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PIONIC 2P-1S X-RAY FROM 23Na

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A recurring feature in the global analysis of pionic x-ray data has been the anomalous width of the π Na 2-1 x-ray. Previous experimental data has shown widths of up to 12 keV, whilst optical model calculations predict values no smaller than 17 keV. In order to resolve this discrepancy, a new measurement has been made at TRIUMF, using a Compton suppression spectrometer to reduce the backgrounds by a factor of about 5. Approximately 10^5 π^-/sec stopping in a NaH target, were registered using a standard scintillator telescope. A Ge detector was positioned 40 cm from the target, allowing time-of-flight separation of neutrons and gammas, and was surrounded by a bismuth germanate suppression system.

The data obtained is shown in Fig. 1, along with the best fit, which has an excellent chi-squared per degree of freedom of less than 1. The fitting function consisted of a broad Lorentzian line for the x-ray, with 3 identified and 2 unidentified contaminants on top. These gammas were fitted with Gaussian lineshape with a 2 parameter exponential tail. The Compton edge from the 440 keV gamma that lies under the x-ray was fitted by analogy to the Compton edge of a gold 412 keV gamma, obtained during the same experiment. The muonic peaks at 250 and 300 keV were excluded from the fit, and the background was fitted as linear. A conventional chi-squared minimization code was used to obtain a x-ray width that was very sensitive to the fitted region and to the contaminants on top. Fitting the data in a similar manner to the previous result from TRIUMF produced a comparable width of about 13 keV. However, extending the fit region, and including the possibility of 5 contaminants on the very top, gave a final width of 16.7(3.1) keV and an energy of 276.2(0.9) keV. These two factors produce the dominant contribution to the systematic uncertainty of ± 2 keV in the width and ± 0.65 keV in the energy.

From the first time, the experimental πNa 2- x-ray width shows some support for the optical model predictions that have been so successful with other elements. This result seems to be confirmed by the preliminary analysis of the Magnesium 2-1 pionic x-ray measured in the same experiment at TRIUMF.

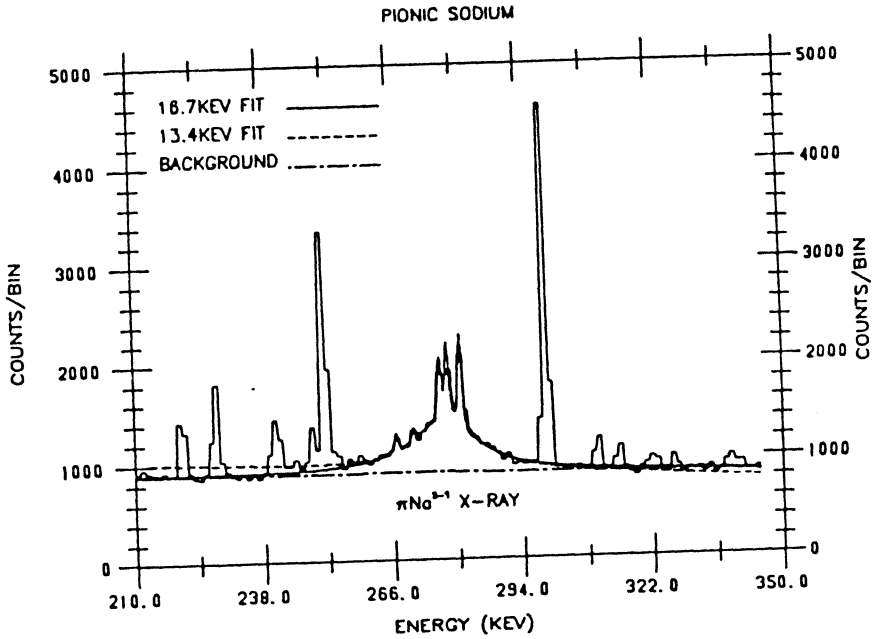

Fig. 1. Fits to the πNa 2-1 x-ray. The data has been rebinned to 4x287 eV/bin for clarity, while the fits correspond to 287 eV/bin. The dashed line shows a fit over the smaller region analysed in our 1978 work, while the solid line is fit to the entire region displayed. The prominent structure outside the 260 keV-295 keV region were not included in the fit.

1. A. Olin et al., Nucl. Phys. A312 (1978)361.

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