Measurements at the IH-cavity of REX-ISOLDE ◇

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For the REX-ISOLDE-project at CERN an IH-accelerator was designed, serving as booster accelerator for radioactive ions from an energy of 300 keV/u to an extraction energy, which can be varied from 1.1 MeV/u to 1.2 MeV/u using capacitive pistons [1]. In 2002 tuning on the IH-cavity and the linac were performed in between the regular beam times and at the beginning of the shut down period. Because beam tuning could not take place in Munich, the adjustement of phase, amplitude and of the matching of the injected beam had to be done. The final goals are a good transverse beam emittance and a small energy spread.

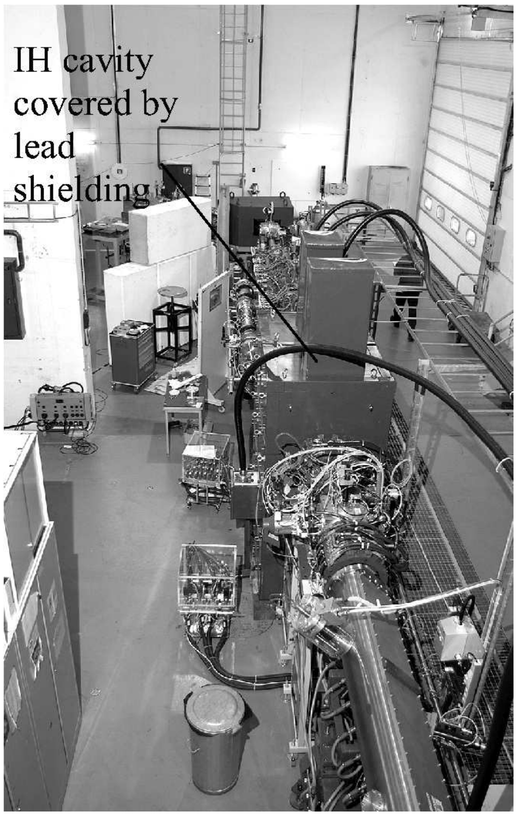

Fig. 1: A view on the REX-ISOLDE linac build up at CERN. In the lower part you see the RFQ, where the beam is accelerated to 300 keV/u. The IH cavity is covered by a lead housing as a protection against the produced X-ray.

Since the high resolution phase shifters were delivered to CERN in spring 2002 phase adjustement with the necessary small step size of 0.1° are possible. Therefore it was possible to set up each resonator step by step. As the overal beam quality is mostly determined in the matching section in front of the IH-cavity one drawn a lot of attention on that region. Measurements from that section are shown in Figure 2. The upper picture shows the energy distribution of the beam accelerated by the RFQ, buncher and IH-cavity with different buncher amplitudes. The lower picture shows the dependence of the energy spread of beam from the IH structure to the buncher power. One can see that around 1450W buncher power it works under ideal conditions regarding the lowest energy spread.

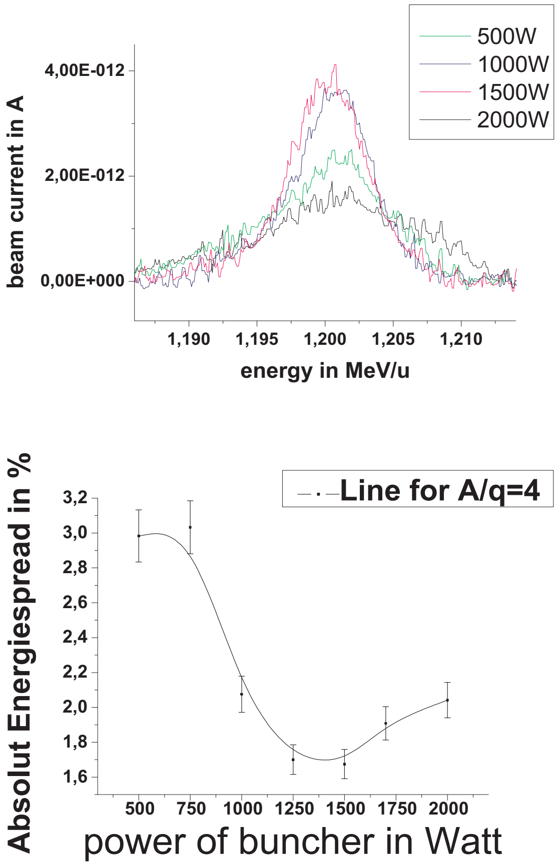

Fig. 2: The upper picture shows the energy distribution of the IH-beam in dependence of the buncher power. The lower picture shows the energy-spread of the IH-beam as a function of the buncher-power.

The variation of the energy spread with the power of the buncher is a result of a different phase-spread of one bunch at the entrance of the IH-cavity. The lower the phase spread at the entrance of the IH the lower the energy-spread at the exit of the IH. The energy spread at IH exit is the smallest with a longitudinally parallel beam at the IH entrance at its minimum phase-spread. This is the case at about 1450W. With less buncher power it is longitudinally konvergent and broader from the phase, with more divergent and broader from phase-spread as well.

Emittance measurements of the separator, RFQ, buncher and IH were done in y-direction showing a normalised emittance of about 0.16 π mm mrad for the RFQ and buncher and 0.27 π mm mrad for the IH cavity, which means a growth factor of 1.6 currently. This emittance growth will be reduced to an estimated upper value of about 1.3 when the control system for the rf-system is improved giving the possibility to tune the amplitude of the IH resonator more accurately. The x-emittance will then also be measured as at the 0 degree beamline.

References

[1] D. Habs *et al.*, Nucl. Instr. Meth. **B139** (1998) 128

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