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HIGH-RESOLUTION PHOTOFISSION MEASUREMENTS IN ^{238}U and ^{232}Th

Progress Report
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Abstract

Intense proton beam currents from the Dynamitron at Brooklyn College have been used to generate gamma rays of variable energy from a number of (p,γ) resonances in various nuclei. Spectra of photofission fragments of ^{238}U and ^{232}Th have been measured with an average gamma ray energy resolution of $\sim$ 300eV. Structure in the photofission cross section of ^{232}Th was observed at $\sim$ 6176 keV.

In our previous progress report we presented results of measurements of photofission cross sections of ^{238}U and ^{232}Th carried out with an average gamma ray energy resolution of $\sim$ 800eV at a number of excitation energies. The installation of the target wobbler in the spring of 1980 resulted in a considerable improvement of the photon energy resolution which we now estimate to be $\sim$ 300eV on the average. The wobbler employs two vibrators moving the target at different frequencies in two mutually perpendicular directions relative to a stationary proton beam. It was tested successfully during long runs in the summer.

With the gamma ray energy resolution thus greatly improved we decided to remeasure the spectrum of ^{232}Th fission fragments around E_γ = 6177keV since this was where the most pronounced case of structure has been found in our spectra so far. The results are shown in Fig. 1 where the increase on the left side of the spectrum appears to represent the high energy slope of a peak centered at an energy below 6175.5keV. This confirms beyond a doubt our previous conclusion that structure is present at this energy. As was mentioned in our previous proposal, a vibrational resonance is predicted at this energy by statistical model calculations with barrier parameters determined partly from our photofission data. To investigate this structure it is necessary to use a (p, γ) resonance yielding photons in the energy range between 6160 and 6180keV. A suitable resonance exists in ^{42}Ca at Ep = 1423keV.

The rather low strength of this resonance makes it necessary to have a proton beam current of at least 300 μA on the target in order to obtain good counting statistics in a reasonable running time. Beam currents of this magnitude turned out to be difficult to obtain from the Dynamitron during the summer when these experiments were being carried out. We also realized that automatic scanning of the over 400 kimfol films generated in each run is a necessity, as the manual scanning

was slowing down the work dramatically.

To restore the beam current capability of the machine it was necessary to replace the focusing grid in the high voltage terminal as well as carry out a number of rather time consuming maintenance steps. After that proton beams up to 500 μA, which at present our target chamber can handle, could be produced without difficulty.

To speed up the scanning we purchased early in the summer a scanning system which employs a high resolution vidicon camera. The camera scans the kimfol films for fission tracks enlarged by etching and sparking, and records their x and y coordinates. This information will be stored in our PDP-11 which will transform it to spectra of the type shown in Fig. 1. The necessary software for transferring and handling the data is being developed. We expect that the work on it will be completed by the end of March.

At the end of the summer the project suffered seriously from the departure of Dr. T.R. Yeh who went to work at Brookhaven on September 1. To find a qualified person to replace him turned out to be very difficult. The difficulty was compounded by the fact that we could start searching in earnest only after it became known, in May, that the contract will be renewed and thus money will be available. An effort to bring a young Ph.D. from the Saha Institute in India failed at the last minute in August when he was denied the USA visa. It took half a year to find a qualified person and have him join our laboratory. Dr. M. Ismail, who arrived at the end of January this year has been a member of the Variable Energy Cyclotron Laboratory at the Bhabha Institute in Calcutta. Before joing the cyclotron group he worked at the Van de Graaff accelerator in Bombay also at the Bhabha Institute. He has done (p, γ) work on several nuclei, a valuable experience for our photofission project.

At the beginning of this semester our group was also joined by a new

graduate student who came last fall from China. Mr. Zhang has a M.Sc in physics and has done some nuclear spectroscopy work on radioactive sources. He will contribute 2 days per week to the project during the academic year and full time during the summer. He is supported financially by the University.

Another addition to our group came in the middle of January in the person of Mr. K. Ionescu, who will devote most of his time to target preparation and development of the Kimfol films. His role is essential to the success of the project in view of the very large number of films produced in an average day of running. Mr. Ionescu has a M.Sc. degree from Romania.

Before the end of the current contract period we expect to have a total of about 250 hours of running time and thus recover most of the ground lost during the fall and early winter.

Since the time when our previous report was submitted the results of our work have been presented in the following publications:

1) T.R. Yeh and H. Lancman, Bull. Am. Phys. Soc. 25, (1980)
2) T.R. Yeh and H. Lancman, Nucl. Instr. Meth. 179, 141 (1981)
3) T.R. Yeh and H. Lancman, Proc. Int. Conf. Nucl. Phys., Berkeley, Calif., August, 1980, p. 266
4) T.R. Yeh and H. Lancman, Bull. Am. Phys. Soc. 25, 785 (1980)
5) T.R. Yeh and H. Lancman, Proc. Sixth Conf. on the Applic. of Accel. in Res. and Ind., Denton, Texas; IEEE Transactions on Nucl. Sci., April, 1981.

The reprints are attached to this report.

These investigations have been in compliance with the requirements of the contract. The principal investigator has devoted full time to the project during the months of June and July 1980 and 50% of his time since September. During the remainder of the current term of this contract the principal investigator expects to devote 50% of his time to the project.

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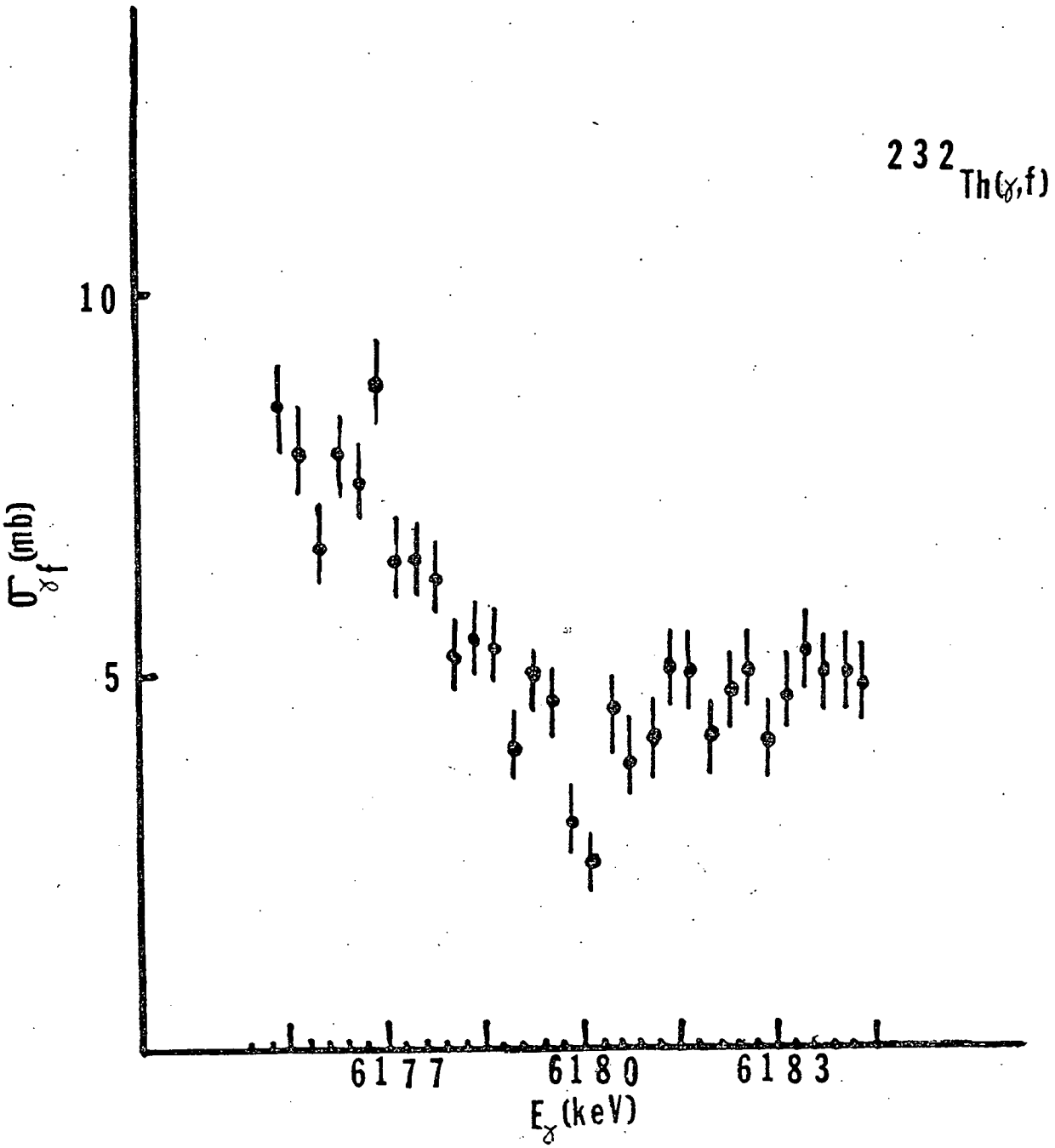

Fig. 1