MAX IV Status

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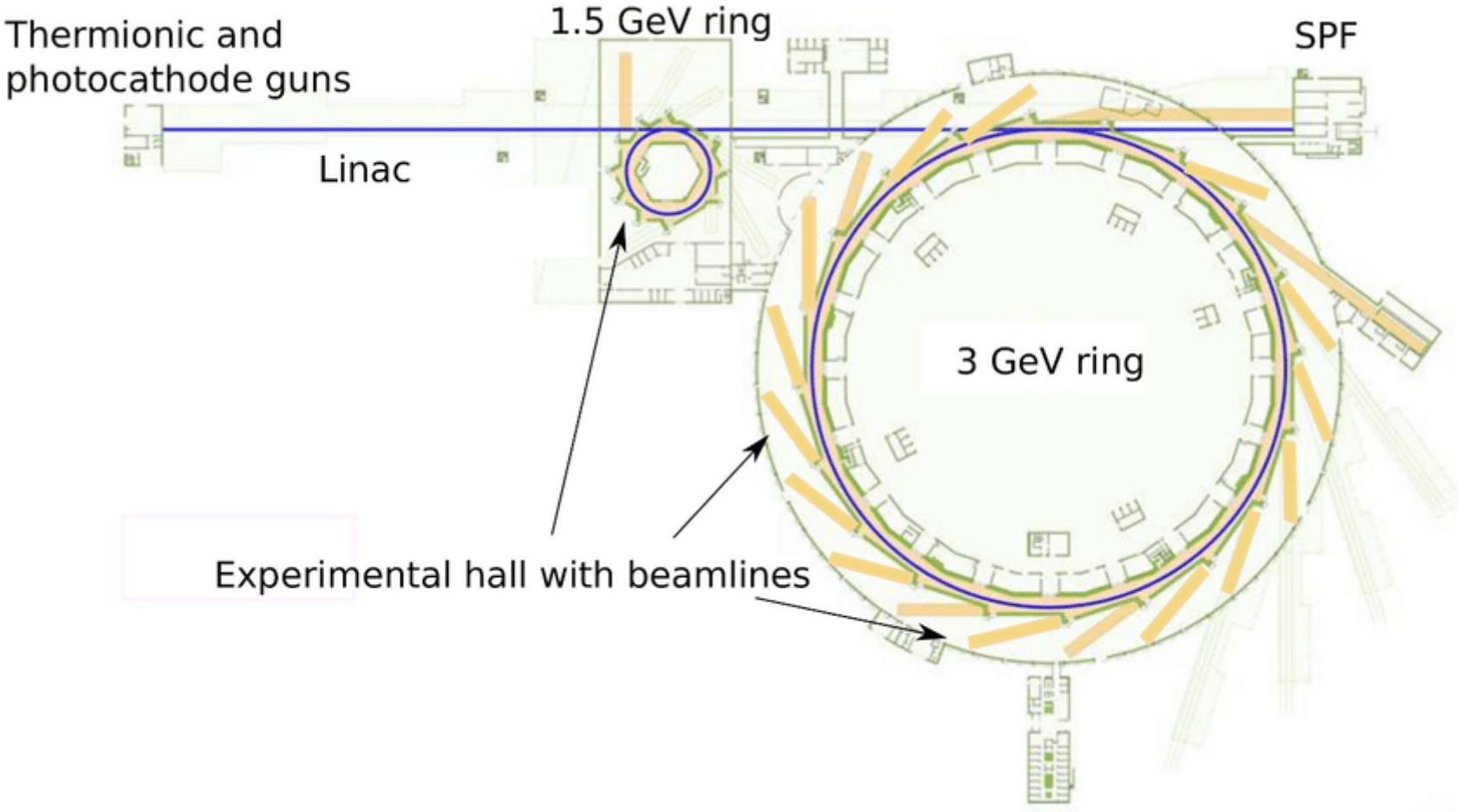
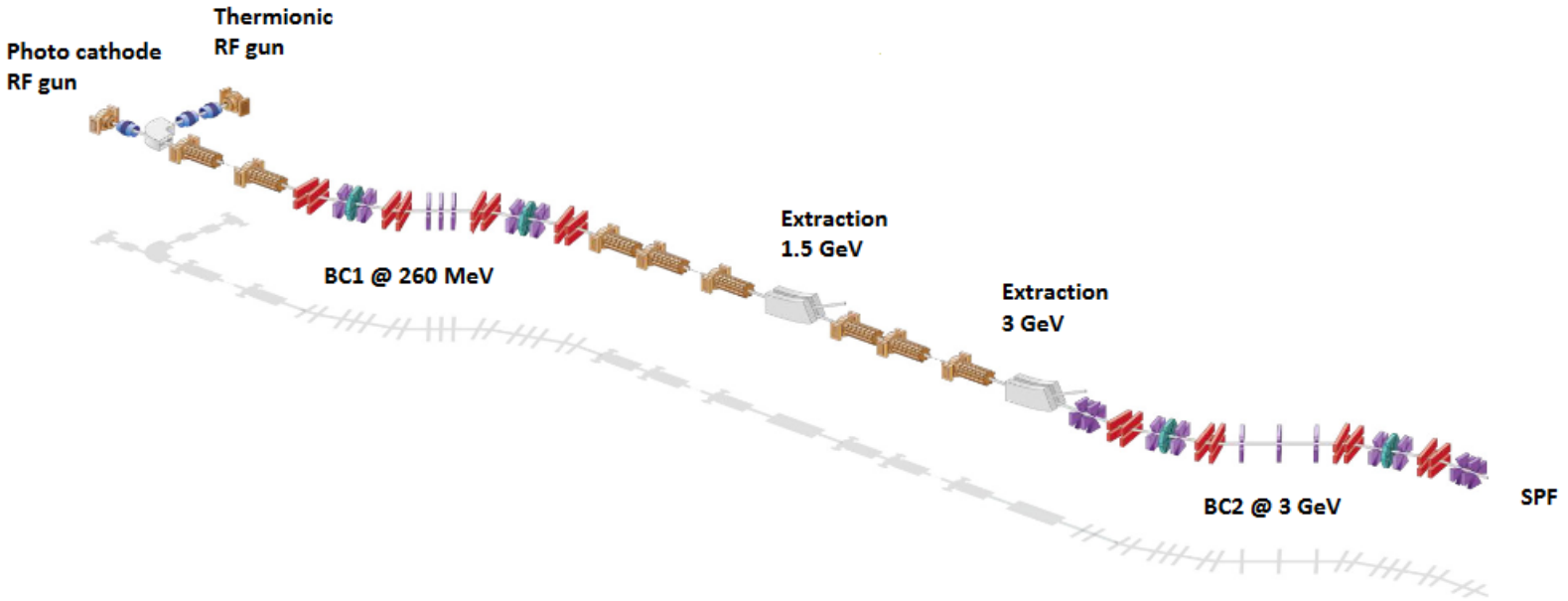
MAX IV Overview

- One linac
- Two separate storage rings at 1.5 GeV (UV) and 3 GeV (x-rays)



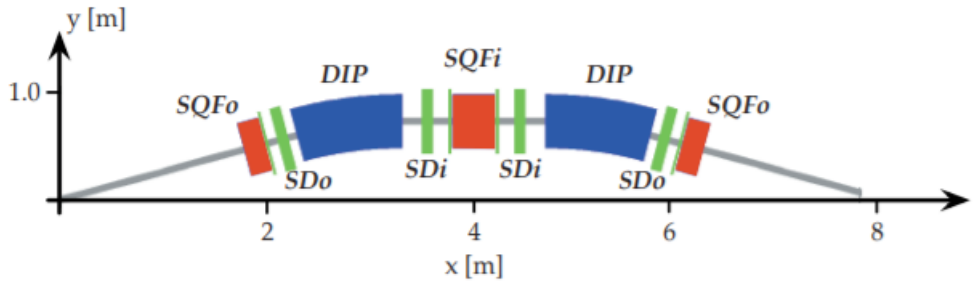
Linac (~ 300m)



- Continuous top-up injector to both storage rings
- Also accelerates and compresses electron bunches for the SPF
- Photo-RF gun for SPF pulses
- Thermionic RF gun for storage ring injection
- Design repetition rate as ring injector: 10 Hz (currently: 2 Hz)
- Design repetition rate for SPF: 100 Hz (currently: 2 Hz)

1.5 GeV Storage Ring (R1)

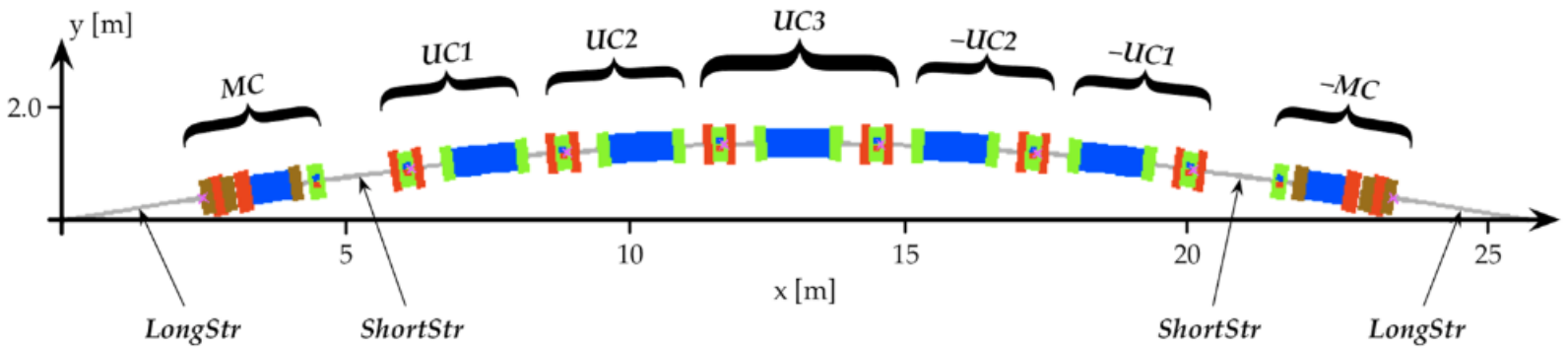
- Circumference 96 m
- 500 mA design store current (currently at 250 mA)
- Double bend achromat lattice
- 12 achromats 8 m long (10 IDs)
- Compact magnet block
- low radio-frequency (100 MHz → max. 32 bunches spaced by 10 ns)



2 dipoles,
Bending angle: 30^0
Bending radius: 3.8 m

3 GeV Storage Ring (R3)

- Circumference 528 m
- 500 mA design store current (currently at 250 mA)
- 7-bend achromat lattice (first of this type in the world)
- 20 achromats 26.4m long (19 IDs)
- Compact magnet block
- low radio-frequency (100 MHz → max. 176 bunches spaced by 10 ns



7 dipoles,
Bending angle: 18^0
Bending radius: 19 m

Accelerator Operations summary

Availability 2018:

	3 GeV Ring	1.5 GeV Ring	Short Pulse Facility
Delivery hours	4068 hours	2953 hours	2467 hours
Availability	96.2%	96.7%	95.4%
Mean Time Before Failure	34.5 hours	59.6 hours	32.7 hours
Mean Time To Repair	1.3 hours	1.9 hours	1.5 hours

Availability 2019, year-to-date:

Min duration(min):	0	Min date:	2019-01-01	Min time:	00:00
Max duration(min):	999999	Max date:	2019-09-26	max time	23:59

Machine	Planned delivery (h)	total downtime (h)	uptime (%)	MTTR (h)	MTTF (h)	MTBF (h)
R1	3639	56.33	98.45	1.01	64.98	63.98
R3	3053	75.03	97.54	1.07	43.61	42.54
SPF	2361	49.93	97.89	0.91	42.93	42.02

500 mA in R3!

- Running at 250 mA:
  → RF power
  → Radiation safety limits (for closing gap at high currents)
- **Beam configuration at 500 mA achieved - December 2018**
- From Ian McNulty: “.... congratulate the entire MAX IV staff on achieving 500 mA stored current in the 3 GeV ring last week. This outstanding achievement by many people working together exemplifies the best in teamwork and technical excellence.”

New RF cavity in R3

- After summer shutdown RF cavity (#19) installed
- More beamlines → more RF power needed!
- Installation was successful and delivery started on schedule

Beamline Status

MAX IV beamlines (June 2018)

Legend:
User Operation
Commissioning
Construction
transitioning

3.0 GeV Ring

NanoMAX
Nanofocus & coherence

DanMAX
Imaging & diffraction

Balder
EXAFS & RIXS

ForMAX
Wood based material

CoSAXS
SAXS & coherence

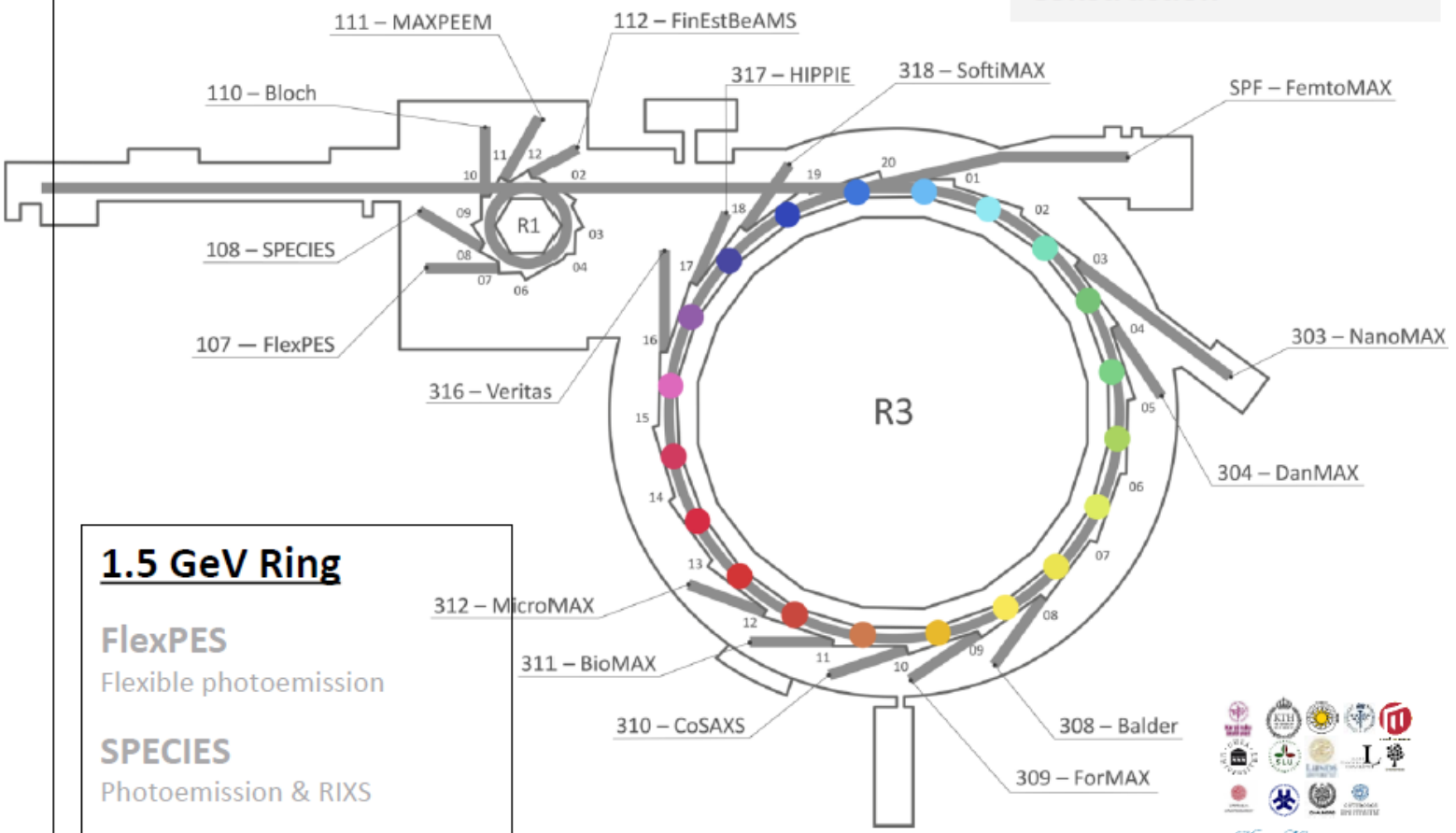
BioMAX
Protein structure

MicroMAX
Protein structure

Veritas
Excitations in solids & liquids

HIPPIE
Operando spectroscopy

SoftiMAX
Microscopy & coherence



1.5 GeV Ring

FlexPES
Flexible photoemission

SPECIES
Photoemission & RIXS

Bloch
Electronic structure & surfaces

MAXPEEM
Microscopy of surfaces

FinEstBeAMS
Gas phase & luminescence

LINAC

FemtoMAX
Ultrafast diffraction & spectroscopy

MAX IV beamlines (May 2019)

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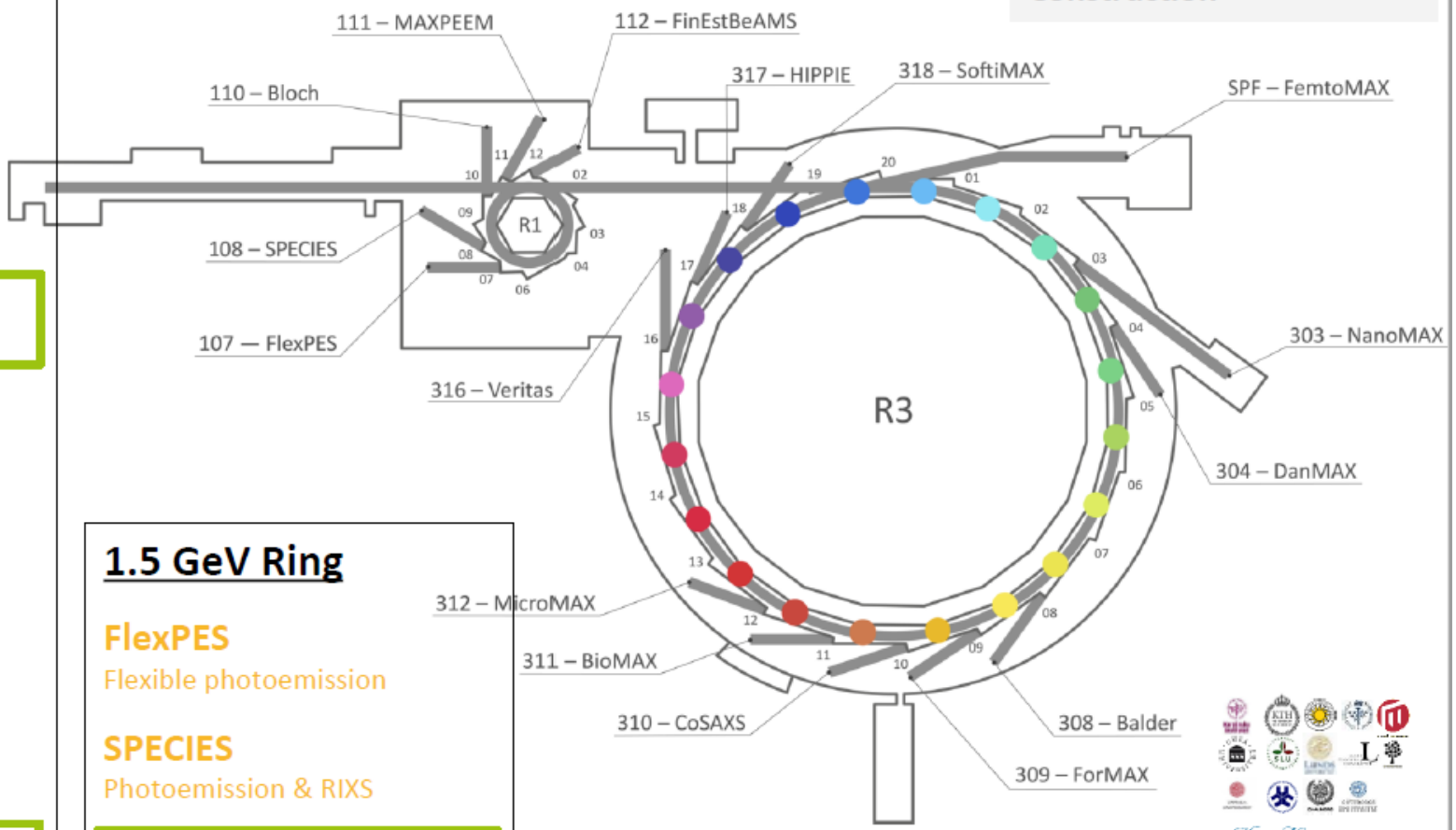

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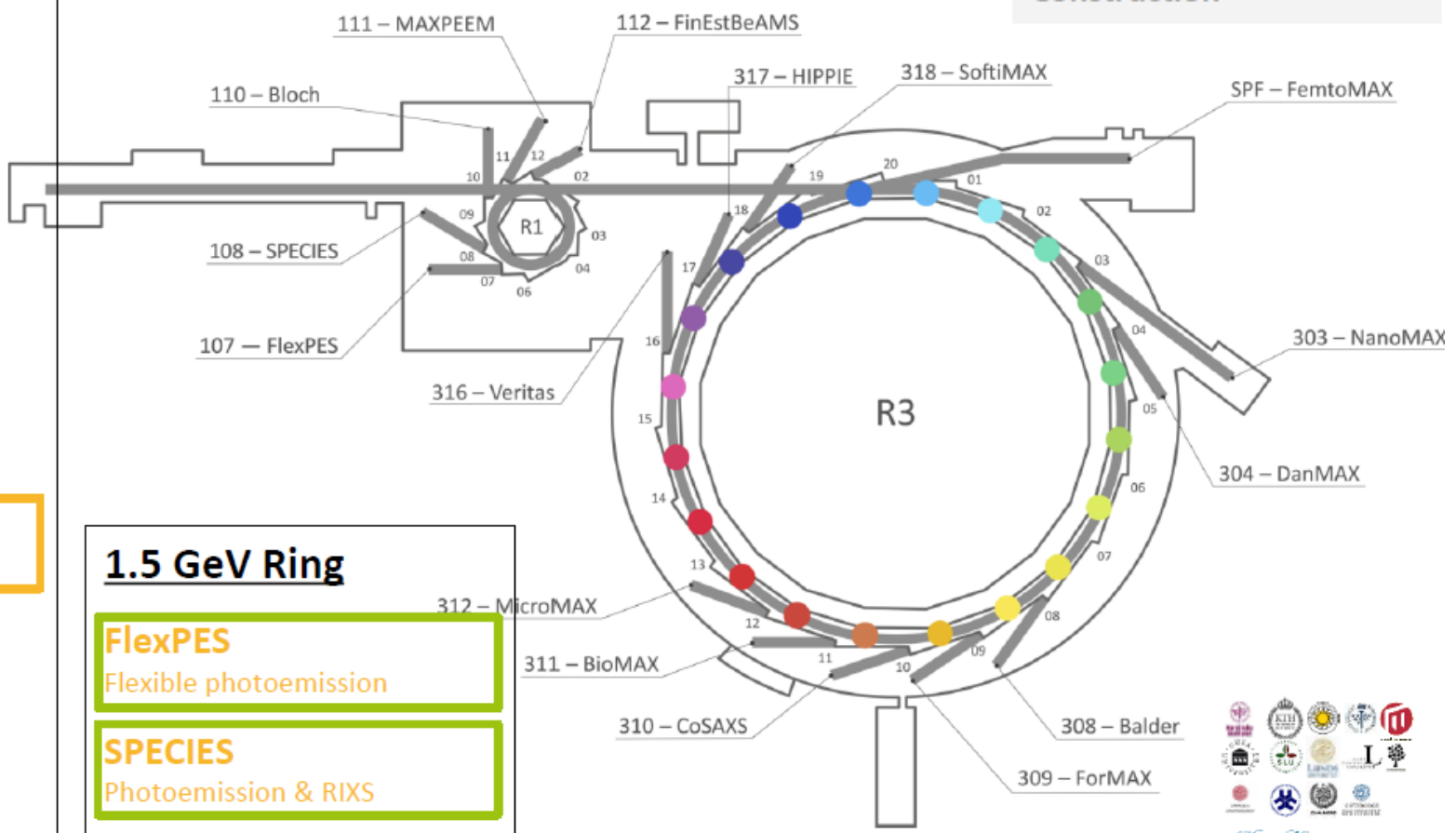

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All 11 beamlines taking light simultaneously!

- Milestone reached in May 2019
- Note: closed undulator gaps ✓
  high bunch charge delivered to SPF ✓

The future

- In addition to 11 beamlines operating/commissioning, 5 more are funded and under construction for soft matter (CoSAXS), microscopy (SoftiMAX), hard materials (DanMAX), forestry (ForMAX), and structural biology (MicroMAX).

- Concepts and partial funding commitments exist for 2 more beamlines for materials diffraction (DiffMAX) and medical imaging (MedMAX).

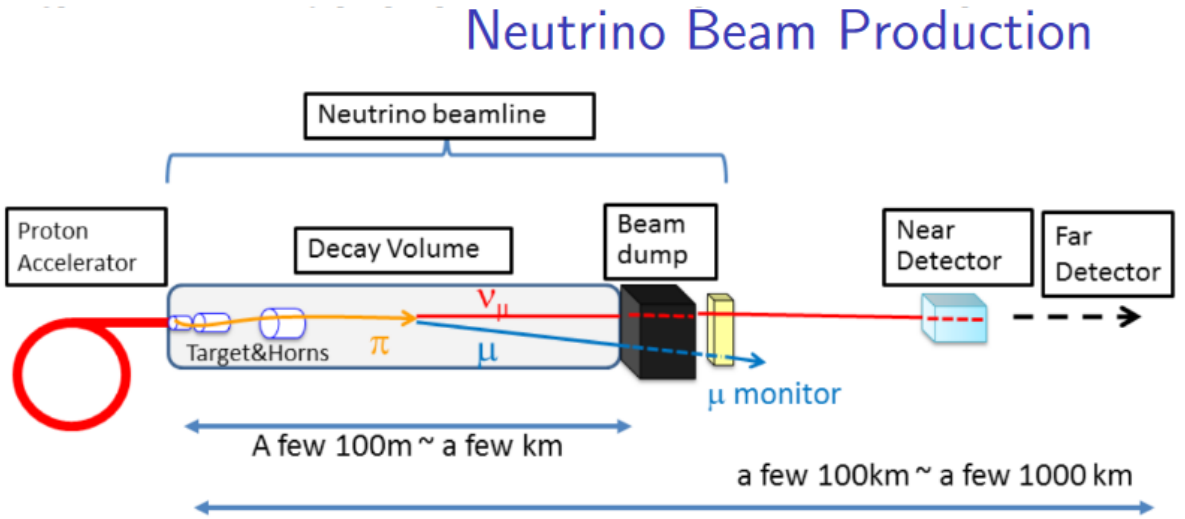
- 8 more ports exist on the 3 GeV ring for new beamlines (up to ~18).

IBIC 2019 – Quick report!

- Hosted by ESS in collaboration MAX IV
- World community of experts in instrumentation for particle accelerators
- Explore the physics and engineering challenges of beam diagnostics and measurement techniques for charged particle beams

IBIC Highlights for Partikeldagarna

Challenges in Continuous Beam Profile Monitoring for MW-Power Proton Beams
M.L. Friend



- Slam high-energy high-intensity proton beam into long target
- Focus outgoing hadrons in electro-magnetic focusing horns
- Pions decay to muons and muon-neutrinos in long decay volume
- Stop interacting particles in beam dump; neutrinos continue on to near and far detectors for neutrino experiments
  - Instrument beam dump to continuously monitor muon beam
- Number of neutrinos is proportional to number of protons incident on the target – maximize proton beam power to maximize flux

→ Continuous proton beam profile monitoring is essential for successfully running fixed target neutrino extraction beamlines!

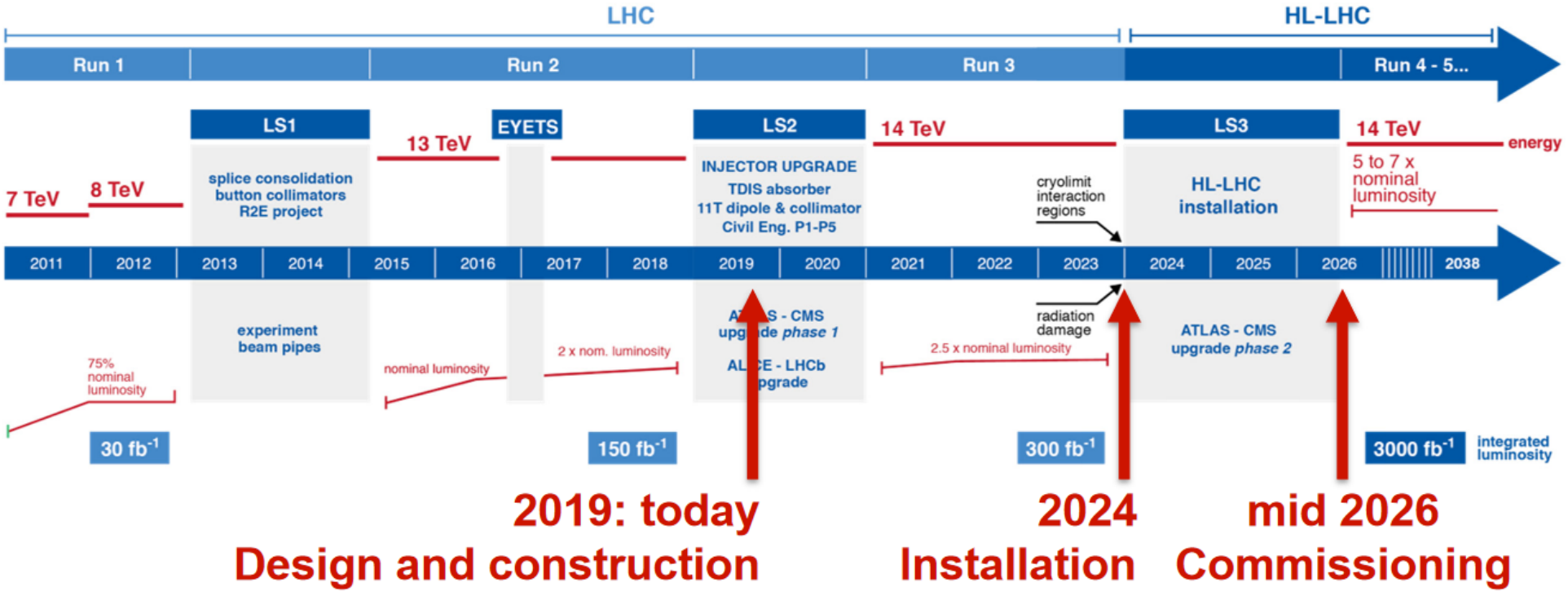
IBIC Highlights for Partikeldagarna

Beam Instrumentation and Diagnostics for High Luminosity LHC

M. Krupa

From LHC to HL-LHC

- HL-LHC beam commissioning planned in 7 years

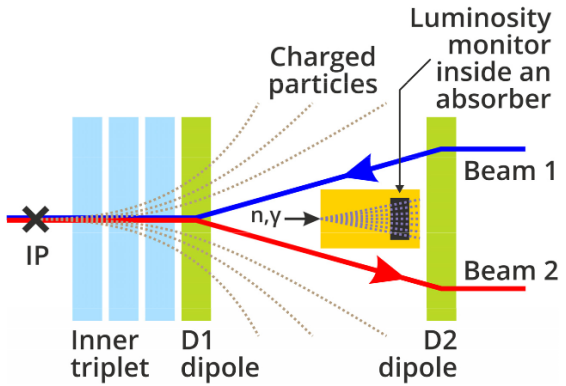


IBIC Highlights for Partikeldagarna

Beam Instrumentation and Diagnostics for High Luminosity LHC
M. Krupa

Luminosity monitoring - BRAN

- Luminosity monitoring independent of experiments
- LHC: ionisation chambers measuring the shower created by forward neutral debris



- High Luminosity LHC → beam instrumentation and diagnostics in the LHC will be upgraded and complemented by new developments
- ATLAS and CMS measure instantaneous luminosities independently → often not available to LHC machine operation during machine study periods
- BRAN (Beam RAte from Neutrals) detectors are installed to complement the luminosity monitoring
- Installed in the neutral absorbing block on either side of the high luminosity experiments

Summary

- MAX IV doing great and improving
- Accelerators achieved new milestones
- Accelerator operations providing higher availability
- Impressive progress on delivering beamlines to users
- Short IBIC report

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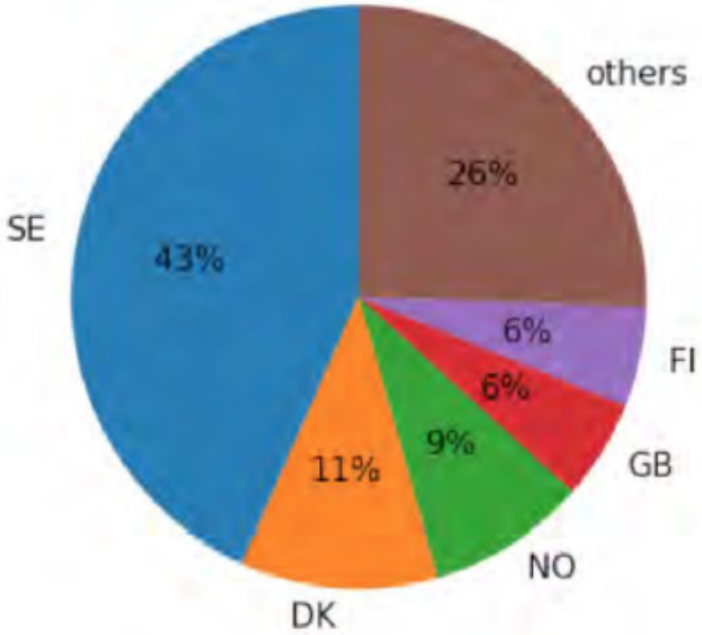
Thanks!

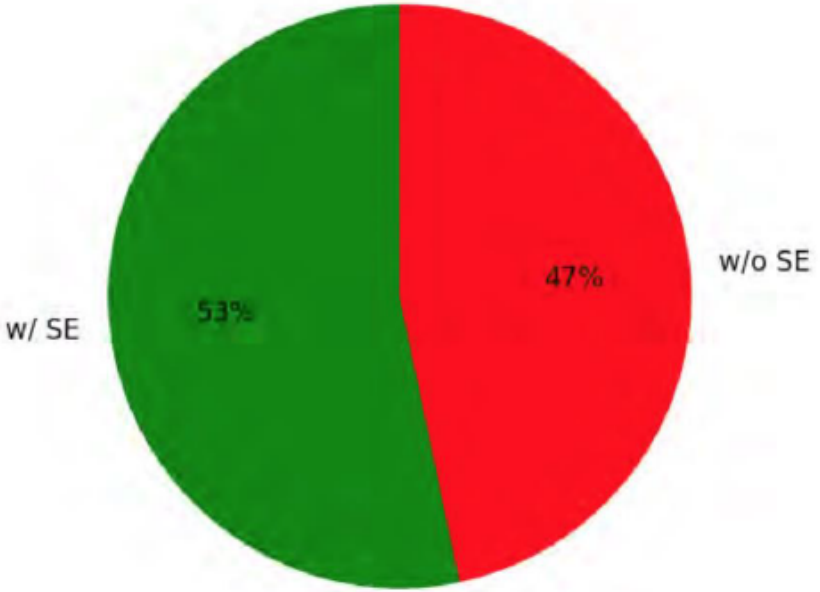
Backup

Successful proposals (first run 2019)

Proposals with Swedish main proposer

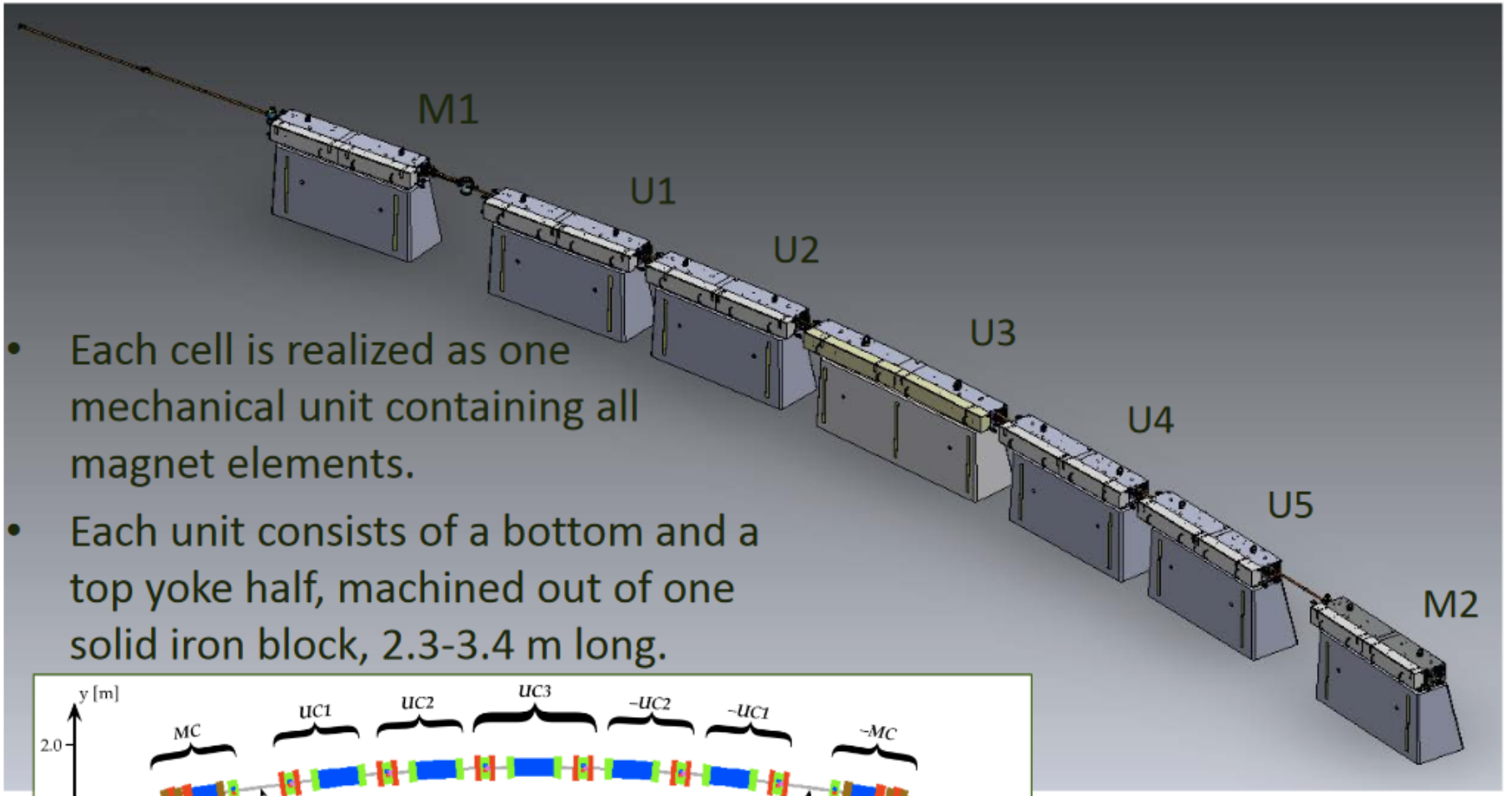


Proposals with Swedish co-proposer*



* MAX IV staff not counted

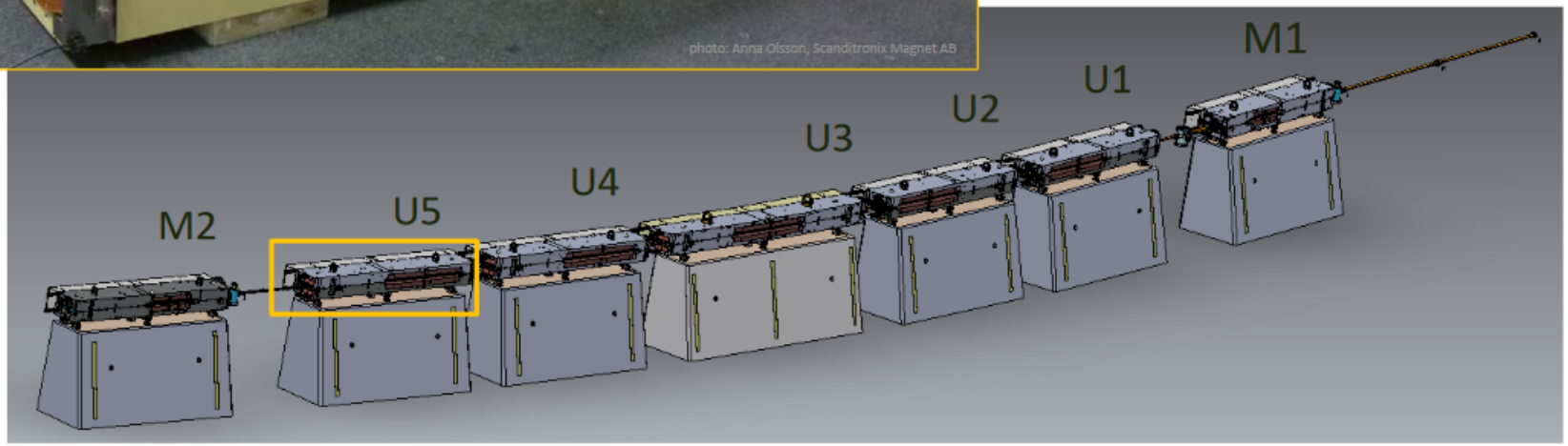
achromat 3D cad assembly:



- Each cell is realized as one mechanical unit containing all magnet elements.
- Each unit consists of a bottom and a top yoke half, machined out of one solid iron block, 2.3-3.4 m long.

a MAX IV magnet block:

- a U5 bottom half →
- ↓ an assembled U5



Linac time structure