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FISSION YIELD MEASUREMENTS

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Irradiation of very pure U-235 and U-233 samples were carried out in the ASTRA core with and without Cadmium shielding of the samples. Cobalt foils were used as monitors for the thermal as well as for the epithermal flux. In order to account for the self absorption in the Uranium samples which was difficult to correct in the geometry of the samples used, the activity of Cs-137 obtained from the chemical separation of the dissolved samples was used as an internal monitor for the irradiation given to the samples. If the thermal yield for Cs-137 is taken from published values (6.15%)[1]) and one assumes that the yield is equal for epithermal fission these correction factors can be exactly deduced. The first results evaluated at the moment refer to the yield of Cs-136.

Yield Cs-136 thermal	: 6.8×10^{-5}	1)
Yields Cs-136 epithermal	: 5.57×10^{-5}	$\pm 5\%$

The error quoted for the epithermal Cs-136 yield is based on counting and weighing errors included in this measurement.

ACTIVATION CROSS SECTION OF THE REACTIONS Fe-56(n,p) AND Ni-58 (n,p)

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Cross sections, $\bar{\sigma}$, for the threshold reactions Fe-56(n,p) and Ni-58(n,p) for fission neutrons are given as follows:

Fe(n,p)	0.82 ± 0.08 mb[2]) 0.95 mb[3])	Ni(n,p)	92 ± 9 mb[2]) 98 mb[3])

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1) S. Katcoff, Nucleonics, 18/11, 201, 1960.
2) Passell, Trans-Am. Nucl. Soc., 2,21 (1959)
3) Mellish, AERE-I/R 2630 1958.

The irradiation concerning ref.2) was performed in the central hole of the fast breeder EBR I, using Al (0.60 mb) as reference, while concerning ref.3) the samples were irradiated in a uranium-rod and other positions in the core of the BEPO-reactor, using sulfur-foils as reference (we renormalized the fission cross section of S-32 from 30 mb to 65 mb). Therefore the fast neutron spectrum was probably rather close to the primary fission spectrum.

The activation cross sections we obtained were performed by irradiations of Fe-wire and Ni-foils of 5-N purity in two locations of a light water moderated highly enriched reactor core with MTR-fuel (ASTRA). Due to the change in the fast neutron spectrum between center and edge of the core, different values for the activation cross sections are obtained for these two positions, using the reaction S-32(n,p) -32 as a reference value ($\bar{\sigma}_s$ = 65mb), in both cases. Even in the central position the neutron spectrum differs from a pure fission spectrum and the values can be used for characterizing the spectral composition of the cast neutron flux in reactors of similar type only.

The following values were obtained:

position	reaction	$\bar{\sigma}$ in mb	$\dfrac{\bar{\sigma}}{\bar{\sigma}_s} = \dfrac{\int_0^\infty \sigma(E)\phi(E)dE}{\int_0^\infty \sigma_s(E)\phi(E)dE}$
core-center	Ni-58(n,p)	121 $\pm$5%	1.86
	Fe-56(n,p)	1.17 $\pm$5%	1.8×10^{-2}
core-edge	Ni-58(n,p)	118 $\pm$5%	1.81
	Fe-56(n,p)	1.34 $\pm$5%	2.6×10^{-2}

The error quoted for $\bar{\sigma}$ is only based on counting and weighing errors included in the measurement, but the error of $\bar{\sigma}_s$ is not taken into consideration.

Work will be continued measuring also the activation cross section of In-115(n,n'), Al-27(n,α) Na-24 and a (n,2n) monitor, in order to complete a set of spectral indices for this type of reactor cores.

PAIR PRODUCTION CROSS SECTION FOR 6 MeV γ-RADIATION

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The 6.13 MeV γ-radiation from N-16 in the primary cooling water of the ASTRA-reactor was used as source of nearly monochromatic γ-rays.

1. Transmission measurements were carried out with Ni and Ag-samples observing the intensity of the 6.13 MeV line in a three crystal pair spectrometer. Using theoretical values for the Compton cross section, results obtained for the pair production cross section are:

$\sigma_P(Ni)$	3.27 ± 0.33 bn
$\sigma_P(Ag)$	1.15 ± 0.13 bn

2. A direct measurement of pair production events in the same materials observing the annihilation radiation in a coincidence set-up yields for the ratio of the pair production cross sections.

$$\frac{\sigma_P(Ag)}{\sigma_P(Ni)} = 2.83$$

which agrees well with the theoretical Z^2- dependence and the result of 1.

3. Taking the ratio of the transmission for the two materials $R = \frac{T_{Ag}}{T_{Ni}}$ using samples which contain the same number of electrons, the Compton effect contribution in R cancels out. This ratio R can be combined with measurement 2 in order to obtain values for the two pair production cross sections without introducing theoretical values for the Compton cross section. The results agree with those from 2, alone, but the errors are still

too large to make this absolute measurement significant.

The preliminary results seem to indicate that the pair production cross sections are about 10% higher than obtained from Bethe-Heitler theory but at present the statistical accuracy of our results is of the same order as this deviation.

NEW INSTRUMENTS

At the Atominstitut der Osterreichischen Hochschulen a second Van de Graaff Generator will be available.

Design:	High Voltage Corporation, Type A 400
Voltage:	100-400 kV
Current:	1-100 μA; protons, deuterons and electrons
Application:	Fast Neutron Generator and Bremsstrahlung source
Delivery:	Autumn 1964
Scientist in charge:	Dr. Aiginger, Atominst.d.Osterr. Hochschulen.