INDSWG-39

EANDC(US)-46
"U"

INDC-39

U. S. FACILITIES FOR MAKING LOW ENERGY NEUTRON CROSS SECTION MEASUREMENTS

October, 1963

Compiled by:

John A. Harvey

000041

TABLE OF CONTENTS

October 24, 1963

Facility: Fast Chopper Spectrometer

Location: Argonne National Laboratory

Scientist in Charge: L. M. Bollinger

Address: Argonne National Laboratory
9700 South Cass Ave.
Argonne, Illinois

Annual Effort (man years): 3 scientific, 2 technical

Program: σ_T of small samples; capture gamma ray spectra

Reactor (power; type; res. flux):	CP-5 4 Mw; enriched U, heavy water; 5×10^{13}	
Rotor (material; diameter; max. speed):	I both K-monel with U cores; 10" dia; 15,000 RPM	II
Neutron Burst (μsec width at half max.):	1.6	1.0
Max. Flight Path (meters):	60	120
Detector (for σ_T data):	B^{10} loaded liq. scintillator	B^{10} loaded liq. scintillator
Time Analyzer (No. of channels):	1024, 3 parameter magnetic tape	(4096 channel analyzer just being completed. When completed, 1024 channel analyzer will be junked.)
Resolution (nanosec/m)	35	12

Additional Comments: This spectrometer is described in detail in a paper by Bollinger, Cote and Thomas, Proc. Second UN Intern. Conf. on the Peaceful Uses of Atomic Energy (UN Geneva, 1958), Vol. 14, 239, Paper 686. Many total cross section measurements to determine resonance parameters and fission studies on Pu-239 have been made with this instrument. In recent years it has been used mainly in a wide variety of measurements on the γ-rays resulting from capture of neutrons in resonances.

October 24, 1961

Facility: Fast Chopper Spectrometer

Location: Brookhaven National Laboratory

Scientist in Charge: H. Palevsky

Address: Brookhaven National Laboratory
Upton, L. I., N. Y.

Annual Effort (man years): 4 scientific, 3 technical

Program: $\bar{\sigma}_T$ of small samples, capture gamma ray spectra

Reactor (power; type; res. flux):	Research Reactor 20 Mw; part. enr. U, graphite; 3×10^{12}
Rotor (material; diameter; max. speed):	aluminum, plastic, steel core; 30" dia.; 10,000 RPM
Neutron Burst (μsec width at half max.):	1.0
Max. Flight Path (meters):	20
Detector (for $\bar{\sigma}_T$ measurements):	$B^{10}F_3$ counters
Time Analyzer (No. of channels):	1024
Resolution (nanosec/m)	50

Additional Comments: Details on the chopper system may be found in a report by F. G. P. Seidl, Brookhaven National Laboratory Report, BNL 278 (T-46), 1954 and a paper by Seidl, Palevsky, Hughes and Zimmerman, Nuclear Instruments 1, 92 (1957). This spectrometer has been used for total cross section measurements to determine resonance parameters in order to study neutron strength functions, the distribution of spacings of resonances, the distribution of neutron widths, and the constancy of radiation widths. It has been used for capture gamma ray studies.

October 24, 1963

Facility: Fast Chopper Spectrometer

Location: Chalk River

Scientist in Charge: D. S. Craig J. A. Moore

Address: Atomic Energy of Canada Ltd.
Chalk River, Ontario, Canada

Brookhaven National Laboratory
Upton, L. I., N. Y.

Annual Effort (man years): 3 scientific, 2 technical

Program: σ_T of Pu^{241} and small samples; σ_S; capture gamma ray spectra

Reactor (power; type; res. flux): NRU
200 Mw; nat. U, heavy water; 1.5×10^{14}

Rotor (material; diameter; max. speed):: aluminum, plastic, steel core; 30" dia; 10,000 RPM

Neutron Burst (μsec width at half max.): 1.0

Max. Flight Path (meters): 88

Detector (for σ_T measurements): $B^{10}F_3$ counters

Time Analyzer (No. of channels): 1024

Resolution (nanosec/m) 12 (calc.)

Additional Comments: This spectrometer, installed at the Chalk River NRU reactor, is a joint project using a BNL-type fast chopper supplied by Brookhaven. Details are given in a published paper in Nuclear Instruments and Methods 13, 1 (1961), by Zimmerman, Palevsky, Chrien, Olsen, Singh, and Westcott. Capture gamma-ray studies and level spin assignments by means of neutron scattering measurements arebeing carried out with this spectrometer.

October 24, 1963

Facility: Fast Chopper Spectrometer

Location: Materials Testing Reactor

Scientist in Charge: M. S. Moore

Address: Phillips Petroleum Company
Atomic Energy Division
Idaho Falls, Idaho

Annual Effort (man years): 5 scientific, 2 technical

Program: σ_T of radioactive isotopes, σ_F of fissile nuclides

Reactor: MTR
(power; type; res. flux): 40 Mw; enriched U, light water; 10^{14}

	I	II
Rotor (material; diameter; max. speed):	aluminum, plastic, with 10,000 RPM	monel cores; 30" dia. 10,000 RPM
Neutron Burst (μsec width at half max.):	1.0	0.5
Max. Flight Path (meters):	20	45
Detector (for σ_T measurements):	$B^{10}F_3$ counters	$B^{10}F_3$ counters
Time Analyzer (No. of channels):	4096 and multi-dim. capacity	
Resolution (nanosec/m):	80	15

Additional Comments: This spectrometer is of the BNL design and the rotors were constructed at Brookhaven. In addition to total cross section measurements on many nuclides, accurate total and fission cross section measurements have been made on U^{233}. Details on this spectrometer are given in a report by Fluharty, Simpson, and Simpson, US AEC Report IDO-16164, 1956, and in a paper by Fluharty, Simpson, and Simpson, Phys. Rev. 103, 1778 (1956). This spectrometer has special facilities for measurements of 1 to 10,000 Curies of radioactive materials.

October 24, 1963

Facility: Fast Chopper Time-of-Flight Neutron Spectrometer

Location: Oak Ridge National Laboratory

Scientist in Charge: J. A. Harvey

Address: Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee

Annual Effort (man years): 4 scientific, 2 technical

Program: σ_T of small samples, capture gamma ray spectra

Reactor (power; type; res. flux):	ORR 30 Mw; enriched U, light water; 10^{14}	
Rotor (material; diameter; max. speed):	I stainless steel; 18" dia; 9000 RPM	II K-monel; 18" dia; 12,000 RPM
Neutron Burst (μsec width at half max.):	2.0	0.7
Max. Flight Path (meters):	45	180
Detector (for σ_T measurements):	$B^{10}F_3$ counters	$B^{10}F_3$ counters
Time Analyzer (No. of channels):	256, 2048 and 4096	
Resolution (nanosec/m):	45 nanosec/m for $E > 50$ eV $\frac{\Delta E}{E} \approx 1.5\%$ for $E < 50$ eV	10 nanosec/m for $E > 100$ eV $\frac{\Delta E}{E} \approx 0.3\%$ for $E < 100$ eV

Additional Comments: The high intensity spectrometer has been used for total cross section measurements on radioactive fission product nuclides and on enriched odd-odd target nuclides which are available only in small quantities, for scattering measurements on Ag, W and Pt, and for capture cross section measurements using a large liquid scintillator. Accurate total cross section measurements have also been made up to 100 eV upon high purity U^{233} samples. The high resolution spectrometer has been used for transmission measurements on the isotopes of Sn, Zr and Lu, W^{184}, Np^{237}, Am^{241}, Pa^{231}, etc. Gamma ray spectra measurements from neutron capture in individual resonances are being studied with a large 9" x 12" NaI crystal with the high intensity spectrometer. Details on the spectrometer are given in a paper by Block, Harvey and Slaughter (Nuclear Sc. and Eng. 8, 112 (1960)).

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: Columbia University

Scientist in charge: R. J. Rainwater, W. W. Havens, Jr.

Address: Nevis Cyclotron Laboratory
Columbia University
New York, N. Y.

Annual Effort (man years): 4 scientific, 4 grad. students

Fraction of time Available for σ Measurements: 10%

Program: σ_T of large samples up to 200 keV

Energy and Beam Current: 385 MeV protons, 0.4 μamps mean

Burst Duration (μsec): 0.05

Recurrence Freq. (pps): 60

Peak Neutron Yield per sec During Pulse: 10^{19}

Max. Flight Path (meters): 200

Time Analyzer (No. of channels): 4000

Detector (for σ_T measurements): B^{10} and NaI, self detection

Resolution (nanosec/m): 0.5 nanosec/m for $E > 1000$ eV; $\frac{\Delta E}{E} = 0.2\%$, $E < 1000$ eV

Additional Comments: A detailed paper (NEVIS-81) on this spectrometer has been published in Review of Scientific Instruments, Rainwater, Havens, Desjardins and Rosen, RSI 31, 481 (1960) describing the instrument with a 35 meter flight path. A paper describing the recent improvements in the spectrometer system has been submitted to the Review of Scientific Instruments, August 1963, Havens, Rainwater and Garg.

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: General Atomic

Scientist in Charge: E. Haddad

Address: General Atomic
P. O. Box 608
San Diego 12, California

Annual Effort (man years): 3 scientific, 2 technical

Fraction of Time Available for σ Measurements: 15%

Program: σ_γ with 4000 liter liquid scintillator, σ_T

Energy and Beam Current: 3 to 45 MeV electrons; 700 ma peak for 4.5 μsec pulses
1.5 amp peak for 0.01 μsec pulses

Burst Duration (μsec): 0.01 to 4.5

Recurrence Freq. (pps): 7.5 to 720

Peak Neutron Yield per sec During Pulse: 2×10^{17}

Max. Flight Path (meters): 20, 50 and 70

Time Analyzer (No. of channels): 1024

Detector (for σ_T measurements):

Resolution (nanosec/m): 2

Additional Comments: The primary objective of the program at General Atomic has been to make accurate capture cross-section measurements in the energy range from thermal to 1 keV. The efficiency of the scintillator is forty times greater than the efficiency of a Maxon-Rae detector, another type of detector currently being used for $\sigma(n,\gamma)$ measurements. Details of the detector are given in General Atomic report GA-3874. Parameters for individual resonances are obtained at the lower energies and average resonance parameters are obtained at the higher energies. The spectrometer is also being used to make measurements of α for fissionable nuclides. These latter measurements are made possible by the good gamma-ray resolution and summing properties of the detector.

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: Livermore

Scientist in Charge: S. C. Fultz

Address: Lawrence Radiation Laboratory
Livermore, California

Annual Effort (man years): 4 scientific, 2 technical

Fraction of Time Available for σ Measurements: 20%

Program: σ_F of fissile nuclides

Energy and Beam Current: 29 MeV electrons, 250 ma peak

Burst Duration (μsec): 0.040 to 2

Recurrence Freq. (pps): 200 for 2 μsec and 360 for 1 μsec

Peak Neutron Yield per sec During Pulse: 10^{16}

Max. Flight Path (meters): 65

Time Analyzer (No. of channels): 1024

Detector (for σ_T measurements): $B^{10}F_3$ counters

Resolution (nanosec/m): 0.60

Additional Comments: The linear electron accelerator at Livermore has been used for neutron cross section measurements in the energy region from thermal to 60 eV. It is planned to extend the measurements into the KeV and MeV regions and to attain a resolution of the order of 0.25 ns per meter. Fission and capture cross section measurements through the KeV region will be undertaken.

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: National Bureau of Standards

Scientist in Charge: K. W. Koch, J. E. Leiss

Address: National Bureau of Standards
Washington 25, D. C.

Annual Effor (man years): 2 scientific, will increase to 4 in 1965

Fraction of Time Available for σ Measurements: 20%

Program: σ_γ, σ_F, etc.

Energy and Beam Current: 100 MeV electrons, 240 ma peak
2 amps for pulses $<$ 0.1 μsec duration

Burst Duration (μsec): 0.02 to 6

Recurrence Freq. (pps): 7.5 to 720

Peak Neutron Yield per sec During Pulse: $\sim 10^{18}$

Max. Flight Path (meters): 45

Time Analyzer (No. of channels): on-line computer; 16,000 words plus magnetic tape

Detector (for σ_T measurements):

Resolution (nanosec/m):

Additional Comments: The NBS electron linac is due to be delivered in January 1964 and it is anticipated that an active research program will be under way by the fall of 1964. A substantial fraction of the machine operating time will be used for photoneutron spectra measurements and neutron cross section measurements by time-of-flight. The principal interests are in the measurement of photoneutron spectra under very clean beam conditions with high neutron energy resolution and the measurement of the "inverse" reaction: neutron capture gamma ray spectra for neutron energies above 10 keV. There are plans for fission fragment mass distribution measurements for both photofission and slow neutron induced fission. In the present below-ground facility the longest flight path available will be 45 meters, and there is only one such path. An additional facility has been proposed for bringing the beam up to a heavily shielded room at ground level which will contain two separate target facilities, each with its own set of flight paths: one for slow-neutron research and one for photoneutron research.

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: Oak Ridge National Laboratory

Scientist in Charge: W. M. Good

Address: Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee

Annual Effort (man years): 4 scientific, 2 technical

Fraction of Time Available
for σ Measurements: 40%

Program: σ_T from 2 to 60 keV, and capture gamma ray spectra

Energy and Beam Current: 1.9 MeV protons, 5 mamp peak

Burst Duration (μsec): 0.001

Recurrence Freq. (pps): 5×10^5

Max. Flight Path (meters): 4

Time Analyzer (No. of channels): 4096

Detector (for σ_T measurements): B^{10} slab + NaI

Resolution (nanosec/m): 3

Additional Comments: This spectrometer uses a technique which is a combination of a Van de Graaff and the time-of-flight technique in which the Van de Graaff supplies only the required spectrum of neutrons in the keV energy region and the time-of-flight technique establishes the precise energy. This spectrometer has been used for total cross section measurements from 2 to 60 keV upon many samples of separated isotopes. The capture cross sections of many elements have been measured from 5 to 150 keV with a large liquid scintillator tank. Capture gamma ray spectra are being studied with a 9" x 12" NaI crystal. A basic description of the technique is given in a paper by Good, Neiler and Gibbons, Phys. Rev. 109, 926 (1958) and by W. M. Good, Saclay Symposium on Neutron Time-of-Flight Methods, 1961, page 309.

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: Rensselaer Polytechnic Institute

Scientist in Charge: Erwin R. Gaerttner

Address: Linear Accelerator Project
Rensselaer Polytechnic Institute
Troy, N. Y.

Annual Effort (man years): 3 scientific, 3 graduate

Fraction of Time Available for σ Measurements: 15%

Program: σ_T and σ_γ with large liquid scintillator up to 20 keV

Energy and Beam Current: 60 MeV electrons, 2 amps peak

Burst Duration (μsec): 0.01 to 4.5

Recurrence Freq. (pps): 1 to 720

Peak Neutron Yield per sec During Pulse: 5×10^{17} for 0.1 μsec pulses

Max. Flight Path (meters): 10, 25, 100, 270 under construction

Time Analyzer (No. of channels): 2048

Detector (for σ_T measurements): B^{10} and NaI

Resolution (nanosec/m): 0.4

Additional Comments: A description of the accelerator was given by Gaerttner, Yeater and Fullwood in Neutron Physics, Academic Press 1962 and in IRE Trans. on Nuclear Science 25, 1962. The spectrometer was described by Russell, Hockenbury and Block, Bull. Am. Phys. Soc. 7, 289 (1962).

October 24, 1963

Facility: Pulsed accelerator time-of-flight neutron spectrometer

Location: Yale University

Scientist in Charge: H. L. Schultz

Address: Yale University
New Haven, Conn.

Annual Effort (man years): 2 scientific, graduate students

Fraction of Time Available for σ Measurements: 30%

Program: neutron capture gamma ray spectra

Energy and Beam Current: 40 MeV electrons, 700 ma peak; 1.6 amps for 0.1 μsec pulses

Burst Duration (μsec): 0.1 to 4.2

Recurrence Freq. (pps): 200, 500 for 0.1 μsec pulses

Peak Neutron Yield per sec During Pulse: 2×10^{17} for 0.1 μsec pulses

Max. Flight Path (meters): 45

Time Analyzer (No. of channels): 2048

Detector (for σ_T measurements):

Resolution (nanosec/m): 10

Additional Comments: The Yale high intensity microwave (1300 mc/sec) electron accelerator has been in routine operation since June, 1962. It is now being used in the study of photonuclear reactions and neutron capture gamma ray spectra (both thermal and resonance capture). After delivery of an elaborate beam analysis system now on order, electron scattering will be undertaken.

October 24, 1963

Facility: Single Crystal Neutron Spectrometer

Location: Brookhaven National Laboratory

Scientist in Charge: V. L. Sailor

Address: Brookhaven National Laboratory
Upton, L. I., N. Y.

Annual Effort (man years): 2 scientific, 2 technical

Program: Low energy neutron cross sections, polarized neutrons and nuclei

Reactor (power; type; usable res. flux):	Research Reactor 20 Mw; part. enriched U, graphite; 3×10^{12}	
	I	II
Energy Range (eV):	0.018 to 0.35	0.35 to $\sim$ 10
Monochromator:	Si (111)	Be ($12\bar{3}1$)
Collimation (minutes):		1
Resolution (μsec/m):	0.7	0.17
Filter:	2" to 12" quartz	Cd

Additional Comments: Details on this spectrometer may be found in papers by L. B. Borst and V. L. Sailor, Rev. Sci. Instr. 24, 141 (1953) and Sailor, Foote, Landon and Wood, Rev. Sci. Instr. 27, 26 (1956). This group has made accurate total cross section measurements up to $\sim$ 10 eV on nearly all rare earth elements and isotopes, activation and capture measurements on several nuclides, scattering measurements on U^{233} and U^{235}, and fission measurements on U^{235}. However, the major effort of this group in the past few years has been in nuclear polarization and a spectrometer to produce polarized neutrons, in order to determine the spins of low energy resonances.

October 24, 1963

Facility: Single Crystal Neutron Spectrometer

Location: Columbia University at Brookhaven National Laboratory

Scientist in Charge: B. M. Rustad

Address: Brookhaven National Laboratory
Upton, L. I., N. Y.

Annual Effort (man years): 3 scientific, 1 technical

Program: Low energy neutron cross sections.

Reactor (power; type; usable res. flux):	Research Reactor at BNL 20 Mw; part. enriched U, graphite; 3×10^{12}	
	I	II
Energy Range (eV):	0.005 to 0.1	0.1 to 5
Monochromator:	Ge (111)	NaCl (200)
Collimation (minutes):		
Resolution (μsec/m):		
Filter:	Mech. vel. selector	none

Additional Comments: This spectrometer has been used for accurate total cross section measurements on Au, U^{233} and U^{235} and a precision determination of the U^{235} fission cross section for thermal and very low energy neutrons. By using either a mechanical velocity selector or a filter with a crystal monochromator, measurements have been made down to 0.0008 eV. Some of the details on this spectrometer may be found in a paper by Gould, Taylor, Havens, Rustad and Melkonian, Nuclear Science and Engineering 8, 453 (1960). A more complete paper has been prepared and is being submitted to Nuclear Science and Engineering.

October 24, 1963

Facility: Single Crystal Neutron Spectrometer

Location: Hanford

Scientist in Charge: B. R. Leonard

Address: General Electric Company
Hanford Engineering Works
Hanford, Washington

Annual Effort (man years): inactive at present

Program: slow neutron cross sections, σ_F, η, ν

Reactor (power; type; usable res. flux):	Pu production reactor natural U, graphite	
	I	II
Energy Range (eV):	0.02 to 2	0.35 to 20
Monochromator:	Be $(10\bar{1}3)$	Be $(11\bar{2}4)$
Collimation (minutes):	20	4
Resolution (μsec/m):	2.8	0.65
Filter:	Gd, Cd	Cd

Additional Comments: This instrument has been used to measure the fission cross sections of Pu^{240}, Np^{237}, Am^{241}, Pu^{239} and Pu^{241} up to ~ 5 eV, the variation of η of Pu^{239} with neutron energy, and the 2200 m/sec fission cross section of U^{235}. Details of the spectrometer are given in a Hanford Progress Report by Leonard, Hauser and Seppi, HW-30128, December 1953.

October 24, 1963

Facility: Single Crystal Neutron Spectrometer

Location: Materials Testing Reactor

Scientist in Charge: J. R. Smith

Address: Phillips Petroleum Company
Atomic Energy Division
Idaho Falls, Idaho

Annual Effort (man years): 3 scientific, 1 technical

Program: Low energy σ_T, σ_F, η

Reactor (power; type; usable res. flux):	MTR 40 Mw; enriched U, light water; 2×10^{14}	
	I	II
Energy Range (eV):	0.02 to 5	0.1 to 20
Monochromator:	Be $(10\bar{1}1)$	calcite (221)
Collimation (minutes):	15	0.5
Resolution (μsec/m)	2.6	0.09
Filter:	Mech. vel. selector	none

Additional Comments: This spectrometer has been used for total cross section measurements and to measure the fission and total cross sections of U^{233} to 10 eV and the variation of η with energy. Details of this spectrometer are given in a report by Evans, US AEC Report IDO-16120 and in a paper by Brugger, Evans, Joki, and Shankland, Phys. Rev. 104, 1054 (1956).

October 24, 1963

Facility: Phased-Chopper Rotating Crystal Spectrometer

Location: Hanford

Scientist in Charge: B. L. Leonard

Address: General Electric Company
Hanford Engineering Works
Hanford, Washington

Annual Effort (man years): 2 scientific, 1 technical

Program: slow neutron inelastic scattering, now under construction

Reactor (power; type; usable res. flux):	Pu production reactor Natural U, graphite

Monochromator:

Energy Range (eV):	0.02 to 0.5
Monochromator:	not fixed
Collimation (minutes):	not fixed
Resolution (μsec/m):	1
Filter:	Mechanical chopper

Analyzer:

Energy Range	0.001 to 0.5
Monochromator	
Collimation	
Resolution (μsec/m)	1
Filter	
Angular Range	0 to 165° (11 detectors)

October 24, 1963

Facility: Phased Chopper Velocity Selector

Location: Materials Testing Reactor

Scientist in Charge: R. M.Brugger

Address: Phillips Petroleum Company
Atomic Energy Division
Idaho Falls, Idaho

Annual Effort (man years): 4 scientific, 1 technical

Program: Inelastic neutron scattering from solids, liquids and gases

Reactor (power; type, res. flux):	MTR 40 Mw; enriched U, light water; 2×10^{14}	
Rotor (material; diameter; max. speed):	2 choppers dura nickel R with nickel and aluminum inserts 4 3/4" 15,000 RPM	2 collimators steel, nylon 12" 7,500 RPM
Burst width	15 μsec at 12,000 RPM or 12 μsec at 15,000 RPM	
Flight Path (meters):	2	
Detectors:	$B^{10}F_3$ counters in parallel to define 12 separate scattering angles	
Time Analyzer:	4096 channels (2 separate memory units of 4096 channels each which can be used for storage, one at a time)	
Resolution ($\Delta E/E$):	3.3% at 12,000 RPM with E_o = 0.025 eV 6.5% at 12,000 RPM with E_o = 0.10 eV	

Additional Comments: This spectrometer is measuring $\frac{d^2\sigma(E)}{d\Omega d E'}$ for solids, liquids, and gases as well as measuring dispersion relations for single crystals. An extensive description of the instrument is given in an article entirled "MTR Phased Chopper Velocity Selector" by R. M. Brugger and J. E. Evans, which was published in Nuclear Instruments and Methods, Volume 12, pages 75-102, 1961.

October 24, 1963

Facility: Triple-Axis Crystal Spectrometer

Location: Hanford

Scientist in Charge: B. R. Leonard

Address: General Electric Company
Hanford Engineering Works
Hanford, Washington

Annual Effort (man years): 2 scientific, 1 technical

Program: slow neutron inelastic scattering

Reactor (power; type; usable res. flux):	Pu production reactor natural U, graphite
Monochromator:	Be $(11\bar{2}0)$
Energy Range (eV):	0.1 to 0.5
Collimation (minutes):	30
Resolution (μsec/m):	4
Filter:	none
Analyzer:	
Energy Range (eV)	0.05 to 0.3
Monochromator	Be $(00\bar{0}2)$
Collimation (minutes)	45
Resolution (μsec/m)	8
Filter	
Angular Range	0 to 80°