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PH III_68/30 19 April 1968

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PROGRESS REPORT ON EXPERIMENT SC2a: NUCLEAR EXCITATION IN MUONIC ATOMS AND STUDY OF NUCLEAR VOLUME EFFECTS

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(received 19 April 1968)

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On account of our proposal of January 1968, 25 shifts have been used up to March 1968. A short summary will be given of what has been achieved so far.

- 1) The experimental set—up has then assembled in Darmstadt, the essential part being a Ge(Li) detector of J.9 keV resolution at 100 keV and a anticoincidence box surrounding the target which can be flushed with He gas to reduce back—ground.
- 2) μ -beam studies have been performed with scanning devices and X-ray films. As a result of the optimization smaller targets (4 x 6 cm) can be used with a reduction of background by a factor of 4 without intensity loss.
- 3) The energy calibration, being essential in this experiment, was improved compared to our first test experiment 1) by accepting pulses from the calibration source proportional to the instantaneous muon—beam intensity. The calibration spectrum, the prompt µ spectrum and the delayed events were detected simultaneously.
- 4) The following isotopes have been measured in natural elements: Sm¹⁵², Ta¹⁸¹, W¹⁸², W¹⁸⁴, W¹⁸⁶, Re¹⁸⁵, Re¹⁸⁷, Os¹⁸⁸, Os¹⁹⁰, Os¹⁹², Jr¹⁹¹, Ir¹⁹³, Tl²⁰³, Tl²⁰⁵. In all cases nuclear γ rays have been observed. A positive isomer shift in Sm¹⁵² is in good agreement with the result of the Columbia group²⁾. For all other even—even nuclei a negative shift up to 580 eV was observed. The analysis for the odd nuclei has not yet been completed but part of them have definitely a positive shift.

The weak excited single-particle states in T1 show well separated doublets due to the large magnetic hyperfine interaction.

The improved experimental technique allows the observation of weak nuclear excitation. The observed negative isomer shifts are in complete disagreement with the existing calculations for deformed nuclei and some shifts measured with Mössbauer technique. More systematic studies are necessary to decide on several possible explanations for the discrepancies.

Another object of future experiments will be the precise determination of the excitation probability and questions concerning the excitation mechanism itself. Furthermore, data on magnetic hyperfine interaction will give valuable information on the Bohr-Weisskopfeffect.

References

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