MAX-III, A 700 MeV STORAGE RING FOR SYNCHROTRON RADIATION

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Abstract

A 700 MeV storage ring for synchrotron radiation is being built at MAX-lab. The ring is optimised for the UV spectral region and will also provide IR radiation. The ring will have a 100 MHz RF system combined with a 500 MHz passive Landau cavity. The lattice is compact, with combined function magnets. The magnets are integrated into the girder providing for ease of alignment.

1 INTRODUCTION

A new storage ring, MAX III, is being designed at MAX-lab. The ring is being built with the intention of providing synchrotron radiation in the UV spectral region.

The ring will have 8 cells. In addition to the insertion devices, IR beamlines using dipole radiation will be built. The storage ring is part of a larger project that also includes a new injector for the MAX rings and an rf electron gun [1,2]. The ring will be installed in the space between the existing rings as can be seen in Figure 1.

The space constraints have led to a compact ring with two families of magnets, a combined horizontal quadrupole/sextupole and a gradient dipole with pole-face windings to control both the quadrupole and sextupole components of the magnetic field. This results in the straight sections being 54% of the total circumference of the ring. There will be six straight sections available for insertion devices. The injection septum, injection kicker and the rf-cavites will occupy the remaining straight sections.

2 THE RING LATTICE

The lattice parameters are shown in Table 1. There are two types of magnets, both of which will have combined functions. A 1.25 m long gradient dipole with pole-face windings for correcting both the gradient and the sextupole component will provide for control of the vertical tune and chromaticity. A .2 meter long combined horizontal quadrupole/sextupole will provide for control of the horizontal tune and chromaticity. All of the magnet poles will be solid.

Table 1: Lattice Parameters

Horizontal tune	3.72
Vertical tune	2.74
Energy	700 MeV
Horizontal emittance	13 nm rad
Ring circumference	36 m
Momentum compaction factor	0.035
Dispersion in straight sections	0.47 m
Periodicity	8
Straight section length	2.45 m
RF	100 MHz

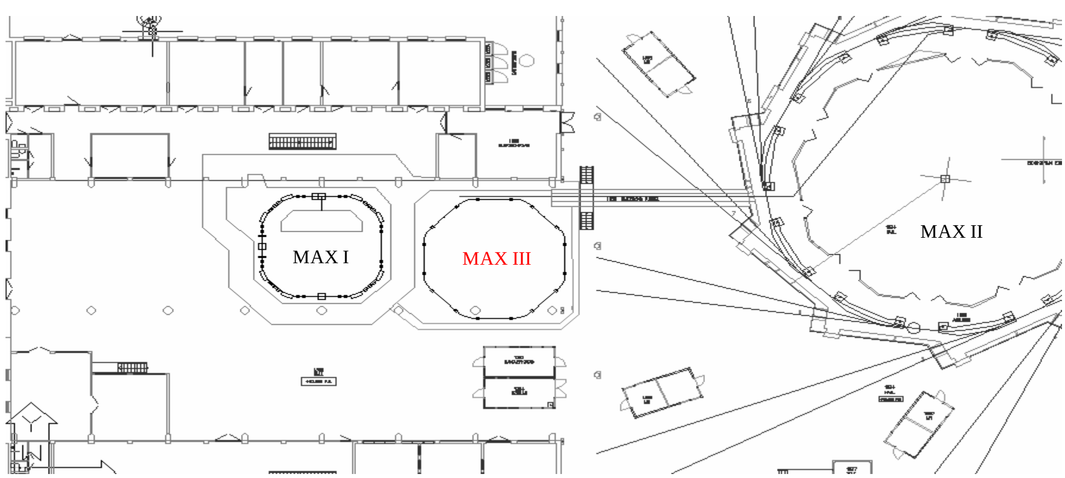

Figure 1: Layout of the MAX-lab hall with planned placement of MAX-III.

The orbit corrections will be achieved with extra windings on the quadrupole cores. Each cell consists of a gradient bend with a combined quadrupole/sextupole on each side. There are two quadrupole strengths and two sextupole strengths that can be varied. The sextupole strengths will be set to obtain positive chromaticity in both the horizontal and vertical planes. The two quadrupole strengths are then available to alter the tunes and the dispersion. The best tunes for dynamic aperture, dispersion, and injection were found by doing a scan of tune space. Different combinations of horizontal and vertical tunes give different apertures, as well as changing the amplitude of the machine functions around the ring.

The chosen working point of the ring is $Q_x = 3.72$ and $Q_y = 2.74$. The machine functions can be seen in figure 3. It will be possible to tune the machine towards coupling of the vertical and horizontal tunes in order to increase the beam size if necessary.

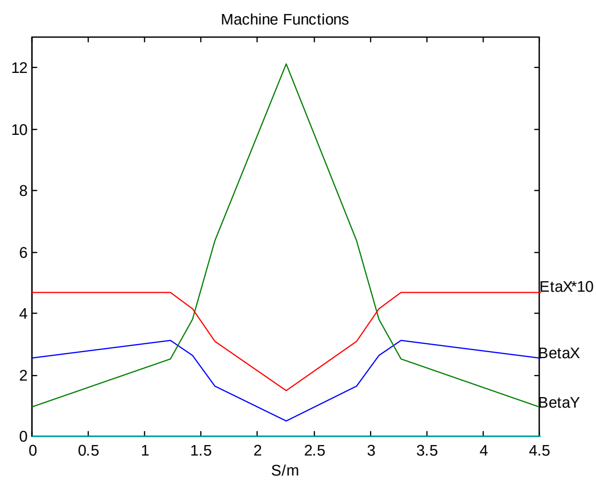

Figure 2: Machine Functions

3 BEAM LIFETIME

The goal is to achieve a sufficiently long beam lifetime so one injection/day should suffice once the vacuum system is fully conditioned. The beam lifetime limiting losses are essentially due to vacuum and Touschek losses.

The same principal for the MAX II vacuum chamber will be used for MAX III. There will be discreet absorbers positioned so that none of the synchrotron radiation will hit the vacuum chamber.

Concerning the Touschek lifetime, the most straightforward way is to use the well proven 500 MHz system. However, we also plan to use a passive Landau cavity system to increase the Touschek lifetime and to damp the longitudinal coupled bunch instabilities. When using a 500 MHz system in MAXIII, we find that the synchrotron frequencies will be close to the frequency shift of the Landau cavities, so we will then suffer from the Robinson instability. This has also been observed in the MAX I ring.

When decreasing the RF to 100 MHz, the Landau cavity will be tuned safely above the synchrotron frequency. Studies have been carried out in order to gain experience with such an rf system [3].

4 SUPPORT STRUCTURE

Each of the 8 cells will contain only three magnets of two distinct types. All three of these magnets will be integrated into double steel plates with the dipole poles and grooves for the coils machined into the plates[1]. The quadrupole poles are also mounted onto the plates, which then serve as the girders. This simplifies the alignment procedure. The cells will be supported on three pylons as seen in Figure 3.

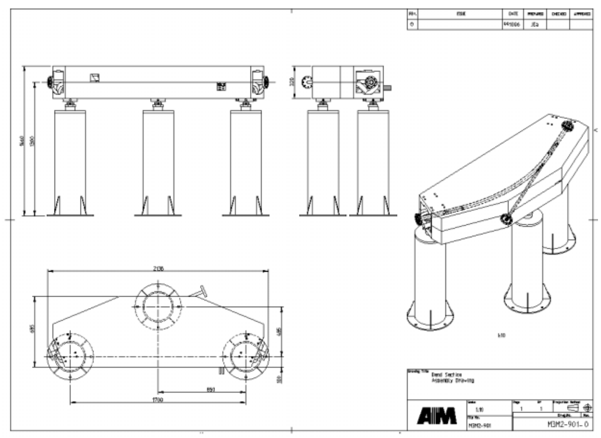

Figure 3: A MAX III cell.

5 REMARKS

The primary motivation for building the 700 MeV ring is to provide those users that want the UV and infrared synchrotron radiation with a machine that will satisfy their needs. This means that the straight sections in the MAX II ring can be fitted with insertion devices optimised for the x-ray and soft x-ray regions. The integrated system used is both compact and cost efficient. The fact that a new injector is already being built in order to de-couple the existing rings means that there is no extra cost involved for an injector.

REFERENCES

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[1] B. Anderberg, AMACC