OBSERVATION OF K^--C ATOMIC X-RAYS WITH CRYSTAL-DEFFRACTION SPECTROMETER AT 70 GeV IHEP ACCELERATOR

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Kaonic atom X-rays are usually studied on secondary K^- beams with semiconductor spectrometers [1]. Here we describe the observation of kaonic carbon atom X-rays by means of a 5-meter crystal-diffraction Cauchois-type spectrometer, situated on an external 70 GeV proton beam. The experimental setup was similar to the one described for the measurment of the π-meson mass [2].

The proton beam had the following parameters: intensity $3 \cdot 10^{12}$ protons per cycle, cycle of acceleration 9 sec, spill of the slowly ejected beam 0.7 sec. The target was a multilayer composition of carbon, molibdenum and copper with dimensions 150 (along the beam) x 30 x 100 mm^3. Only the carbon was in sight of the 3-meter multislit steel collimator, installed in a proton beam shielding.

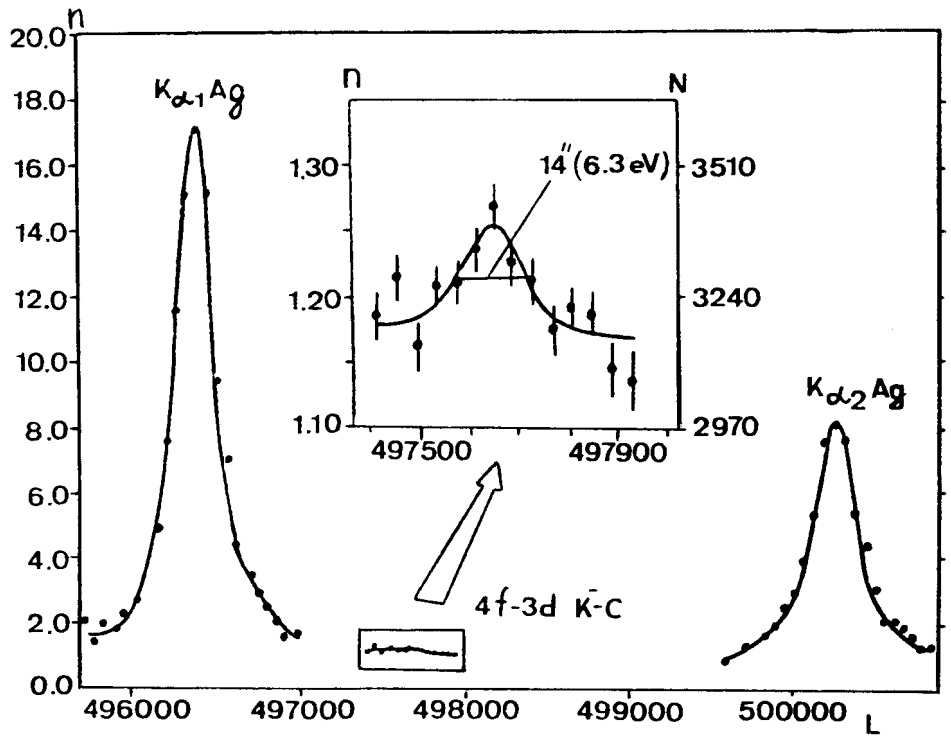
n
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
K_{α_1} Ag
n
N
1.30
1.20
1.10
14" (6.3 eV)
3510
3240
2970
497500
497900
4f-3d K̄-C
K_{α_2} Ag
496000
497000
498000
499000
500000
L

Fig. 1.

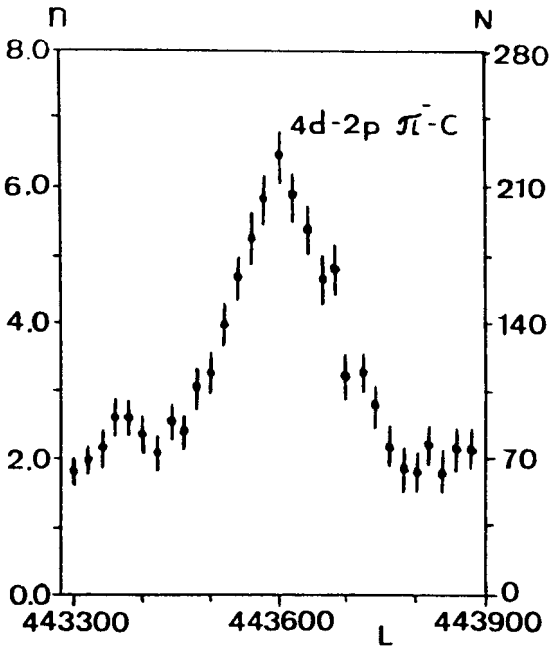
n
N
8.0
6.0
4.0
2.0
0.0
280
210
140
70
0
4d-2p π̄-C
443300
443600
443900
L

Fig. 2.

The K^--atomic X-rays were the result of the capture of K^- mesons, produced in collisions of high energy protons with the nuclei of the target, by carbon atoms. The crystal was a thin quartz plate. Its dimensions were 140 x 115 x 1.1 mm^3. The reflection planes were planes 130. The latter and the optical axis were perpendicular to the big planes of the plate. The crystal was bent in between two cylindrical mirrors. The radius of the cylinder was 5 meters, the aperture of the mirror window was 80 x 80 mm^2. The calculated elastic quasimosaic of the bent reflected planes was 11 arcsec, the measured one was 12 arcsec. The width of the slit before the detector was 0.35 mm, its heigth was 160 mm. The angular resolution of the spectrometer was 14 arcsec for the γ-line of 67.75 keV from ^{182}Ta. For X-ray detection the solid-state Ge(Li) was used. The size of its sensitive volume was 4 x 5 x 160 mm^3 and its resolution was 1.8 keV for the γ-line of 59.9 keV from Am^{241}. The Ge(Li) detector, mirrors and quartz crystal plate were made in the LNPI.

The collimator and the space between the crystal and the Ge(Li) detector were filled with helium gas to minimize X-ray absorbtion. The efficiency of the spectrometer was about $2 \cdot 10^{-9}$ in the energy region of 20 — 30 keV.

The calculated energy of 4f-3d transition of the K^--C atom is 22104 4 eV. The calibration of the spectrometer in this energy region was performed by means of $K_{\alpha 1}$ and $K_{\alpha 2}$ x-rays of Ag with an energy of. 22162. 9 eV and 21990.3 eV respectively. These X-rays were induced in Ag foil, that was set up on a second target and was periodically irradiated by a proton beam. The measured X-ray lines are shown in fig. 1. On the horizontal axis a count of the sinus mechanism (which is proportional to the sinus of the Bragg angle) is shown. On the vertical axis are shown intensity n and the total count N per point. The measured intensity of the 4f-3d transition of the K^--C atom is equal to (0.081 ± 0.017) per 10^{12} protons, the effect to the background ratio is 1/15. The 4d-2p transition in the π^- -C atom with a calculated energy of 24827.7 eV was measured as a test. The result is shown in fig. 2. Here N and n are identical to N and n in fig. 1. Using the number of X-rays per stopped meson from [3] we can calculate that the number of stopped π^- is 200 times greater than the number of stopped K^-.

REFERENCES

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3. *Pearce R. M. et al.* Can. J. Phys. V. 57. 1979. P. 2084.