Energy Upgrade of REX-ISOLDE above 4 MeV/u ◇

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Coulomb excitation and particle transfer experiments with isotopes of heavier masses above A = 80 with REX-ISOLDE require an increase of the final energy of the LINAC above 4 MeV/u. Therefore in a design study possible upgrade scenarios have been discussed and the key structures have been designed.

A major change of the LINAC structure will be required in order to reach energies of approximately 4.2 MeV/u and beyond. Thus two of the three 7-gap spiral resonators with 101.28 MHz resonance frequency have to be replaced by a 1.5 m IH-cavity with 202.56 MHz resonance frequency to boost the energy to required region of 3.75 MeV/u [1]. Then a 7-gap IH-resonator of the MAFF type cavity can be used to adjust the energy between 3.2 and 4.2 MeV/u. To reach even higher energies up to 6 MeV/u a 101.28 MHz IH-Tank has to replace the remaining 7-gap spiral resonator and two or three 7-gap IH-resonators, depending on the energy range, have to be installed. Fig. 1 does show the different energy upgrade structures of the REX-ISOLDE LINAC.

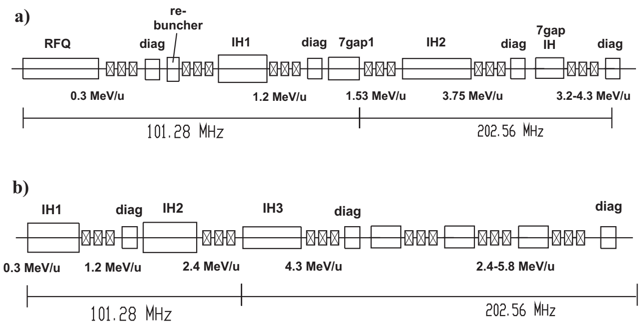

Fig. 1: Schematic of the proposed REX-ISOLDE LINAC for different beam energy ranges. a) Beam energy between 3.2 - 4.2 MeV/u b) Beam energy between 3.4 and 5.8 MeV/u

Key elements of the REX-ISOLDE LINAC upgrade are the 28 gap booster cavity and the 7-gap IH-resonator [2]. Both resonators are tuned to a resonance frequency of 202.56 MHz. The 28 gap structure has been examined with LORASR concerning the beam dynamics. The first four gaps are used to bunch the beam longitudinally at -30^o synchronous phase. The remaining gaps establish the 0^o synchronous particle structure. The gap voltage distribution has been optimized and the emittance growth will stay below 10%. The input emittance assumed in the calculations has been 0.15 π mm mrad normalized, which is five times the REXEBIS emittance.

The typical energy range of such structure is 1.5 - 4.5 MeV/u. In order to boost the energy of the radioactive ions from ISOLDE an energy gain of 2.25 MeV/u is required. Thus an effective acceleration voltage of 10.14 MV for particles with a mass-to-charge-ratio of 4.5 has to be generated. Assuming an effective shunt impedance of 180 MΩ/m, a 400 kW rf-power amplifier must be used. Fig. 2 show a lay-out of the tank of the booster cavity. Due to the energy range, no magnetic inner-tank triplet lens is required. In the next half year the cavity geometry has to be examined with CST Microwave Studio, and the shunt impedance will be optimized.

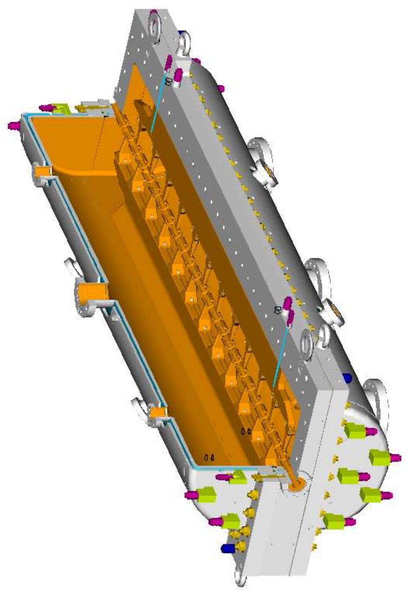

Fig. 2: Lay-out of the 28gap booster cavity for the REX-ISOLDE energy upgrade

The magnetic bender, presently installed in the REX-LINAC beam line, can not bend ions beams with energies above 3.1 MeV/u and A/q > 4.5 into the 65^o beam line. In addition the space required for the modified LINAC, does exceed the present floorspace of the LINAC. Therefore an extension of the REX-ISOLDE beam line into the new ISOLDE hall extension is forseen. The new beam transport within the new hall extension, the achromatic bend towards the experiments and the matching from the LINAC to the transport line has been calculated with COSY infinity and is optimized with a minimum of focusing elements included.

References

[1] O. Kester *et al.*, proc. of the LINAC2004 Germany, Lübeck (2004)
[2] H. Bongers, Ph.D. thesis, LMU München, 2003

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