Status of the REX-ISOLDE Project ◇

O. Kester, D. Habs, T. Sieber, H. Bongers, A. Kolbe, S. Emhofer, P. G. Thirolf, K. Rudolph, S. Hegewisch, G. Bollen [a], I. Deloose [a], H. Ravn [a], F. Ames [b], P. Schmidt [b], G. Huber [b], P. v. Duppen [c], M. Huyse [c], L. Weismann [c], R. v. Hahn [d], R. Repnow [d], D. Schwalm [d], H. Podlech [d], L. Liljeby [e], K. G. Rensfelt [e], F. Wenander [f], B. Jonsson [f], G. Nyman [f], U. Ratzinger [g], A. Schempp [h], G. Walter [i], A. Richter [j], G. Shrieder [j], A. Shotter [k], A. Ostrowski [k], T. Davison [k], P. J. Woods [k], and the REX-ISOLDE collaboration

[a] CERN, CH-1211 Geneva 23, Switzerland
[b] Johannes Gutenberg Universität, D-55099 Mainz, Germany
[c] Instituut voor Kern- en Stralingsfysica, B-3001 Leuven, Belgium
[d] Max-Planck-Institut für Kernphysik, D-69029 Heidelberg, Germany
[e] Manne Siegbahn Laboratory, S-10405 Stockholm, Sweden
[f] Chalmers University of Technology, Gothenburg, Sweden
[g] Gesellschaft für Schwerionenforschung, D-64220 Darmstadt, Germany
[h] J.W.Goethe-Universität Frankfurt, D-60325 Frankfurt am Main, Germany
[i] Universite Louis Pasteur, F-67037 Strasbourg, France
[j] Technische Universität Darmstadt, D-64289 Darmstadt, Germany
[k] University of Edinburgh, GB-Edinburgh, EH9 3JZ, Scotland

The Radioactive beam Experiment (REX-ISOLDE) at ISOLDE/CERN [1–3] is under progress and first hardware components are completed and some tests of the components have been carried out. In the experiment the radioactive ions from the on-line mass separator ISOLDE will be cooled and bunched in a Penning trap, charge bred in an electron beam ion source (EBIS) and finally accelerated in a short LINAC to a target energy between 0.8 and 2.2 MeV/u. The LINAC consists of a radio frequency quadrupole (RFQ) accelerator, which accelerates the ions up to 0.3 MeV/u, an interdigital H-type (IH) structure with a final energy between 1.1 and 1.2 MeV/u and three seven gap resonators, which allow the variation of the final energy. All components of the experiment are either in production or undergo first test measurements.

A 3-dimensional lay-out of REX-ISOLDE is shown in fig.1. The Penning trap is fed from the ISOLDE main beam line where the beam axis is 1.27 m above the floor. The Penning trap is fully assembled on a 60 kV high voltage platform including the differential pumping stages which ensure good vacuum conditions in the beam line. High tension tests with the equipment and first tests of ion injection into the trap have been carried out in order to test the injection optic [4]. The electrode structure consisting of gold plated copper rings isolated by ceramic spacers is assembled and installed in the solenoid bore. The central field strength is 3 T and the gas pressure inside the trap 10^{-3} mbar for rest gas cooling. A plasma ion source has been installed to test the ion capture with a stable 60 keV $^{40}Ar^+$ beam. These capture tests will be done in the beginning of 1999.

The singly charged ions will be extracted from the trap and accelerated to 60 keV. Between trap and EBIS there is a transfer line which consists of two electrostatic 90^o bender and two quadrupole triplet lenses (fig.1). Along the transfer beam line there are several differential pumping stages in order to decouple the buffer gas filled Penning trap from the ultra high vacuum of the EBIS. The construction of the Trap-EBIS transfer beam line has been completed. Drawings of the electrostatic elements, the supports and the ridge, which carries the whole beam line are completed and given to the work shops. The transfer beam line, which has an angle of 64.6^o can be bend horizontal for alignment reasons.

In the EBIS the ions are bombarded by an 0.5 A, 5 keV electron beam with a current density of about 200 A/cm^2 [5]. In the EBIS the ions will be charge bred to a charge to mass ratio between 0.22 and 0.34, which is well suited for the mass separator and the LINAC. After several repairs of the REX-EBIS solenoid by the manufacturer due to damages occurring during quench tests, the EBIS magnet is now back at CERN. The vacuum system is completed and assembled at Stockholm. The electron gun, the collector and the electrode system are completed and will be shipped to CERN. As shown in fig.1 the EBIS rests on a platform above the trap. This platform has been completed and the high voltage platform for the EBIS has been mounted on top of that support.

The S-shaped beam line between the EBIS and the LINAC consists of a mass separator [6] to get the few highly-charged radioactive ions out of the ions from the residual gas. The deflecting magnet has been ordered and the construction of the electrostatic elements has been completed. The electrostatic lenses are now in production. The massive ridge which carries the electrostatic deflector and the vertical beam line of the separator (fig.1) will be mounted to the same concrete tower which carries trap-EBIS transfer beam line. This ridge is in construction. The electrostatic quadrupole quadruplet lens for the injection into the RFQ has been completed and will be used in the RFQ-test beam line [7].

The RFQ is the first structure of the Munich part of the LINAC [7]. It is now fully assembled, which means the water cooled ground plates, the stems and the mini-vane like quadrupole electrodes are mounted in the tank and the capacitive plungers are installed, cabled and tested.

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The vacuum system has been installed and first vacuum tests have been performed. Low level frequency tuning and flatness measurements have been done. Alignment of the electrodes, final adjustment of the voltage flatness and the installation of the incoupling loop will follow soon.

In order to match the beam into the acceptances of the IH-structure a section consisting of two magnetic quadrupole triplet lenses and a rebuncher is required. The first triplet lens focuses the beam through the rebuncher and produces a waist for diagnosis. The second triplet lens matches the beam to the transverse acceptance of the IH-structure. The aperture of the lenses is 3 cm. The design of the matching section is finished and the lenses with a maximum gradient of 60 T/m are ordered. The rebuncher, a three gap quarter wave spiral resonator [8], is copper plated, assembled and tuned on low rf power level.

The IH-structure of REX-ISOLDE [9] is a short version of the IH-tank1 of the CERN LINAC III [10] and consists of a center frame which carries the drift tubes and two half shells carrying cooling jackets. After the first acceleration section an inner tank quadrupole triplet lens is foreseen, which has been delivered and will be installed after magnet measurements and the delivery of the IH-vacuum tank. The drift tubes and the stems are completed and will be copper plated together with the IH-vacuum tank. The piston tuners are in production. The change of the final energy of the IH-structure via the piston tuners has been examined once more by a detailed MAFIA model of the power resonator. The calculations are in very good agreement with measurements taken from the vacuum tank of the power resonator and show the required tuning by changing the half shell height [11]. The power resonator will be copper plated in February 1999 and then assembled in Munich. Then power tests will follow until the middle of 1999.

The three seven gap spiral resonators from the back part of the LINAC [12] are built by the MPI für Kernphysik in Heidelberg. Model measurements show that 1.75 MV resonator voltage can be achieved with 90 kW rf-power. The model measurements are finished and the first 7-gap resonator has been completed and is ready for power tests in Heidelberg. The first power transmitter from BERTRONICS is delivered to Heidelberg and will be used for the power tests. The second power amplifier is in production and will be delivered in February 1999. The residual three power amplifiers will be completed until the middle of 1999.

The MINIBALL γ-detector array [13] consists of a new generation of Ge-detectors with large full-energy peak efficiency to make an optimum use of the expensive radioactive beams. With its compact arrangement it is mainly suited for detecting events with small γ-ray multiplicities. In the final system the array will consist of 6 clusters with 7 individually encapsulated 6-fold segmented Ge-detectors which are a new development of Eurisys. A prototype has been tested and had shown a resolution of 2.1 keV at 1.33 MeV γ-energy. First measurements with a flash-ADC system to determine the position where the γ enters the detector have been performed. A new design of the detector arrangement has been done with smaller clusters of detectors (3 and 4 detectors). It is possible to combine a cluster of 3 detectors with a cluster of 4 detectors to a 7 fold cluster, but in a first stage an array with 3-fold clusters can be assembled with a good photo peak efficiency. Currently 5 detectors in Munich, 4 detectors at the MPI-K in Heidelberg and 2 detector in Cologne are operational. The favoured electronics for the MINIBALL is developed by the company XIA and will be comparable to that of the GRETA project in Berkeley, USA. In contrast to former Ge-detector electronics analog circuits are replaced by digital electronics using flash ADC's and DSP's. The target chamber is completed and has been vacuum tested. Prototypes of the particle detectors (double sided silicon strip detector DSSSD) have been produced and tested with an alpha-source. The pre-amplifiers have been manufactured and tested as well as cablings and connectors. Tests of the multiwire gas chamber behind the target chamber which is the beam position and intensity monitor has been tested in Heidelberg with heavy ions.

The infrastructure for REX-ISOLDE, concerning the power cabling, air conditioning of the power amplifier room and the supply of cooling water, has to be established. Thus the construction of the air conditioning of the power amplifier room has been completed. In addition first holes have been drilled into the wall between ISOLDE hall and the power supply room, in order to get the rf-power cables, data cables, water pipes and electrical power cables to the supply rooms. In fig.1 the distribution of the power rf-cables can be seen. In addition the concrete tower for the alignment of the beam line between EBIS and electrostatic deflector of the mass separator which supports the rf-cables. A walk way is under construction, which will be established beside the LINAC, to allow the work at the structures (beam axis is 1.75 m above ground) and which carries the water supply, the power cables and the data cables on cable trays.

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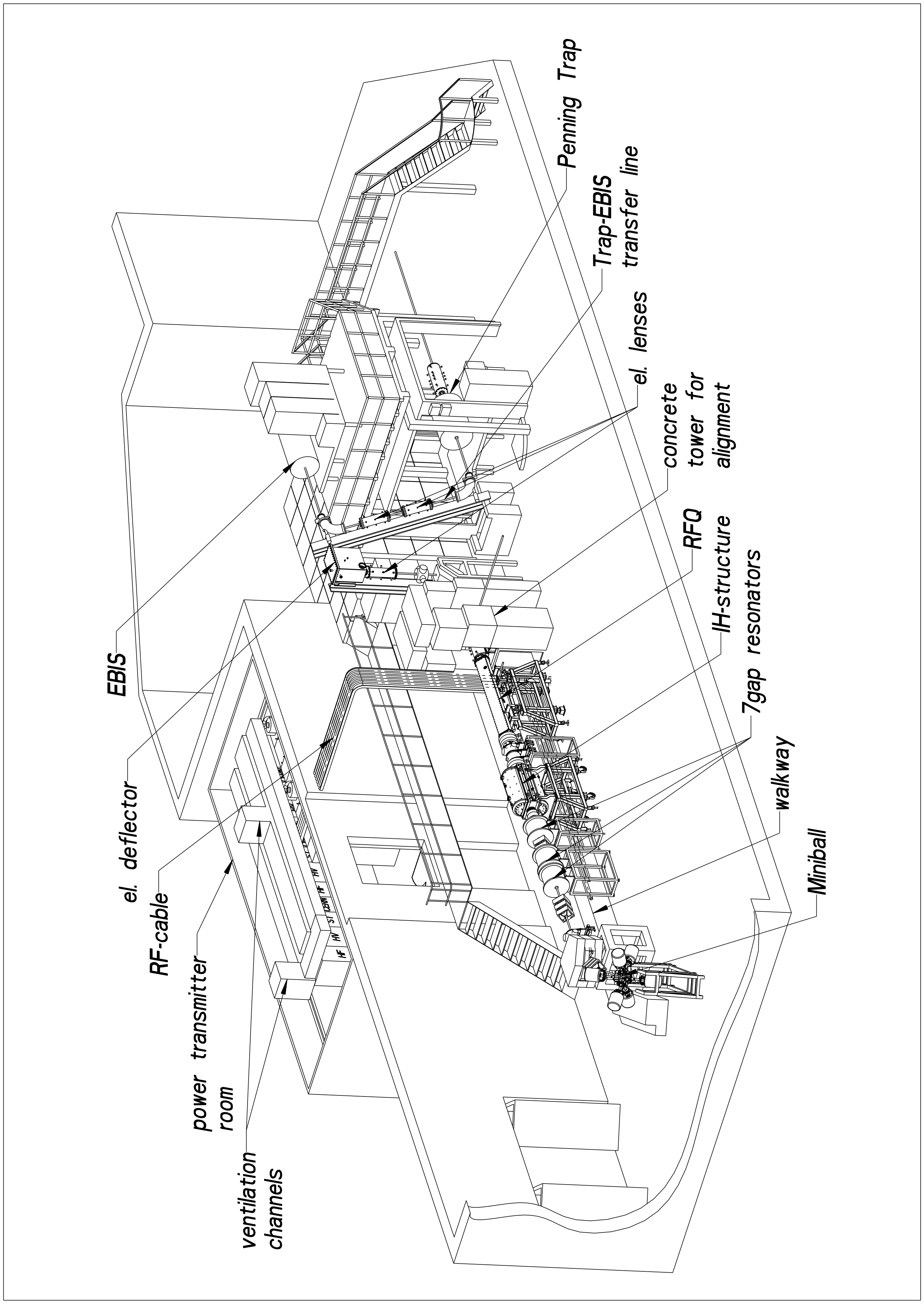

Fig. 1: Lay-out of the REX-ISOLDE experiment