RSIC Newsletter

RADIATION SHIELDING INFORMATION CENTER

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION • FOR THE U.S. ATOMIC ENERGY COMMISSION

POST OFFICE BOX X •
OAK RIDGE, TENNESSEE 37831

No. 66 May 1970

Knowledge is proud that he has learn'd so much;
Wisdom is humble that he knows no more.
- William Cowper
(1785)

MONTE CARLO SEMINAR-WORKSHOP AT OAK RIDGE IN THE AUTUMN

Preliminary plans are being made by RSIC for a seminar-workshop on "Monte Carlo Methods and Computer Codes for Radiation Transport in Shielding Applications" at Oak Ridge about the middle of October. The workshop, sponsored by Mathematical Applications Group, Inc. (MAGI) and the ORNL Neutron Physics Division will focus on the codes ANTE, contributed by MAGI, and MORSE, contributed by ORNL. Contributed papers to the seminar are invited, especially on the subjects of adjoint calculations, coupled neutron gamma-ray calculations, and combinatorial geometry or other new treatments. If you wish to contribute a paper, please submit the title and abstract to RSIC by August 15. A summary paper should be made available at the time of the meeting for inclusion in the proceedings.

RADIATION IN SPACE CONFERENCE IN LAS VEGAS, MARCH 1971

A National Symposium on Natural and Manmade Radiation in Space has been scheduled to be held at the Frontier Hotel in Las Vegas on March 2-5, 1971. This National Topical Meeting is sponsored by the AEC and NASA with co-sponsorhip by the ANS Shielding and Dosimetry Division and the Aerospace Division.

The planned program includes contributed papers on natural space radiation and radiation associated with space nuclear propulsion systems and isotopic and reactor space electric power systems. Contributed papers are encouraged in the related areas of radiobiology and radiation transport and shielding.

Brief (200-400 word) abstracts of papers to be presented at this symposium should be submitted to E. A. Warman, General Chairman, Aerojet Nuclear Systems Company, Sacramento, California, by November 2, 1970 so that the final program may be planned and the abstracts printed for distribution to attendees at the symposium. Complete manuscripts of papers should be submitted by January 3, 1971, in order that they may be included in the symposium proceedings, which are scheduled to be published subsequent to the meeting.

TABLE 1

Computer Code Packages Available from RSIC

CCC No./ Code Name	Contributor	Computer*	Radiation Type	Method	Geometry	Ref.	Comments
CCC-116/TRECO	NASA-G	(A) IBM 360/75 (B) CDC 6600	p,e	Numerical integr.	3-dimens.	1,2	Integrates earth radiation belt flux along satellite orbits
CCC-117/BETA	ART	IBM 7090	e,Brems.	Monte Carlo	Complex	3	Uses importance sampling throughout.
CCC-118/SIGMA	MD-A	IBM 7090	p,e	Kernel integr.	Complex	4	Computes space radiation dose inside space vehicle, uses CCC-70/CHARGE data.
CCC-119/ELBA	NASA-MSFC	IBM 7090	e,Brems.	dE/dx	Slab	5	Computes electron and Bremsstrahlung dose behind aluminum slab.
CCC-120/ SPACETRAN	ORNL-N	IBM 360/75	n,γ	Numerical integr.	3-dimens.	6	Computes dose at detector points due to leakage from cylindrical surface.
CCC-121/SABINE	EURATOM	IBM 360/75	n, sec.γ	Spinney	1-dimens.	7	Particular attention paid to energy transfer in removal source.
CCC-122/RAD 2	GGA	IBM 7090	fp	Numerical		8	Computes fission-product activity distributions, decay chain any length. Designed for gas-cooled reactor problems.
CCC-123/XSDRN	CTC,ORNL-N	IBM 360/75	n	Discrete ordinates	1-dimens.	9	Designed to flux-weight cross sections, has extensive data library.
CC-124/KDLIBE	GE-N	GE 635	n,γ	Kernel integr., Spinney	Complex	10-12	Incorporates CCC-48/QAD, NRN-like code, and others into system.
CCC-125/RSAC	PPC	IBM 7044	γ	Kernel integr.	Infinite cloud	13	Computes dose from release of fission products to atmosphere.
CCC-126/ASOP	CTC	IBM 360/75	n,γ	Discrete ordinates	1-dimens.	14	Designed to optimize shields using CCC-82/ANISN
CCC-127/MORSE	ORNL-N	(A) CDC 1604 (B) IBM 360/75	n,γ	Multigroup Monte Carlo	Complex	15	Uses same cross-section format CCC-82/ANISN.
CCC-128/O6R	ORNL-N	(A) CDC 1604 (B) IBM 360/75	n	Monte Carlo	Complex	16-18	Revised version of CCC-17/O5R.
CCC-129/ TWOTRAN	GGA,LASL	(A) CDC 6600 (B) IBM 360/75	n,γ	Discrete ordinates	2-dimens.	19,20	Coarse-mesh and Chebyshev convergence accelerations. general anisotropic scattering, positive spatial difference scheme.
CCC-130/DTF66	SL	CDC 6600	x,γ	Discrete ordinates	1-dimens.	21	Special version of CCC-42/DTF-IV for X-ray transport.

*Computer for which versions are available.

714000	Isotope Power Sources
715000	Nuclear Energy Rocket Vehicle Propulsion
716000	Space Nuclear Auxiliary Power
793000	Data Library Collection Used
794000	Peripheral Shielding Routine Used
870007	Nitrogen
870090	Thorium
870091	Proctactinium
870094	Plutonium

Please let us know if you wish to add these categories to your selective-dissemination-of-information (SDI) profile or if you wish to have a copy of our revised subject category list.

CORRECTION TO CCC-82A/ANISN CODE PACKAGE

K. M. Newlon, Babcock and Wilcox, and Ward E. Engle, Jr., Computing Technology Center, Oak Ridge, have called our attention to a correction to the IBM 7090 version of ANISN to avoid weighting with flux moments. A simple change to Subroutine WATE will take care of the problem. Any user of CCC-82A/ANISN (7090-7094) may call 615-483-6944 (FTS), or 615-483-8611, ext. 3-6944, or write for the details.

THE ABSOLUTE SPECTRUM OF PHOTONS EMITTED IN COINCIDENCE WITH THERMAL-NEUTRON FISSION OF URANIUM-235*

Data obtained earlier[1,2] have been fully analyzed to yield the absolute energy spectrum of prompt photons emitted from the fission of ^{235}U by thermal neutrons. In the measurement, each of three types of NaI(Tℓ) scintillation spectrometers (single-crystal, Compton, and pair) was operated in coincidence with a fission chamber exposed to thermal neutrons from the Oak Ridge Graphite Reactor or the Bulk Shielding Reactor at the Oak Ridge National Laboratory. The effective coincidence resolving time was ≤ 69 nsec. Detailed and careful construction of the response functions of the spectrometer was based on their exposure to radioactive sources of known disintegration rates. These data were used to "unfold" the measured pulse-height spectra to give the absolute differential energy spectrum and uncertainty. The average number of photons per fission was 8.13 ± 0.35 and the energy release per fission was 7.25 ± 0.26 MeV, both over the energy region from 10 keV to 10.5 MeV. Output spectra are given with an effective resolution only slightly broader than the inherent energy resolution of the spectrometers except at energies above 5 MeV, where the raw pulse-height bins were made wider than the spectrometer resolution to reduce statistical uncertainties. Combinations of the data into four sets of coarser energy groups are also included to simplify use of these data in computations. The results obtained here are in approximate agreement with the measurement of Verbinski et al.[3] in the energy region above 100 keV. From 1.5 to 4 MeV the calculation of Zommer et al.[4] gives results which are surprisingly close to the measurements. The observed total energy release in photon emission per fission is predicted reasonably closely by the Thomas and Grover[5] calculation which takes into account the large angular momentum of the fission fragments.

The results are summarized here in Fig. 1 and by energy groups in Tables 2 and 3.

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* Abstract of report by R. W. Peelle and F. C. Maienschein, "The Absolute Spectrum of Photons Emitted in Coincidence with Thermal-Neutron Fission of Uranium-235," ORNL-4457 (April 1970).

1 F. C. Maienschein et al., Proc. U. N. International Conf. on Peaceful Uses of Atomic Energy, Second Geneva Conference, 15, 366 (1958).

2 R. W. Peelle et al., Pile Neutron Research in Physics, International Atomic Energy Agency, Vienna, p. 273, 1962.

3 V. V. Verbinski et al., "Measurement of Prompt Gamma-Rays from Thermal Neutron Fission of ^{235}U and ^{239}Pu, and from Spontaneous Fission of ^{252}Cf," DASA Report No. 2234 (GA-9148) (April 5, 1969).

4 V. P. Zommer et al. Sov. J. Atomic Energy, 19, 1004 (1965).

5 T. D. Thomas and J. R. Grover, Phys. Rev., 159, 980 (1967).

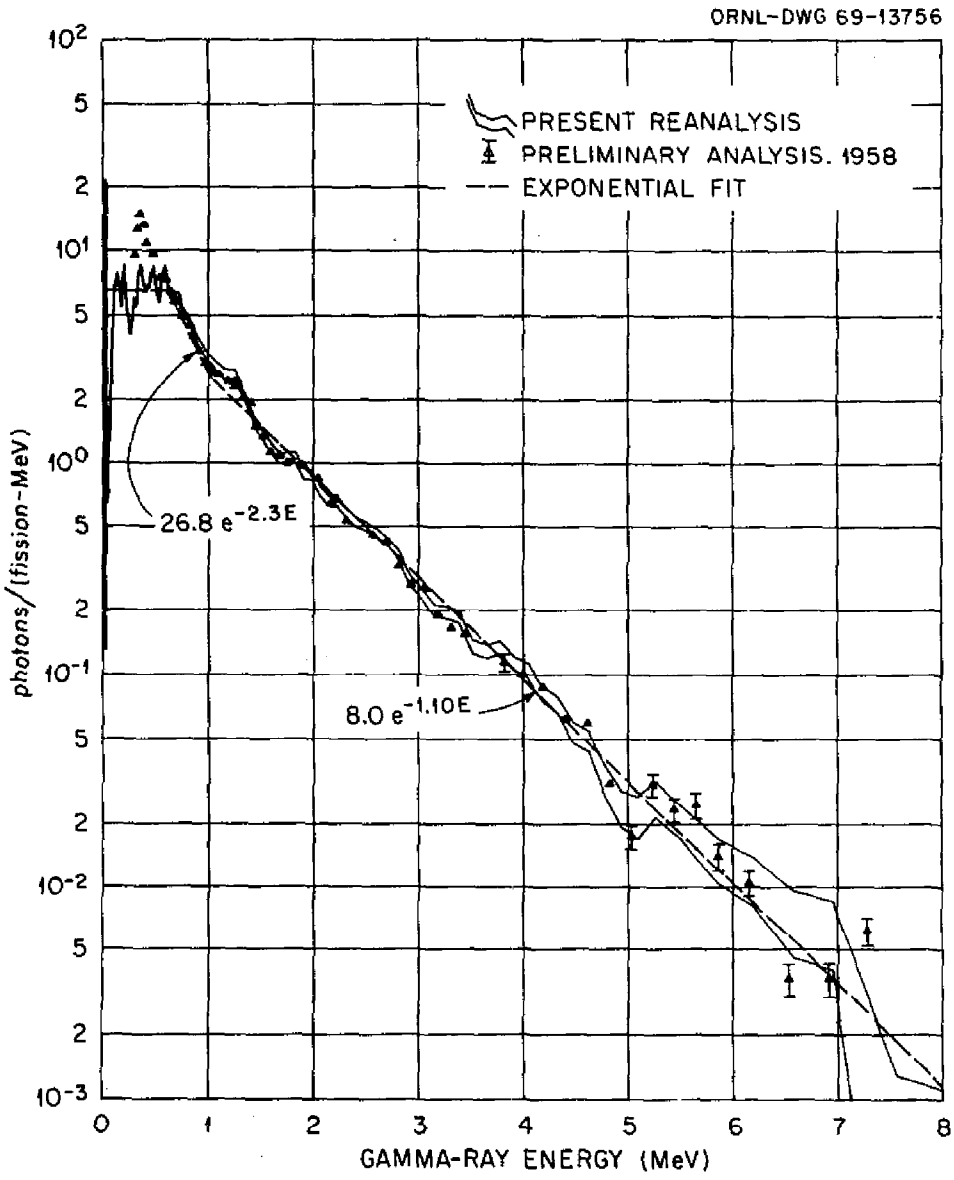

Fig. 1. Comparison of the 1958 Preliminary Analysis with Final Results for the Energy Spectrum of Gamma Rays Emitted Within 69 nsec After Fission of ^{235}U by Thermal Neutrons.

TABLE 2

Photon Yields per Fission for Energy Groups as Shown

Energy Range (MeV)	Photons·Fission^{-1}	MeV·Fission^{-1}
0.010 - 0.021	0.084 ± 0.018 (.005)[a]	0.0013 ± 0.0003(.0001)[a]
0.021 - 0.044	0.233 ± 0.018 (.003)	0.0074 ± 0.0006(.0001)
0.044 - 0.100	0.121 ± 0.012 (.003)	0.010 ± 0.001 (.0002)
0.10 - 0.20	0.651 ± 0.046 (.005)	0.099 ± 0.007 (.001)
0.20 - 0.30	0.548 ± 0.031 (.005)	0.135 ± 0.008 (.001)
0.30 - 0.45	1.033 ± 0.048 (.007)	0.390 ± 0.018 (.003)
0.45 - 0.70	1.710 ± 0.074 (.012)	0.976 ± 0.043 (.007)
0.70 - 1.0	1.305 ± 0.058 (.013)	1.088 ± 0.047 (.012)
1.0 - 1.5	1.170 ± 0.050 (.017)	1.424 ± 0.060 (.020)
1.5 - 2.0	0.535 ± 0.024 (.018)	0.919 ± 0.042 (.032)
2.0 - 2.5	0.316 ± 0.019 (.017)	0.703 ± 0.041 (.036)
2.5 - 3.0	0.189 ± 0.011 (.009)	0.515 ± 0.029 (.025)
3.0 - 4.0	0.159 ± 0.006 (.004)	0.546 ± 0.023 (.015)
4.0 - 5.0	0.057 ± 0.003 (.002)	0.253 ± 0.014 (.010)
5.0 - 6.0	0.0194 ± 0.0025(.0022)	0.106 ± 0.014 (.012)
6.0 - 7.2	0.0093 ± 0.0022(.0020)	0.060 ± 0.013 (.012)
7.2 - 10.5	0.0005 ± 0.0012(.0012)	0.004 ± 0.009 (.009)
0.010 - 10.5	8.13 ± 0.35 (.05)	7.25 ± 0.26 (.03)

[a] Contribution due to random uncertainties in parentheses.

TABLE 3

Photon Yields per Fission for Energy Groups as Shown

Energy Range (MeV)	Photons·Fission^{-1}	MeV·Fission^{-1}
0.021 - 0.200	1.00 ± 0.07 (.02)[a]	0.116 ± 0.008(.001)[a]
0.20 - 0.40	1.24 ± 0.06 (.007)	0.381 ± 0.019(.002)
0.40 - 0.60	1.41 ± 0.06 (.008)	0.706 ± 0.031(.004)
0.60 - 0.90	1.60 ± 0.07 (.016)	1.17 ± 0.05 (.012)
0.90 - 1.35	1.28 ± 0.05 (.019)	1.41 ± 0.06 (.023)
1.35 - 1.80	0.593 ± 0.027 (.018)	0.910 ± 0.041(.028)
1.8 - 2.2	0.331 ± 0.014 (.011)	0.655 ± 0.028(.021)
2.2 - 2.6	0.215 ± 0.011 (.009)	0.513 ± 0.028(.024)
2.6 - 3.0	0.144 ± 0.010 (.009)	0.398 ± 0.027(.025)
3.0 - 3.5	0.097 ± 0.005 (.0045)	0.314 ± 0.017(.015)
3.5 - 4.0	0.0623 ± 0.0039(.0034)	0.233 ± 0.015(.013)
4.0 - 4.5	0.0393 ± 0.0029(.0025)	0.166 ± 0.013(.011)
4.5 - 5.0	0.0186 ± 0.0020(.0018)	0.087 ± 0.009(.008)
5.0 - 5.5	0.0117 ± 0.0040(.0040)	0.061 ± 0.021(.021)
5.5 - 6.0	0.0079 ± 0.0045(.0045)	0.045 ± 0.025(.025)
6.0 - 6.5	0.0052 ± 0.0023(.0023)	0.032 ± 0.014(.014)
6.5 - 7.0	0.0035 ± 0.0023(.0023)	0.023 ± 0.015(.015)
7.0 - 8.0	0.0009 ± 0.0018(.0018)	0.006 ± 0.014(.014)
8.0 - 10.0	0.0005 ± 0.0007(.0007)	0.005 ± 0.006(.006)

[a]Contribution due to random uncertainties in parentheses.

VISITORS TO RSIC

Visitors to RSIC during the month of April were: Arme Bergström, Research Institute of National Defence, Stockholm, Sweden; James O. Buchanan, Office of Civil Defense, Washington, D. C.; A. B. Chilton, University of Illinois, Urbana, Illinois; Martin Cohen, MAGI, New York, N. Y.; Richard K. Disney and Richard G. Soltesz, Westinghouse Astronuclear Laboratory, Pittsburgh, Pa.; Richard W. Enz and Robert Price, DASA, Washington, D. C.; David E. Groce, Science Applications, Inc., La Jolla, Calif.; T. P. Hamrick, Operations Division, ORNL; Larry Harris, Gulf General Atomic, San Diego, Calif.; E. J. McGrath, TRW Systems, Redondo Beach, Calif.; John G. Picarelli, Kirtland Air Force Base, New Mexico; Norman Schaeffer, Radiation Research Associates, Fort Worth, Tex.; Victor Staggs, Physics International Co., San Leandro, Calif.;Frank P. Szabo, Defence Research Board, Ottawa, Canada; J. R. Trinko, Ebasco Services, Inc., New York, N. Y.; I. Zartman, USAEC (Ret.), Washington, D.C.; Members of COSATI Panel #1 on Methods and Operations for Information Handling.

APRIL ACCESSION LIST OF LITERATURE

The RSIC is now aware of the literature cited in the following list. This literature has either been obtained by RSIC or has been placed on order. When received, this material will be examined and assigned to various files if suitable for our information system. The accession list is divided into three fields (1) reactor and weapons shielding, (2) space and accelerator shielding, and (3) shielding computer codes. These titles are announced before processing and indexing so that there will be no delay and can serve as a prompt announcement of current literature.

RSIC is not a documentation center. Copies of the literature cited must generally be obtained from the author or from a documentation center such as the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

RSIC maintains a microfiche file of literature entered into its information system. Computer searches of this system (which produces a special bibliography) and duplicate microfiche copies of the literature in our file are available upon request. Naturally, we cannot supply copies of literature which is copyrighted (such as books or journal articles) or whose distribution is restricted. Neither service is available for the codes literature.

REACTOR AND WEAPONS SHIELDING

AEC-TR-7128

USSR Reports on Natural and Fallout Radioactivity
(Translation of Russian articles - 286 pages)

AHSB(RP)R-95 — January 1970

Radiothermoluminescent Dosimetry
W. N. Saxby, D. T. White (eds.)
(United Kingdom Atomic Energy Authority, Harwell, England, Authority Health and Safety Branch)
Available: AEC Depository Libraries; CFSTI (U. S. Sales Only), UK 3s.6d

ANS-RPD-2 (CONF-690609-25 (26-27)) — March 1970

Proceedings of the Tutorial Session on Nuclear Models
E. Vogt, R. Vandenbosch, V. A. Madsen
Available: AEC Depository Libraries; CFSTI

AWRE-0-50/69 — November 1969

The Development of Accelerator Neutron Sources for Fast Reactor Physics Experiments
J. Gray, M. L. Mullender, D. L. E. Smith

B.S. 4094 — 1966

Recommendation for Data on Shielding from Ionizing Radiation. Part I. Shielding from Gamma Radiation
Nuclear Energy Industry Standards Committee
Available: British Standards Institution, British Standards House, 2 Park St., London, W.1. Price 40s. net.

BNL-tr-318 (Translation of BMwF-FBK-67-90)

Calculation of the Scattering of Fast Neutrons on 238-U.
F. Buehler, F. Schmidt
Available: AEC Depository Libraries; CFSTI

BNWL-500 (Vol. 32) — April 24, 1969

Fast Flux Test Facility. Conceptual Component Design Description for the Reactor Vessel and Shield Component No. 32.
D. P. Schively
Available: AEC Depository Libraries; CFSTI

CONESCO REPORT NO. 4895-1 — March 1968

The Preparation of Simplified Manuals for Shielding Analysis
A. W. Starbird, J. F. Batter
Available: CFSTI as AD-700123

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Neutron and Gamma-Ray Spectra in an Iron Spherical Assembly
R. J. Cerbone
Available: CFSTI

CGS-TR-29 November 1969

Analysis of Roof Radiation Experiments Under Typical and Ideal Conditions
R. Spring, J. Velletri
Available: Datametrics Division, CGS Scientific Corporation
127 Coolidge Hill Road, Watertown, Mass. 02172

COO-2049-1 February 1970

Fast Neutron Transmission Measurements for Reactor Core and Shielding Materials
W. Meyer
Available: AEC Depository Libraries; CFSTI

DASA 2393-1 March 1970

Mathematical Programming and the Numerical Solution of Linear Equations
B. W. Rust, W. R. Burrus
(Tennecomp, Inc., P.O. Box J, Oak Ridge, Tenn.)

KFK-666 (In German) November 1969

Transportation of Irradiated Fuel Elements from Fast Breeder Reactors
G. Boehme, K. Gast, D. Gupta, A. Hagen, R. Kraemer, W. Schilarski, W. Schmidt, G. Sebold, H. W. Wiese, H. Zimmerman
Available: AEC Depository Libraries; CFSTI (U.S. Sales only)

LA-4289 October 1969

A History-Dependent Random Sequence Defined by ULAM
M. Kac
Available: AEC Depository Libraries; CFSTI

LA-4312 February 20, 1970

An Atlas of Gamma-Ray Spectra
J. P. Balagna, S. B. Helmick
Available: AEC Depository Libraries; CFSTI

NEDO-12037 January 1970

Summary of Gamma and Beta Energy and Intensity Data
M. E. Meek, R. S. Gilbert
(General Electric Co., Pleasonton, Calif.)

NASA-TM-X-1971 March 1970

Monte Carlo Calculations of a Hemispherical-Duct Neutron-Streaming Experiment
L. Clemons, Jr. G. N. Wrights, D. F. Shook
Available: CFSTI

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Comprehensive Experimental Differential Number, Energy and Dose Albedos for Semi-Infinite Media, for Normally-Incident Gamma Photons
J. J. Steyn, D. G. Andrews
Available: NUS Corporation, 2351 Research Blvd., Rockville, Md. 20850

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The Absolute Spectrum of Photons Emitted in Coincidence with Thermal-Neutron Fission of Uranium-235
R. W. Peelle, F. C. Maienschein
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R. E. Maerker, F. J. Muckenthaler
Available: CFSTI

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A General Method of Importance Sampling the Angle of Scattering in Monte Carlo Calculations
C. E. Burgart, P. N. Stevens
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A Comparison of Folding and Unfolding Techniques for Determining the Gamma Spectrum from Thermal Neutron Capture in Aluminum
R. S. Booth

ORNL-TR-2168 (IKF-21 in German) September 1968

Energy Distribution and Dose Rate of the Gamma-Radiation of Radioactive Clouds Above Ground Level
A. Schmidt
Available: AEC Depository Libraries; CFSTI

PB-188813 1969

Neutron Capture Gamma-Ray Studies of Silicon, Titanium and Erbium Isotopes
K. C. Tripathi
Available: CFSTI

SC-RR-70-98 January 1970

Use of Solutions to the Adjoint Transport Equation for the Evaluation of Radiation Shield Designs
J. H. Renken

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International Atomic Energy Agency, Vienna (Austria)
(Findings of a Panel on Neutron Data Compilation Organized by the International Atomic Energy Agency and held in Brookhaven, 10-14 February 1969)
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K. D. Lathrop

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Y. Harima, Y. Nishiwaki

Nucl. Appl. Tech., 8(5), 450-455 (May 1970)
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Dose Rates in a Slab Phantom from Monoenergetic Gamma Rays
H. C. Claiborne, D. K. Trubey

Nucl. Eng. Design, 10, 381-387 (July 1969)

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Nucl. Sci. Eng., 40(1), 38-50 (April 1970)

The Linear Vector Space Theory of Unfolding
N. Karayianis, C. A. Morrison, D. E. Wortman

Nucl. Sci. Eng., 40(1), 128-129 (April 1970)

Buildup Factors in Water for Gamma Rays of 1 MeV and Lower Energy (Tech. Note)
E. E. Morris, A. B. Chilton

SIAM J. Appl. Math., 17(2), 280-286 (March 1969) (AD-695604)

A Maximum Property of Cauchy's Problem for the Multigroup Neutron Transport Equation
P. K. C. Wang

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An Analytic Approach to Variance Reduction
J. Spanier

BOOK *1969*

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Oxford; Pergamon Press

SPACE AND ACCELERATOR SHIELDING

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OV3-4 Dose Rate and Proton Spectral Measurements
A. L. Thede
Available: CFSTI as AD-848584

CEA-R-3942 (In French) *January 1970*

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L. Pages, E. Bertel, H. Joffre, L. Sklavenitis

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K. O'Brien
Available: AEC Depository Libraries; CFSTI

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Neutron Dose Equivalents from Multisphere Accelerator-Shield Leakage Spectra
M. S. Weinstein, F. Hajnal, J. E. McLaughlin, K. O'Brien
Available: AEC Depository Libraries; CFSTI

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B. G. Bennett, J. E. McLaughlin, K. O'Brien, M. S. Weinstein
Available: CFSTI

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Research in Space Physics
J. A. Van Allen
Available: CFSTI as N70-17045

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Comparisons of the Results Obtained with Several Electron-Penetration Codes
W. W. Scott
Available: CFSTI

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Article: Radiobiological Aspects of Radiation Safety in Space
Yu. G. Grigor'ev, E. E. Kovalev
Pavel Levit (ed.)
Prague, Charles University

ORNL-TM-2902 February 16, 1970

Calculated Activation of Copper and Iron by 3-GeV Protons
T. W. Armstrong, J. Barish

ORNL-TM-2908 November 20, 1969

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Y. Shima, R. G. Alsmiller, Jr.

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The Absorbed Dose and Dose Equivalent from Neutrons in the Energy Range 60 to 3000 MeV and Protons in the Energy Range 400 to 3000 MeV
R. G. Alsmiller, Jr., T. W. Armstrong, W. A. Coleman

UCRL-19374 October 1969

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J. B. McCaslin, A. R. Smith

UCRL-19386 (CONF-691101-16) October 1969

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L. D. Stephens, A. J. Miller
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UCRL-19391 (CONF-691101-17) April 29, 1969

Stopping Power, Range, and Terminal Ionization of any Nucleus with 0.01 to 500 MeV/amu in Any Nongaseous Material, Including Nuclear Effects
R. Wallace, G. M. Litton, P. G. Steward
(From 2nd International Conference on Accelerator Dosimetry and Experience, Stanford, Calif.)
Available: AEC Depository Libraries; CFSTI

Acta Phys. Pol., 36, 457-467 (Sept. 1969)

Inelastic Interactions of High Energy π-Mesons with Photoemulsion
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The Space Radiation Environment
F. Holly, L. Trafton

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Correlation of Dose Rate Measurements with the Proton Environment in the Inner Van Allen Belt
A. Thede

Aerospace Med., 40 (Sect. 2), 1495-1503 (Dec. 1969) (A70-17265)

Solar Flare Dose Rates in a Near Earth Polar Orbit
G. Radke

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The Influence of the Density Effect on Electron-Induced Cascade Showers in Water and Aluminum
H. L. Beck

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M. Awschalom, W. Schimmerling

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(A69-41057)

A Simplified Method of Simulating Electromagnetic Showers
G. Cioni, A. Treves

Solar Physics, 8, 341-347 (Aug. 1969)
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R. E. Lingenfelter

Solar Phys., 10, 465-471 (Dec. 1969)
(A70-18008)

A Search for Energetic Neutrons Emitted During Solar Flares
R. R. Daniel, G. J. Gokhale, P. J. Lavakare, B. S. Sekhon

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(ORNL-TR-2247) (mf)

Measurement and Calculation of Dose Rate Removal Cross Sections and B-Factors of Neutrons
by E. Kolb and E. Tschirf

AECL-3038 *November 1969* *FISSPROD*

FISSPROD - A G-20 Computer Program
by F. E. Lane
APEX IV for CDC G-20

DASA 2379 (ENDF-130) *November 1969* *PHOX*

Translation to ENDF/B and "Physiscs" Checking of Cross Sections for Shielding
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