Recent Progress on the MAX IV 1.5 GeV Storage Ring Lattice and Optics

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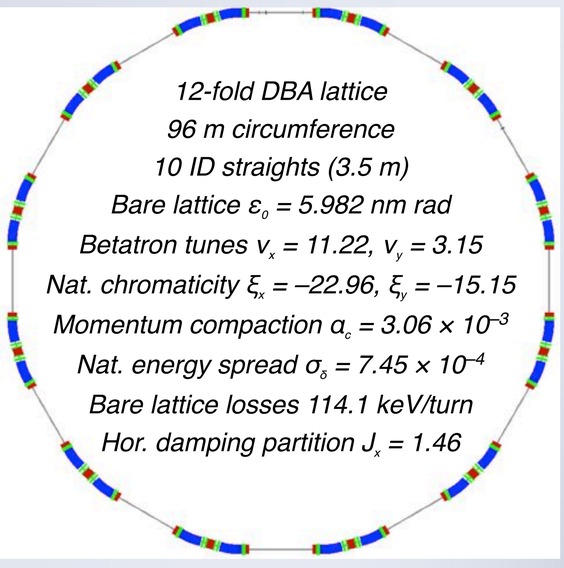
1.5 GeV Storage Ring

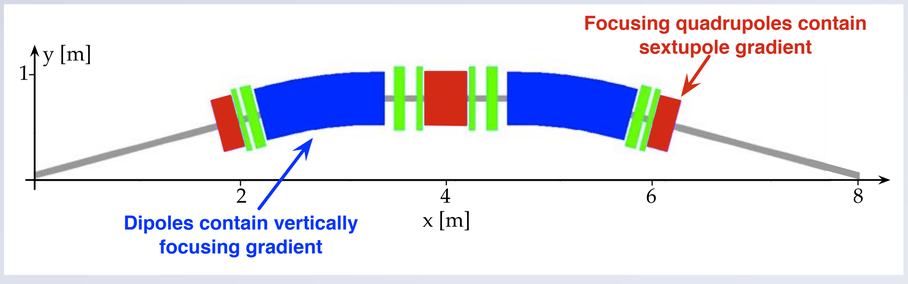


12-fold DBA lattice
96 m circumference
10 ID straights (3.5 m)
Bare lattice ε_0 = 5.982 nm rad
Betatron tunes ν_x = 11.22, ν_y = 3.15
Nat. chromaticity ξ_x = –22.96, ξ_y = –15.15
Momentum compaction $\alpha_c = 3.06 \times 10^{-3}$
Nat. energy spread $\sigma_\delta = 7.45 \times 10^{-4}$
Bare lattice losses 114.1 keV/turn
Hor. damping partition J_x = 1.46

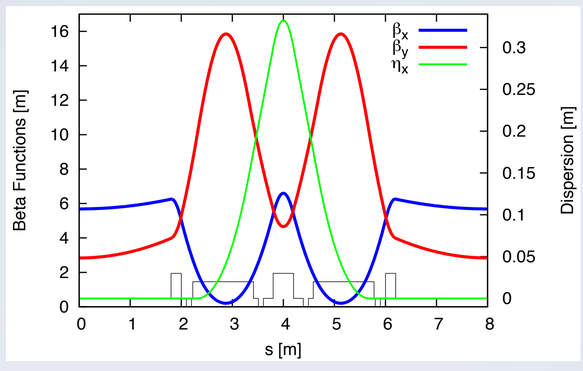
MAX IV Facility Overview

MOA signed 4/2009, funded 9/2010, construction started 11/2010, installations to begin 4/2013.
Commissioning: 4/2014 - 4/2015 (linac & transfer lines), 4/2015 - 4/2016 (storage rings).
User operation expected to commence 2015.

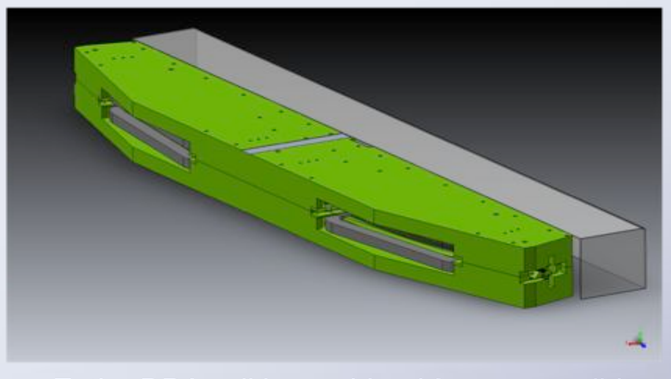
Linear Optics



Combined-function magnets described in lattice by array of slices → model includes fringe fields, crosstalk, and multipoles.

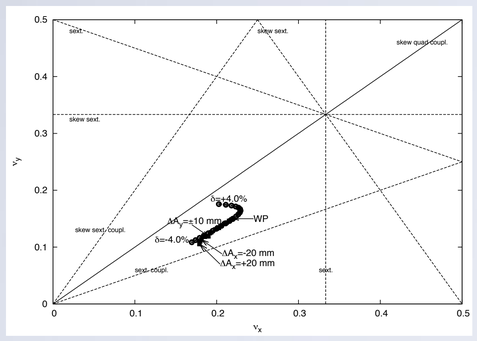


Beam size at center of the ID straight: σ_x = 184 μm, σ_y = 13 μm (κ = 1%).

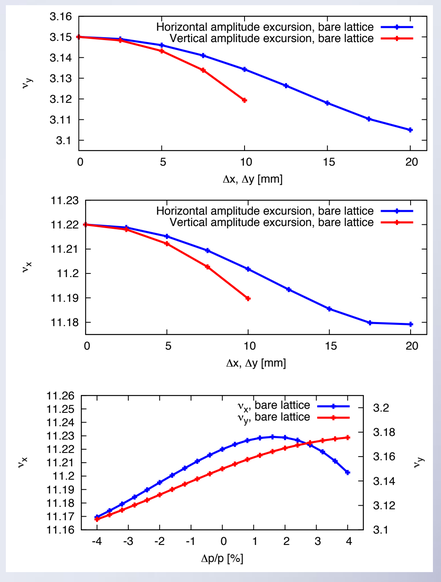


Entire DBA cell is machined from one solid iron block (demonstrated in MAX III).

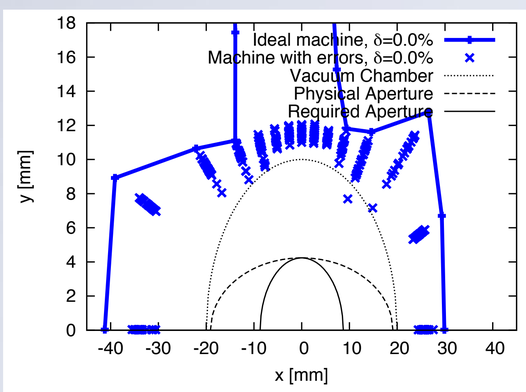
Nonlinear Optics



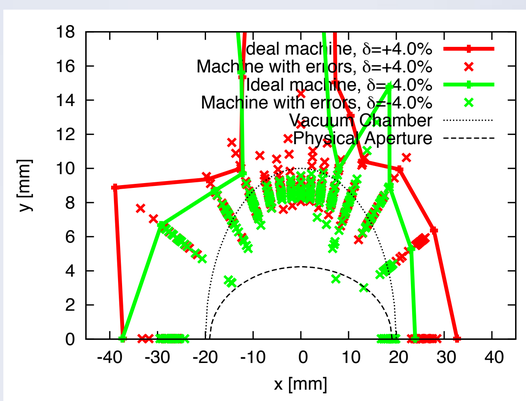
Nonlinear optics optimization strategy: correct chromaticity, minimize RDT's, tailor tune shifts to minimize tune footprint → large DA and MA.



Dynamic Aperture

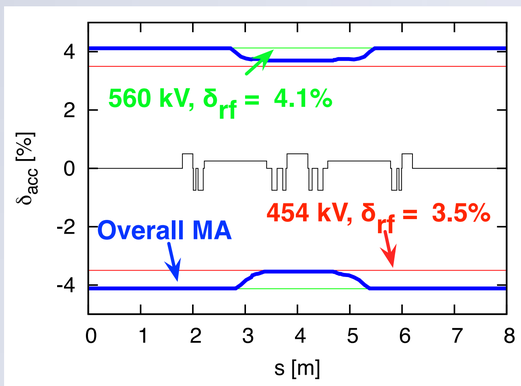


Large on-energy DA for high injection efficiency.

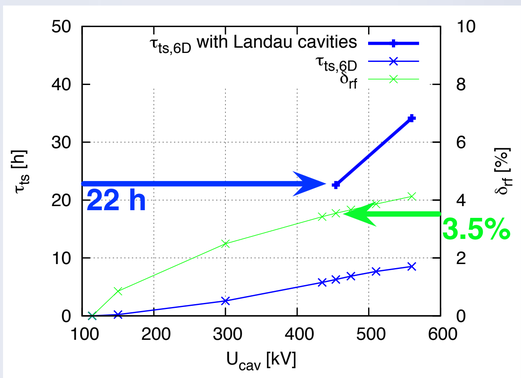


Off-energy DA ensures large momentum acceptance.

Momentum Acceptance & Touschek Lifetime



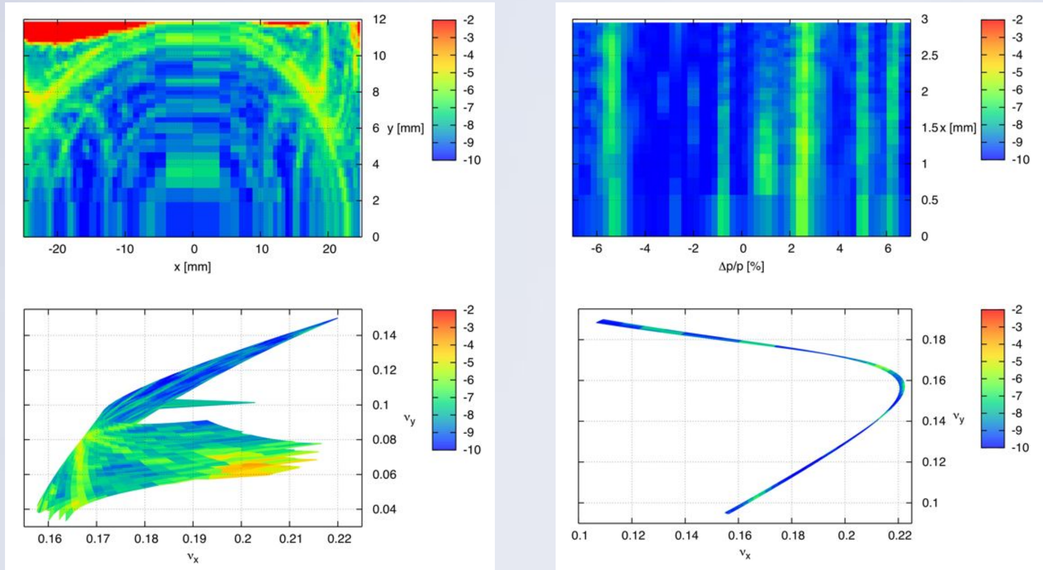
Lattice momentum acceptance (incl. vacuum apertures) matches RF acceptance throughout most of the cell.



RF acceptance beyond 3.5% ensures Touschek lifetime above 22 hours at 500 mA (incl. Landau cavities).

Total lifetime beyond 10 hours expected at 500 mA.
(Touschek 22 h, elastic gas scattering 30 h, bremsstrahlung 53 h)

Frequency Map Analysis



Large continuous area of low diffusion around the design orbit.

Low diffusion at beam core over wide range of energies.

MAX IV Project → http://www.maxlab.lu.se/maxlab/max4

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