CHALLENGE OF MAX IV TOWARDS A MULTIPURPOSE HIGHLY BRILLIANT LIGHT SOURCE

PAC´11 New York

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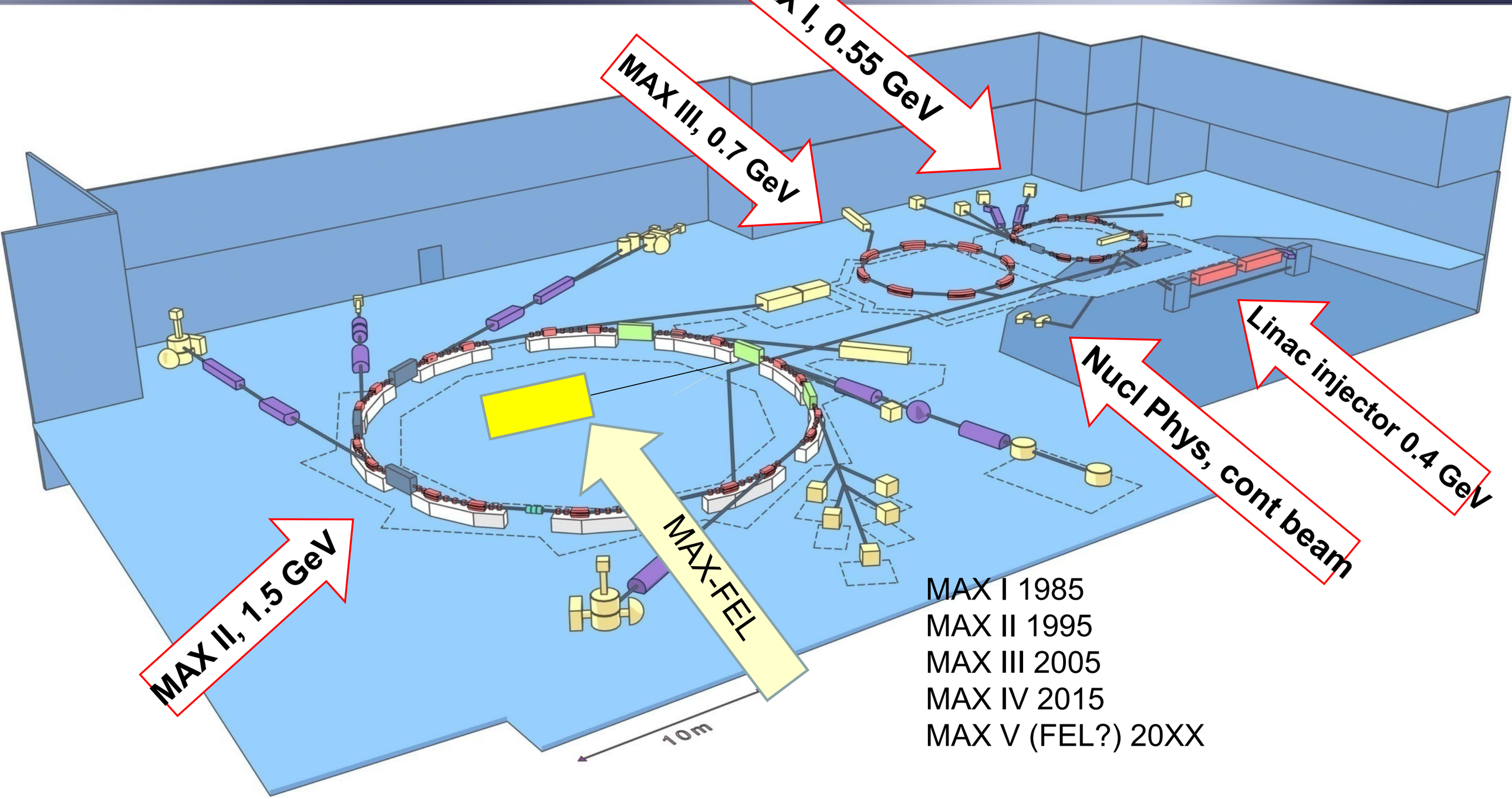
MAX-lab today

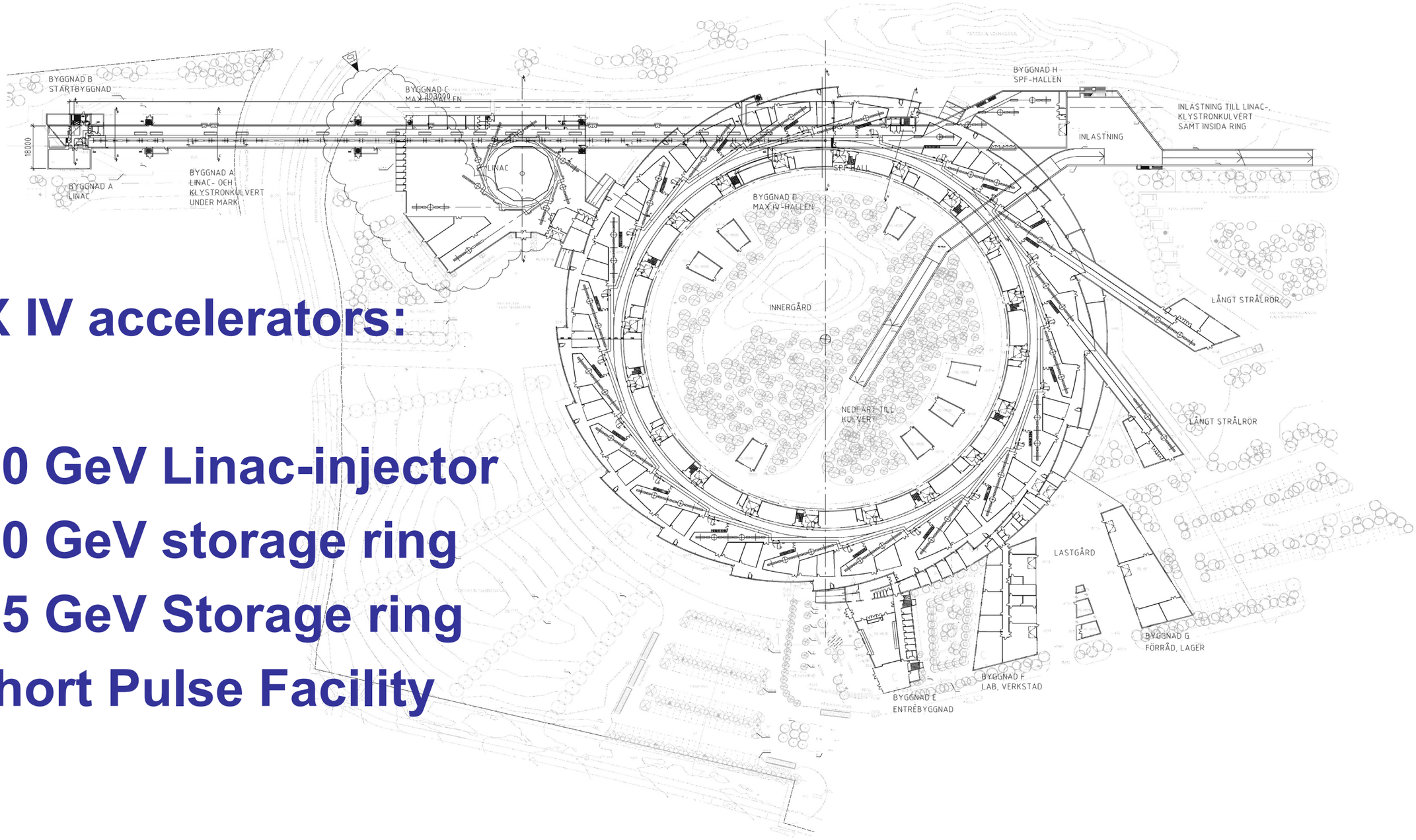


MAX I 1985
MAX II 1995
MAX III 2005
MAX IV 2015
MAX V (FEL?) 20XX

MAX IV basic assumptions:

- Storage rings will remain the workhorses for synchrotron radiation science
- 3rd generation sources performance can be radically increased
- FELs are important complements to 3rd gen rings

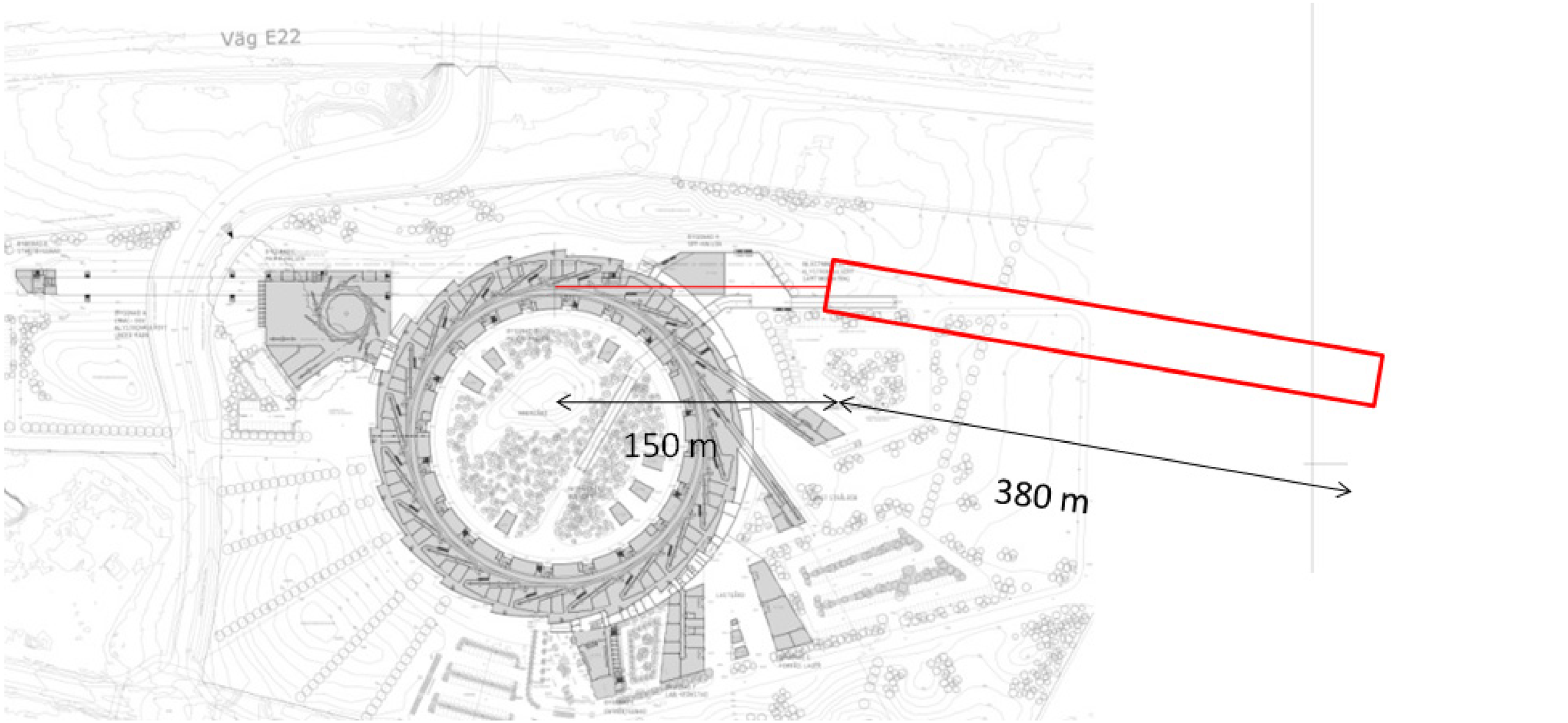
MAX IV layout



MAX IV accelerators:

- 3.0 GeV Linac-injector
- 3.0 GeV storage ring
- 1.5 GeV Storage ring
- Short Pulse Facility

Possible X-FEL extension

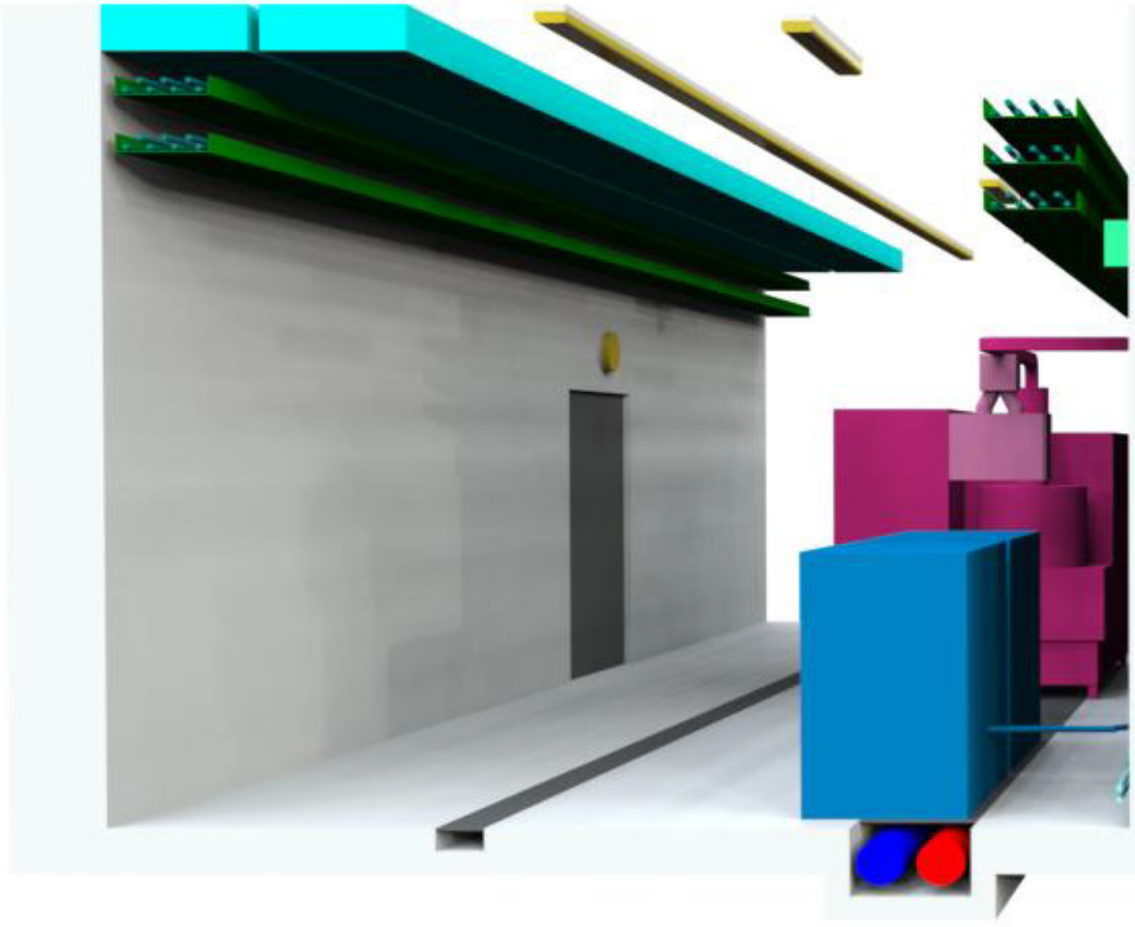


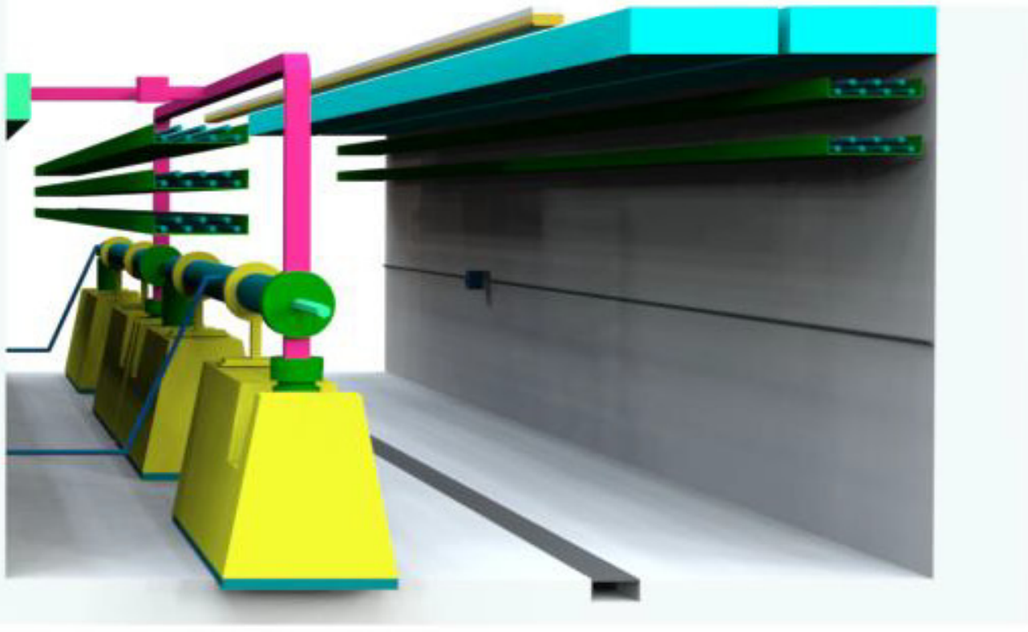
MAX IV bldg

Specifications Linac

3 GHz warm Linac

	Injector	SPF
End Energy (GeV)	3.0	3.0
Charge/pulse (nC)	0.5-5	0.1
Bunch length (fs)	3000	30-100
Rep Rate (Hz)	<10	100
Peak bunch current (kA)		3
Emittance (mm mrad)	<10	0.4
Energy spread	$1*10^{-3}$	$1*10^{-3}$





Klystron gallery & LINAC

Achromat Bunch Compressor with linearization

More details: S. Thorin, “Design of the MAX IV Ring Injector and SPF/FEL Driver”, THP178, this conference

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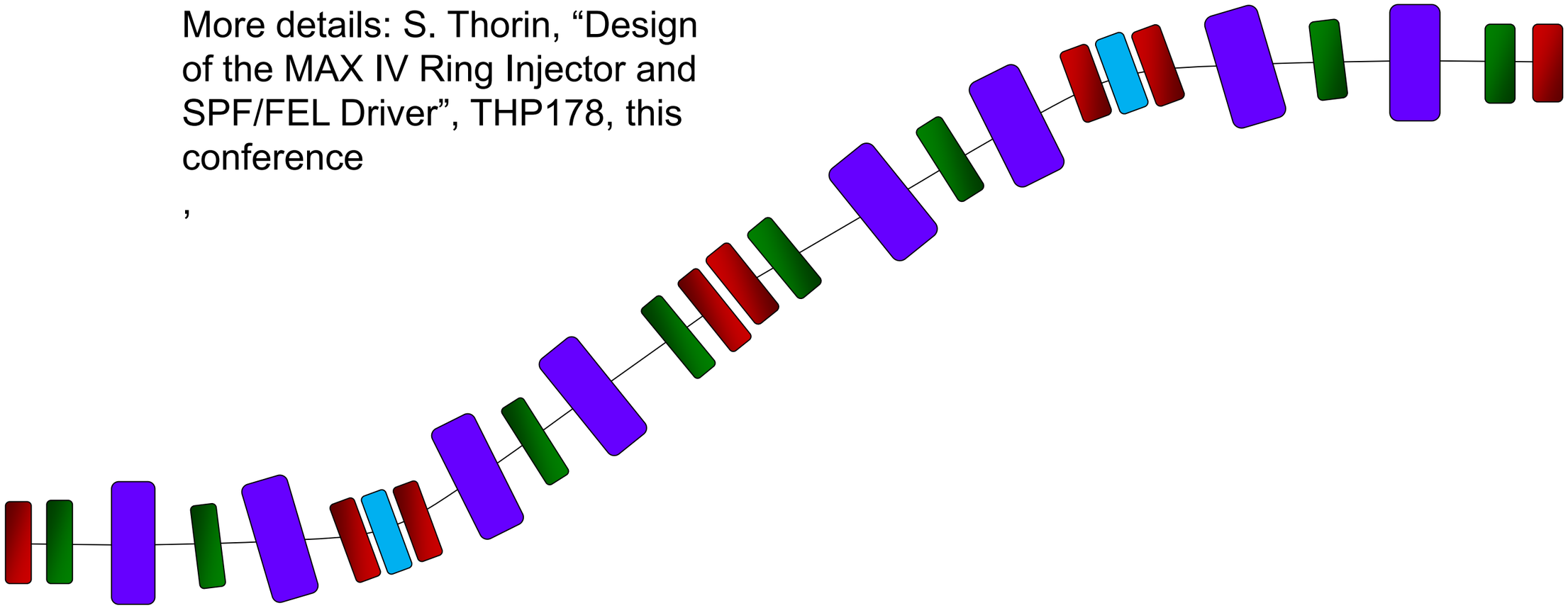
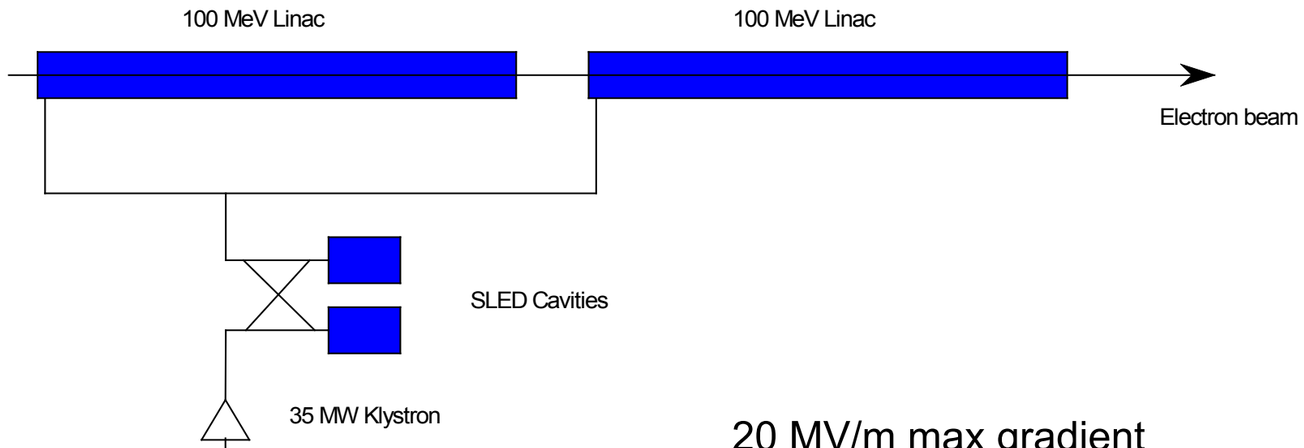
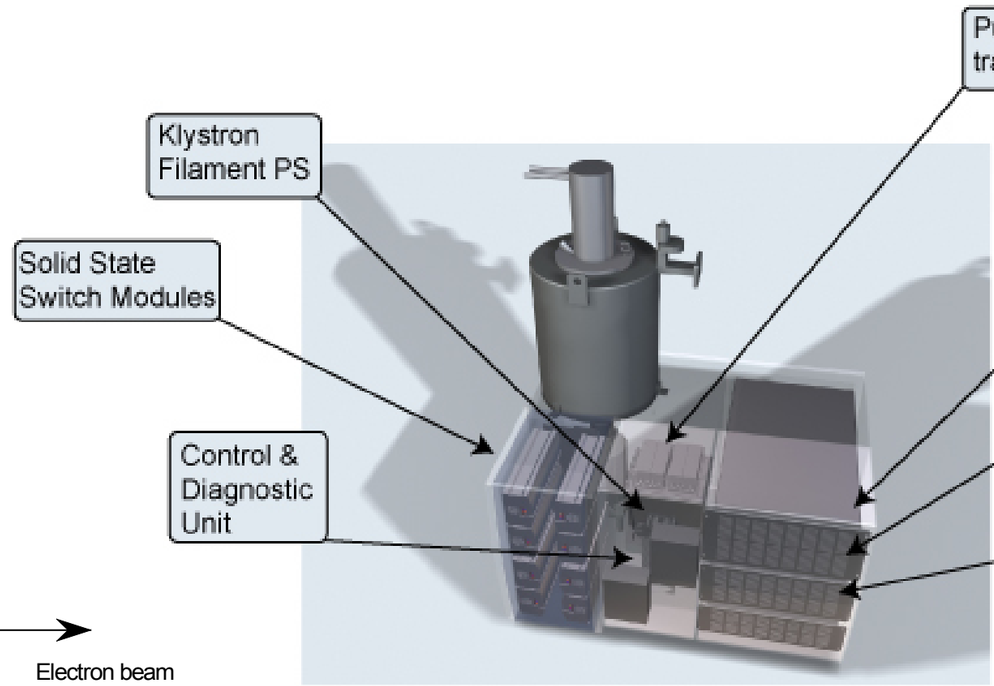


MAX IV – linac

Linac Module (18 of them)





1 35 MW klystron

1 Pair of SLED cavities

2 pcs 5 m linac structures

20 MV/m max gradient

Max dutyfactor 0.001

Solid state modulators
=>variable pulse length

Status linac:

- Design for long and transv optics (incl compressors) frozen.
- Purchasing for linac structures, klystrons, SLEDs, modulators finished (Red line)
- Parts for first electron gun finished.
- Linac tunnel defined
- Transport lines to rings (LRT) defined
- Work ongoing for intra-sections between linac
- All items defined

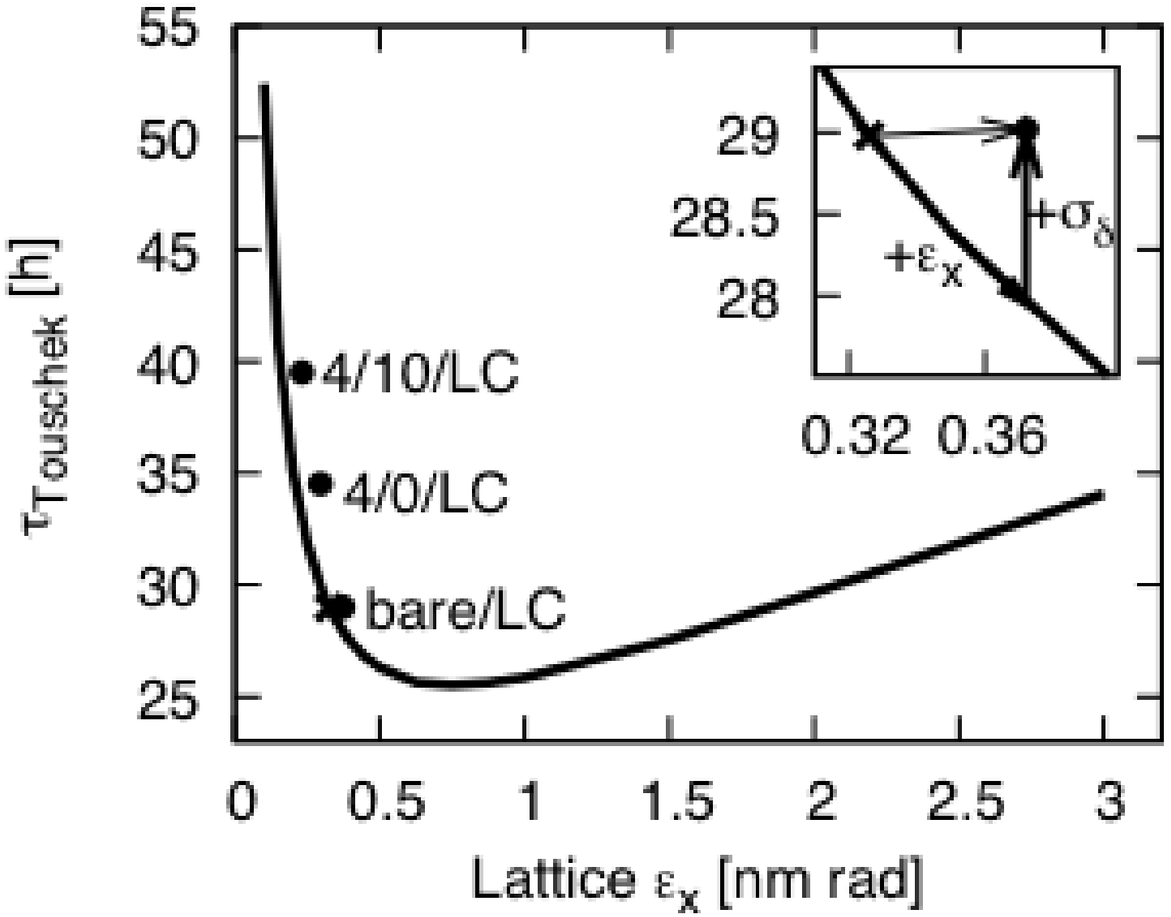
Specifications Storage Rings

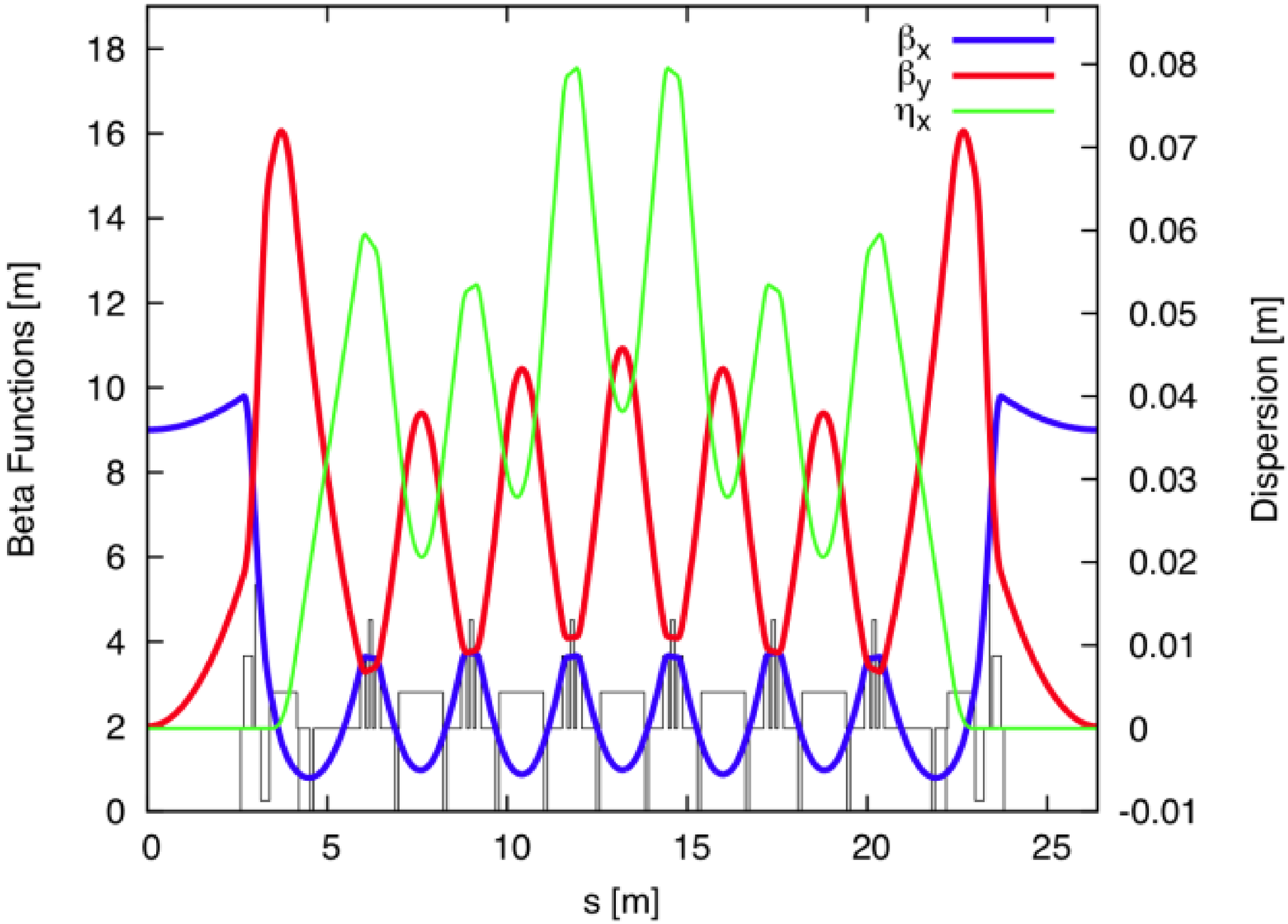
Electron energy (GeV)	3	1.5
Circ current (mA)	500	500
Circumference (m)	528	96
Nr of long straights	20	12
Length (m)	5	3.5
Hor emittance (nm rad)	0.24	5.6
Hor RMS beam size (μm)	45	200
Vert RMS beam size (μm)	1-4	10
Beam life-time (h)	10	5

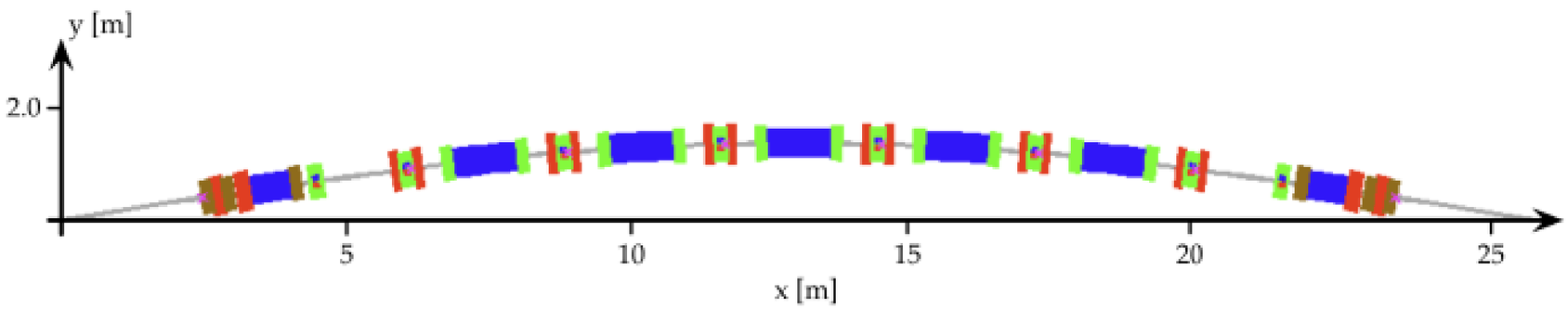
Top-up injection in both rings

Two 1.5 GeV rings will be built. One goes to Krakow (Polish Light Source)

Touschek lifetime







•Chromaticity brick wall:

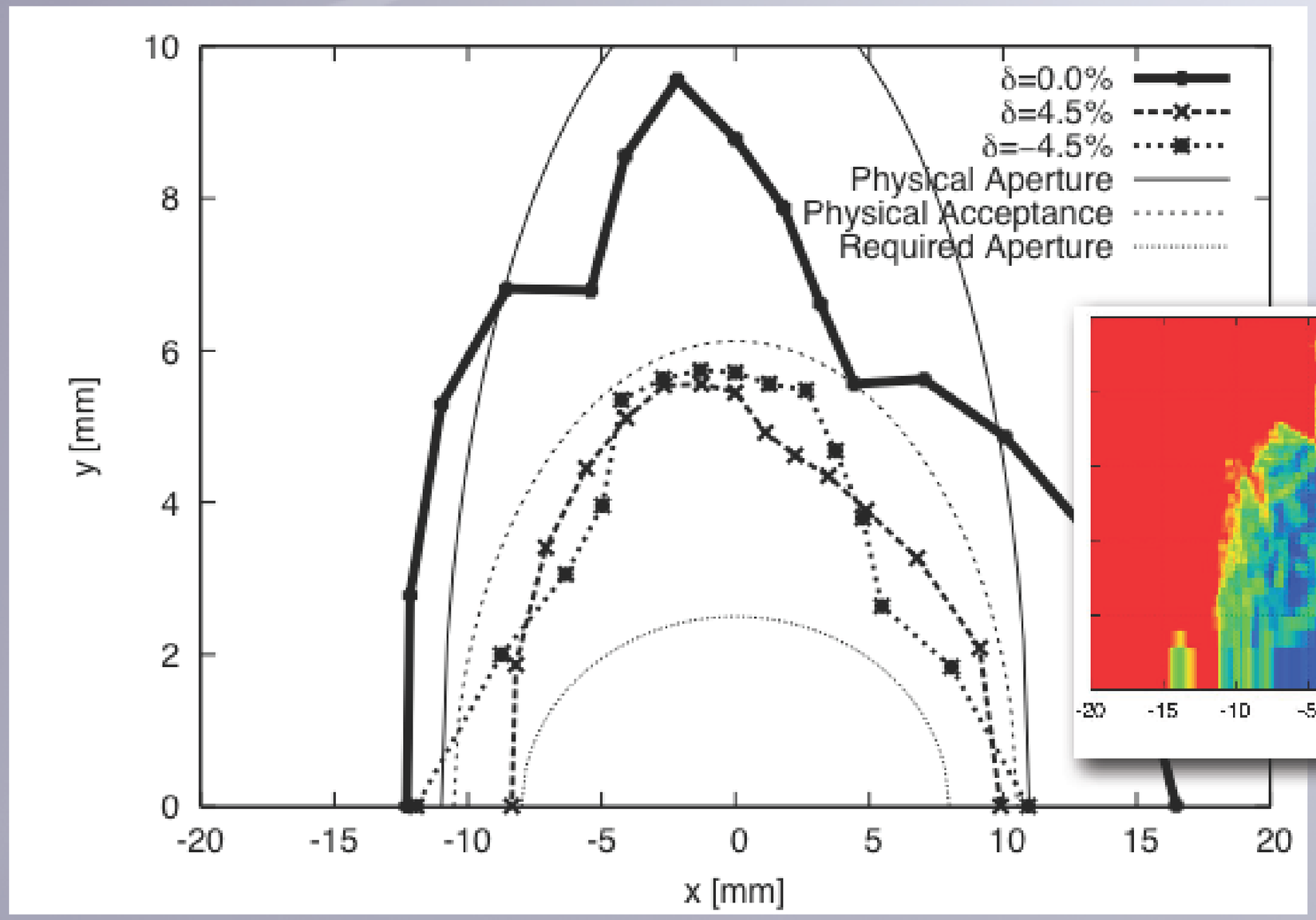
•Sextupole magnets necessary for chromaticity correction, but they decrease the dynamic aperture.

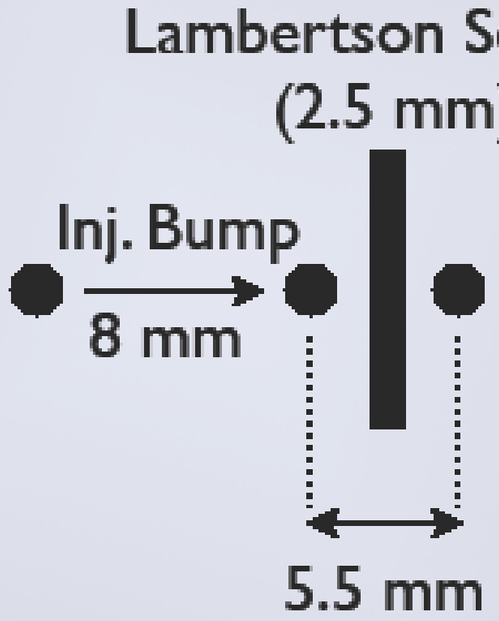
•Conventional (DBA) lattices have few sextupoles=>can't minimize driving terms within cell

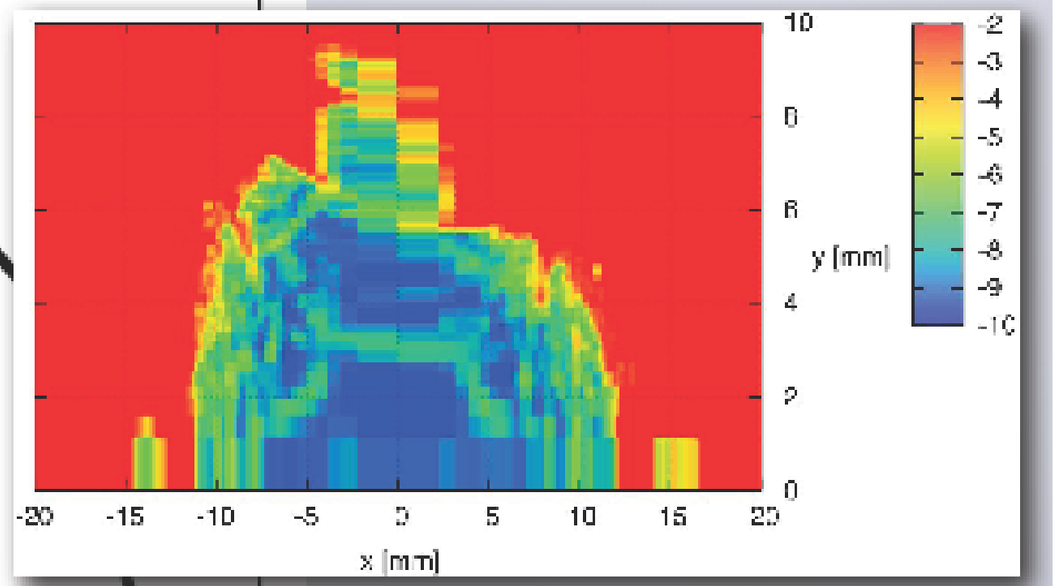
•7-bend achromats have several sextupoles and we can.

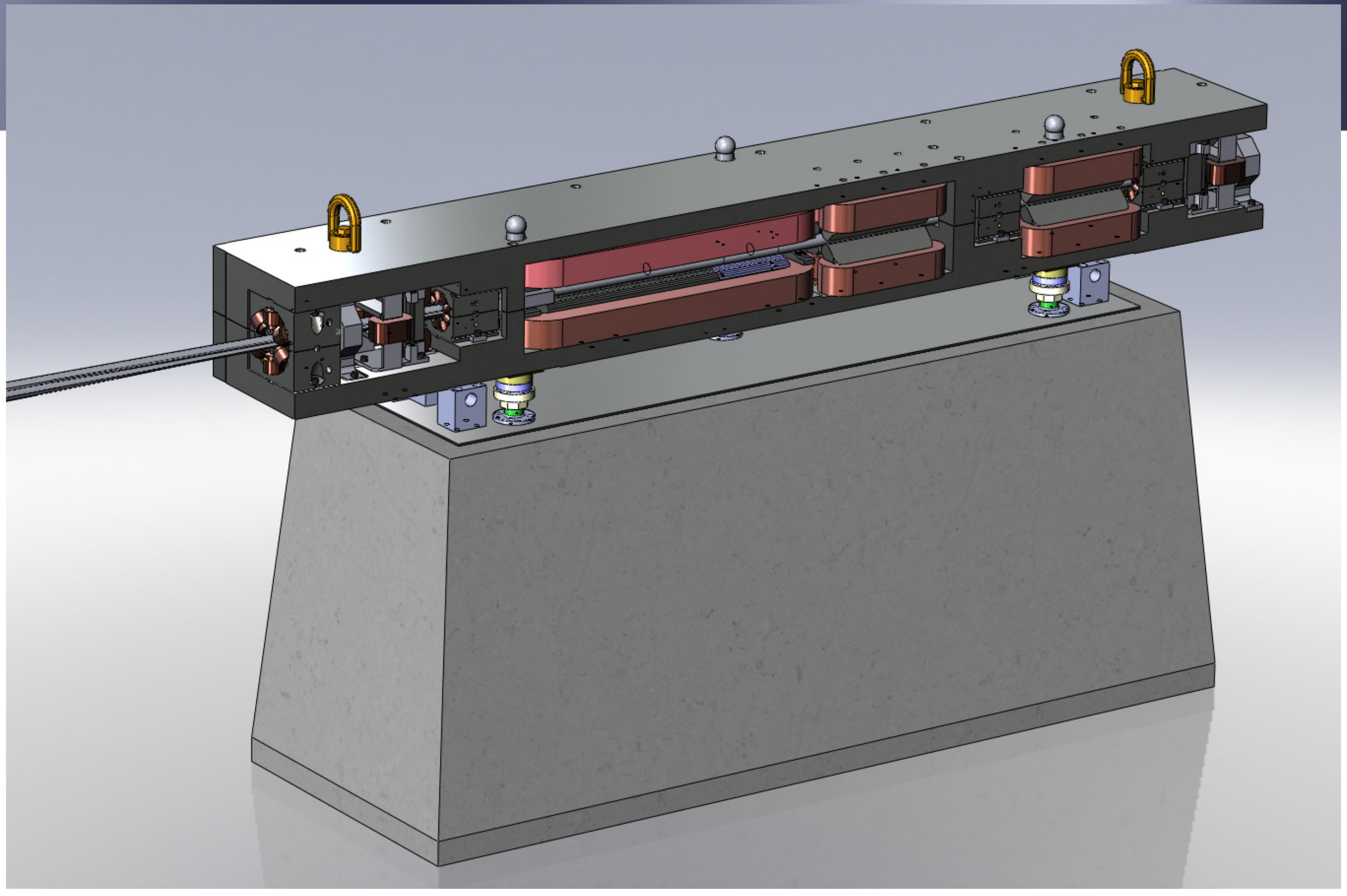
Dynamic Aperture

- Octupoles → minimize ADTS (first-order effect!)
- Injection requirement: 8 mm (2.5 mm safety margin)
- Vertical: in-vacuum IDs, 4 mm full-gap height

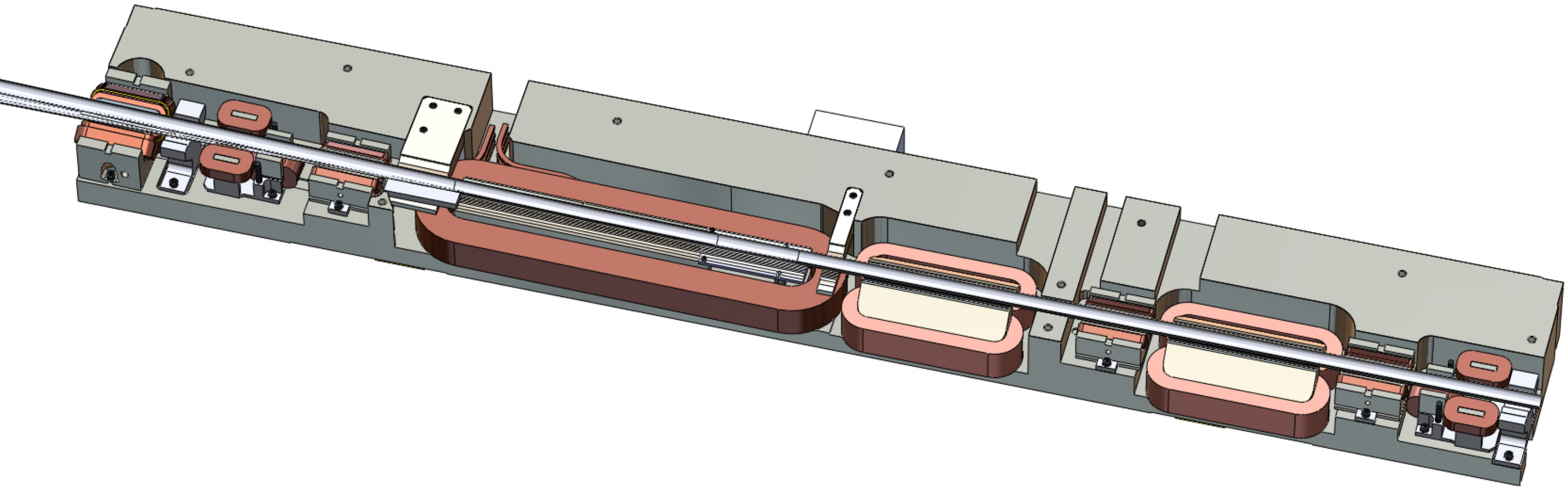




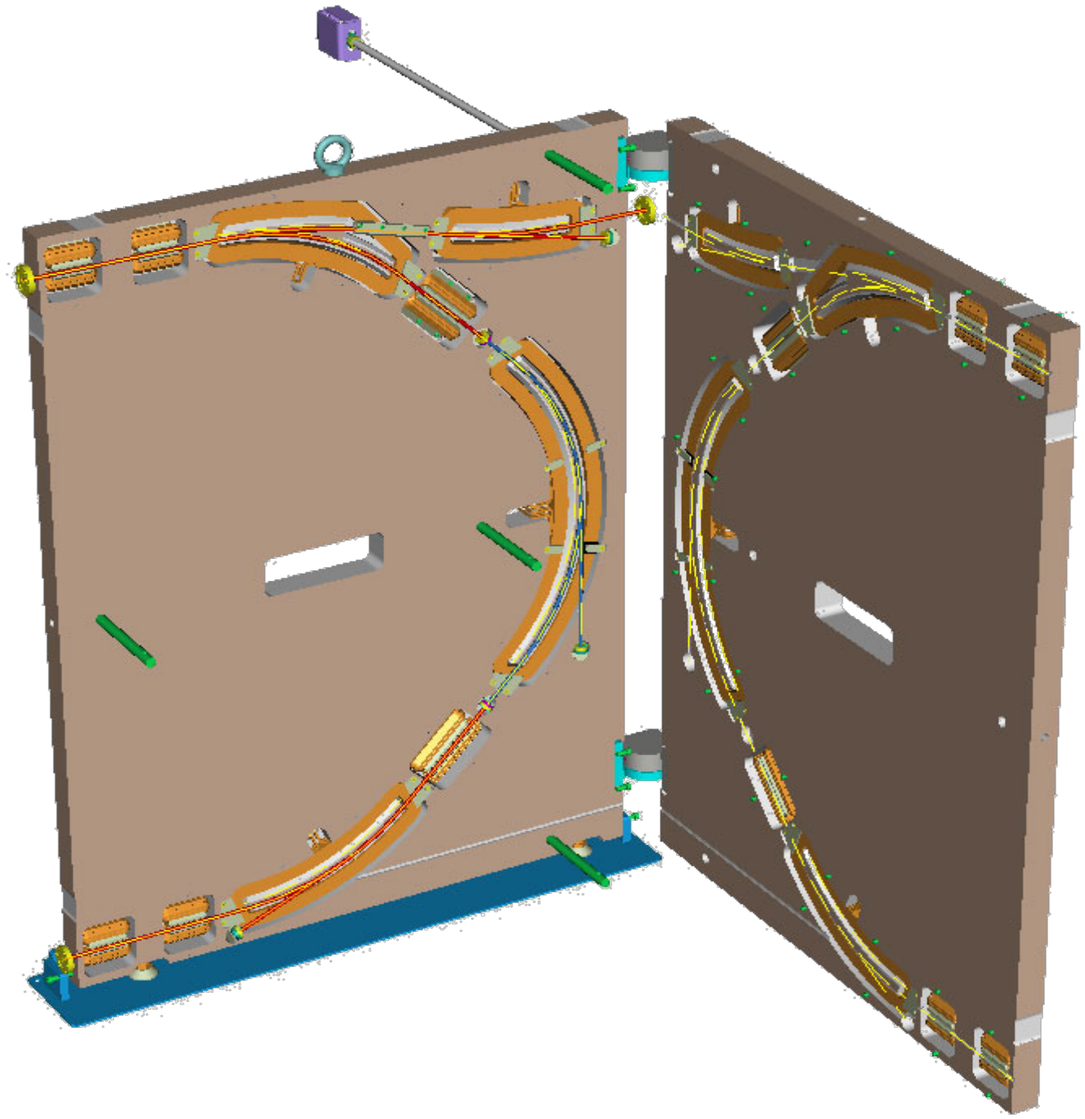




Magnet half



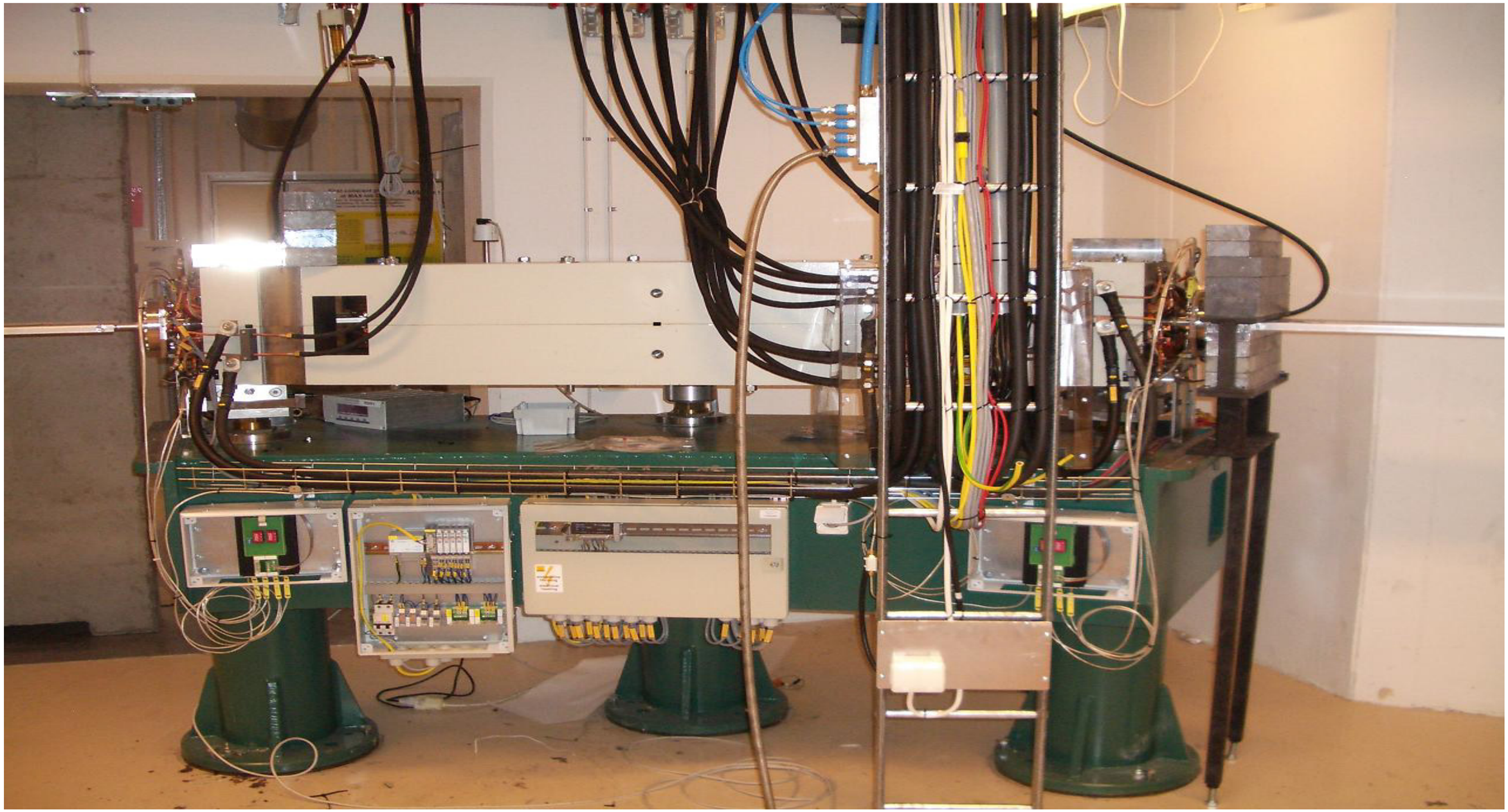
180 degrees bends



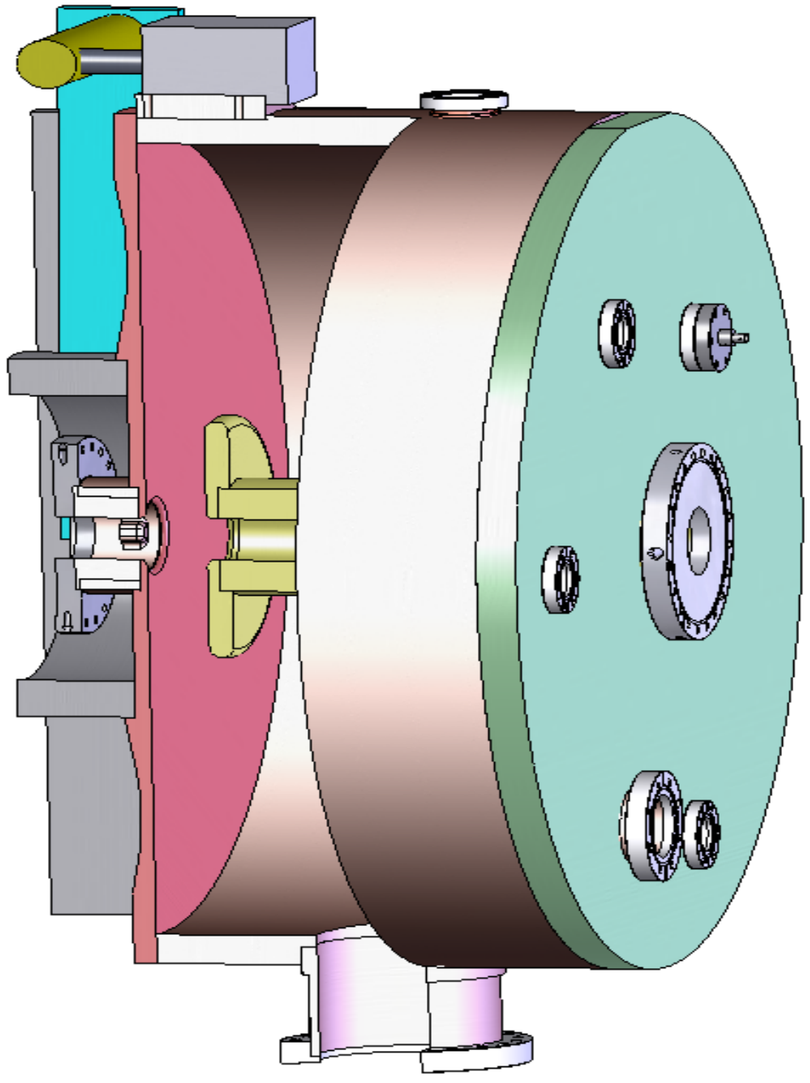
Two 5 m LINACs give 500 MeV using the SLED technique and a recirculator.

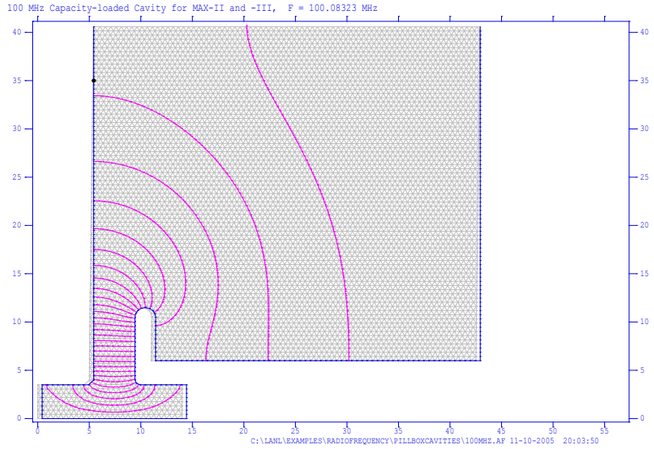
- Replacement of aging 100 MeV microtron
- Decoupled injection into all storage rings
- Possibility to use the LINAC for FEL research
- Higher energy regime for nuclear research

MAX III cell (Proto for M IV)

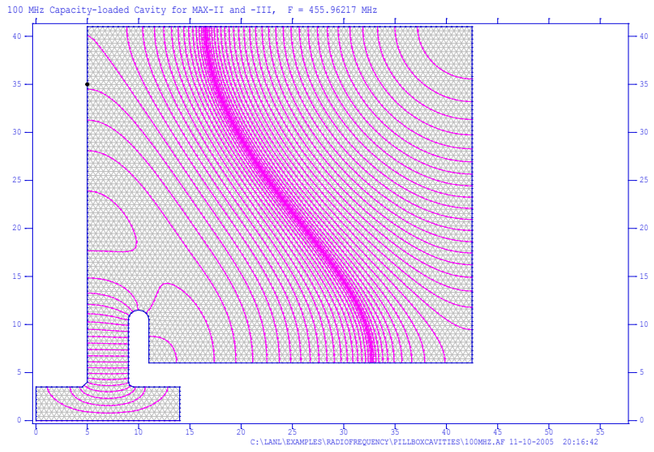


100 MHz cavity

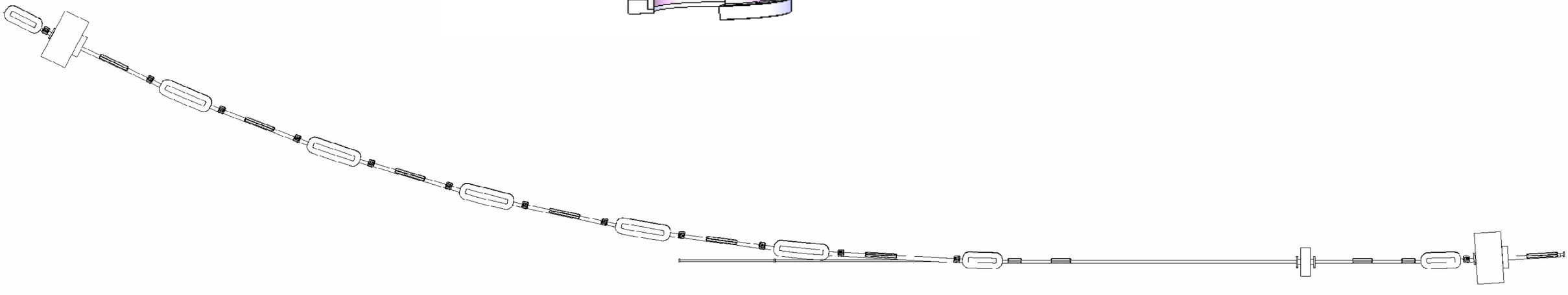




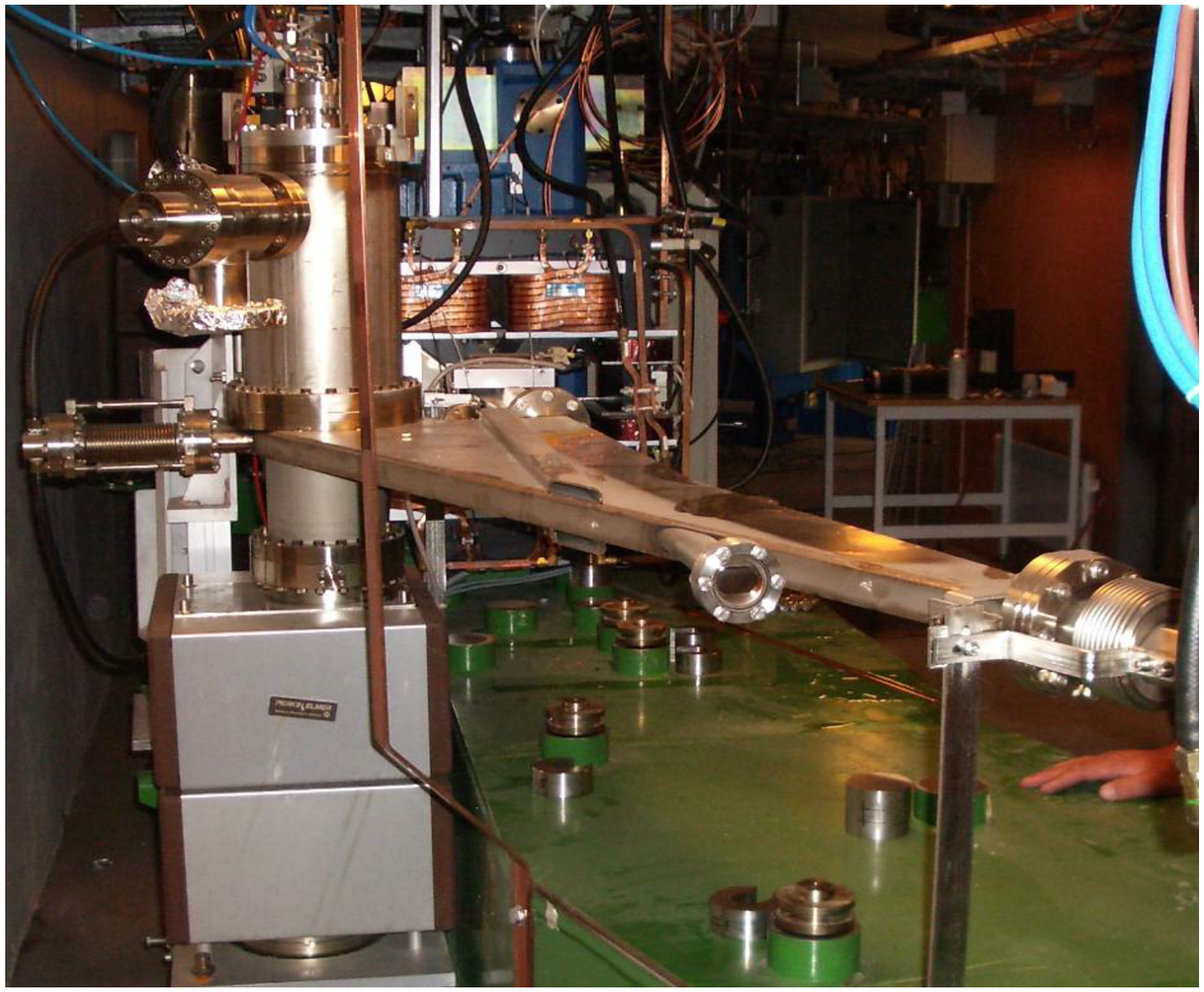
100 MHz cavity profile with fundamental mode E-field lines



E-field lines of the high order mode at 456 MHz



Standard MAX II dipole chamber made of stainless steel.



NEG coated dipole chamber of Cu to be tested in MAX II.

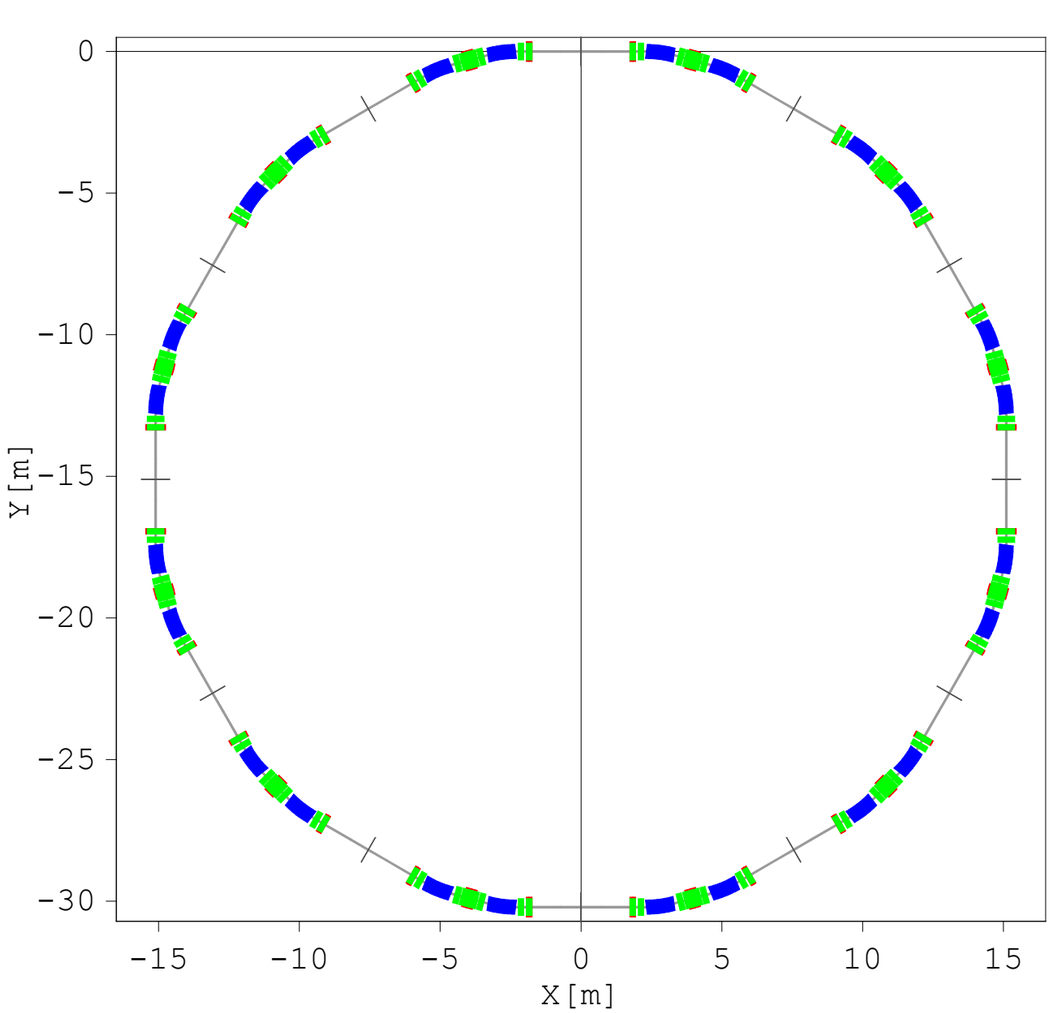
Status 3 GeV Ring

- Magnet iron bought now. One single batch.
- Magnet tender prepared. CFT released
- Cavities contract signed now
- Vacuum system designed in cooperation with ALBA. CFT in June.
- RF transmitter tender prepared.
- Remaining main tenders: Pulsed elements, diagnostics, IDs (to be defined)

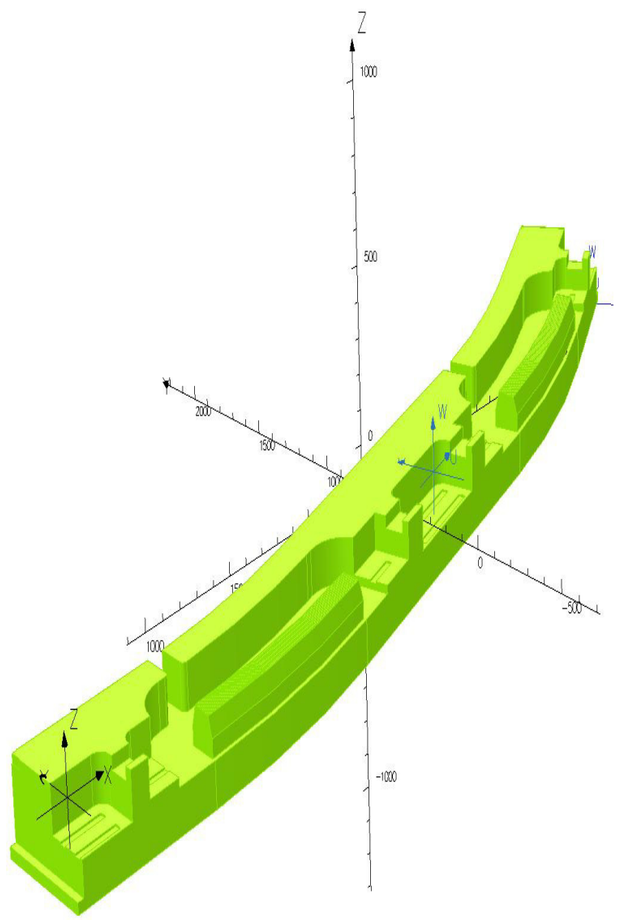
1.5 Gev Ring

Motivation: Extended spectral range with SR from optimized undulators
2 rings will be constructed, one for Krakow and one for us

MAX IV 1.5 GeV lattice

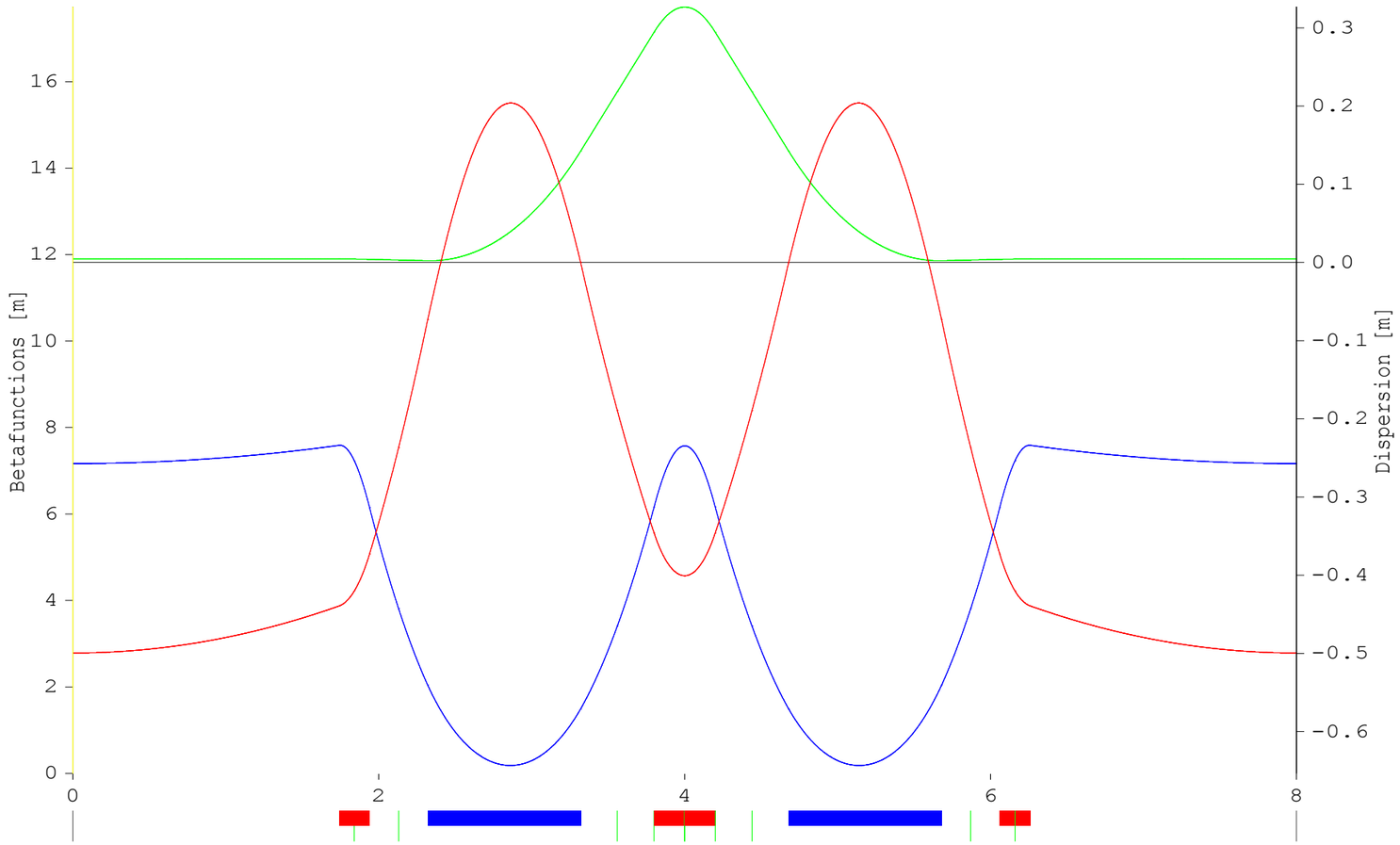


Achromat



Vector Fields
software for electromagnetic design

MAX IV 1.5 GeV



Energy	1.5 GeV
Circ current	0.5 A
Circumference	96 m
Hor emittance	5.6 nm rad
Achromat nr	12
Straight section	3.5 m
Hor RMS beam size	0.200 mm

Time schedule MAX IV

	2010	2011	2012	2013	2014	2015
Linac building						
Linac installation						
Linac commissioning						
Linac operation						
Ring buildings						
Ring installations						
Ring commissioning						
Ring operation						
MAX I, II, III						

END

See also:

•S.C. Leemann, "Pulsed Multipole Injection for the MAX IV Storage Rings", THP214, this conference.

•S. Thorin, “Design of the MAX IV Ring Injector and SPF/FEL Driver”, THP178, this conference