The Control System of the Harmonic Double Sided Microtron @ MAMI*

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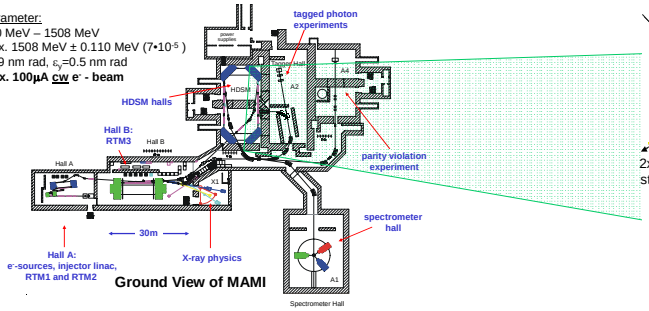
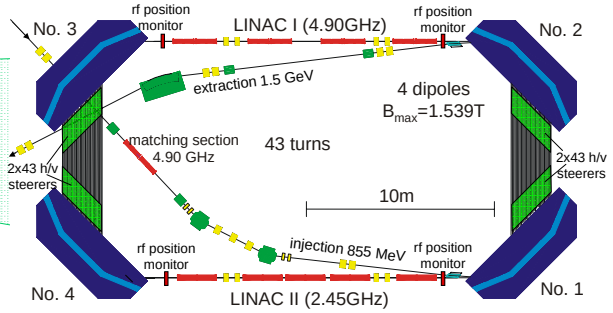
The MAMI Electron Accelerator Facility

Parameter:
180 MeV – 1508 MeV
max. 1508 MeV ± 0.110 MeV ($7 \cdot 10^{-5}$)
ε_x=9 nm rad, ε_y=0.5 nm rad
max. 100µA cw e⁻ - beam



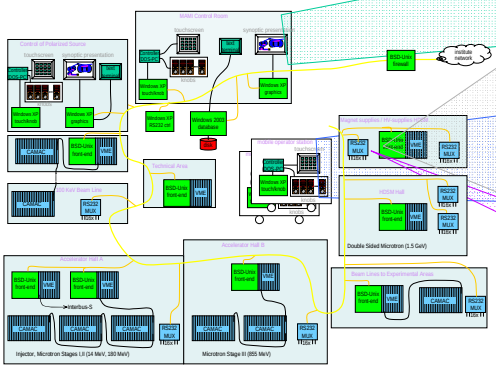
The MAMI (Mainz Microtron) facility is a normal conducting machine, consisting of a pre-accelerator equipped with a polarised and a thermal electron gun, a cascade of four microtrons and beam-lines to four experimental areas. The output of the accelerator is a c.w. electron beam with 1.5 GeV @ 100 µA maximum.

The Harmonic Double Sided Microtron (HDSM)



The 4th stage, boosting the energy from 0.855 GeV to 1.5 GeV, was built in parallel to regular operation of the first 3 RTMs. Its commissioning started in Dec 2006 and since Februrary 2007 it is in routine operation for experiments in nuclear physics.

The Control System



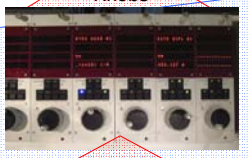
The control system was updated and extended to enable also the control of the HDSM. The figure above shows its topological layout. Two separate main control desks (main accelerator and polarised gun test-facilities) and mobile control units are provided. A lot of VME-crates, equipped with front-end computers, connect to various devices. Devices with a serial interface are connected via RS232-Ethernet converters.

View of the main operator desk.

VME-CPU

The VME-Bus CPUs are based on an embedded PC. Its PCI-Bus is connected to the VME-Bus via a CPLD, which converts the PCI signals directly into those according to VME standard. No VME-Bus chip-set is used, therefore special software is dispensable by the use of memory mapped I/O. As operating system Free-BSD is used at the moment. It is installed on a local disk connected via the VME P2-connector. The running from a local disk avoids any confusion in error diagnostics in case of a network failure.

Knobs



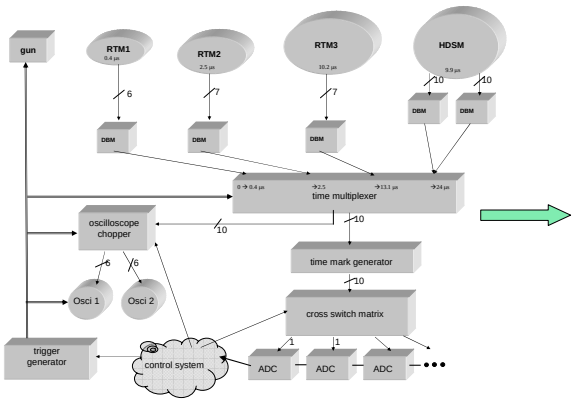
Digital rotary knobs are the main operator input device for analogue data. A clear readable LED-display informs the operator about the element status details. Push-buttons provide the change of speed, save/recall of values and other useful actions.

Mobile Station

Mobile stations allow controlling and testing of arbitrary parts of the accelerator facility. They consist of a PC under Windows XP and are also equipped with touch screens and digital rotary knobs. The touch screen also provides the textual information messages.

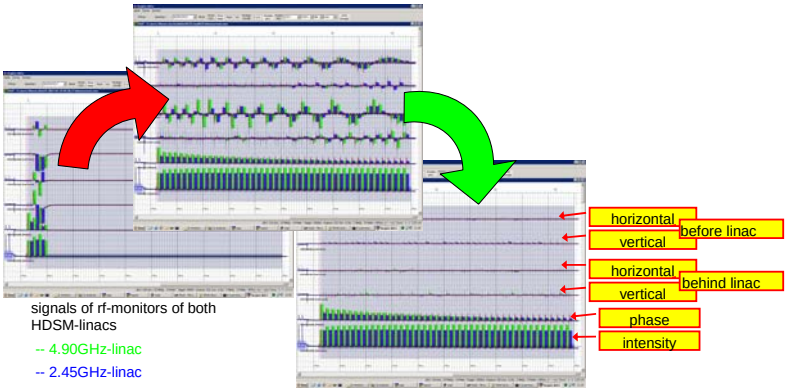
To supply the predominant fraction of all smaller magnets in the HDSM, four 128-channel power supplies were developed and built in-house, providing bipolar 6A and 20V maximum each channel.

Digitisation of the RF-Monitor Signals



Scheme of the hardware to multiplex and to digitise the signals of rf-beam-monitors on the linac axes. A short (12 ns) pulse is running through the accelerator inducing a turn-by-turn train of pulses in the position & phase monitors. The signals of all microtrons are composed to one train by a time multiplexer and are distributed via a programmable cross switch among a set of up to 6 ADCs. This enables parallel digitisation of the trains of selected monitors. Additionally the analogue signals are displayed on oscilloscopes.

Automatic Steerer Optimisation in the HDSM



signals of rf-monitors of both HDSM-linacs

-- 4.90GHz-linac

-- 2.45GHz-linac

The digitised signals are used to optimise the beam positions and the beam phasing. Above figure shows the process of transverse optimisation by computer controlled tuning of the dipole beam steerers in the recirculation paths. In the first picture only 3 turns are achieved in the HDSM. During optimisation all turns get visible, but still deviations are present. The last picture shows the signals of the optimised beam.

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