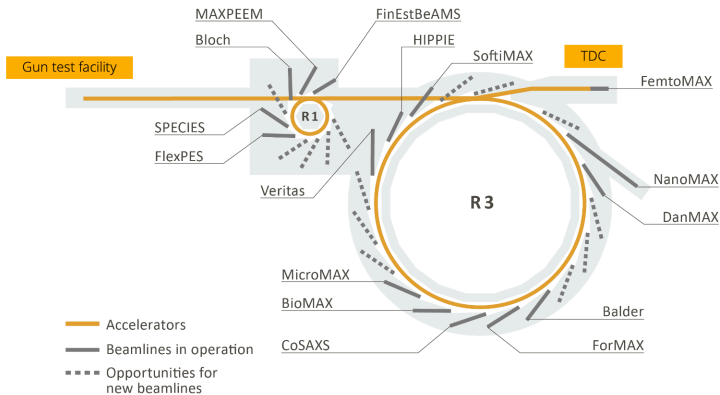


# Status update of the MAX IV Laboratory

Johanna Paulsson, MAX IV Laboratory  
RadSynch25 CNPEM, Campinas, Brazil

# MAX IV: Facility Update- Current status

## 16 operational beamlines



# MAX IV: Facility Update- Recent developments

TomoWISE: Funding for the 17th beamline at MAX IV granted

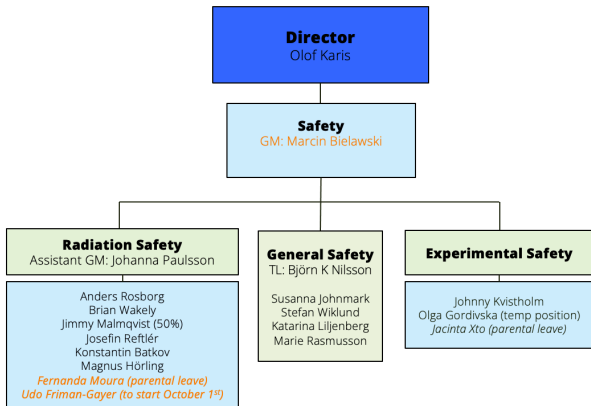
- Full-field tomography beamline
- 20-65 keV
- Two IDs: Cryo-cooled undulator for a highly brilliant beam and wiggler for a wide beam
- Expected user operation 2029

MAX 4U: CDR project to be finished 2025

- Upgrade of the 3 GeV ring to decrease emittance to below 100 pmrad
- Plan to maintain much of the existing hardware

# MAX IV: Facility Update- The radiation safety team

- New safety manager
- Two newly hires in the radiation safety team



# The radiological commissioning process for MAX IV beamlines

Johanna Paulsson, MAX IV Laboratory  
RadSynch25 CNPEM, Campinas, Brazil

# Introduction

Purpose: Describe the radiological commissioning process of beamlines at MAX IV and get experience from other facilities.



# Overview of the commissioning process

- The radiological commissioning can be structured into four different phases:



- Developed collaboratively across MAX IV teams





# Pre-commissioning- Checklist

The checklist contains many items, here are some examples:

- PSS installed and tested
- Signage in place
- Infrastructure with relevance to radiation safety labelled and in database
- Light check of hutches
- Permit received after submitting risk analysis report and commissioning plan
- Detailed survey plan

Beamline Pre-commissioning Checklist

Task	Responsible	When	Done by/date	Checked by/date
QA FE done (separate checklist)	Johanna	1 month before commissioning		
QA OH done (separate checklist)	Johanna	1 month before commissioning		
PSS and PSS testing	Anders/Jimmi	1 month before commissioning		
EPD on transport in OH	Johanna	When transport built		
Check so that FE shutters are in place	Johanna	When FE is built		
Insertion device gap information in Watchdog	Johanna	When ID is installed		
Beamline IRM in place, tested with cable	Johanna	1 month before commissioning		
Beamline IRM in Watchdog	Johanna	1 month before commissioning		
Beamline GUI on cc-10	Johanna	2 weeks before commissioning		
Search buttons and possibly mirrors in place	Anders	1 week before commissioning		
Maintenance mode variable in Watchdog (if available)	Johanna	1 month before commissioning		
Risk analysis scat	Konstantin/ Anders			
Commissioning plan scat	Johanna			
Permit in place	Magnus, Johanna			
Shielding and safety screws/nuts in place and added to shielding database (including FE)	Johanna	1 month before commissioning		
Shielding and safety screws/nuts added to shielding database (including FE)	Johanna	1 month before commissioning		
Commissioning measurement plan done	Johanna	1 week before commissioning		
OSLs in place	Johanna	1 week before commissioning		
EPDs in place in shelf	Johanna	2 weeks before commissioning		

# Pre-commissioning- Detailed survey plan I

The survey plan details the measurements that will be done with hand-held detectors (primarily GM-type detectors)

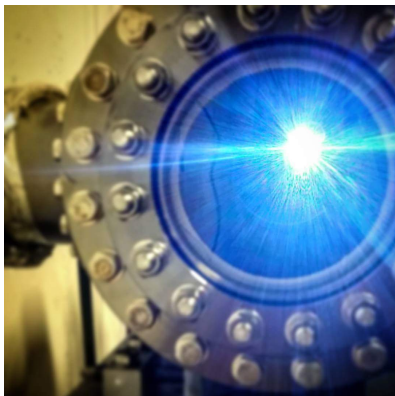
- Power table from ID team
- Spectrum of monochromatic beam from beamline team
- Close collaboration with the beamline office, the ID team, accelerator development and accelerator operations, as well as beamline team
- For OH: Full survey at predefined currents and gaps
- For EH: Full survey at predefined energies and fluxes and “scattering experiment”

# Pre-commissioning- Detailed survey plan II

MicroMAX detailed measurement plan for Radiological and FE Commissioning																			
Operation of the beamline outside commissioning hours is <b>prohibited</b> until normal operation status has been given by the radiation safety team. Full commissioning of OH.														FE prerequisites: Changes for FE Commissioning MicroMAX - 2-4					
Commissioning of OH and OH up to 25 kV and "CO" for max. ph. Scattering experiment after final step, to be discussed with beamline staff.																			
W	Gen. Com Site	IRL SR	Hours (mean - hours)	Description	Dipole HA	FE HA	FE MM	FE Fluor. Screen	FE BSI B52	Screen OH	MS1 B52	Screen IH1	Screen OH2	Ring current [nA]	Gap [mm]	Local Dump [kA, V] (start)	Measurements	Resource	Rad. Safety Comments
<b>ID commissioning</b>																			
0	1			ID commissioning	Closed	Closed	Open = (H1,F1,L2,V2) / (D0,SR)	Out	Closed	N/A	Closed	N/A	N/A	<3.5	7			IO, Ops, RST	Mostly for the IO team and the ID commissioning (see forward table). Radiation safety measurements are done continuously during the ID commissioning, but the ID group will pause at the predefined gaps for complete radiation safety (RST/MS1) scans.
<b>FE commissioning - Cold Beam</b>																			
1	2	1	2	Bremsstrahlung ring tunnel	Open	Closed	Open	Out	Closed	N/A	Closed	N/A	N/A	<3.5	Fully open	0/0	Ring tunnel, from 10 m upstream of ID to 25 m downstream of ID. REW inside OH. Particular emphasis vacuum pipe through REW in OH, GM.	RST, Ops	
1	3		2	FE Outgassing	Open	Closed	Open	Out	Closed	N/A	Closed	N/A	N/A	<3.5	48-18		Observe FE Vacuum, stop and wait if above <i>See 7-nbr</i>	PI, Ops	Total 4 man-hours from a radiation safety perspective.
1	4	2	2	SR ring tunnel	Open	Closed	Open	Out	Closed	N/A	Closed	N/A	N/A	<3.5	4.5		Ring tunnel, from 10 m upstream of ID to 25 m downstream of ID. REW inside OH. Particular emphasis vacuum pipe through REW in OH, GM.	RST, Ops	
<b>Start of OH commissioning-first light - Cold Beam</b>																			
1	5			FE-OH Outgassing	Open	Open	Open	In	Open	N/A	Closed	N/A	N/A	<3.5	Fully open		Observe FE-OH Vacuum, stop and wait if above <i>See 7-nbr</i>	PI & MicroMAX	
1	6	3	0.5	Verify functioning of HA	Open	Open/Close	Open	In	Open/Close	N/A	Closed	N/A	N/A	<3.5	Fully open		Verify that the HA completely stops the synchrotron radiation. Measure by Oh back wall, BL and GM.	RST, PI	
1	7	4	2	Bremsstrahlung OH	Open	Open	Open	Out	Open	Out	Closed	N/A	N/A	<3.5	Fully open		Complete scan of OH with GM. Measurement with BL in beam height.	RST	2 man-hours of early radiological commissioning with reduced ring current.
1	8			FE-OH Outgassing	Open	Open	Open	Out	Open	Out	Closed	N/A	N/A	<3.5	48-18		Observe FE-OH Vacuum, stop and wait if above <i>See 7-nbr</i>	PI & MicroMAX	
1	9	5	0.5	Verify functioning of HA	Open	Open/Close	Open	In	Open/Close	N/A	Closed	N/A	N/A	<3.5	4.5		Verify that the HA completely stops the synchrotron radiation. Measure by Oh back wall, BL and GM.	RST, Ops/IO, PI, MicroMAX	
1	10	6	2	SR OH	Open	Open	Open	Out	Open	Out	Closed	N/A	N/A	<3.5	4.5		Complete scan of OH with GM. Measurement with BL in beam height.	RST, MicroMAX	
<b>Continued FE commissioning at delivery current (Hot Beam)</b>																			
2	11			FE Outgassing - Current ramp	Open	Closed	Open	Out	Closed	Out	Closed	N/A	N/A	0-300	Fully open		Observe FE Vacuum, stop and wait if above <i>See 7-nbr</i>	PI, Ops	
2	12			FE Outgassing - Closing Gap	Open	Closed	Open	Out	Closed	Out	Closed	N/A	N/A	300	48-18		Observe FE Vacuum, stop and wait if above <i>See 7-nbr</i>	PI, Ops	
2	13	7	2	Bremsstrahlung ring tunnel	Open	Closed	Open	Out	Closed	Out	Closed	N/A	N/A	300 or delivery current	10		Ring tunnel, from 10 m upstream of ID to 25 m downstream of ID. REW inside OH. Particular emphasis vacuum pipe through REW in OH, GM.	RST, Ops	2 man-hours of continued radiological commissioning with normal delivery ring current.
2	14			FE Outgassing	Open	Closed	Open	Out	Closed	Out	Closed	N/A	N/A	300	10-4		Observe FE Vacuum, stop and wait if above <i>See 7-nbr</i>	PI, Ops	
2	15	8	2	SR ring tunnel	Open	Closed	Open	Out	Closed	Out	Closed	N/A	N/A	300 or delivery current	4.5		Ring tunnel, from 10 m upstream of ID to 25 m downstream of ID. REW inside OH. Particular emphasis vacuum pipe through REW in OH, GM.	RST, MicroMAX	
<b>Accelerator Studies</b>																			
- Depending on situation Accelerator Studies will be performed before or after OH commissioning																			
3	16			Accelerator Studies	Open	Closed		Out	Closed	Out	Closed	N/A	N/A	300	4		All steps Closed impedance Studies etc.	R3	at least a day
<b>Continued OH commissioning at delivery current (Hot Beam)</b>																			
4	17			FE-OH Outgassing - Current ramp	Open	Open	Open	Out	Open	Out	Closed	N/A	N/A	0-300	Fully open		Observe FE-OH Vacuum, stop and wait if above <i>See 7-nbr</i>	PI & MicroMAX	
4	18			FE-OH Outgassing - Closing Gap	Open	Open	Open	Out	Open	Out	Closed	N/A	N/A	300	48-18		Observe FE-OH Vacuum, stop and wait if above <i>See 7-nbr</i>	PI & MicroMAX	
4	19	9	0.5	Verify functioning of HA	Open	Open/Close	Open	Out	Open/Close	In	Closed	N/A	N/A	300 or delivery current	10		Verify that the HA completely stops the synchrotron radiation. Measure by Oh back wall, BL and GM.	RST, Ops/IO, PI, MicroMAX	
4	20	10	2	Bremsstrahlung OH	Open	Open	Open	Out	Open	Out	Closed	N/A	N/A	300 or delivery current	10		Complete scan of OH with GM. Measurement with BL in beam height.	RST, MicroMAX	2 man-hours of continued radiological commissioning with normal delivery ring current.

# Commissioning- First light and rules

- Radiation safety and beamline staff must be present when:
  - ID gap not fully open
  - Front-end shutters enabled
- Detailed survey plan used. Full radiation surveys at:
  - Ring tunnel walls and roof
  - Optics hutch
  - Experimental hutch, if applicable



# Transition to normal operation

- Commissioning report submitted to authority and approved
- Beamline specific training for beamline staff, including hutch searches, has been conducted
- Beamline listed as in normal operation in documentation
- Software alarms removed
- Daily surveys until normal operation



MAX IV

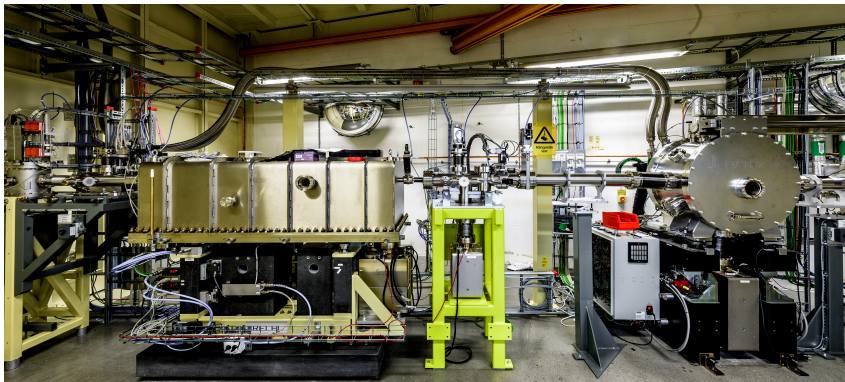
# Normal operation

- Routine radiation checks, varying periodicity
- Training of new staff members as required, repetition training for every 6 years
- On-site training of users done by beamline staff using checklist
- Remote operation of beamline allowed for staff members
- Remote operation of beamline allowed for users under certain conditions

# Current gaps and future focus

Identified areas of improvement:

- Make sure components critical to radiation safety match documentation (QA-like process)
  - Permanent magnet in FE
  - Fixed masks in FE
  - Beam shutters in FE and OH
  - Collimators in OH



# Summary

- We have commissioned 16 beamlines in 10 years
- Early on there was a need for a structured and collaborative commissioning
- Phases aim at safe ramp-up to normal operation
- Ongoing development to improve quality

Thank you!

