BEAM TRANSPORT CALCULATIONS FOR LEBIT

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One important aspect of the LEBIT project is an efficient transport of the low-energy beams. The beam needs to be transported from the gas stopping cell through the shielding wall, to the RFQ buncher, and finally to the Penning trap mass spectrometer. Switchyards have to be foreseen for the delivery of the beam to other experimental stations (laser spectroscopy, decay studies) and for the injection of beams from test ion sources. Since the beam energy is low (<60 keV) an electrostatic ion transport system has been chosen.

In the first section between the gas cell and the beam accumulator and buncher the ions will be transported with an energy of 5 keV. Einzel lenses are used as focusing elements. Several focal positions are foreseen where beam observation systems will be installed. SIMION was used for the calculations and the position and design of the lenses was optimized towards a beam transport with minimum aberrations and beam losses.

Figure 1 shows the layout of the ion optics for this section. The starting point is a beam observation system in front of the shielding wall. An emittance of the beam of 10 π mm mrad has been chosen which is typical for cooled 5 keV ion beams from ion guides. The ions are first transported through the shielding wall by a long cylindrical Einzel lens. With additional Einzel lenses they are guided through a 4-way beam switch and focused into the electrostatic retardation system at the entrance of the buncher. The final energy with which they enter the buncher is 50 eV. After optimization of the system it was verified that the original beam emittance is practically conserved. The relative increase was less than 10%.

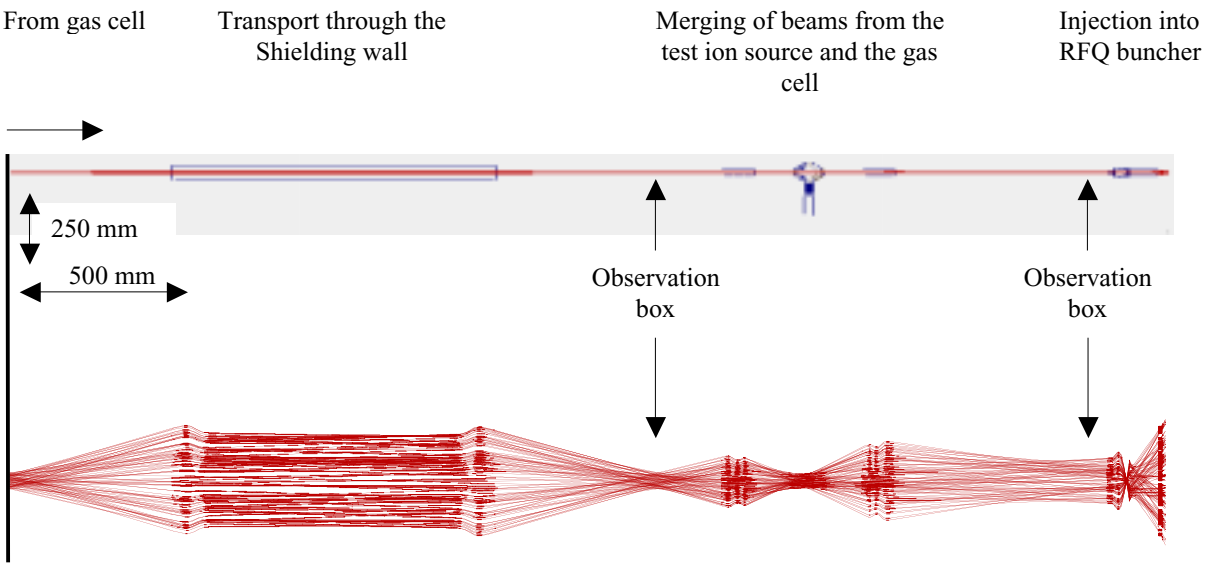

Fig.1 Layout of the ion beam transport system and calculated ion trajectories. The trajectories have been scaled transversely by a factor of ≈10.

For several of the foreseen low-energy beam experiments it is decisive to have a test beam of stable ions delivered, which has the same properties as the radioactive beam. Therefore, the best place to install a test ion source is in front of the buncher, since the ions will have forgotten their history after having passed

this cooling system. In order to allow a fast switching between radioactive ions and test ions a 4 way deflector was chosen for this purpose. This system is shown in more detail in Fig. 2. The 90-degree quadrupole deflector is installed between two einzel lenses in the main beam line. The test ion source is mounted perpendicular to the main beam axis. And a cylindrical and a planar einzel lens are used to properly shape the beam from the test ion source.

In addition to the SIMION calculations shown here, COSY has been used to calculate the beam transport of the 60 keV beam available after the cooler and buncher. This energy will be used when transporting the beam into the horizontal and vertical beam lines for future experiments. Here electrostatic quadrupole multiplets and deflectors will be used.

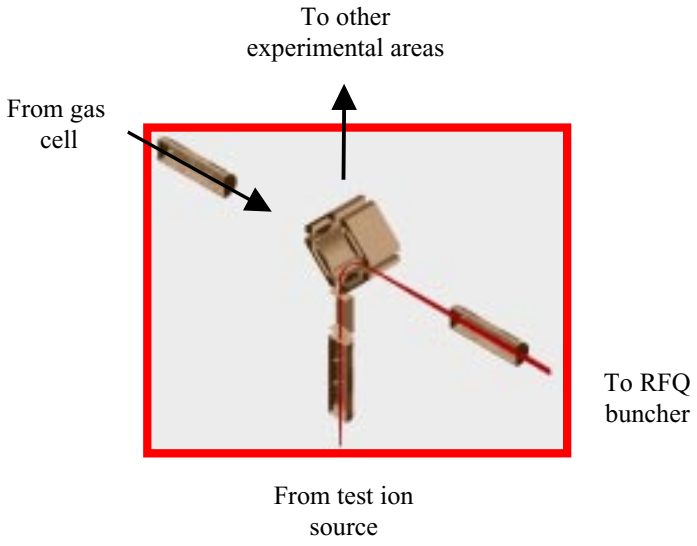

Fig.2 The 4-way beam switch