Test report
Iodine gas cell I-100-11

Introduction

Current plans on upgrading the ion storage PALLAS involve stabilizing the frequency of a dye laser beam to an atomic frequency standard given by an optical transition in I_2. For this purpose an iodine gas cell provided by Sacher Lasertechnik has been tested in a Polarization Spectroscopy setup. The results are listed below.

Top and side view of the iodine cell I-100-11 tested for Sacher Lasertechnik

Results

The gas cell has been tested at a constant room temperature of 22° Celsius. Since it is not equipped with a cold finger no systematic studies on Doppler broadening due to vapor pressure variations have been performed.

The total length of the gas cell body is 100 mm. On each end a quartz window is glued to the cell tube with the incident plane tilted by the Brewster angle relative to the cell body axis.

Cleanliness

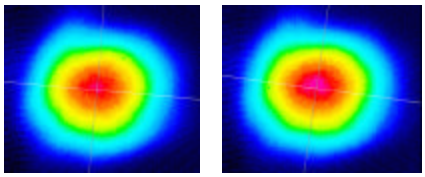
Remnants of glue inside the cell can sublimate and change the cell vacuum conditions. The tested cell has a very clean connection surface between window and cell body without visible remnants of glue. Inevitable depositions of solid iodine sticking to the window surfaces can be easily removed by heating the windows without affecting the glue connection. No leaking effects during normal operation or after heating were observed.

Mechanical stability

The window diameter slightly exceeds the cell body diameter, thus if put on a plane surface the cell will lay fixed on the window edges. With this configuration no acoustic jitter picked up by the gas cell body was observed which might influence the laser beam traversing the cell.

Optical flatness of the cell windows

A good optical flatness of the cell windows is required to avoid steering of the laser beam and a distortion of the laser beam profile. With the laser beam passing through a 200mm pinhole placed in a distance of about 1.25 m from the gas cell no beam steering due to displacements of the cell was observed.



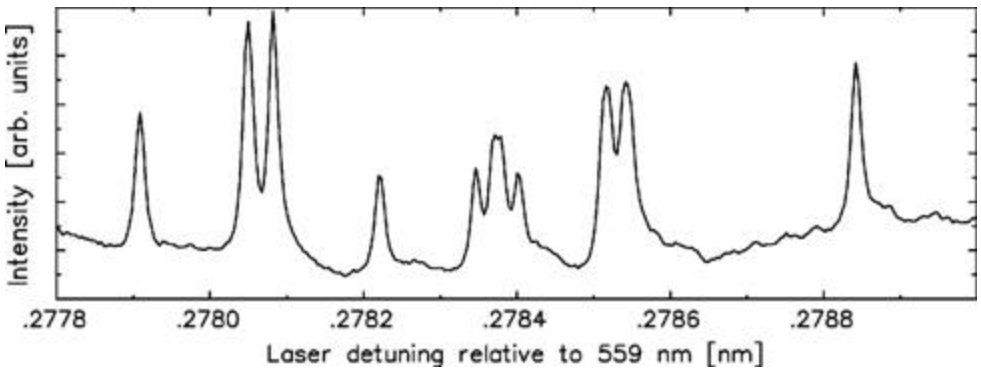
Furthermore, the beam profile measured with a CCD camera did not show any variations due to a displacement of the cell (See beam profiles on the right. For the second image the cell was displaced slightly from its position compared to the first image). With the windows glued to the cell body quartz windows of a defined optical flatness can be used with this cell design – this design issue becomes important if special requirements on the beam quality are given.

Optical properties important for Polarization Spectroscopy

The incident planes of the windows are tilted by the Brewster angle relative to the axis of the cell body. This allows for maximum transition of the linearly polarized light of the laser and minimizes unwanted reflections at the windows' surfaces. As expected no change in the polarization of the laser beam was observed, owing to the fact that the windows are made of plane quartz substrates and no mechanical stress is exerted on them.

When changing the laser frequency a (fortunately negligible) etalon effect is visible – a series of interference fringes appear, changing size if the laser frequency is detuned. The interference occurred between the front and back surface of a single plane window, but not between the two cell windows – the latter case is impossible because of the relative alignment of the window planes. This etalon effect can be reduced by changing the angle of incident of the laser beam.

To illustrate the good performance of the cell a small part of the iodine Doppler-free spectrum measured with the Sacher gas cell is plotted in the figure below.



Conclusion

The gas cell tested showed excellent performance in our tests and is a good choice for Polarization Spectroscopy setups at room temperature. Frequency stabilization of a dye laser to several atomic transition frequencies in iodine has been achieved.

Contact

Michael Bussmann
LMU Sektion Physik, LS Habs
Am Coulombwall 1
85748 Garching
E-Mail: michael.bussmann@physik.uni-muenchen.de