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Troy, New York 12181

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LINEAR ACCELERATOR PROJECT

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Troy, New York 12181

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NEUTRON CROSS SECTIONS

NEUTRON CAPTURE CROSS SECTIONS OF ^{105}Pd, ^{151}Eu, ^{153}Eu AND ^{103}Rh

H. D. Knox, M. V. Costello, R. W. Hockenbury and R. C. Block

Neutron capture measurements have been performed on ^{105}Pd, ^{151}Eu, ^{153}Eu and ^{103}Rh. These measurements were made in the energy region from 20 eV to approximately 100 keV. For these experiments the LINAC was run at a repetition rate of 550 pps. and a burst width of 66 ns. Notch filters of sulfur, aluminum, sodium and manganese were left in the neutron beam at all times so that a determination of the background at 111, 35, 2.8 and 0.337 keV can be made.

Along with the four capture samples, data was also obtained for a thin steel sample. The capture data will be normalized to the 1.1 keV resonance in ^{56}Fe observed with this steel sample. A second, independent method of normalization will also be used with the capture data in order to reduce any uncertainties in the absolute normalization. This second method is to normalize the capture data to transmission data.

Pulse height vs. time-of-flight data have also been obtained for these four isotopes in order to determine the detector efficiency for capture.

Analysis of these data is currently underway.

RESONANCE AND THERMAL $\bar{\nu}$ MEASUREMENTS ON ^{239}Pu

R. W. Hockenbury, R. L. Reed* and R. C. Block

Routine data processing including checks for consistency of sub-groups of resonance $\bar{\nu}$ runs has been finished. The thermal $\bar{\nu}$ data have been processed. The data in the resonance region will be normalized to the thermal data for an absolute normalization.

All results support our previous observations[1] that $\bar{\nu}$ fluctuates in the resonance region and that $\bar{\nu}$ increases monotonically going from 0.3 eV to 0.01 eV.

REFERENCE:

1. Linear Accelerator Project Progress Report, January - March 1973, COO-3058-34.

*Now at Savannah River Laboratory.

$Fe(n,E_\gamma)$ DATA ANALYSIS (PRELIMINARY)

P. Brown,* J. R. Tatarczuk and R. C. Block

An experiment was performed using the RPI LINAC to determine the spectrum of gamma rays emitted following neutron capture in an ARMCO iron target (740.8 gm). The experimental details parallel those for the ^{60}Ni experiment reported in the previous Progress Report.[1] The data (39 time-of-flight regions, each containing 4096 channels of pulse-height data) were stored on-line by the PDP-9 two-parameter data acquisition system.

The data accumulation required 2 runs totaling 134 hours of linac time. The linac beam parameters were as follows: width 50 nsec, repetition rate 500 Hz, average current 26 μA and 70 μA. The higher average current is for the second data run which utilized the Model 12 electron gun in the LINAC.

The data for ^{56}Fe are shown in Table 1 for those gamma rays and neutron energy regions where transitions were intense enough to be analyzed. These data are obtained by dividing the areas under the gamma-ray transition peaks by the Ge(Li) detector efficiency and then normalizing to the total number of captures in each neutron energy region.

REFERENCE:

1. Linear Accelerator Project Progress Report, January - March 1973, 4, COO-3058-34.

*Based in part on the Ph.D. Thesis of P. Brown.

Table 1. ^{56}Fe γ-rays per Capture

γ-ray #		3	4	3+4	5	6	14	7	11	12	8	10	13	9
Region #	E_n (eV) \ E_γ (keV) $J_f^{\pi_f}$	7646 GS, ½-	7632 1st ex., 3/2-	7646 + 7632	7279 3rd ex., 3/2-	6380 5th ex., 3/2-	898* 3rd ex., 3/2-	6019 6th ex., 3/2-	1613* 1st ex., 3/2-	1260* 3rd ex., 3/2-	5920 7th ex., ½-	1725* GS, ½- +	1019* 4th ex., 5/2-	4219 15th ex., 3/2-
Cd	0.010 - 0.40	26	28	53	6.0		0.7	9.1	5.4	2.4	9.2	7.1	1.6	4.4
38	13.2 - 17.3	25	31	56	5.8		1.3	8.3	4.9	2.7	8.6	7.3	2.0	3.1
37	17.3 - 23.7	24	29	53	5.4		1.3	8.9	4.3	2.6	8.0	7.4	1.3	3.6
36	23.8 - 34.6	22	26	48	5.0		1.3	6.8	4.2	2.1	7.6	7.4	1.5	3.2
35	34.6 - 46.7	20	24	44	4.8		1.1	6.6	3.6	2.1	6.0	6.9	1.2	4.0
34	46.7 - 48.0	X	X	31				3.1				4.5		
33	48.0 - 54.8	X	X	38	2.6			6.2	3.6	1.1	5.8	6.5	1.2	
32	54.9 - 90.7	15	19	34	3.4		0.8	5.4	2.6	2.0	5.3	5.8		2.0
31	90.8 - 153	5.8	7.6	13				1.9	1.1		1.8	2.4		
30	154 - 206	X	X	17				2.5	1.2		2.1	3.1		
29	206 - 224	X	X	12										
28	225 - 264	X	X	9.6										
27	265 - 318	X	X	11										
26	319 - 391	X	X	8.0										
25	392 - 480	X	X	7.7										
24	482 - 665	X	X	6.3										
33	667 - 1120	X	X	7.9										
{20 + 21 + 22}	1130 - 1590	10	37	47		16	11							
19	1600 - 1645													
18	1650 - 3020	X	X	3.6										

X could not separate GS and 1st excited state due to poor statistics
* non-primary transition from level in first column to left without an * to specified level
\+ also includes 1714 keV SE peak from hydrogen capture

DIFFERENTIAL ELASTIC SCATTERING CROSS SECTIONS OF KEV NEUTRONS FROM IRON AND NICKEL

R. Zuhr* and K. Min

We have previously reported the preliminary results of our differential elastic scattering cross-section measurements on iron and nickel in the energy region from 5 to 650 keV.[1] More complete data, using revised beam and target geometry in order to increase the counting rate and thus the statistical accuracy, have also been taken.[2] Analysis of this data indicated that the original method of background determination, that is by resonance absorption dips, was not adequate for this case. Attempts to fit the background at points of known cross section were also unsuccessful. In order to pinpoint the importance of various contributions to the background, new measurements, using the revised target geometry, were recently completed. Time dependent, time independent, target independent, and gamma-ray backgrounds were separately evaluated at each data-taking angle. Analysis utilizing this information is currently being carried out, and, although not complete, it indicates that we now have a satisfactory assessment of the actual background situation.

REFERENCES:

1. Linear Accelerator Project Progress Report, January - March 1972, 7, COO-3058-14.
2. Linear Accelerator Project Annual Technical Report, October 1, 1971 - September 30, 1972, 49, COO-3058-27.

*Based in part on the Ph.D. Thesis of R. Zuhr.

REACTOR PHYSICS AND ENGINEERING - EXPERIMENTAL

FAST AND INTERMEDIATE NEUTRON SPECTRA MEASUREMENTS IN A BULK SODIUM ASSEMBLY

A. Mallen,≠ N. N. Kaushal, B. K. Malaviya and E. R. Gaerttner

Neutron spectrum measurements on a bulk sodium assembly have been completed. The analysis of the measurements is still underway, using 49-group ENDF/B-1 and ENDF/B-3 data sets. Initial difficulties that were encountered with the ENDF/B-3 have been traced to the DLC-2 code which was modified[1] locally to process SUPERTOG output P_8 multigroup cross sections to generate DTF-IV data. The local version of DLC-2 incorrectly modified the group self-scattering cross section, and produced a negative self-scattering source in backward angles for certain groups.

The consistent P_n approximation to transport theory multigroup scattering cross sections requires that the ℓth component of the self-scattering cross section $\sigma_{s\ell}^{g\to g}(\ell)$ be modified so that

$$\sigma_{s\ell}^{g\to g}(\ell)^* = \sigma_{s\ell}^{g\to g}(\ell) + (\sigma_t^g(0) - \sigma_t^g(\ell))$$

where $\sigma_t^g(0)$ is simply the scalar flux averaged total cross section and $\sigma_t^g(\ell)$ is the ℓth flux moment averaged total cross section. This change has been incorporated in the DLC-2 code.

Preliminary comparisons of ENDF/B-3 sodium data against ENDF/B-1 data indicate that ENDF/B-3 multigroup set will help explain some of the disagreements obtained between the theory and experiment.

Preliminary investigations make it appear that ENDF/B-3 is superior to ENDF/B-1 in predicting angular fluxes for very high energy neutrons (E_n>4 MeV), but for intermediate energies (500 keV<E_n<1.2 MeV) the flux prediction is too low.

REFERENCE:

1. Linear Accelerator Project Progress Report, October - December 1972, COO-3058-29.

≠Based in part on the Ph.D. Thesis of A. N. Mallen.

REACTOR PHYSICS AND ENGINEERING - THEORETICAL

REACTOR THEORY AND ANALYSIS

M. Becker

Good results on spectra now are being obtained with the continuous slowing down integral transport treatment of space-dependent spectra, particularly at interfaces (with G. Epstein). The most difficult situation to handle is the combination of a thin zone and a deep cross-section minimum. Cross-section maxima have not caused us difficulties to date. Results to date have been for uranium and iron systems, together and separate, of various sizes. The slowing down parameter ξ (and therefore the separable kernel) is obtained by matching the exact solution in an "infinite-medium" problem with a buckling term to simulate leakage.

INSTRUMENTATION DEVELOPMENT

RENSSELAER INTERACTIVE GRAPHICS ANALYSIS SYSTEM

M. Danchak,* M. Becker and W. R. Moyer

Hardware design and development for RIGAS is currently entering its final stages. A complete augmenting push-button system as well as an Asynchronous Transmission Control Unit (Async TCU) has been interfaced with the PDP-15 computer and is operational. Design of a Binary Synchronous Transmission Control Unit (Bisync TCU) is also complete and awaiting parts for prototype construction. Once the Bisync TCU is built and interfaced, the hardware aspects of RIGAS will be complete.

The augmenting push-button system is actually a replacement for the six push-buttons indigenous to the VTØ4 Graphic Display Console. These were judged to be deficient in number and awkward to use. The new system has the capability of handling up to 32-capacitance-type push-buttons (Magic Dot) with LED indicators, through a 32-Line Priority Encoder. The Encoder, in turn, presents a unique 5-bit word to the CPU's accumulator through a standard interrupt system. The software handler for this device allows it to be called by a FORTRAN READ statement which returns an associated integer to the calling program. These push-buttons will be utilized so as to allow the RIGAS user to enter any portion of the analysis system he wishes, as well as to obtain help in using the system and making the appropriate acceptance and rejection decisions asked of him. Panel light indicators monitor device interrupt enable and interrupt request functions.

The Async TCU was designed for maximum flexibility as well as ease of use in working with the Western Electric 1Ø3, 113 and 2Ø2 data sets. This is achieved by allowing the programmer to select various transmission conditions through a simple FORTRAN statement which can modify conditions after the program and device handler have been loaded. This can be used to select baud rates of 11Ø,

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*Based in part on the Ph.D. Thesis of M. Danchak.

3ØØ, 12ØØ and 48ØØ. In addition, any combination of bits per character (5, 6, 7 or 8) and number of stop bits (1 or 2) can be selected along with parity (odd or even) or no parity. Error checks for parity, overrun and framing can be made as well as transmission line checks for device interrupt enable, Clear to Send (CB), Data Set Ready (CC), Data Carrier Detector (CF) and Supervisory Received Data (SB). The letters in parenthesis indicate the associated RS-232-C circuit designators. A ring interrupt system, which can be software-controlled, is also included to allow for automatic answer. Additional device handler options set default conditions for transmission rate by assigning appropriate unit numbers which can also suppress the echoing of control characters. Panel light indicators monitor states of the RS-232-C circuits along with device interrupt enable, receive interrupt request, transmit interrupt request and ring interrupt request functions. This device will be used to communicate, asynchronously, with the AEC Computer Center CDC-66ØØ (NYU) on a time-sharing basis as well as with remote terminals such as the Textronix 4Ø1Ø Computer Display Terminal.