

ROSPEC Irradiations

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ROSPEC™

ROtating neutron SPEctrometer

- Calculates kerma, maximum dose equivalent, dose rate and ambient dose equivalent ($H^*(10)$) from thermal to 4.5 MeV
- Generates data simply and routinely in minutes
- Turn-key system includes associated electronics, cabling, laptop PC, UPS battery backup and software
- Specified in NATO operational manual for alliance military research
- Units at work in Defence Departments in Canada, Germany, France and USA, also at several DOE sites, major fuel fabricator/reprocessors in Europe and Japan and standards labs around the world



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ROSPEC Detectors

Detector ID	Radius (cm)	Fill Gas	Pressure (kPa)	Energy Range
SP6	7.62	Ar/CH4	500	1.2 – 5.0 MeV
SP2-10	2.54	H2	1000	0.4 – 1.5 MeV
SP2-4	2.54	H2	400	0.15 – 0.75 MeV
SP2-1	2.54	H2	76	0.05 – 0.25 MeV
He-3 (B)	2.54	He-3	-	-
He-3	2.54	He-3	-	-



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ROSPEC Spectrum Unfolding

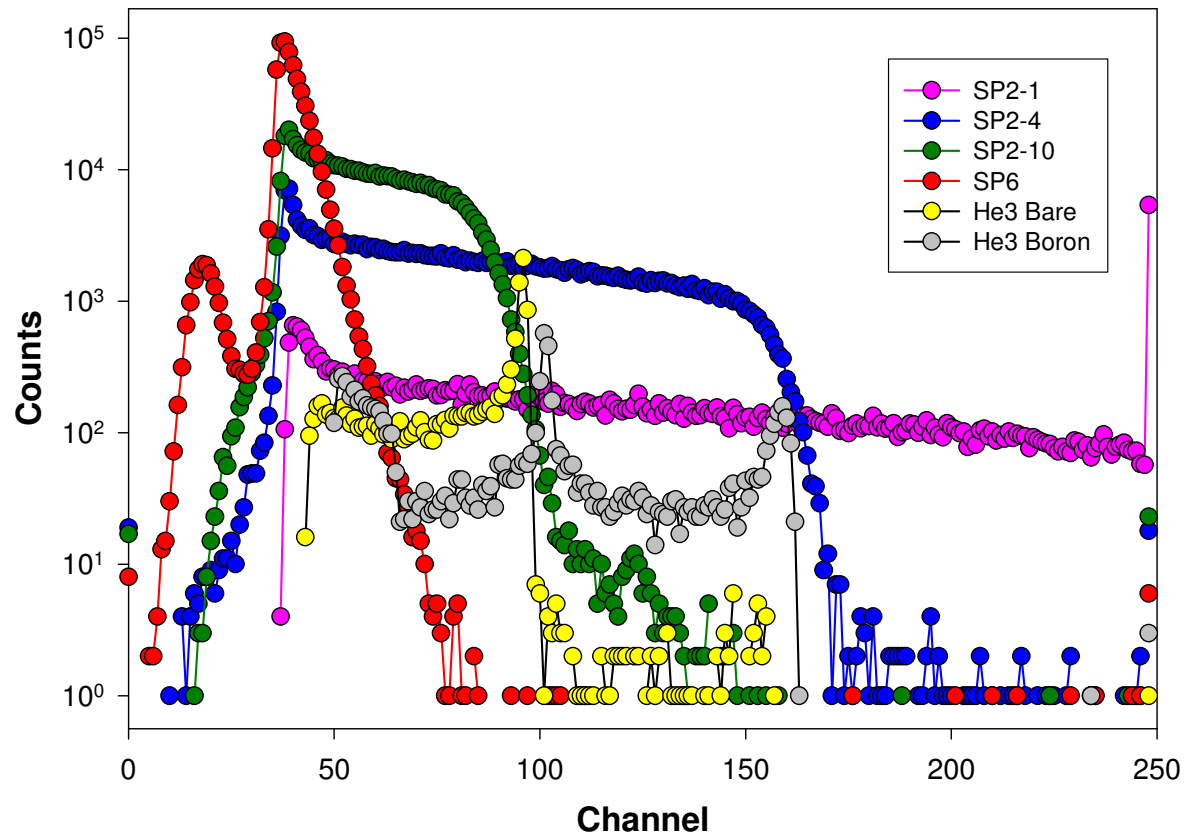
- Uses modified version of the SPEC4 code [Benjamin, Kemshall and Brickstock, AWRE (1968)]
- Response functions calculated by Snidow and Warren method (only accounting for the wall effect)
- Correction factors for difference between calculated and measured responses are from Kemshall (1973)



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Measured Pulse Height Distributions



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Irradiations Performed

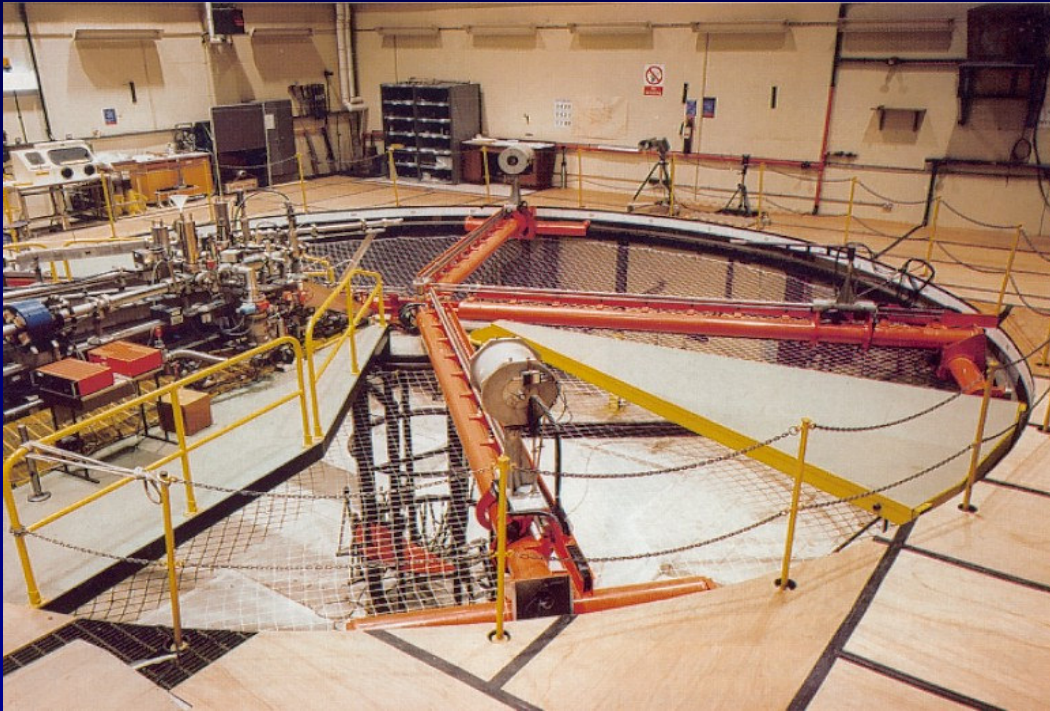
- NPL
 - Monoenergetic neutrons at 71, 144 & 565 keV
 - NPL Realistic Field (${}^7\text{Li}(p,n)$ $E_p = 3.0$ MeV + D_2O moderator)
- CONSORT
 - Reactor spectrum in maze adjacent to beam port investigated as a reproducible spectrum
- ND, HMS SULTAN
 - ${}^{241}\text{Am}/\text{Be}$ neutron source in water tank



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NPL Monoenergetic Irradiations



3.5 MV Van de Graaff
accelerator in a low scatter
environment

Reaction	Energy (MeV)
$D(d,n)^3\text{He}$	5.0
$T(p,n)^3\text{He}$	2.5
$T(p,n)^3\text{He}$	1.2
$^7\text{Li}(p,n)^7\text{Be}$	0.565
$^7\text{Li}(p,n)^7\text{Be}$	0.250
$^7\text{Li}(p,n)^7\text{Be}$	0.144



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Monoenergetic Irradiation Details

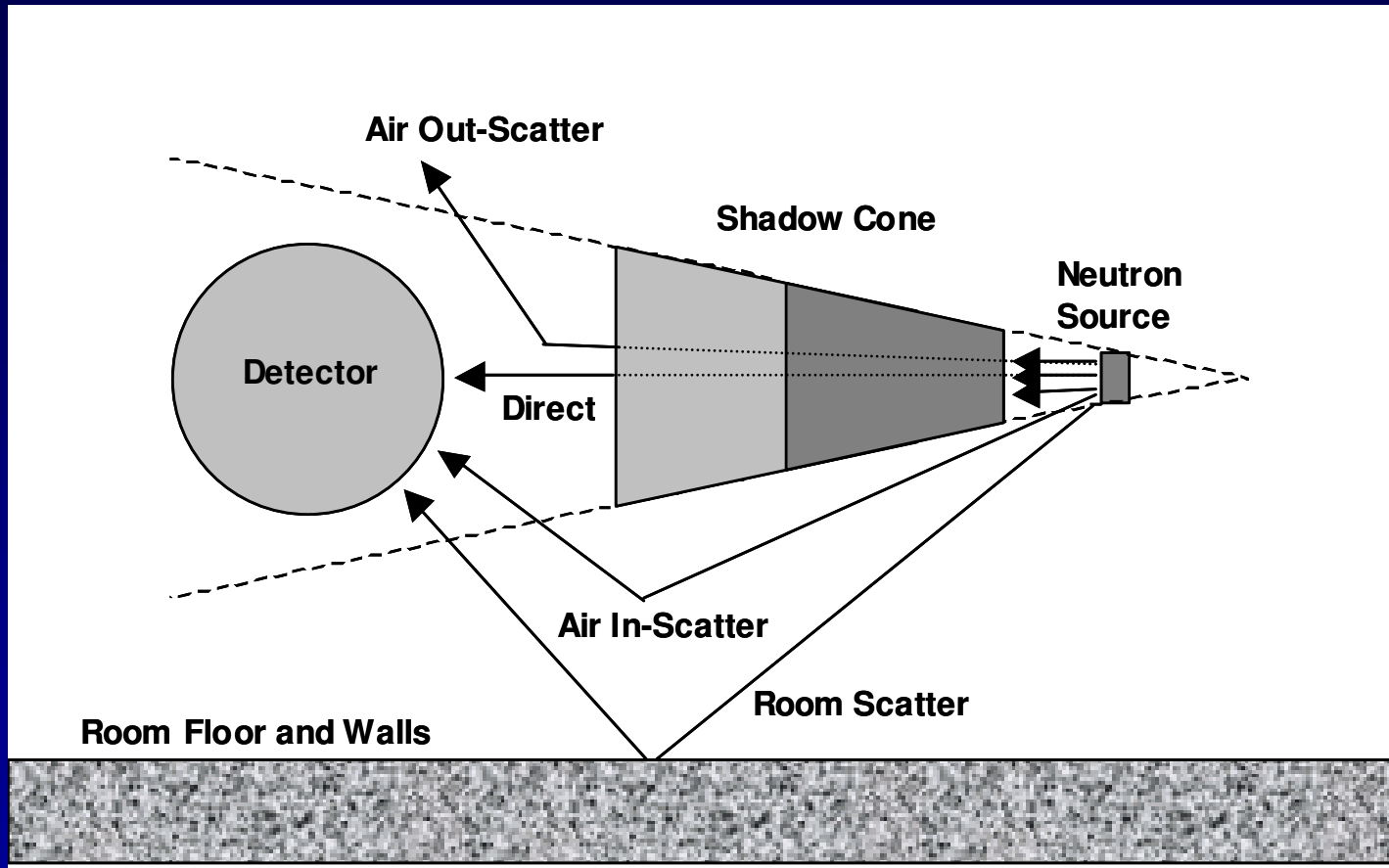
Neutron Producing Reaction	${}^7\text{Li}(p,n)$	${}^7\text{Li}(p,n)$	${}^7\text{Li}(p,n)$
Incident Particle Energy	2296 ± 3	1938 ± 3	1938 ± 3
Target Thickness	5.6 ± 1.4	6.4 ± 1.4	6.4 ± 1.4
Angle of Fluence Measurement	0°	0°	50°
Neutron Energy	565 ± 4	144 ± 4	71 ± 4
FWHM of Neutron Energy Distribution	6.1 ± 1.5	9.3 ± 2.0	8.4 ± 1.8



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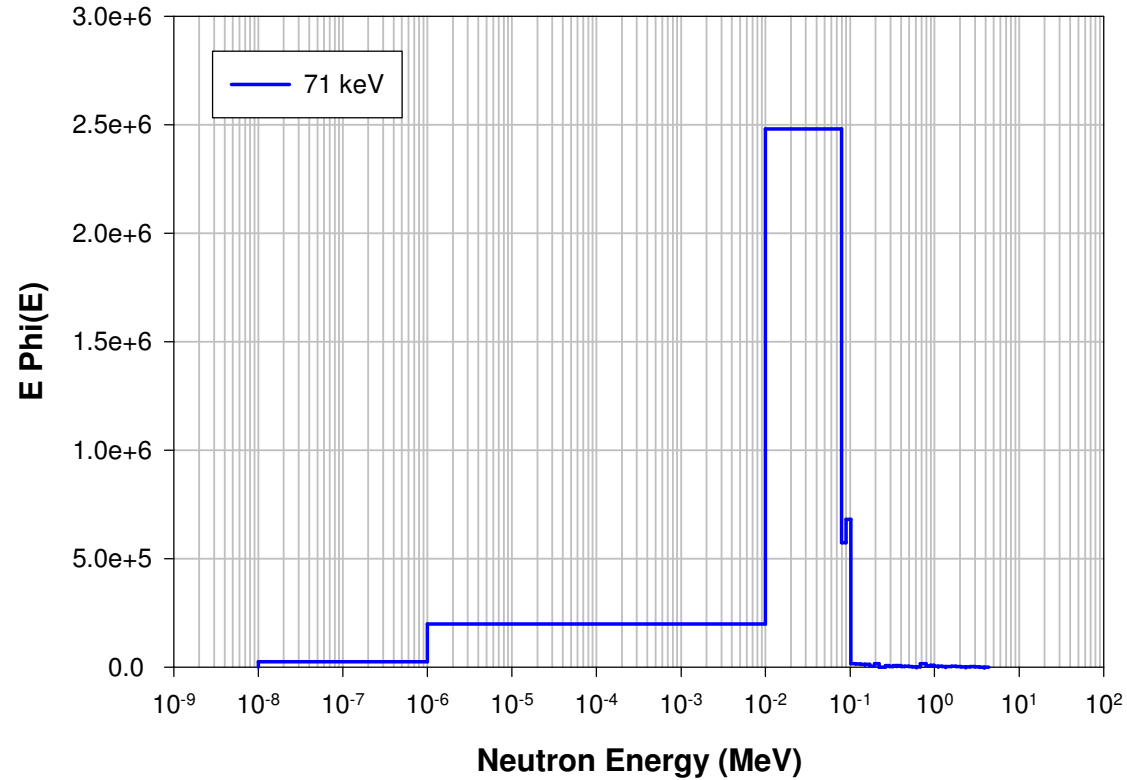
Shadow Cone Measurements



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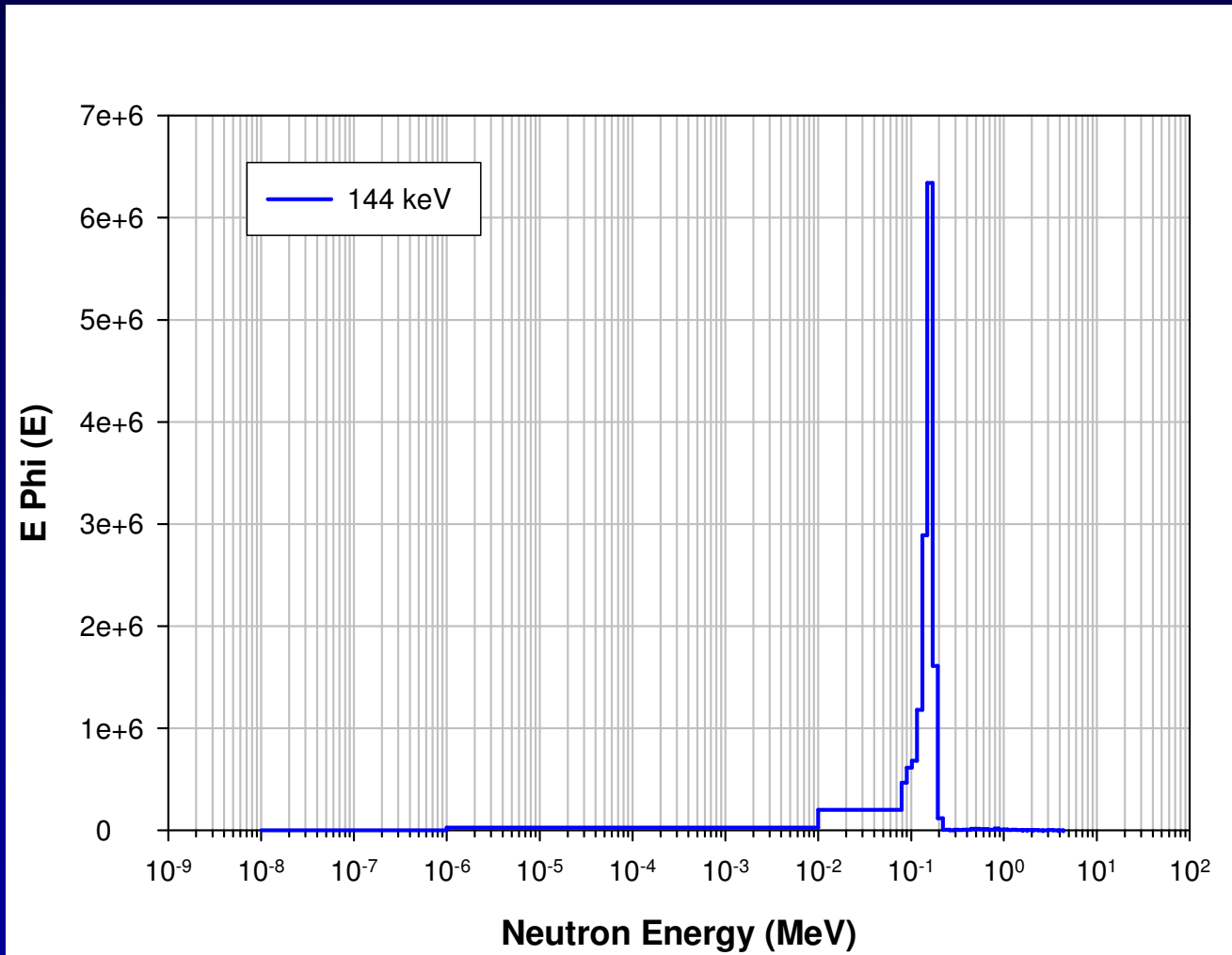
Monoenergetic Neutrons: 71 keV



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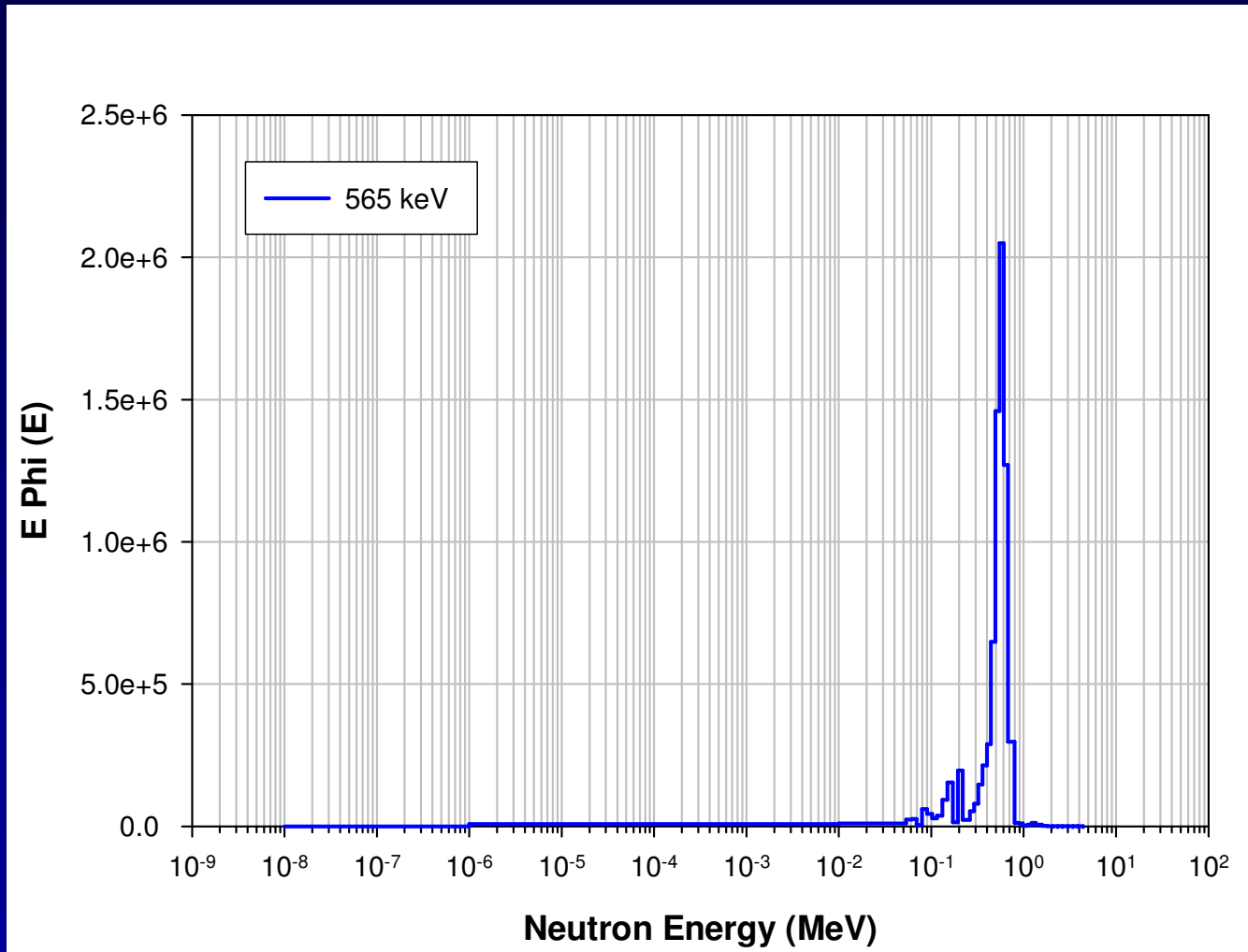
Monoenergetic Neutrons: 144 keV



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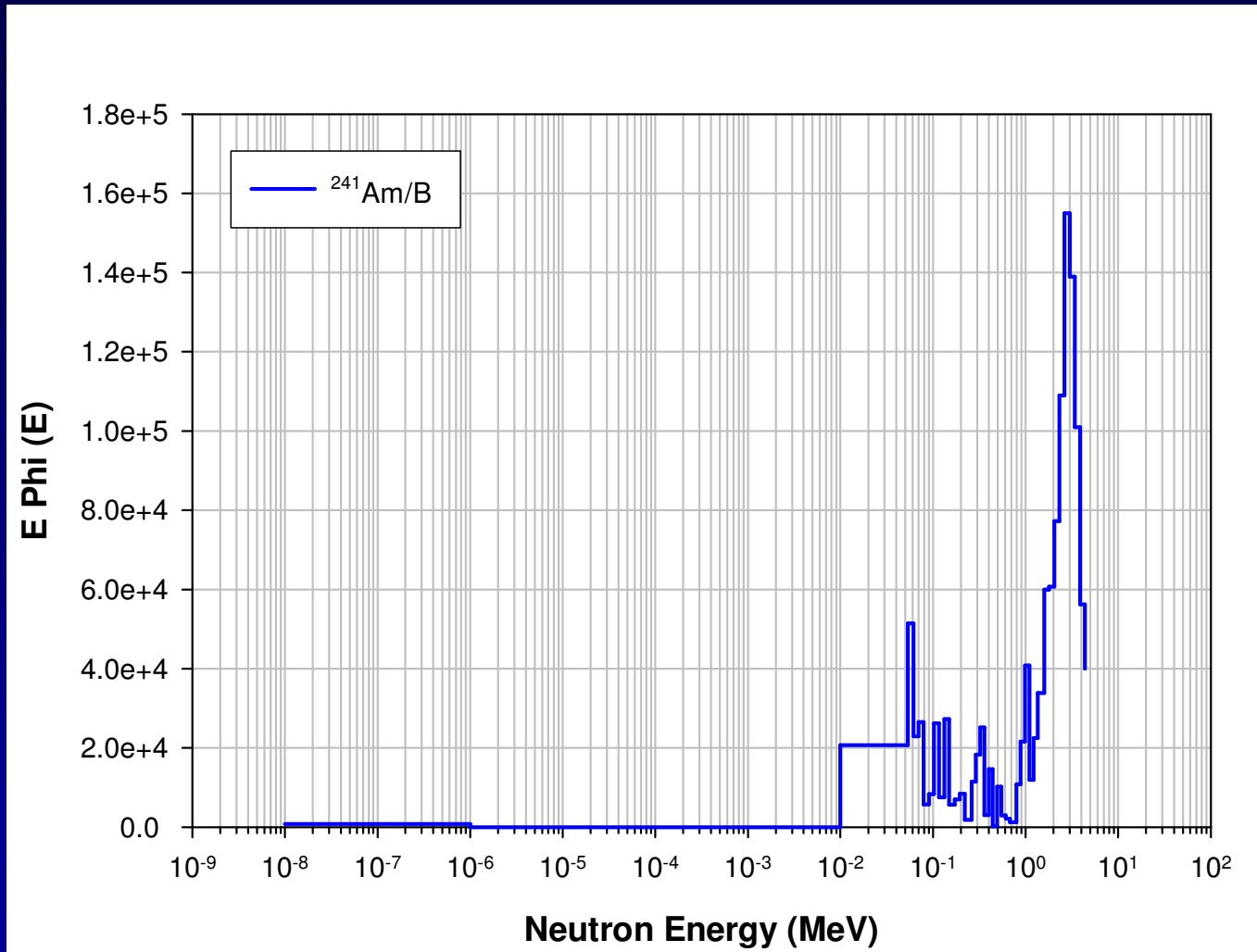
Monoenergetic Neutrons: 565 keV



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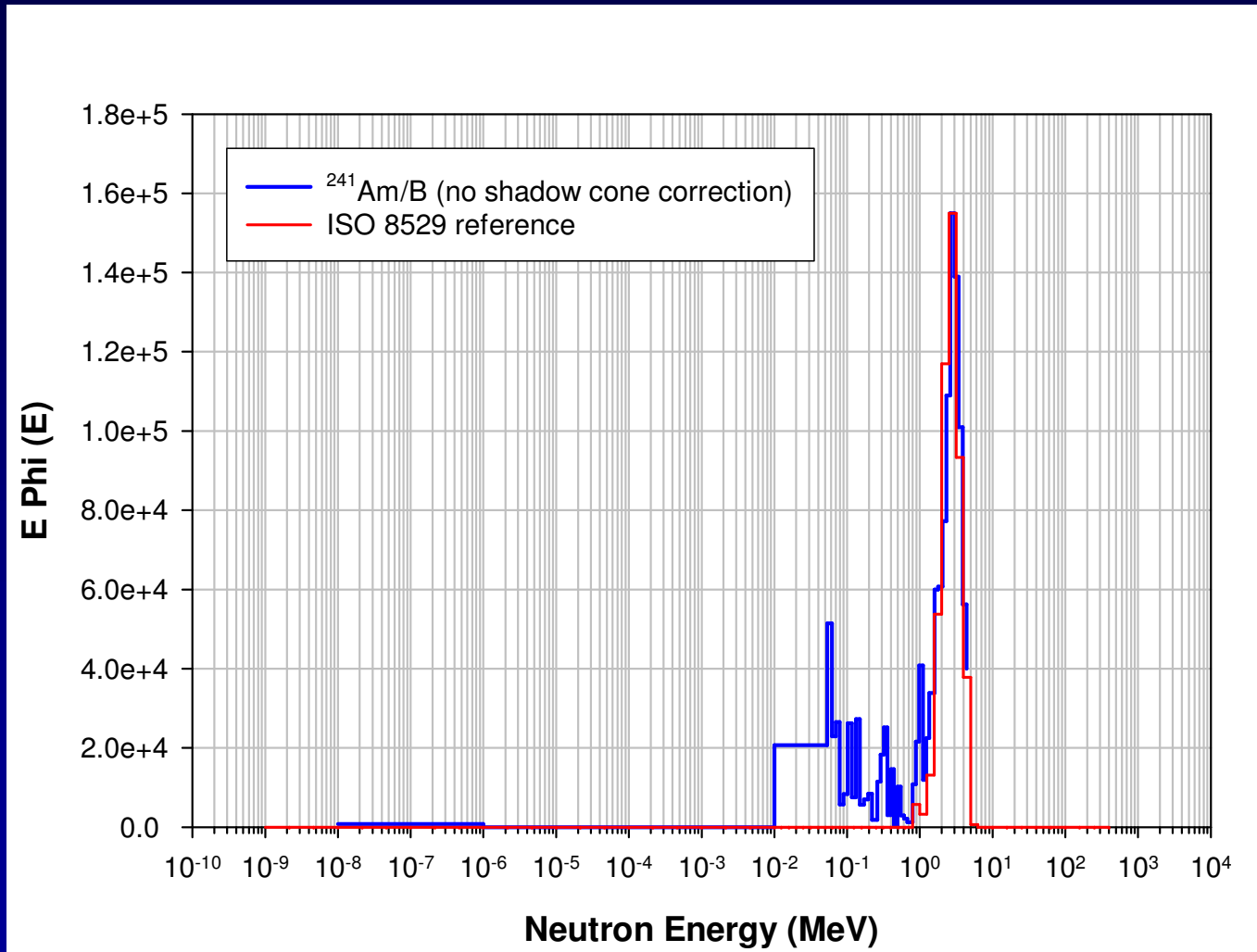
Americium-Boron Source



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ISO 8529 Am/B Reference Spectrum



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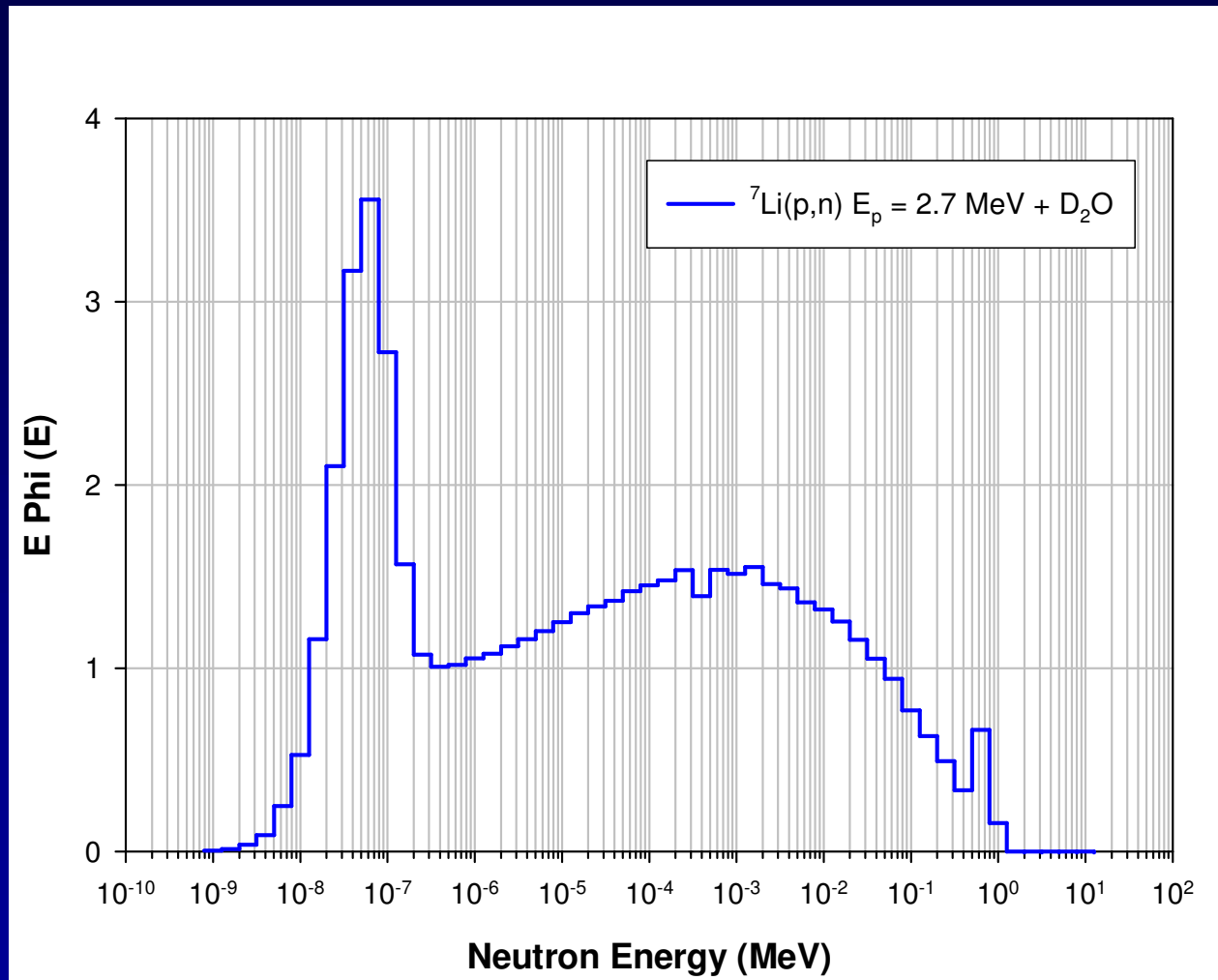
NPL Realistic Field



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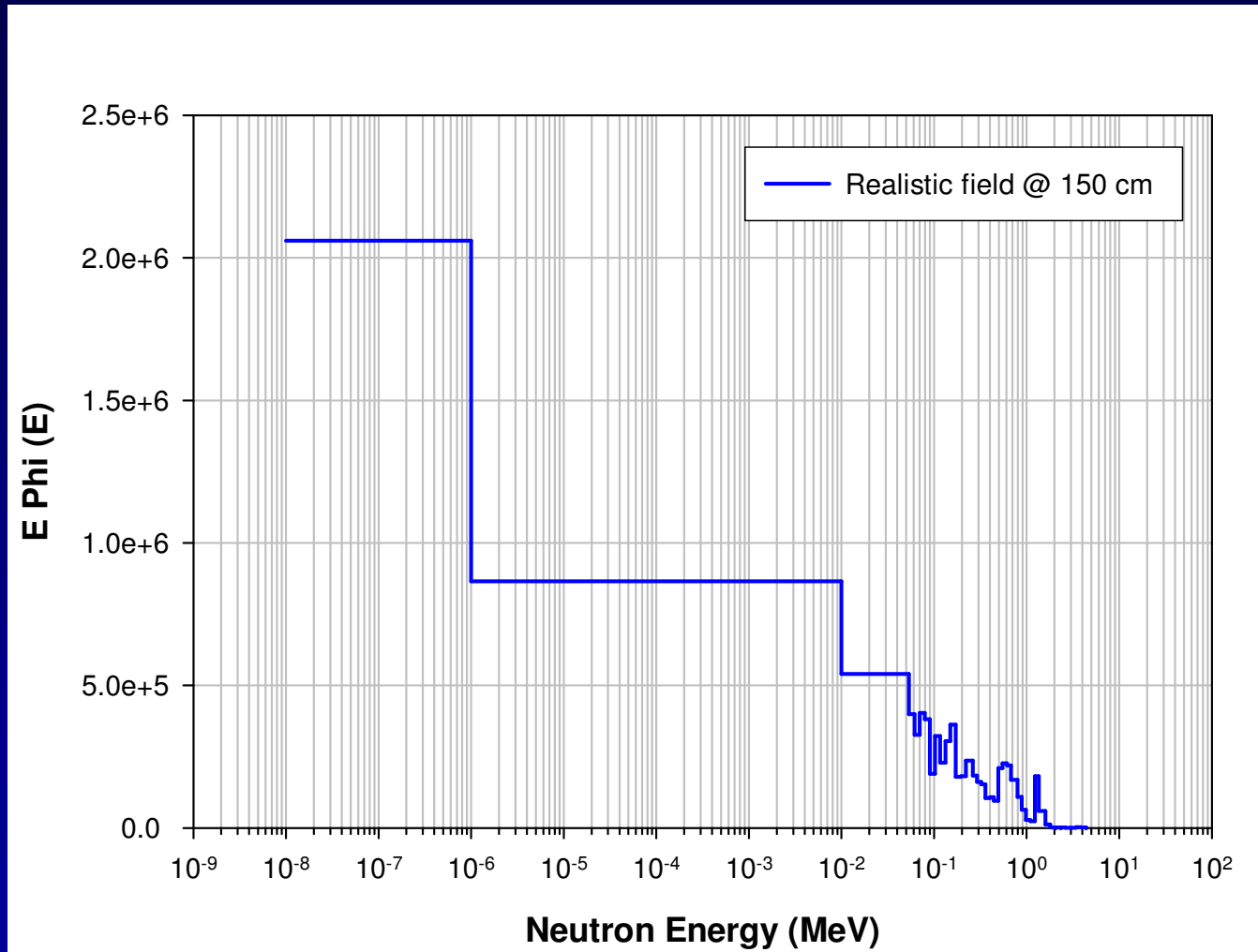
NPL Realistic Field Spectrum



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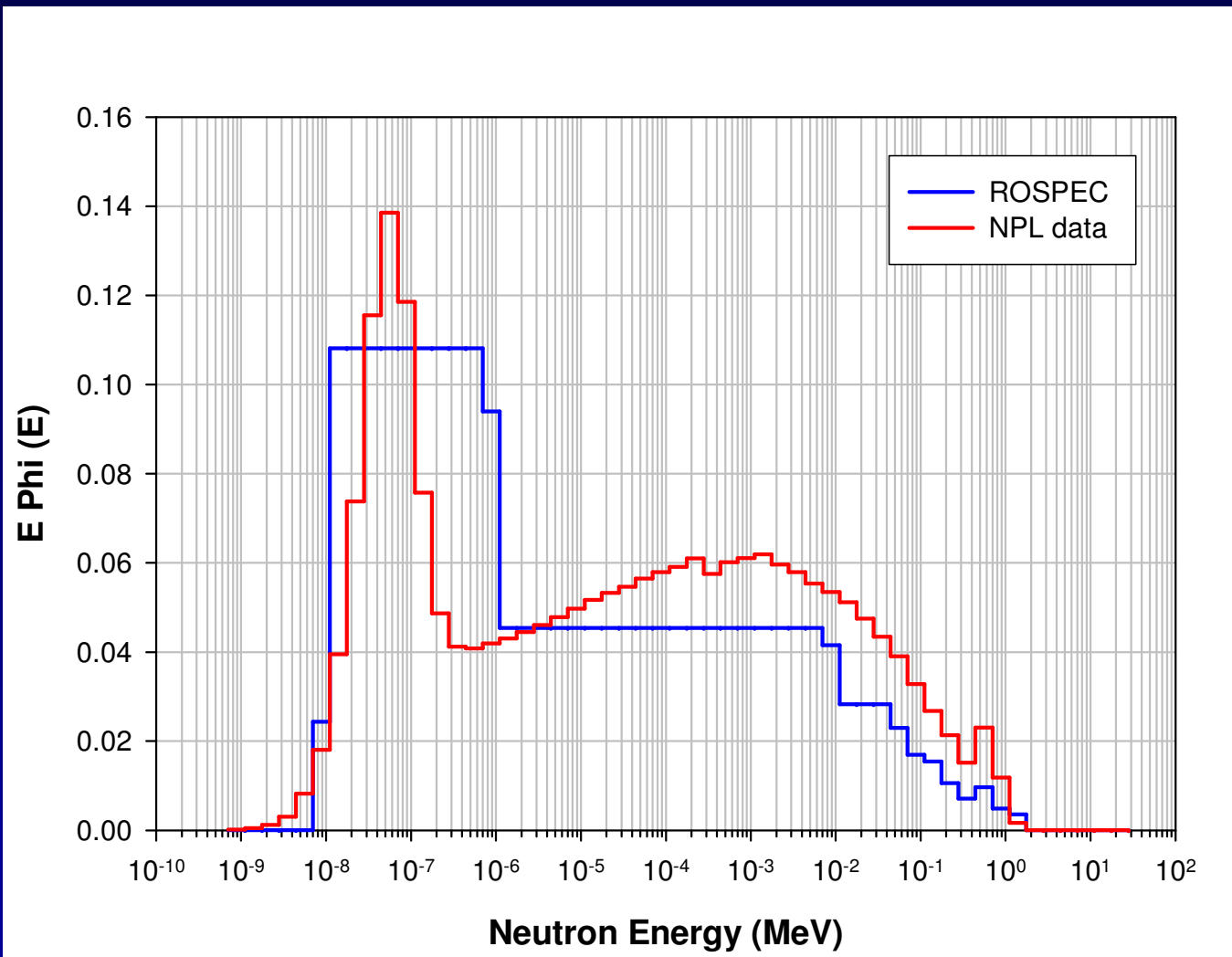
ROSPEC in NPL Realistic Field



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NPL Realistic Field



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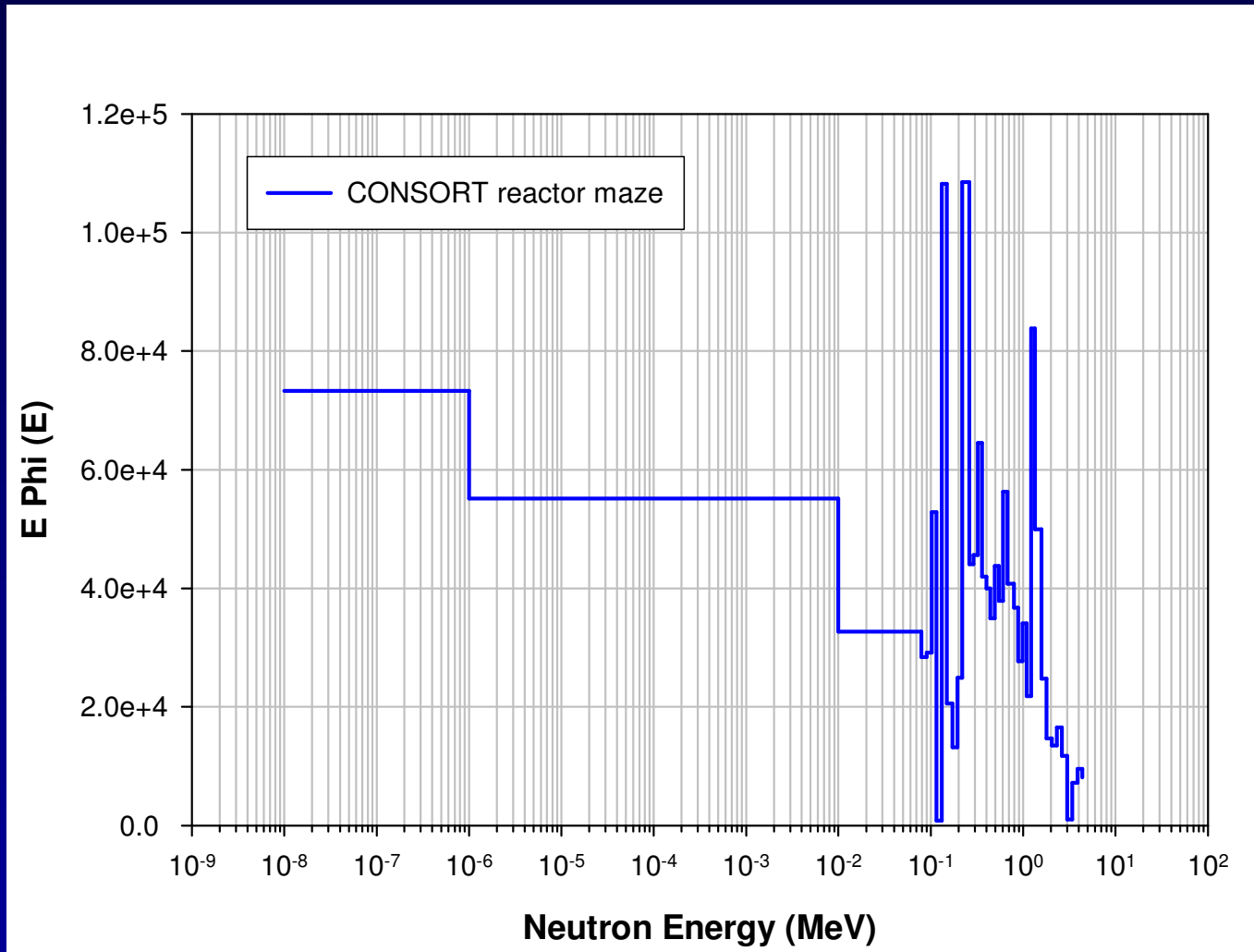
CONSORT Reproducible Spectrum



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CONSORT Reactor Maze Spectrum



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Comparison of Spectrum Integral Quantities

Spectrum	Mean Energy (keV)	Mean Radiation Weighting factor (ICRP 60)	Mean Ambient Dose Equivalent (pSv cm ²)
144 keV	119.6	15.1	102.4
565 keV	456.3	19.7	280.1
Am/B	1330	14.8	265.0
Realistic Field	12.1	5.6	17.9
CONSORT	99.6	7.3	48.5



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Questions ?



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