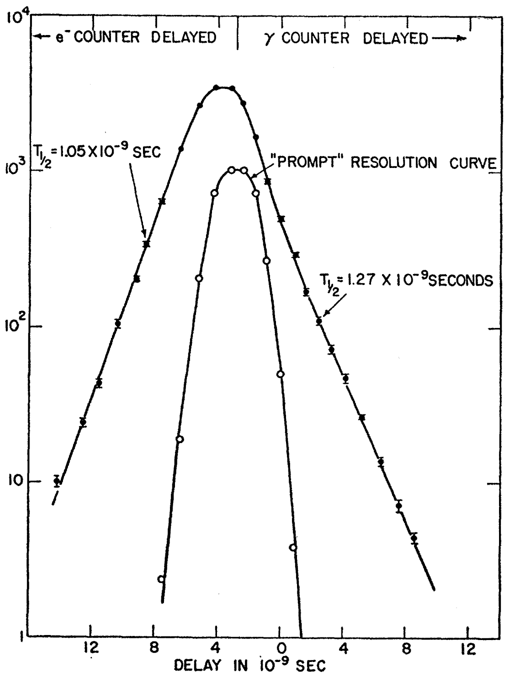

FIG. 2. Time distribution of β^+ conversion electron—hard γ-ray coincidences. Lower-edge energy discrimination imposed upon both counters.

$\sim$1.2-Mev energy in W^{182} would be expected to have a half-life of $\sim 1.6\times10^{-8}$ sec (based on the 9×10^{-7} sec half-life[9] for the 513-kev $M2$ transition in Rb^{85}).

(2) A similar coincidence experiment involving coincidences between hard γ rays and soft electrons has shown that conversion electrons of a well-converted low-energy γ ray are delayed with respect to hard γ rays with a half-life of $1.27\pm0.10\times10^{-9}$ sec. It is not possible to obtain the hard γ-conversion electron delay curve free of interference from the β—hard γ lifetime of 1.02×10^{-9} sec even with narrow window energy selectors because of the continuous β-ray spectrum. We therefore show in Fig. 2 the time distribution of coincidences between the electron and hard γ-ray counter taken with lower-edge energy discriminators. The results were checked with narrow-window energy selectors and agreement was obtained with the results shown in Fig. 2.

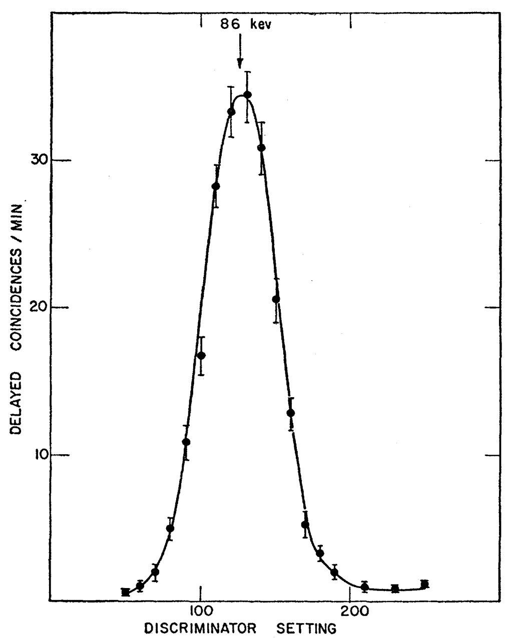

FIG. 3. Pulse-height spectrum of conversion electrons following the decay of the 1.27×10^{-9} sec delayed state.

A pulse-height spectrum of the conversion electrons which show the 1.27×10^{-9} sec lifetime is given in Fig. 3. The spectrum was measured with the hard γ counter delayer by about 6×10^{-9} sec relative to the electron counter. The energy scale was established by pulse-height analysis on the conversion electrons of the 104-kev γ ray in Eu^{153}. We interpret the peak at $\sim$86 kev as the L conversion electron peak of a γ ray of 98 ± 6 kev and identify this with the intense well-converted 100.0-kev γ ray occurring in the decay of Ta^{182}. The 100-kev transition has been shown to be an $E2$ transition[10] and the 1.27×10^{-9} sec lifetime is appropriate for a fast 100-kev $E2$ transition of the "cooperative" type[11,12] in this region of the periodic table. From the fact that no other radiation appears to follow the hard γ rays with this lifetime, we infer that the 100.0-kev state represents the first excited state in W^{182}. This interpretation is in agreement with the energy-systematics of the first excited states of even-even nuclei.[13,14] Further proof of the interpretation that the 100-kev state is the first excited state of W^{182} has been furnished by Coulomb excitation of W.[15]

† Work done under the auspices of the U. S. Atomic Energy Commission.
[1] For a complete list of references see National Bureau of Standards Circular 499 (U. S. Government Printing Office, Washington, D. C., 1950) and its supplements, as well as Hollander, Perlman, and Seaborg, Revs. Modern Phys. **25**, 469 (1953).
[2] Muller, Hoyt, Klein, and Dumond, Phys. Rev. **88**, 775 (1952).
[3] F. K. McGowan, Oak Ridge National Laboratory Report ORNL-952 (1951).
[4] Bell, Graham, and Petch, Can. J. Phys. **30**, 35 (1952).
[5] F. K. McGowan, Oak Ridge National Laboratory Report ORNL-952 (1951).
[6] S. de Benedetti and H. J. Richings, Revs. Modern Phys. **23**, 37 (1952).
[7] T. D. Newton, Phys. Rev. **78**, 490 (1950).
[8] Z. Bay, Phys. Rev. **77**, 419 (1950).
[9] Sunyar, Mihelich, Scharff-Goldhaber, Goldhaber, Wall, and Deutsch, Phys. Rev. **86**, 1023 (1952).
[10] J. W. Mihelich (private communication). The conversion in the various L subshells follows that for $E2$ transitions.
[11] M. Goldhaber and A. W. Sunyar, Phys. Rev. **83**, 906 (1951).
[12] A. Bohr and B. R. Mottelson, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. **27**, No. 16 (1953).
[13] G. Scharff-Goldhaber, Phys. Rev. **90**, 587 (1953).
[14] P. Preiswerk and P. Stähelin, Nuovo cimento **10**, 1219 (1953).
[15] T. Huus and J. H. Bjerregaard, Phys. Rev. **92**, 1579 (1953); McClelland, Mark, and Goodman, Phys. Rev. **93**, 904 (1954).

Relative Intensities of π and μ Meson X-Rays of The K and L Series in Low Z Elements*

M. B. STEARNS, S. DEBENEDETTI, M. STEARNS, AND L. LEIPUNER
Carnegie Institute of Technology, Pittsburgh, Pennsylvania
(Received January 15, 1954)

THIS is a preliminary account of work in progress on the x-rays emitted when π and μ mesons[1,2] are captured in light elements. The mesons from a 450-Mev synchrocyclotron are slowed down by a copper absorber and brought to rest in the target of the element investigated (Fig. 1). The stopped mesons

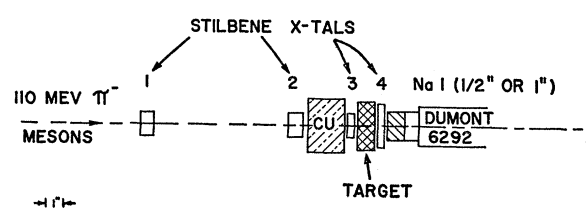

FIG. 1. Detection apparatus.

are detected with an anticoincidence telescope (1+2+3−4) and the resultant x-rays give a pulse in the NaI counter. The NaI pulses are analyzed with a 24-channel pulse-height selector

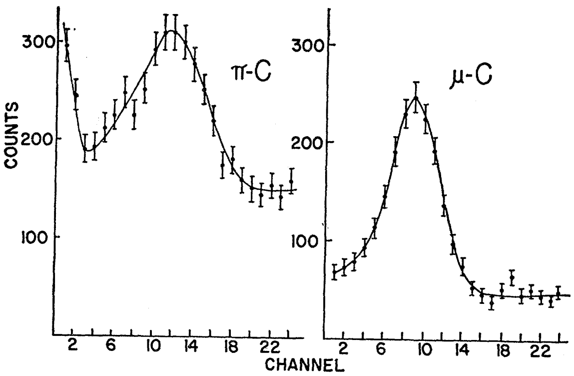

FIG. 2. Typical pulse-height distribution curves of x-rays from the $2p$ to $1s$ transition in C. The first curve corresponds to 400 000 stopped π mesons and the second to 50 000 stopped μ mesons.

whenever they are in coincidence (10^{-7} sec) with the output of the meson telescope.

Meson x-rays from the K, L, and M series have been observed. Typical examples of the curves obtained are shown in Figs. 2 and 3. The width of the peaks is mainly instrumental. Part of this width is due to the statistical fluctuations in the NaI phototube, which are considerable at low energies, and part to the effects of the high singles counting rate. The positions of the peaks agree within our present errors of 10–15 percent with the energies computed in an elementary way.

For the measurements of relative intensities the targets used had the same surface density and linear thickness. After subtracting the background estimated visually from the shape of the curves (this procedure introduces one of the largest errors in the measurement) the counts of all channels within each peak were added together, and then divided by the number of counts in the meson telescope. The relative intensities thus obtained were corrected for (1) absorption of the x-rays in the target and intervening material, (2) chemical effects, (3) NaI detection efficiency, (4) detection efficiency of coincidence circuits. Adequate tests proved that (4) was practically 100 percent down to 25 kev. When compounds were used (N_2H_4 for N, H_2O for O, LiF for F, and LiCl for Cl) it was assumed that each atom, except H, captured in proportion to Z. The intensities from C and CH_2 were found to be the same within 10 percent.

The results for π x-rays are shown in Fig. 4. The small intensity at low Z is believed to be due to competition with the Auger effect. However, if this is the sole contribution to the decreased intensity, our data agree with the approximate estimates of Fermi and Teller[3] but disagree with the calculations of Burbidge and deBorde.[4] The

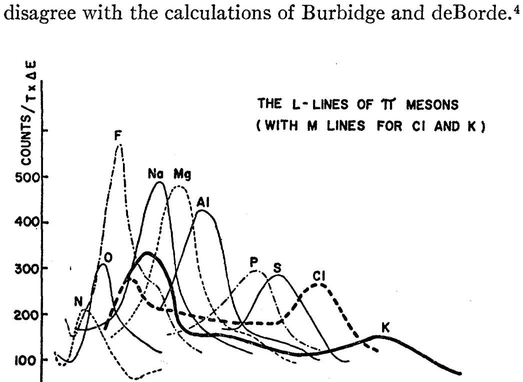

FIG. 3. Pulse-height distribution curves for $\pi-L$ radiation. All curves reduced to the same scale by dividing each reading by telescope counts and by pulse-height-selector channel width. The points have been omitted for clarity. $\pi-M$ radiation appears in Cl and K curves.

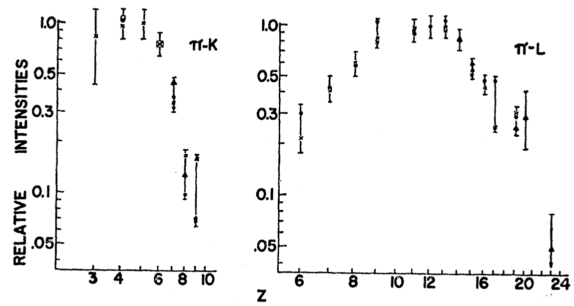

FIG. 4. Z dependence of relative intensities of K and L radiation from π mesons. Each symbol represents a different run. The intensities of B and Mg were arbitrarily set equal to unity in the K and L plots, respectively. The intensity of Li$-K$ line is uncertain because of large corrections due to low energy.

decrease for high Z is due to nuclear capture from mesonic orbits of total quantum number 2 ($2p$ state) for the K lines, and 3 (presumably $3d$ state) for the L lines. Work is in progress to study the behavior of the M lines.

The μ x-rays behave similarly except that the "Auger effect" is more important at a given Z, and that nuclear capture is not observed.

Work is in progress for the determination of the absolute intensities and for a more careful study of the energies.

* Supported in part by the U. S. Atomic Energy Commission.

[1] Camac, McGuire, Platt, and Schulte, Phys. Rev. **88**, 134 (1952).
[2] V. L. Fitch and J. Rainwater, Phys. Rev. **92**, 789 (1953).
[3] E. Fermi and E. Teller, Phys. Rev. **72**, 399 (1947).
[4] G. R. Burbidge and A. H. deBorde, Phys. Rev. **89**, 189 (1953).

Decay of V[52]

J. M. LeBlanc, J. M. Cork,* S. B. Burson, and W. C. Jordan
Argonne National Laboratory, Lemont, Illinois
(Received January 14, 1954)

THE irradiation of normal V with thermal neutrons has been reported to produce three activities[1] which have been assigned to V^{52}. These activities were found to decay with half-lives of 2.6 min, 3.75 min, and 16 hr. Recent work has been reported[2] on the 16-hr activity and an energy level scheme proposed which includes all three activities.

The present study of V^{52} was made using 180° magnetic photographic spectrometers and a 10-channel coincidence scintillation

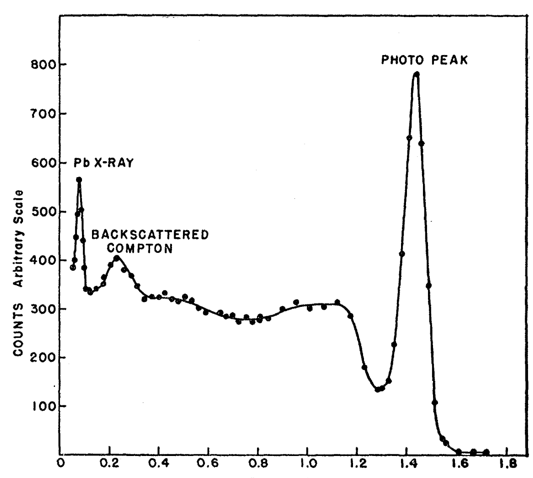

FIG. 1. Gamma-ray pulse-height distribution resulting from V^{52} (3.7 min).