Conversion Electron Measurements in the 2nd Minimum of ^{240}Pu ◇

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At the munich accelerator laboratory there are now 2 experimental facilities for conversion electron measurements operable. An electron spectrometer consisting of 3 magnetic transport systems called Mini-Oranges[1] and the Bonn-Berlin super conducting solenoid. While the Mini-Orange(M.-O.) spectrometer represents a system allowing for highest transmission rates in a narrow energy range, the superconducting solenoid covers a much broader energy range under a larger solid angle. To reach a comperable level of solid angle coverage like the solenoid, the M.-O. spectrometer consists of 3 M.-O. covering a total of 25% of 4 Π for the closest geometry. The distinct feature of the high transmission in a narrow energy range of the M.-O. spectrometer was already used to search for a strong E0 transition of 806 keV in the 2nd Minimum of ^{240}Pu, proposed by D. Pansegrau et al.[2]. In this first experiment which used the recoil shadow technique, the M.-O. were mounted under forward angles and the closest possible geometry. By using the ^{238}U(α,2n)^{240}Pu reaction in 80 hours of beamtime, 35000 delayed fission events were recorded. Unfortunately it was discovered that beam scattering on the wings of the closely packed M.-O. contributed to such a huge background in the SiLi-detectors, that it became necessary to pull back the Mini-Oranges. As a consequence the total efficiency had decreased from 4% to below 0.5%. At this level the E0-transition couldn't be identified. In order to avoid the beam scattering problems in a further experiment, a new scattering chamber (fig. 1) was designed and is under construction.

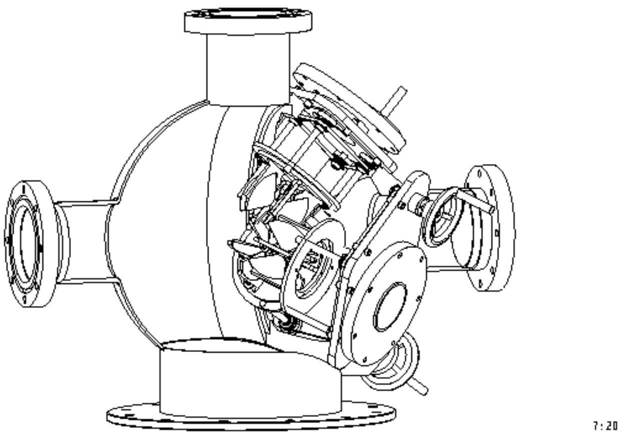

Fig. 1: The new scattering chamber with 3 Mini-Oranges mounted

Having a larger opening angle for the outgoing beam and a variable M.-O. to target distance it will be much better suited for this kind of measurements then the old scattering chamber which was originally designed to hold the M.-O. under backward angles. With the techniques of the measurement well established, the meantime until the completion of the scattering chamber will be used to optimize the transmission efficiency of the M.-O.. Two considerations are most promising to improve the transmission efficiency. At first, the strongest permanent magnets available $Nd_2Fe_{14}B$, a rare earth material, will be used instead of the ceramic $SmCo_5$ magnets. The blocking factor b can be lowered by 20%. It results from the magnet sides facing the target and is proportional to the transmission efficency T$\propto$(1-b) . The second point concerns the radial and azimuthal inhomogenities of the magnetic field in the gaps of the M.-O.(fig. 2). Three-dimensional magnetic field calculations will further optimize the shape and number of the magnets for an optimal homogenious toroidal magnetic field.

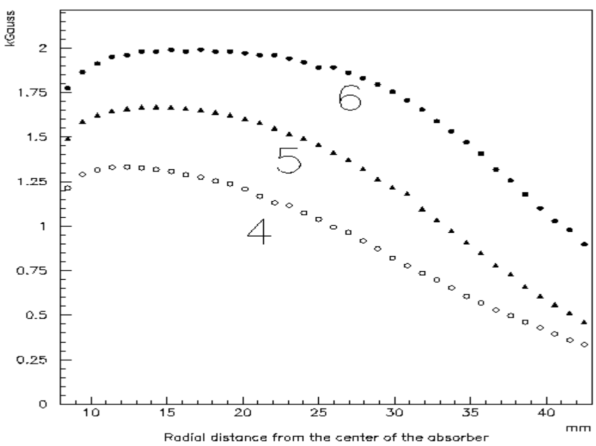

Fig. 2: Measured radial B-fields for 4,5 and 6 magnets per M.-O. emphasize that at least 6 magnets must be used to accomplish a rather homogenious field in the outer regions as far as 30mm from the center of the M.-O.

Present measurements with discrete and continuum β-ray sources performed in a test setup showed good agreement of the M.-O. acting as magneto-static lenses with the expected optical mapping features. Different source to M.-O. distances were investigated to determine the optimal target distance. By varying the number of magnets, their thickness and the source to M.-O. distance, a complete data set for different energy ranges and target to M.-O. distances was generated.

References

[1] J.van Klinken and K.Wisshak, Nucl.Instr. **98** (1972)
[2] D.Pansegrau, Ph.D. thesis, MPI Heidelberg, 1998

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