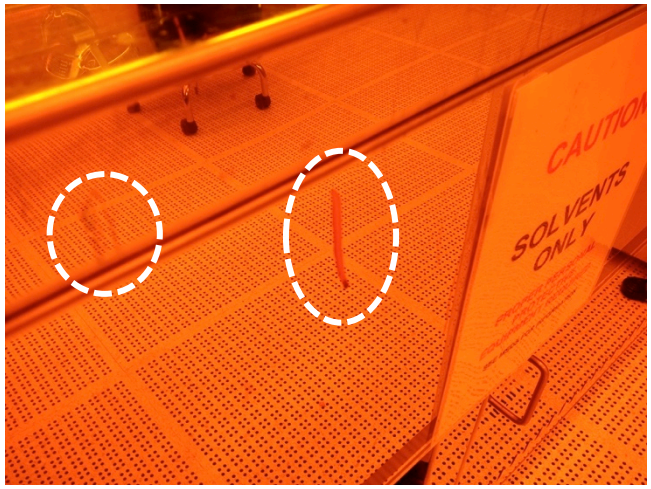


Photoresist on safety glasses!

The POOR BEHAVIOUR which resulted in the issues noted in these photos can lead to accidents causing serious injury or death

Photoresist on HMDS oven

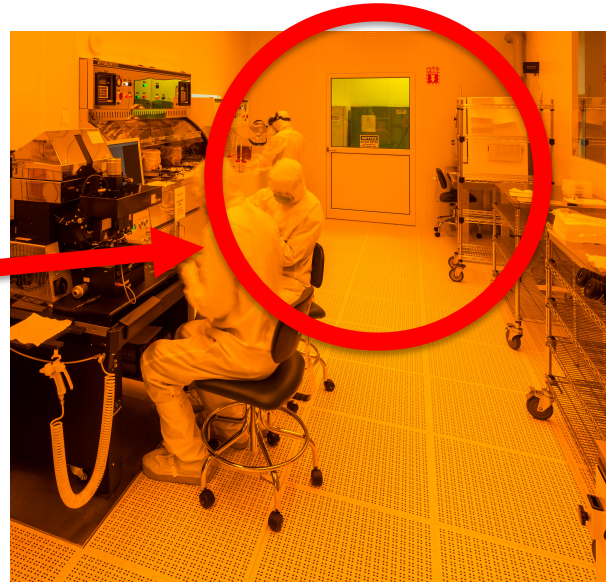
Control panel of hotplate in spin coating hood destroyed by excessive and sloppy use of (flammable!) solvents



Photoresist on front of Reynoldstech spin coating hood

Chemical transport

- Some wet benches have built-in storage
- Other chemicals retrieved from cabinets:
  - Storage (in chase) at end of litho bay
  - 4 dedicated cabinets + fridge:
    - Developers (MF-319, MicroDev, etc.)
    - Solvents (Acetone, Remover PG, etc.)
    - Acids (Sulfuric, etc.)
    - Caustics (KOH, etc.)
    - Fridge for sensitive resists
  - **ALWAYS** use chemical totes to transport bottles
  - **NEVER** leave bottles on floor



- **Need your own chemicals? Complete process review form and attach SDS**
- **Only staff have permission to bring chemicals into cleanroom**

Emergency Plan: Chemical spills

A. If spill is only a few mL (size of a quarter) & contained in hood:
   - Clean up on your own (request assistance from staff if needed)

B. If uncontained spill (ie., outside hood):
   - Ask your Buddy to advise others to leave the area and to summon staff
   - Move to a safe (ventilated) location & remain on site until staff arrives
     - Staff will take charge to render site safe & may request your assistance
     - Staff may issue an evacuation order

Note importance of safety buddy

First Aid procedures for chemical contact:

① Proceed immediately to nearest safety shower / eyewash station

② Your Buddy should alert nearby lab members to summon cleanroom staff and Your Buddy should then remain with you to assist you

③ Remove ALL contaminated clothing as you rinse the affected area

Rinse according to SDS directives, typically a minimum of 15 minutes

Use available privacy blankets as needed

Note on physical injuries

A. If major

Ex: difficulty breathing, heart attack

① Call 911 immediately

② Inform Staff (many have first aid training)

B. If minor

Ex: small chemical burn, cuts

① Inform Fab Staff (first aid)

- UW first aid poster is a good reference

② If needed, call UW Police (dial 22222)

③ If needed, Staff will accompany injured

Any injury **must be reported** to Fab Staff!

University of Waterloo

First Aid
Emergency Procedures

Major injury/illness
When a person cannot or should not be moved
Breathing Difficulty or **Suspected Heart Attack**
Call Ambulance 911

Minor injury/illness
Department/Residence - first aid kit/station location

Health Services - first aid services available — 519-888-4096 or Ext. 84096

UW Police - assists if the above services are not available — 519-888-4911 or Ext. 22222

Poisoning/Overdose Information — 1-800-268-9017

Telehealth Ontario (24 hr. phone access) — 1-866-797-0000

Emergency Instructions
1) **Call 911.** After calling 911, call UW Police at 519-888-4911 or Ext. 22222 to advise. If using a cell/mobile phone call UW Police at 519-888-4911.
2) When requesting assistance, state University of Waterloo, the building name/address and room location.
3) Enlist the aid of the nearest person (when available) to go to the designated **"Emergency Entrance"** of the building to await arrival of emergency vehicles and to direct the emergency personnel.

Emergency Entrance Location:

Loading Dock off Ring Road

Carl Pollock Hall

UW Police
519-888-4911 or Ext. 22222
Responds to and assists with emergency calls.

Unconsciousness
1) Assess responsiveness. Call 911.
2) If no signs of life open the airway, check breathing and pulse.
- if not breathing give 2 breaths
- if no pulse begin CPR
3) Place breathing person on their side (recovery position and monitor).
4) Keep person comfortably warm.
5) Continue to monitor for responsiveness until emergency personnel arrive.

Seizures
1) Protect the person from injury while seizure lasts.
2) Do not use force to restrain person.
3) Only move the person if in danger.
4) Do NOT put anything in their mouth.

Fainting
1) If person feels faint lie them down with the feet elevated.
2) Provide circulation of air and loosen tight clothing.
3) If person has fainted. Call 911. Check for breathing.
4) Place person on their side (recovery position and monitor).

Choking
1) Determine if person is choking. Offer to help.
2) Hold person from behind.
3) Give abdominal thrusts until breathing is clear.
4) Obtain medical attention.
5) If person becomes unconscious, begin CPR. Call 911.

Bleeding
1) Apply direct pressure to the wound.
2) Elevate the wound.

Bones and Joints
If injured person must be moved, immobilize injured part.

Heat Burns
1) Soak in cold water (15 minutes).
2) Remove any constrictions (jewellery).
3) Do not remove anything sticking to burn.
4) Cover burn loosely if minor.
5) Do not apply lotion or ointment.
6) If large or deep seek medical attention.

Chemical Burns
1) Rinse affected area with running water according to Material Safety Data Sheets (MSDSs).
2) Remove contaminated clothing.
3) Advise emergency personnel of chemical(s) involved. Provide MSDS(s).

Electrical Shock
1) Shut off power. Call 911.
2) Check for breathing and pulse. If no signs of life start CPR.

Reporting Injuries
1) Report to your supervisor/department.
2) Complete UW "Injury/Incident Report" on Safety Office website or by phone.
3) Send report to Safety Office.

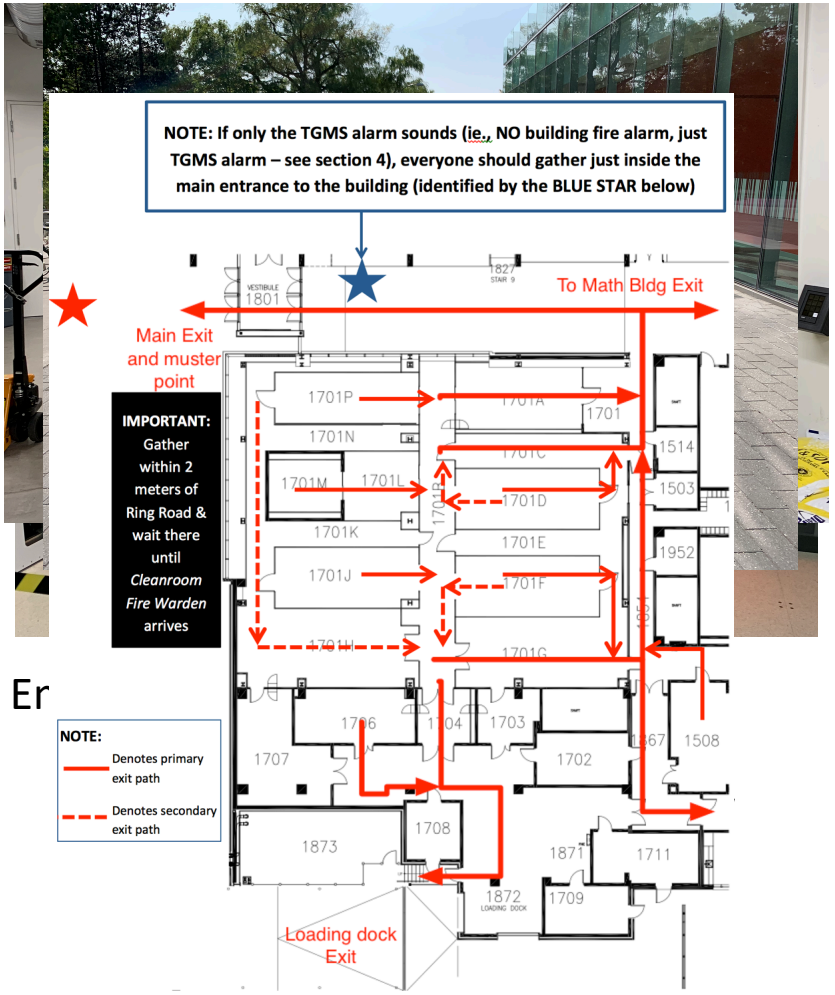
First Aid Training and Kits
Refer to Safety Office website or call.

Safety Office (Commissary Bldg.)
- www.safetyoffice.uwaterloo.ca
- Ext. 33587

Safety Office 08/06 Main Campus

Emergency Response Plan

- Plan found online:
  - https://qnfcf.uwaterloo.ca/data/access/safety-policies/emergency-response-plan-qnc-cleanroom-only
  - Serious emergencies:
    - Fire
    - Toxic gas release
    - Large chemical spill
- Leave cleanroom immediately:
  - Move quickly but do not run
  - Use closest exit
  - Do not de-gown
  - Assemble at proper muster point
  - Do not re-enter until advised by Fab Team Management



Evacuation routes

Emergency Plan: Toxic gas alarm

- Several toxic gases are used in the fab
- Fab is equipped with a *Toxic Gas Monitoring System* (TGMS)
  - Sensors monitor all toxic gases on a real-time basis
    - Sensors will trip alarm if gas is sensed
    - System will automatically cut off gas supply
    - *Emergency Gas Off* (EGO) buttons can be used to trip alarm manually
  - If activated: **evacuate immediately**

Important: In the event of any emergency requiring evacuation (ex: large chemical spill): exit cleanroom and activate EGO as you leave

TGMS sensor

EGO

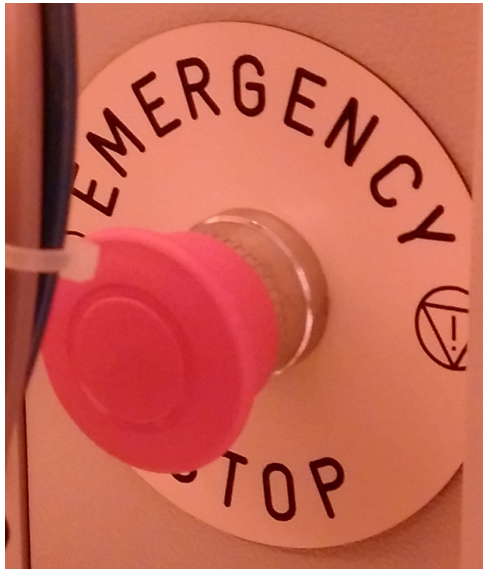
TGMS alarm

Equipment Emergency Off/Stop Buttons

Should **ONLY** be pushed if:

- Machine is about to hurt you
- Machine is about to hurt another person
- Machine is about to hurt itself

NO Exceptions!

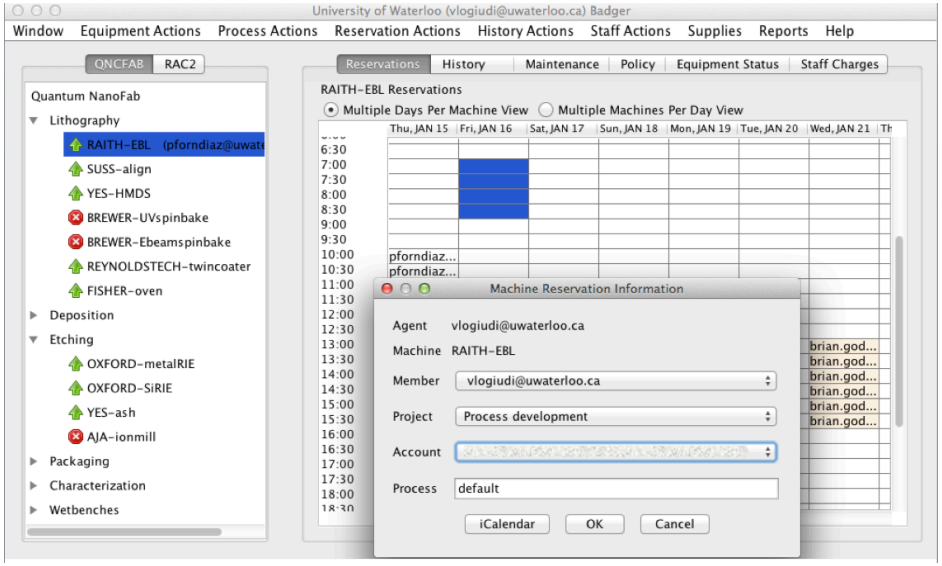


Part 4

1. Introduction
   - General information & resources
   - Lab layout, Hours of operation
2. Cleanroom Etiquette & Gowning
   - Sources of contamination, Keeping things clean
   - Gowning
   - Acceptable materials, In-cleanroom storage
   - Etiquette
3. Safety
   - General comments
   - Chemical safety
   - Emergency response plan
   - Specific hazards
4. *Badger* lab scheduler and file transfer mechanism
   - What is *Badger*, Getting started, How to use it

Badger Lab Management System

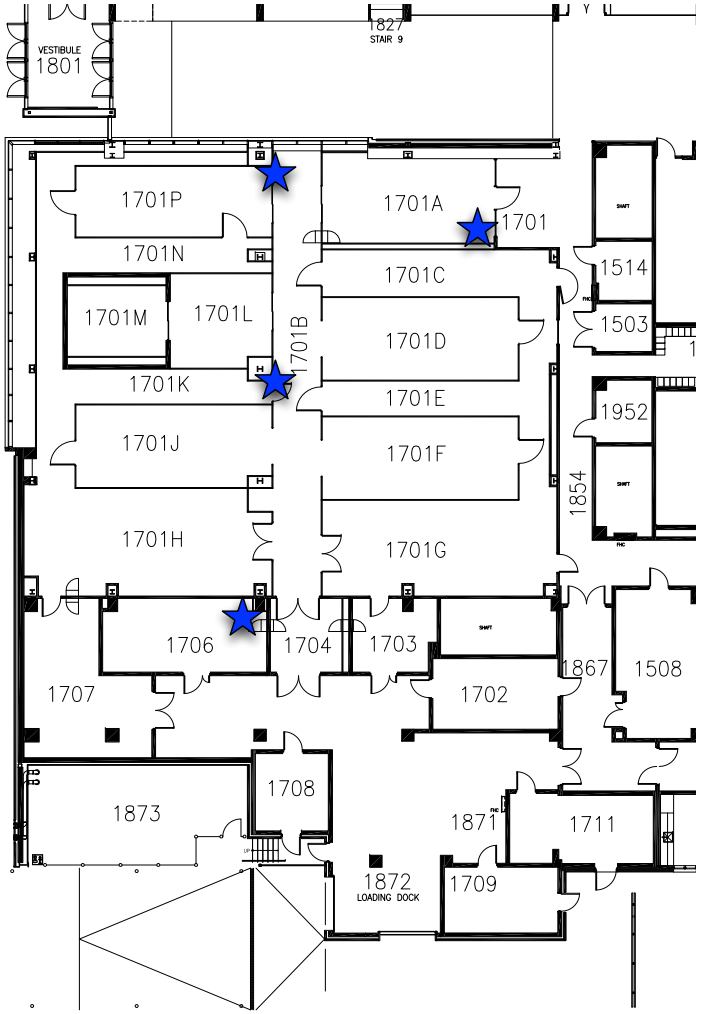
- *Badger* is a *Java* based lab management system incorporating:
  - User permissions tracking
  - Equipment scheduling
  - Equipment Enabling / Disabling
  - Equipment interlocking
  - Equipment problem reporting
  - Consumables tracking
  - User fees accounting



- Can download to your own PC/Mac

Badger: Workstation locations

- Workstation locations:
  - In gowning room (1701A)
  - In Packaging Lab (1706)
  - 4x in cleanroom central aisle (1701B)
- Located near safety TV panels in central aisle:
  - Good habit to develop: glance up at TV to verify others in lab and find a buddy



Badger workstation locations

Badger: Getting started

http://uwaterloo.badgerlms.com/badger/News.html

Badger email sent ONLY after you complete ALL required Online Training modules (Step 3 of becoming a lab member protocol)

① You will receive confirmation of account creation via email: follow instructions

A. Install *Java* then download & run *Badger* "jnlp" file
B. Run *Badger*
C. Click on "New Member" button

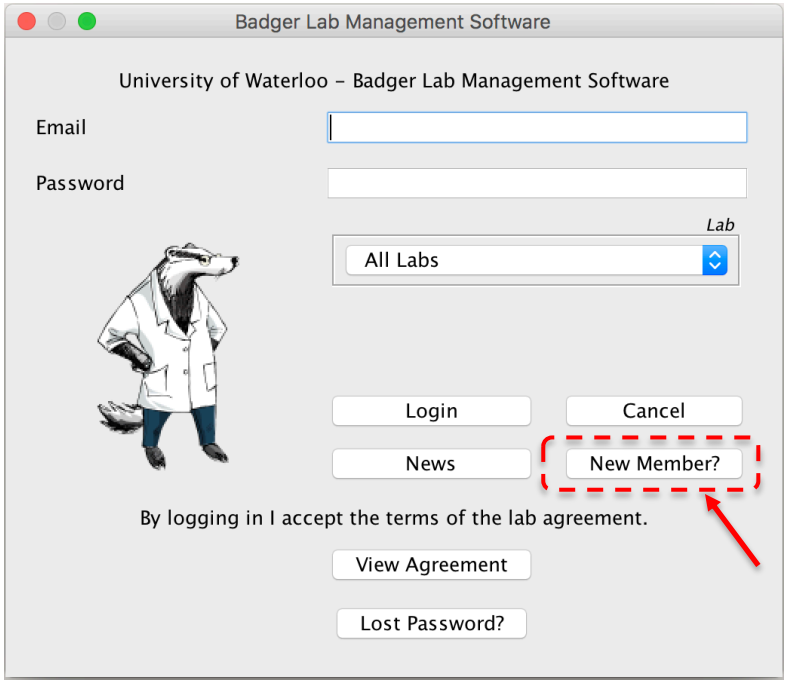
② Fill out form:

- Staff auto-notified once form is completed
- You receive a notification once staff has verified & enabled your account

NOTE: Staff requires several days to enable your account

③ Once your account has been verified & enabled:

- You may begin making reservations
- You may enable tools on which you have been trained and have been authorized to use



UWaterloo *Badger* login screen

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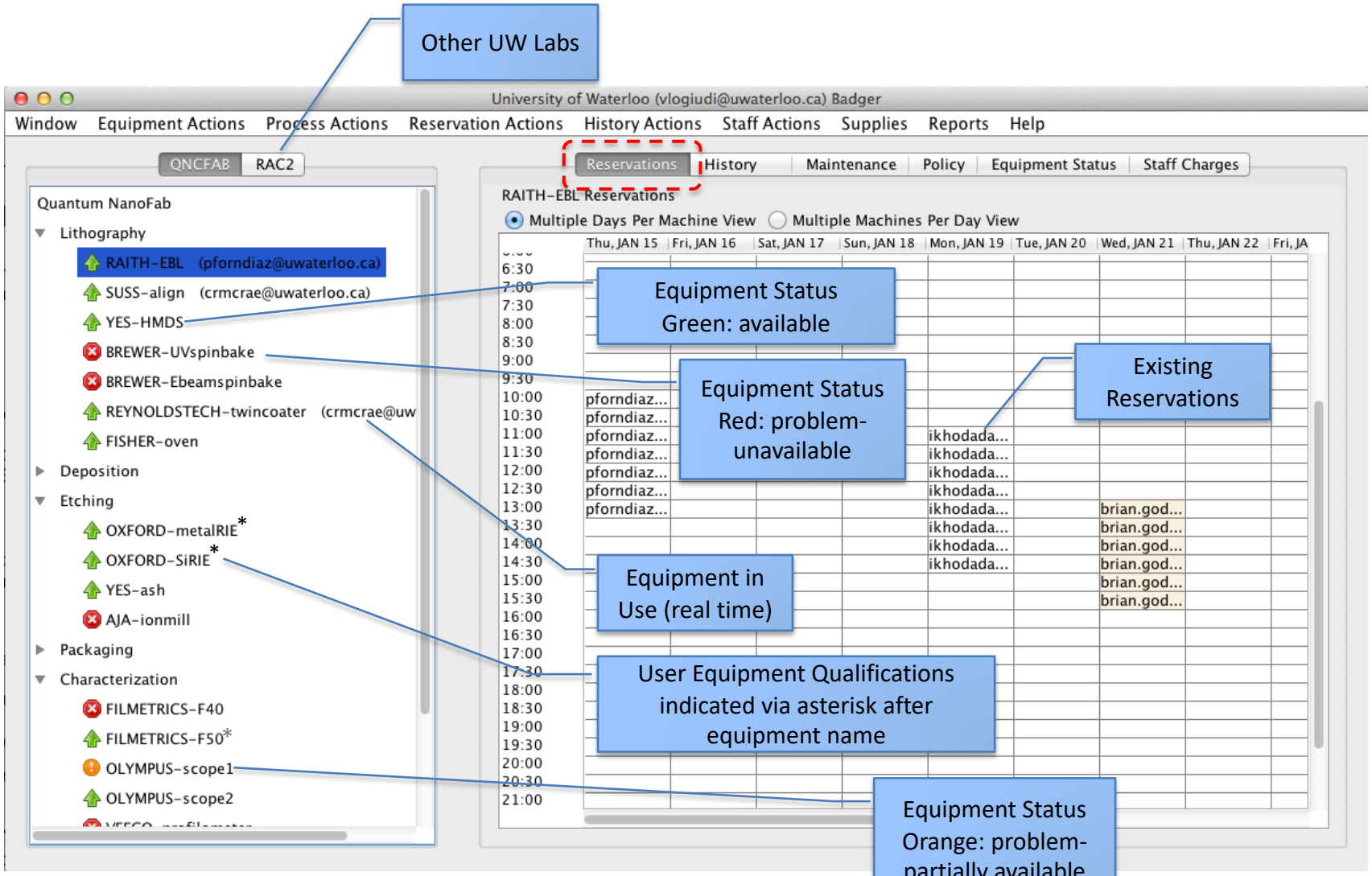
Badger: Home (Reservations) screen



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Badger: Reservations

Reservations:

- Free (not billed)
- May be deleted right up to your reservation start time

  PLEASE: ***Delete*** *a reservation that is no longer needed* ***ASAP***

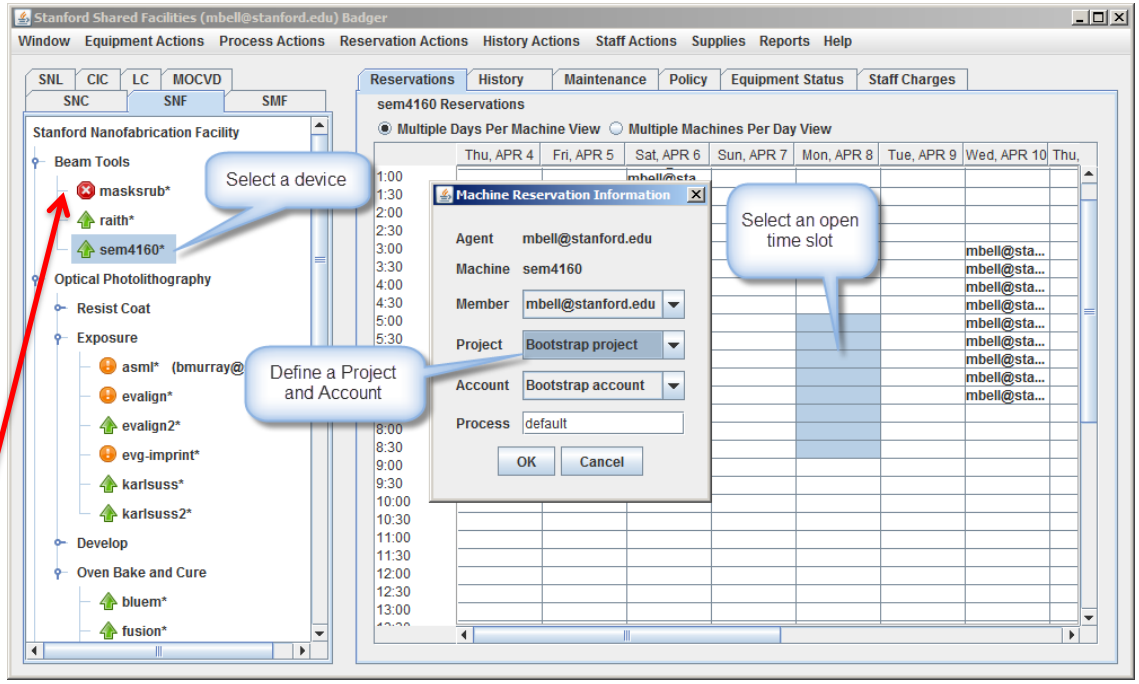
- Are unlimited in most cases*

  *Except for most frequently used tools

- Can be made up to 14 days in advance
- Can only be made for tools on which you have been trained/qualified

NOTE: Possible to make future reservations on systems which are currently offline. Check equipment status before coming in to use the system!

Demo



Sample reservation

PLEASE:

1. Reserve tools **BEFORE** using and **CANCEL** if you can't attend
2. Do **NOT** book tools excessively and then allow your reservations to expire unused. This prevents others from using equipment.
3. Non-compliance may lead to **suspension of access privileges**

Badger: Enable/Disable

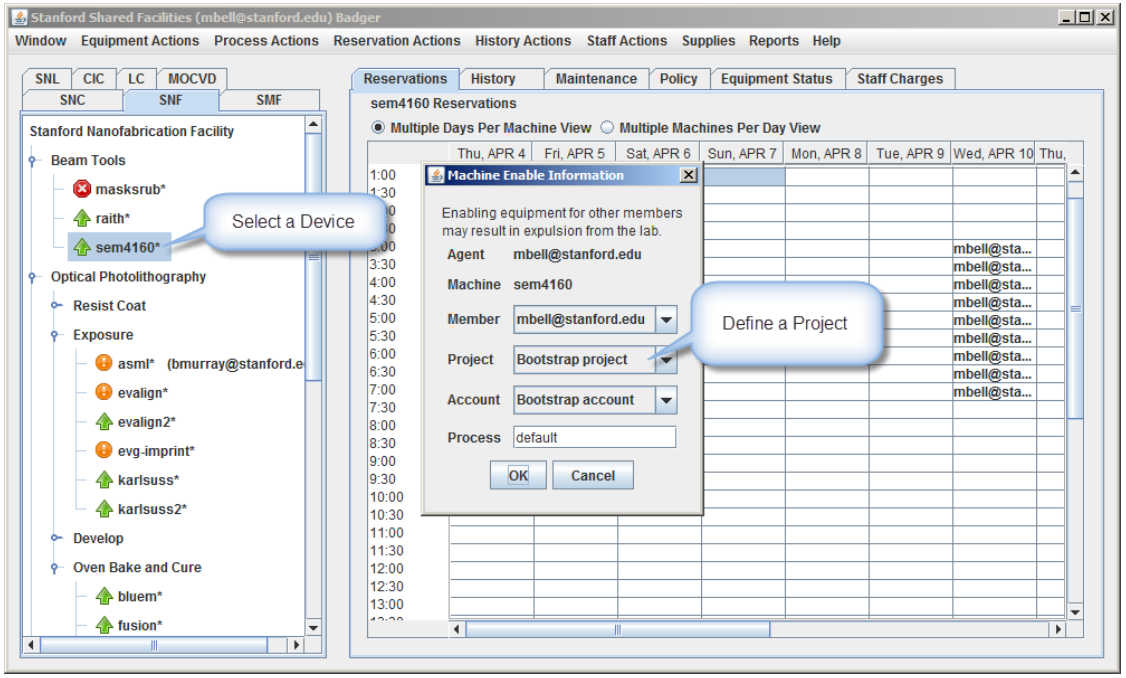
A. Enabling a tool:

- **MUST** be done prior to use
- This is billed! (by the minute)
- Visible in real time

B. Disabling a tool:

- Disable when finished
- Ends billing

Don't forget to disable!



Example: enabling a tool

NOTE:

1. Most systems equipped with a physical **interlock**. Systems will not operate if not enabled in *Badger*.
2. Enable monitor is available at cleanroom exit. Check this monitor before leaving!

Demo

Badger: Reservation Policies

Reservation policies:

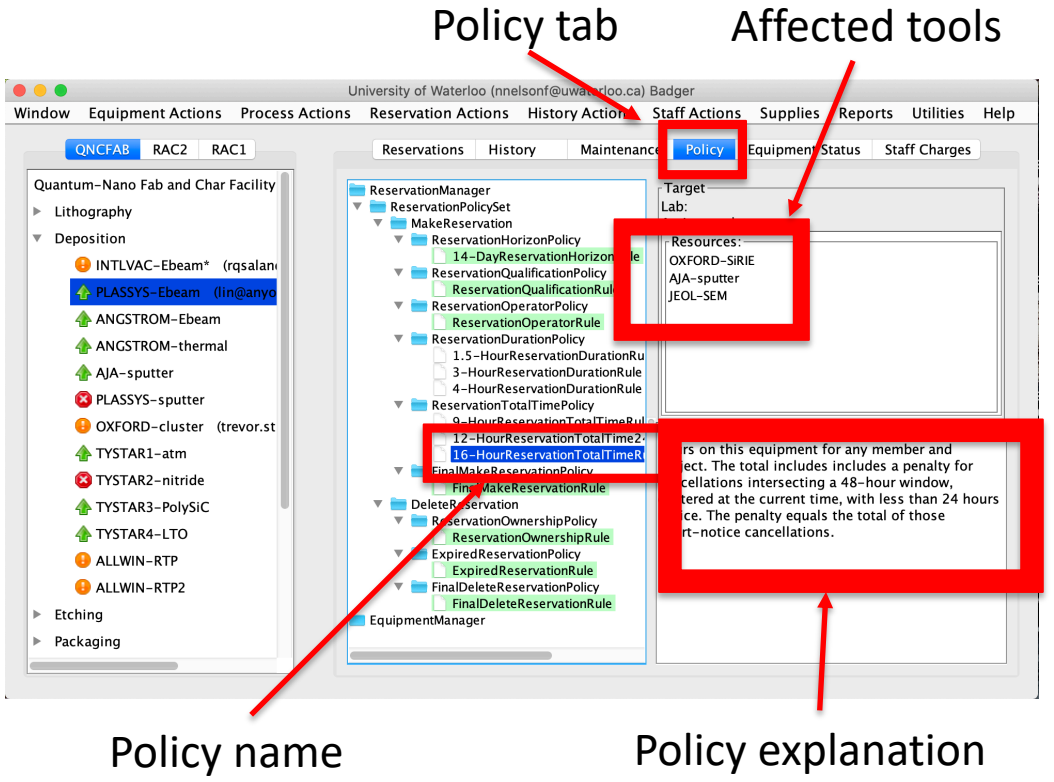
- Ensure equitable access to equipment
- Implemented on popular tools

Reservation duration policy:

- Limits maximum length of reservation

Reservation total time policy:

- Set maximum reservable time (over next 14 days)
- Time deducted for “short notice” cancellations



NOTE: Reservation policies evolve as needed

Badger: Reporting problems

A. Shutdown (red):

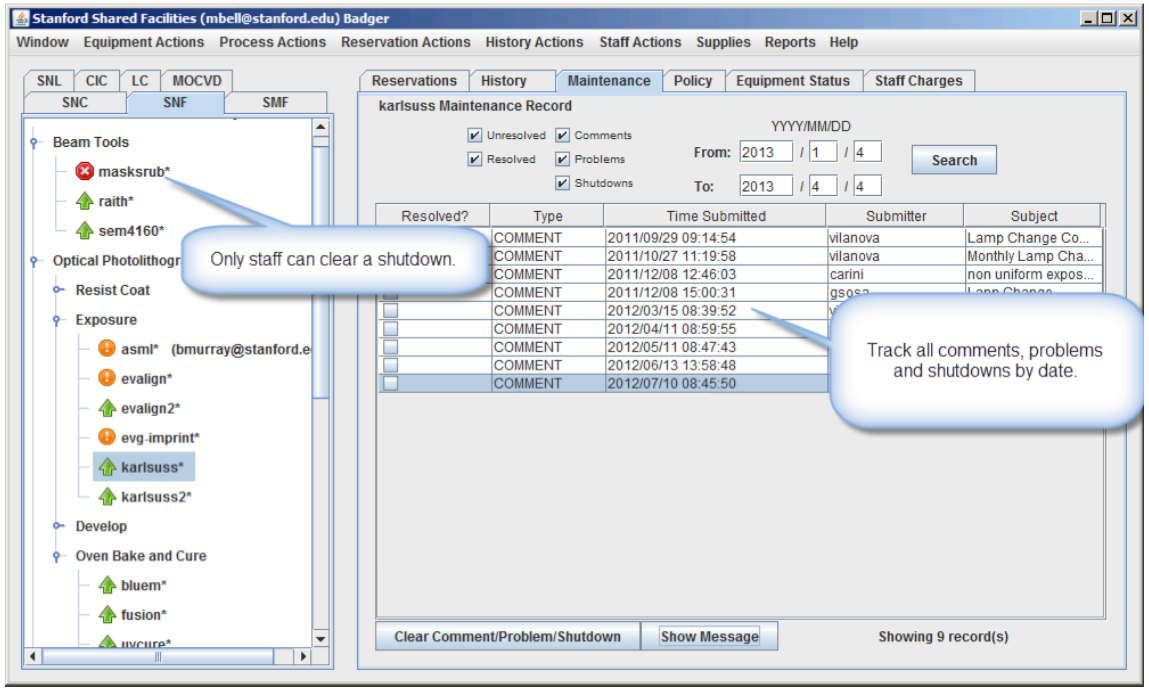
- Tool is unusable

B. Problem (orange):

- Tool usable but:
  - Partial functionality
  - Special care required
  - Tool not meeting spec

C. Comment:

- Non-critical messaging



Demo time

NOTE:

1. All reports trigger an email to staff members
2. Reports are the "paper trail" for maintenance issues. Please describe observed problems clearly and completely.

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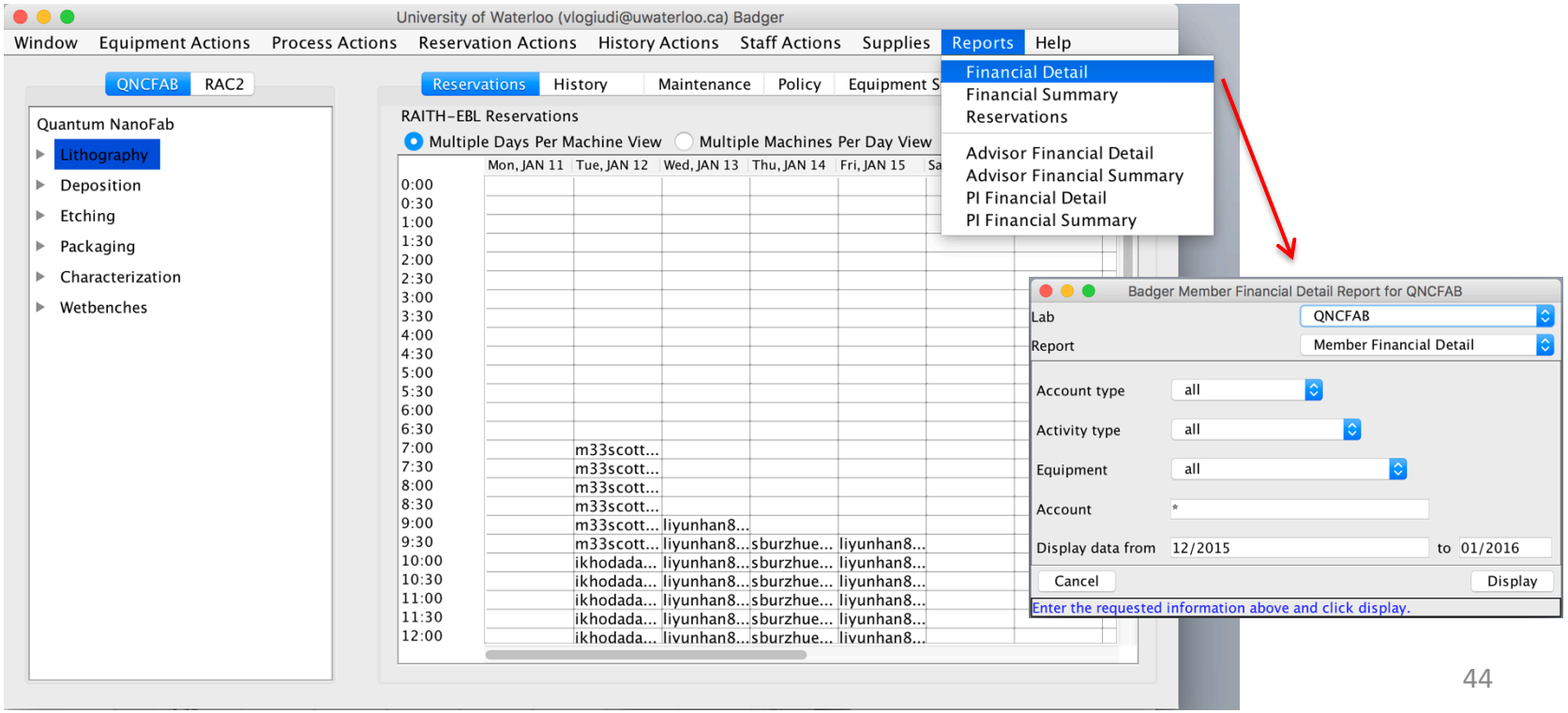
Badger: Facility Use Cost Reports

Equipment use is charged by the minute

- Detailed & most current listing of access fees may be found online https://qnfcf.uwaterloo.ca/data/access/fees/
- Each Member has real-time access to their personal cost report via *Badger*



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Monthly invoicing

- Invoices generated as a function of your facility use activities logged in *Badger.*
- Invoices reflect your equipment enables and inventory acquisitions over previous month
- Detailed invoices are sent to supervisors once per month
- Please direct any invoicing questions to Emma DeSousa e2desousa@uwaterloo.ca

Sample invoice:

UNIVERSITY OF WATERLOO | Quantum NanoFab

Quantum NanoFab
Lazaridis QNC 4108
200 University Avenue West
Waterloo, ON Canada N2L 3G1

Invoice

Month Beginning	Invoice #
7/1/2015	124

Bill To

Jonathan Baugh
RAC1 - 2123
University of Waterloo
200 University Ave W
Waterloo, ON N2L 3G1

For questions contact:
Melissa Floyd
mmfloyd@uwaterloo.ca
5190888-4567 ext. 39026

Lab	Alternate Account to Charge:	Terms
QNCFAB		Due upon receipt

Project	Activity	Description	Device	Amount
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	DEVELOPEBL	15.76
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	DEVELOPUV	13.26
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	INTLVAC-Ebeam	55.51
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	OLYMPUS-scope1	53.56
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	OLYMPUS-scope2	14.68
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	OXFORD-metalRIE	47.59
Baugh-CNT	inven_activity	[redacted], Willick, Kyle	Pt-evap	43.31
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	RAITH-EBL	103.84
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	REYNOLDSTECH...	18.92
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	SOLVENT1	19.69
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	SOLVENT2	47.29
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	SUSS-align	31.77
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	YES-ash	16.77
Baugh-CNT	eq_activity	[redacted], Willick, Kyle	YES-HMDS	39.51
Baugh-hybrid	inven_activity	[redacted], Gharavi, Kaveh	1-fluoro-cover	3.16
Baugh-hybrid	inven_activity	[redacted], Gharavi, Kaveh	1-fluoro-tray	3.44
Baugh-hybrid	eq_activity	[redacted], Gharavi, Kaveh	DEVELOPUV	49.27
Baugh-hybrid	training	[redacted], Gharavi,	HFACID	18.75

File Transfer System

- USB memory sticks are forbidden on all *QNFCF* systems (due to virus threat)

- File transfer system is available for transferring files to/from fab tools:
  - System based on *OwnCloud* software using a local, private server: https://owncloud.org
  - Files may be transferred from any computer on campus: URL is https://fab-xfer.qnc.uwaterloo.ca/login
  - Files are password protected
  - **NOTE**: The system is not backed up so it should not be treated as extra storage space

DEMO

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Final Steps before access

YOU MUST NOW *(in the following order)*:

① Attend an In-Cleanroom Orientation

② Submit an online **Process Review Request**
- If you are not certain of your process, submit rough details now & then submit a more complete one later

③ Submit proof of completion of all required UW Safety Office courses

④ Submit an online **Equipment Training Request** *(1 request per tool of interest)*
- You *must* complete items 1, 2 and 3 above **FIRST**
- You may wish to start by requesting training on a simple piece of useful equipment (ex: microscope)

NOTE: Your access FOB & ID Badge will be issued **only after** you have been trained on at least one tool

⑤ Contact appropriate staff member to schedule equipment training (please *allow 2 weeks*)

WE WILL:

A. Review & approve your process

B. Initiate your *Badger* user account (*you will receive an email with instructions*)

C. Respond to your equipment training request

D. Issue your FOB & ID Badge (*when you have been trained on at least 1 machine*)

NOTE: Photo ID must be shown to receive your access FOB & ID Badge

Final Questions?