Mounting of the FeLiKx experiment
Hellma glass cell

Florian Schreck
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1) Description of the glass cell

The central part of our BEC machine vacuum chamber consists of a glass cell made by Hellma (Fig. 1). It has a DN40CF entrance port for an atomic beam and a DN63CF exit port towards a pump chamber (Larson SQ-200-F3 and SQ-125-F2 out of 316 non-magnetic steel). The glass cell itself consists of five millimetre thick spectrosil 2000 glass and is 32 mm height, 170 mm wide and 110 mm long. The windows towards the entrance port are at Brewster angle to allow an optical resonator dipole trap to be built orthogonal to the glass cell axis. The windows to the exit port are at 45 degrees.

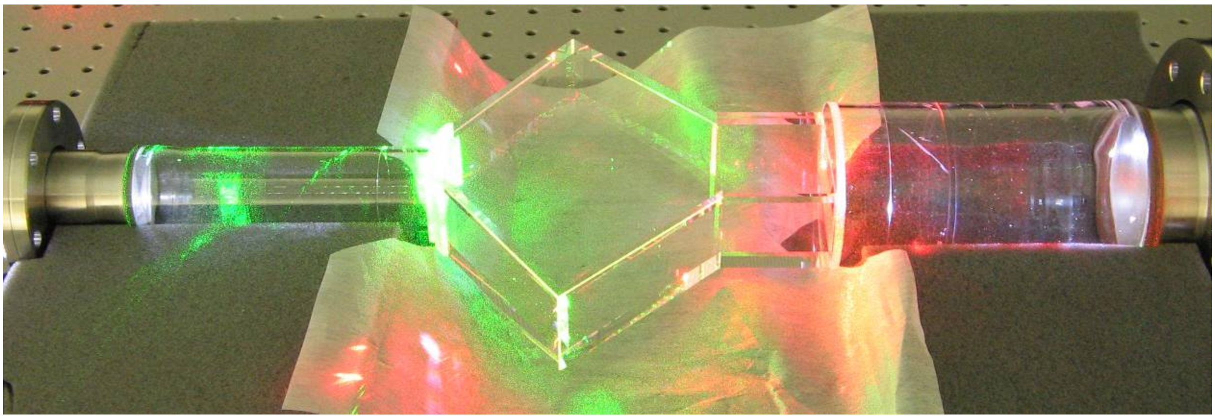

Fig. 1: the FeLiKx experiment glass cell. The atomic beam passes from left to right.

2) Mounting

It is in the nature of such glass cells to be quite fragile. We have developed a special procedure to minimize stress on the glass cell during mounting. The result of this procedure is a glasscell which is mounted at its entrance port using a welded bellow and a spring loaded supporting rod and to the exit port rigidly attached to the pumping chamber (Fig. 2). In the following the mounting steps are described.

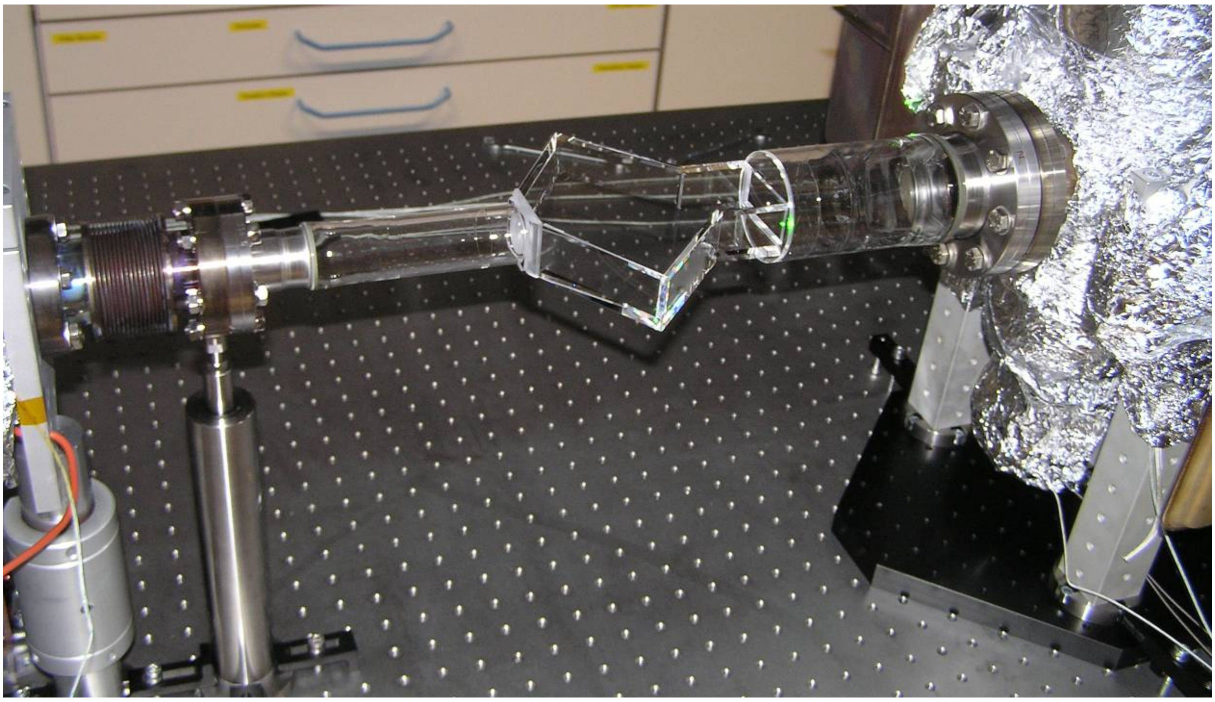

Fig. 2: The glass cell in its final position.

2.1) Mounting of the entrance port

We started by mounting the entrance port of the glass cell to the bellow. To assure that no stress is made on the glass cell while tightening the screws of the bellow, we first have to attach the DN40CF flange of the cell to a clamp attached to the optical table (Fig. 3).

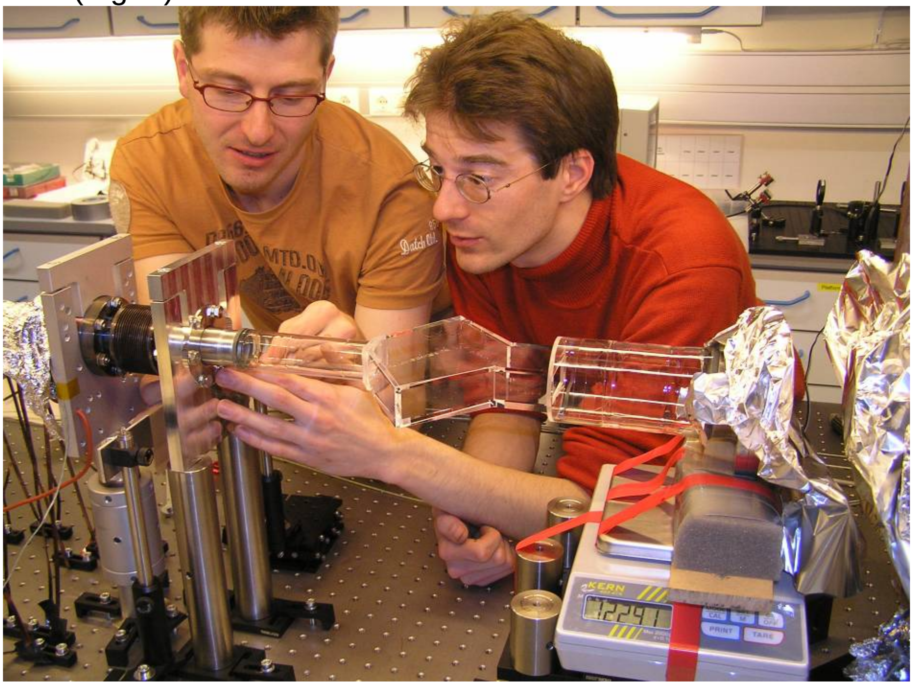

Fig. 3: Attaching the entrance port.

When tightening this clamp the glass cell might be lifted upwards or pushed downwards. To avoid breaking the cell, we measure the force with which the exit port of the cell presses downwards while tightening the entrance port clamp. We regulate this force to be always the same while slowly tightening the clamp. To do this regulation, we positioned a scale on a labjack. The scale indicates the force by giving a weight measurement. We adapt this weight by rising or lowering the labjack. On top of the scale we damped the motion with foam which we covered on top with a Teflon tape covered metal plate to allow the cell to slide sideways. While tightening we also check the rotational alignment of the glass cell using a dial gauge.

We use a standard copper gasket (not an annealed one since they are prone to leaks) to attach the glass cell entrance port to the bellow. The gap between the flanges was measured with shims and left at about 0.1mm.

Now we opened the clamp again and carefully adapted the height of the labjack during this process. We measure the rotation of the glass cell again by a dial gauge. If we are not satisfied the whole procedure is repeated.

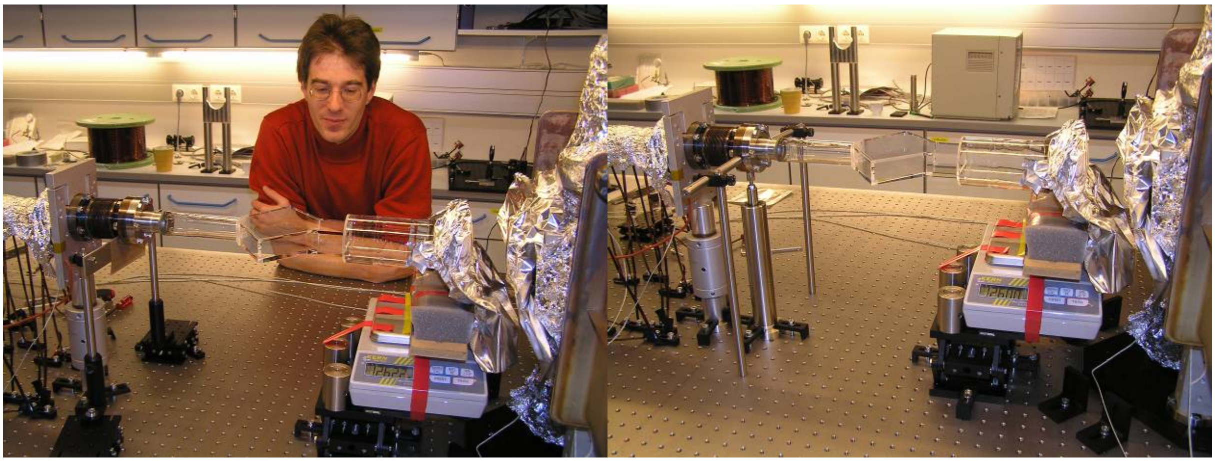

Fig. 4: replacing the entrance port clamp by the spring loaded rod.

2.2) Spring loaded support of the entrance port

As can be seen on Fig. 4 we replaced the clamp first with a Teflon coated supporting structure. We aligned the glass cell height with respect to the flange at the other side of the bellow using a dial gauge from the mechanical workshop. Now we placed the spring loaded rod. We adjusted the height of the rod using the screw on top of the moveable part (see picture). Inside the tube of the spring loaded rod we installed ball bearing tubes for vertical motion. Use high temperature versions of those ball bearing tracks so that they withstand bakeout.

2.3) Attaching the exit port to the end chamber

The scale support is now replace by a rod (Fig. 5). The end chamber is mounted on a breadboard. The breadboard is pushed towards the glass cell by screws mounted vertically on the optical table (see Thorlabs KL01 and KL02 kinematic stops). The gap between glass cell and the rotating end chamber flange is measured with shims. The orientation (position and angle) in horizontal and vertical direction is adapted by inserting shims in between the breadboard and the holders of the end chamber until the gap is nowhere more than 0.1 mm. Now the breadboard is clamped to the optical table. Finally a non annealed copper gasket is inserted and the exit port is fixed to the end chamber. Finally the glass cell is surrounded by a cage.

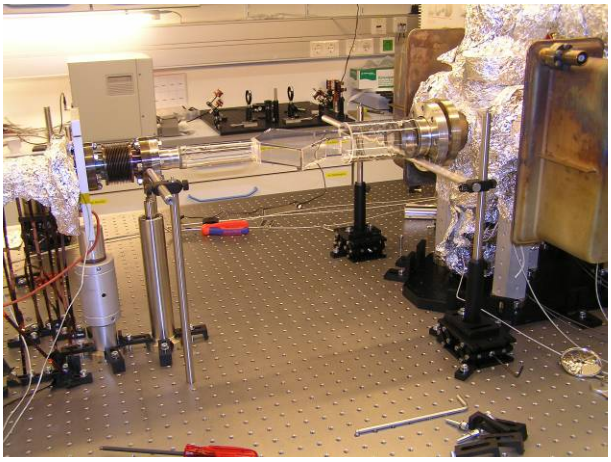

Fig. 5: replacement of scale and approaching of end chamber.

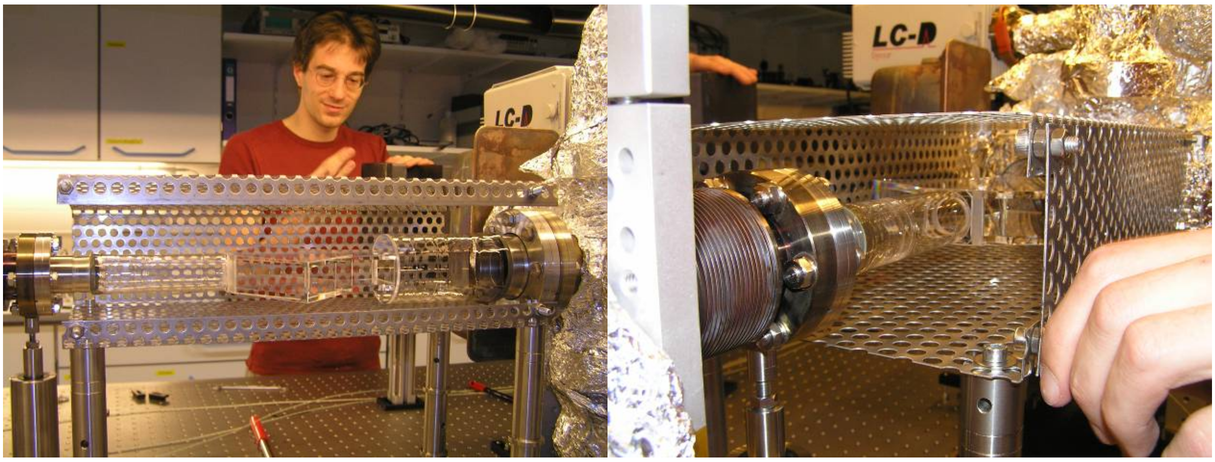

Fig. 6: protecting the glass cell.

3) Bakeout

The bakeout of our vaccum chamber was done in several steps. All parts from the workshop have been baked to 450 °C. The apparatus without glass parts has been baked at 300°C for several weeks (heating rate: 10°C/hour). After installing the glass parts the apparatus was heated to 200°C with a heating rate of 3°C/hour and left there for a week. Then the Titan sublimation pumps where flashed and the ion pumps activated with the chamber still being hot. The Titan sublimation pumps where then flashed about every three days until they where clean. After 10 days the chamber was brought back to room temperature with a rate of 3 °C/hour. For debugging a residual gas analyzer was very useful. Helium leak tests where also preformed using an RGA.

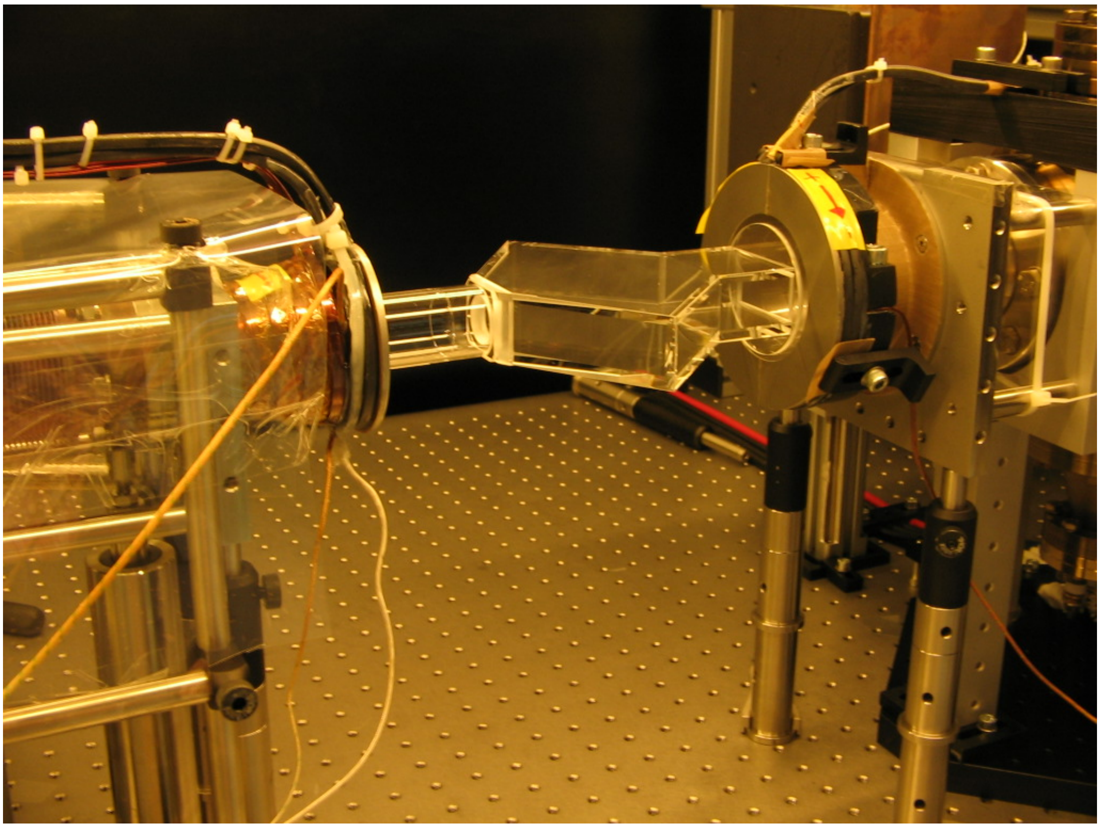

Fig. 6: Second Zeeman slower and compensation coil around glass cell

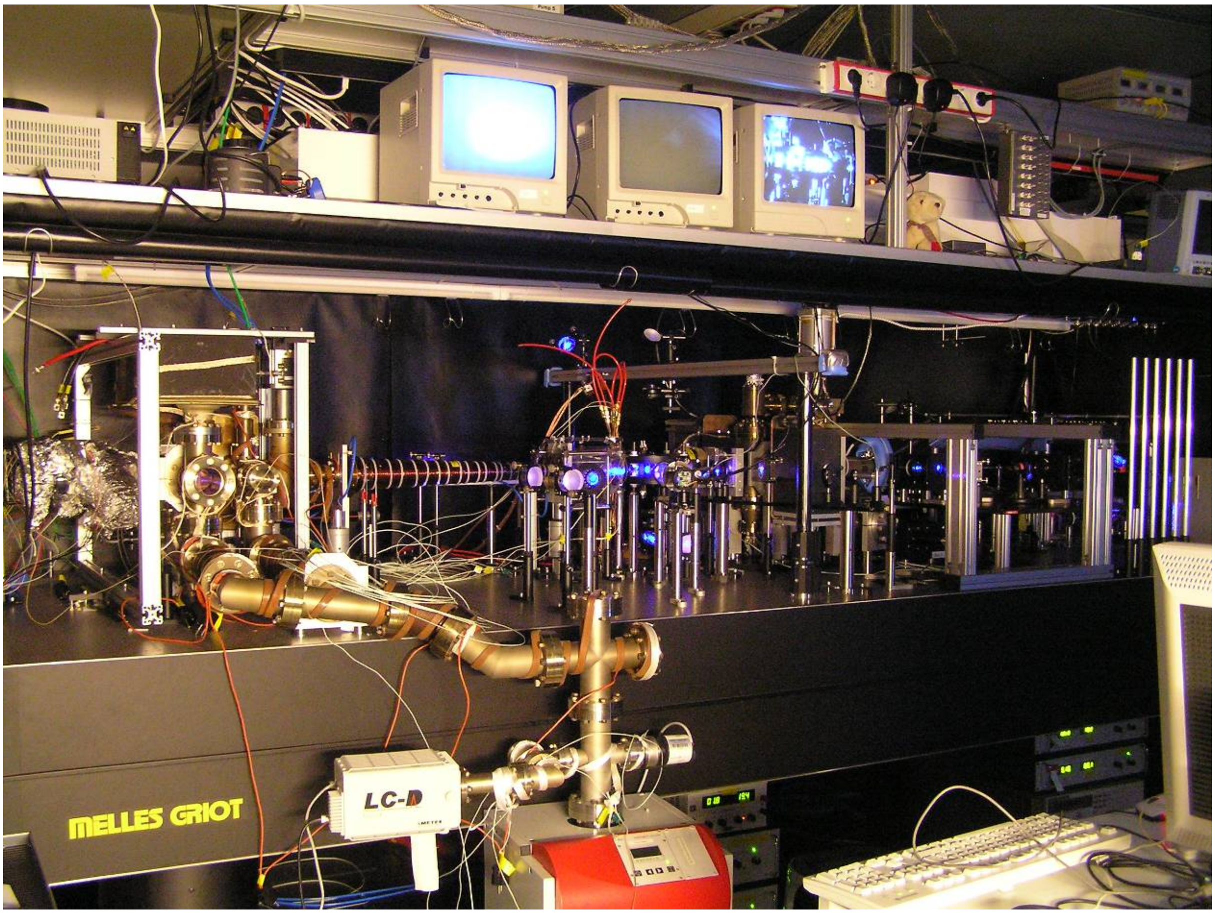

Fig. 7: A full view of the vacuum chamber.

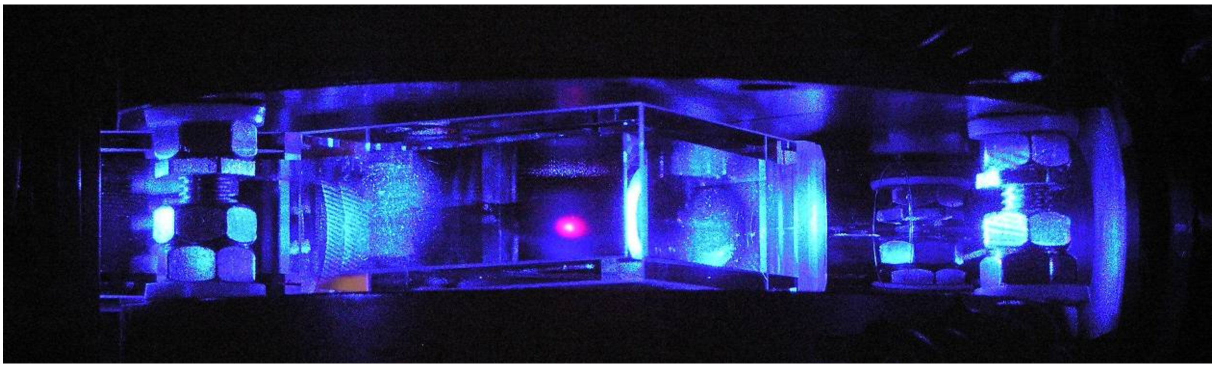
Fig. 8: A Lithium and Strontium double MOT inside the glass cell.