MAX 4, A 3 GeV LIGHT SOURCE WITH A FLEXIBLE INJECTOR

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Abstract

The MAX4 ring is intended to be the future user facility at MAXlab. The high-brilliance 3 GeV storage ring, equipped with small gap, short period superconducting undulators, demonstrates a high mean brilliance over a wide photon energy spectrum. The ring itself is defined from the routine operation of the small gap insertion devices, which is reflected in the small aperture of the ring magnets.

The development of future light sources, like the free electron laser and energy recovery systems, opens up new challenging possibilities to create high brilliance, short pulse radiation. This development is today far from being mature, a strong development of new ideas and techniques will most probably take place during the next decade(s).

The MAX4 full-energy injector is constructed to incorporate these future developments. The proposed 3 GeV energy recovery race-track microtron will open up the possibility of topping up injection and to deliver Fourier transform limited spontaneous as well as coherent radiation up to the hard X-ray spectral region.

1 INTRODUCTION

A new synchrotron radiation facility is studied at MAX-lab. It consists of a 3 GeV storage ring optimised for a high mean brilliance in the X-ray spectral region and an injector also working as a FEL electron source.

Two injector options are being studied. The first one is a 3 GeV microtron as in the MARS [1] concept; the other one is a SLEDed 3 GeV warm linac. The final choice will depend on the scientific programme, economy and resources available.

2 THE 3 GeV STORAGE RING

2.1 Magnet lattice

A short period, high K-value undulator is chosen as the X-ray light source. This implies a small vertical gap of the undulator, which in its turn defines the vertical aperture in the storage ring. The main mission for the ring is to deliver a high mean brilliance so only multibunch filling is foreseen. The shortpulse need, including coherent light generation, is to be covered by the injector.

The most important parameter values for the ring are given below.

Table 1. Storage Ring Parameters

Electron energy	3 GeV
Circumference	277 m
No of straight sections	14
Straight section length	4.6 m
Circulating current	200 mA
Energy loss (naked lattice)	616 keV/turn
Emittance (naked lattice)	1.0 nm rad
Emittance (9 SC undulators)	<1 nm rad
RF	100 MHz
Injection	Topping up
Quadrupole bore	0.01 m
Dipole gap	0.02 m
Photon energy range (und)	up to 20 keV
Mean brilliance f/s,0.1%,mm^2,$mrad^2$	10^{20}-10^{21}

2.2 Magnets

The magnets are of the combined multipole type. So are gradients and sextupole components included in the dipole magnets. The quadrupole magnets are equiped with a sextupole magnet component.

The small magnet aperture needed makes permanent magnets a tempting choice.

2.3 Insertion devices

The insertion device, in fact defining the ring, is the short-period SC one [1].

Magnet type	Superconducting
Undulator period	0.012 m
Max K-value	2.3
NR of periods	200
Magnet structure length	2.4 m

3 THE MICROTRON INJECTOR

This is certainly the most challenging injector option. A 6-orbit microtron with a 500 MeV superconducting linac

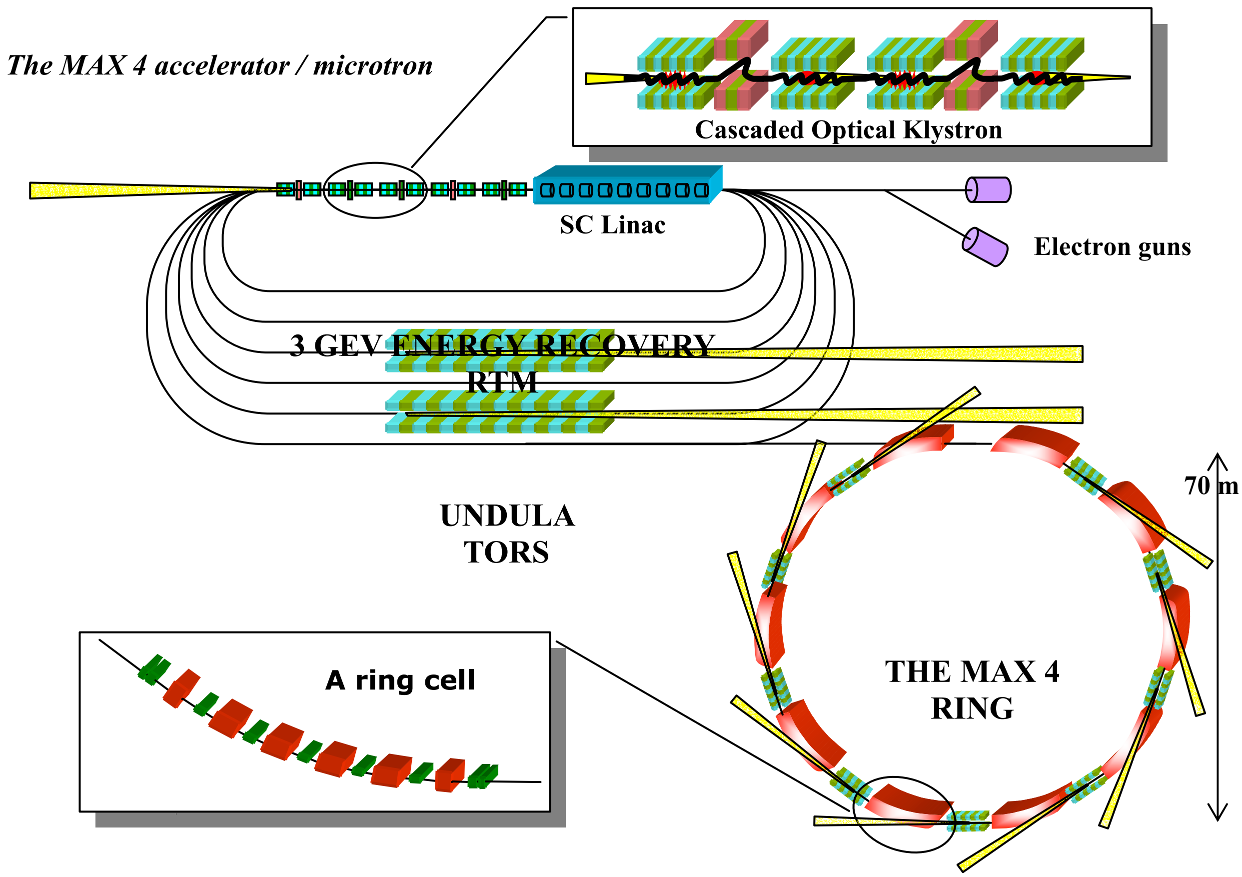

Fig.1. The MAX 4 storage ring with the microtron injector option.

will allow for energy recovery. A cascaded optical klystron on the linac axis should allow for transform limited radiation up to several keV and operated at a very high rep rate.

4 THE LINAC INJECTOR

The linac of a conventional design utilising the MAX injector technology. 18 klystron stations will then power 36 5.2 m long 3 GHz linac sections via SLED systems. This gives some redundancy for the electron energy needed.

Extra RF electron guns offer the possibility to create macrobunches consisting of different electron energies for the cascaded optical klystron scheme as in the microtron case but not operated at the same high rep rate.

5 REFERENCES

[1] E. Wallén, M. Eriksson, R. Rossmanith, “A supercnductive undulalator at the 500 MeV RF-gun driven Linac-recirculator at MAX-lab”, EPAC’02, Paris, June 2002.

[2] G. N. Kulipanov, A. N. Skrinsky and N. A. Vinokurov, MARS-a project of the diffraction-limited fourth generation X-ray source based on a supermicrotron, NIM A-467-467 (2001) 16-20.