High Voltage Calibration at ISOLDE/CERN

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Introduction: The precise knowledge of the ion source potential of better than 10^{-4} is mandatory for collinear laser spectroscopy [1]. At ISOLDE/CERN [2] there are two power supplies available to accelerate ion beams up to 60 keV (later ascribed as *Astec* and *Heinzinger*). At the University of Münster a high precision voltage divider *KATRIN* has been build, which was specified by the PTB Braunschweig to sub-ppm accuracy and stability [3]. This device has been installed at ISOLDE to perform calibration measurements on *Astec* and the new *Heinzinger* power supply.

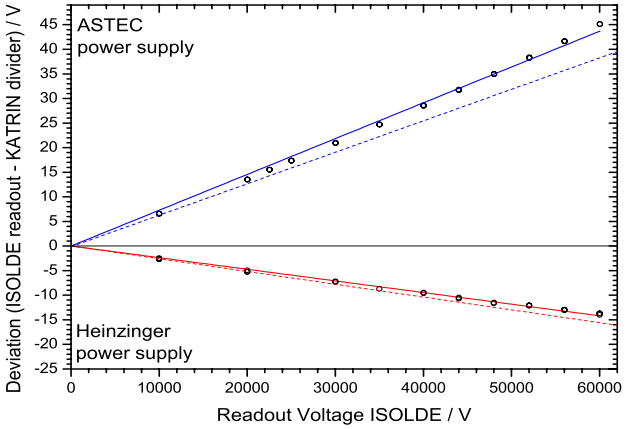

Figure 1. Deviation of the voltage determination between the KATRIN divider and ISOLDE HV readout applied to the *Heinzinger* and *Astec* power supply. The dashed lines show the deviation between the first version of the KATRIN divider and the two *Astec* devices from the year 2008. At that time we were able to measure up to 35 kV only, thus we had to extrapolate up to 60 kV.

Experimental: The *KATRIN* voltage divider scales the applied voltage down by a factor of 3636. This divided voltage is measured by a FLUKE 8508A digital reference multimeter. In order to avoid drifts within this precision voltmeter, a 10 V reference potential has been provided by a Fluke 732A high stability power supply. To calibrate the ISOLDE power supplies, the displayed potential given by the internal HV dividers from the ISOLDE controls is compared with a synchronous measurement of the *KATRIN* divider.

Results: For the calibration measurements, the voltage of the power supplies was stepwise increased from 10 kV up to its maximum of 60 kV. After setting a new voltage the power supplies had 7 minutes to thermally stabilize before we took three times synchronous voltage readings of the ISOLDE controls and the *KATRIN* setup in a sequence of 30 seconds. Figure 1 shows the discrepancy of the ISOLDE display against the *KATRIN* divider measurement. We found a disagreement of the displayed voltage by the *Heinzinger* power supply to the *KATRIN* device of $2{,}36(13) \times 10^{-4}$ and thus about 14 volts at 60 kV. In case of the *Astec* power supply we observed a discrepancy of 45 V at 60 kV. This corresponds to a relative deviation of about $7{,}50(23) \times 10^{-4}$. In comparison with our HV measurements of the previous *Astec* power supply that was replaced by the new *Heinzinger* device performed in 2008, the calibrations seem to be in good agreement independent of the power supplies. As the associated ISOLDE HV dividers and measurement devices, used to display the readout voltage, have not been exchanged, it seems obvious that these components are responsible for the discrepancy to the applied voltages.

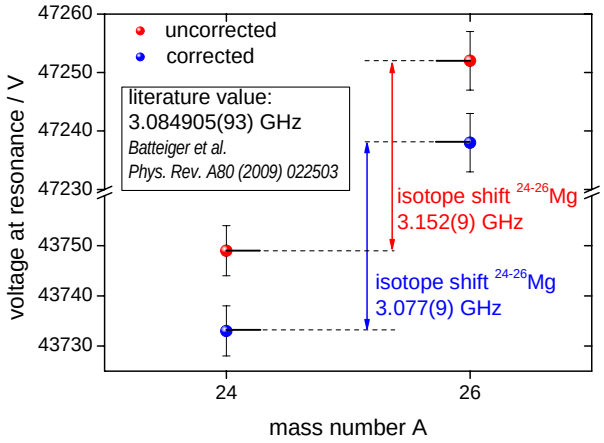

Figure 2. Discrepancy of the isotope shift $^{24-26}$Mg measured in 2009 at COLLAPS/CERN to the literature value. Including the high voltage calibration decreases the difference and thus it is in agreement with the measurements from Batteiger et al.

To demonstrate the importance of this calibration for collinear spectroscopy, fig.2 shows its influence on the $^{24-26}$Mg isotope shift measurements from 2009 [4]. The red dots ascribe the evaluated values from collinear laser spectroscopy. Here we found a substantial deviation in the order of about 80 MHz to the literature value that was measured with high accuracy in a Paul trap [5]. Including the high voltage calibration eliminates the discrepancies.
These calibration measurements demonstrated the longterm stability of the power supplies and therewith our previous calibration. It eliminated discrepancies between other laser spectroscopic measurements in previous years and will improve the accuracy of further experiments.

References

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