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Oak Ridge National Laboratory
Spallation Neutron Source

Dr. Malcom Cochran
Laue Diffractometer
Structure and Dynamics of Soft Matter
Oak Ridge, TN 37831, USA

Quotation Reference

Number	**QU20053-CP-00**
Title	SNS, Cochran – Polarizing V-Cavity
Date	Klingnau, June 25, 2020

Your Request for Quotation

Solicitation number	NA
Equipment specification	Your request for quotation: email from 29-Apr-2020

Dear Dr. Cochran

Thank you very much for your interest in a polarizing V-cavity of the type offered to Dr. Crow in 2017.

SwissNeutronics offers as follows:

A. V-Cavity Polarizer: 1.5 Å

Pos.	Item		Price
1.1	**Neutron guide body**		
	▪ Design:	guide element for the integration of 4 polarizing V-cavities arranged parallel to each other (Fig. 1)	
	▪ Guide axis/profile:		
	– Axis (hor. / vert.):	straight / straight	
	– Profile (hor. / vert.):	parallel / parallel	
	▪ Cross section:		
	– Entrance:	50.00 mm (h) × 30.00 mm (w)	
	– Exit:	50.00 mm (h) × 30.00 mm (w)	
	– Dimensional tolerance:	±0.02 mm, 0.01 mm (RMS)	
	– Waviness:	η < 1.5·10-4 rad	
	▪ Length of guide:	L = 550 mm	
	▪ Coating:		
	– Sides:	m = 1.0, R_{ave} = 99%, non-magnetic	
	– Top/bottom:	m = 2.0, R_{ave} = 93%, non-magnetic	
	▪ Substrates		
	– Material of substrates:	borofloat	
	– Thickness of substrates:	9 mm	
	▪ Reinforcement plates	not applicable	
	▪ Contact pads	none	
	▪ Alignment features		
	– Scratch marks:	yes	
	– Location of scratch marks:	center of entrance and exit	
	▪ Remarks: The choice of a non-magnetic Ni-coating (m = 1.0) for the sides of the guide body allows		

	the transmission of neutrons with a divergence given by $2 \cdot 0.099 * 1.0 * 2.41 = 0.48^0$ (here: 0.0990/Å is a constant, m = 1.0 the index of the Ni-coating, and 2.41 Å the wavelength).	
1.2	**Dividing blades** ▪ Substrates – Material of substrates: boron containing glass – Thickness of substrates: d = 0.3 mm ▪ Coating: m = 1.0, R_{ave} = 99%, non-magnetic (on both sides) ▪ Number of blades: 3 ▪ Remark: The blades are integrated into the guide body (Pos. 1.1).	
1.3	**Polarizing Vs** ▪ Design: Si-wafer with Fe/Si polarizing coatings (on both sides) ▪ Critical wavelength: λ^* = 1.5 Å (design value to warrant a good polarization at 2.41 Å) ▪ Substrates – Material of substrates: Si-wafer – Thickness of substrates: 0.3 mm ▪ Coating: Fe/Si, m = 4.0, R_{ave} = 80% (on both sides) ▪ Magnetizing field: 500 G ▪ Remarks: – The polarizing Si-wafer are integrated into the guide body (Pos. 1.1). – The critical wavelength is strongly decreased in order to obtain a reasonably high polarization at $\lambda \cong$ 2.41 Å. This is the wavelength where the cavity will be used.	
1.4	**Total price for Pos. 1.1 – 1.3**	**CHF 69'390**

B. Magnetic Casing

Pos.	Item	Price
2.1	**Magnetic casing for polarizer** ▪ Design: magnetic casing to provide magnetization field for Fe/Si ▪ Structure of casing: the magnetic housing comprises steel plates at top/bottom and an Al-frame at the sides to accommodate the magnets (Fig. 2) ▪ Materials – Yoke (top/bottom): steel ST37, Ni-plated – Sides: aluminum – Magnets: NdFeB ▪ Dimensions – Maximum cross section: to be determined – Length: $L \cong$ 550 mm (tbd.) ▪ Magnetic field: B = 500 G	
2.2	**Total price for Pos. 2.1**	**CHF 10'540**

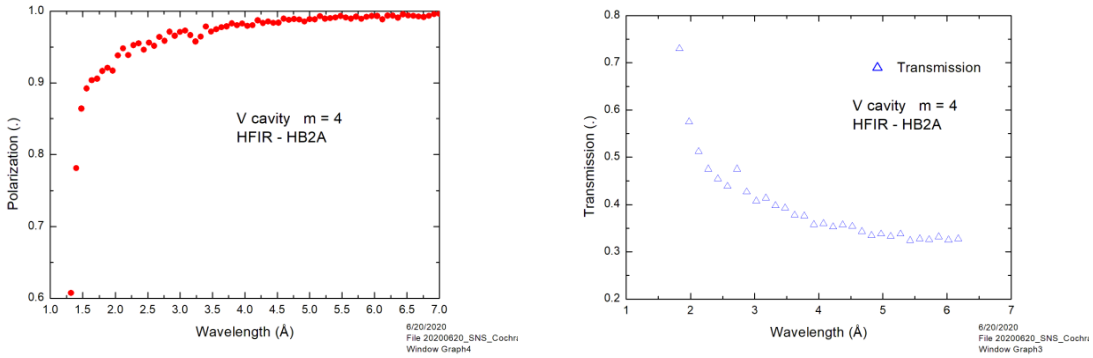


Fig. 1: Polarization (left hand side) and transmission (right hand side) of the V-cavity designed for the beamline HB2A at HFIR. The data was calculated using the program McStas. The critical wavelength of the cavity is λ = 1.5 Å that is significantly smaller than the wavelength where the cavity is operated in order to achieve a high polarization.

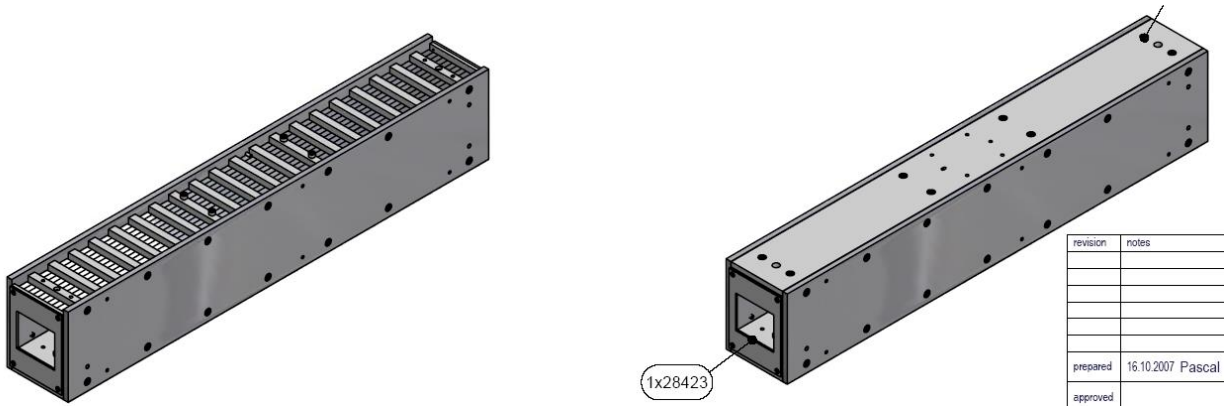


Fig. 2: Mechanical design of the magnetic housing (rotated by 90^0). The NdFeB-magnets are mechanically fixed by means of grooved Al-plates. The polarizing cavity is aligned by means of adjustment screws. The housing protects the cavity against damage.

C. Packaging & Transport

Pos.	Item	Price
3.1	**Packaging & Transport** ▪ Destination: ORNL, Oak Ridge, USA ▪ Excluding import duty and tax	CHF 1'050

General terms	
Validity of quotation:	60 days
Delivery:	14 months after receiving the order
Guarantee:	24 months after delivery; guarantee covers damages of the coatings and the mechanical structure of the polarizer and the mechanical equipment under normal operating conditions.
Terms of Dispatch:	ORNL, Oak Ridge, USA
Terms of Payment:	30 days after delivery
General Terms and Conditions:	GTC SwissNeutronics AG

We hope this quotation is of interest and look forward to hearing from you. Please inform us, if you need any further information.

Yours sincerely

Prof. Dr. P. Böni
CEO SwissNeutronics

Dr. C. Schanzer
COO SwissNeutronics

Appendix

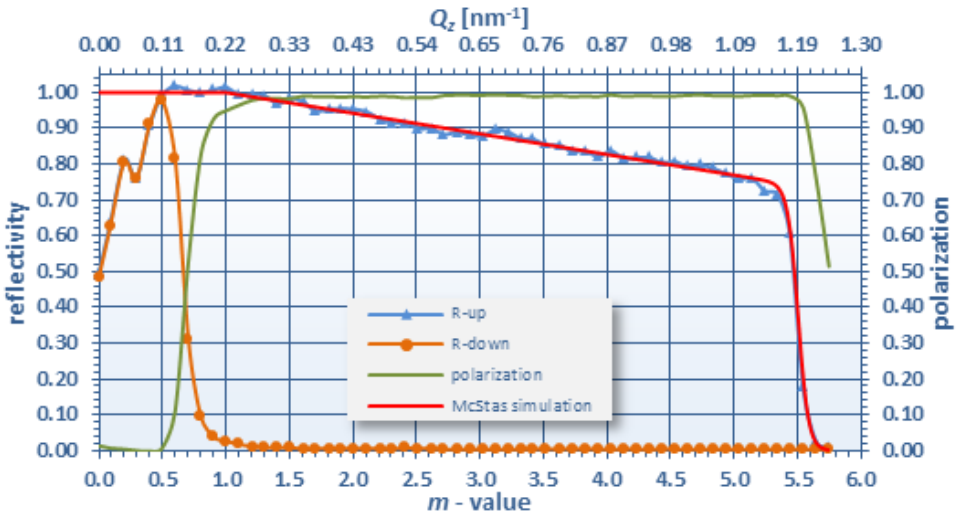
A. Performance specifications

A1. Fe/Si polarizing supermirrors

SwissNeutronics produces polarizing coatings providing excellent performances in terms of reflectivity, transmission and polarization (see Figure A1). General properties are:

- polarizing Fe/Si and FeCoV/TiN (remanent) supermirror
- high reflectivity and polarization
- large *m*-values
- highly reproducible large scale fabrication

a)



b)

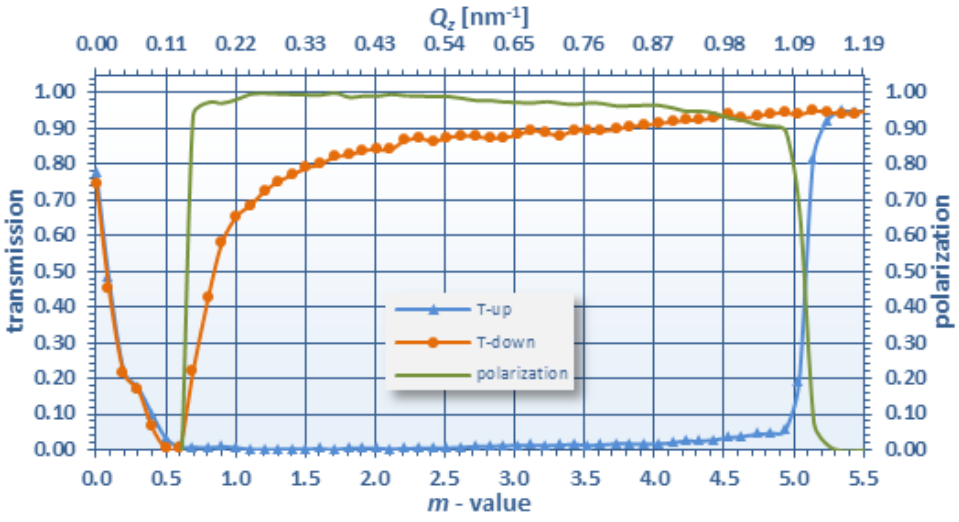


Figure A1: Fe/Si polarizing coatings: a) spin-dependent reflectivity and polarization of Fe/Si with m = 5.5 on glass, b) spin-dependent transmission and polarization of Fe/Si with m = 5.0 on Si-wafer with thickness t = 0.3 mm (double-sided coating).

B. References

SwissNeutronics produced polarizing devices (cavities, bender, reflectors, filters, etc.) for various laboratories. The key element of the devices are Fe/Si polarizing supermirrors with excellent reflectivity and polarization up to large *m*-values (currently up to *m* = 5.5). In combination with precise mechanics a wide range of devices is available, which are customized to the specific individual requirements. In the following a few selected polarizing devices are briefly described, which are similar to the present proposal.

B1. Synopsis of recently fabricated polarizing devices

Multichannel V-cavity polarization analyser – KOMPASS @ FRM-II (2013)

V-cavity design

- Number of serial V: 1
- Number of channels: 15
- Taper angle of V: 1.4°
- Length of V: 560 mm
- Substrate : single crystal Si, *t* = 0.3 mm
- Coating: Fe/Si, *m* = 4, double-sided
- Critical wavelength: λ^* = 2.15 Å

Body design

- Cross-section: 100 mm (*w*) × 214 mm (*h*) → 52 mm (*w*) × 214 mm (*h*)
- Length: 642 mm
- Width of channel: 14 mm
- Substrate dividing walls: borosilicate glass, *t* = 0.3 mm
- Coating: none

Specials:

- Magnetic casing with *B* = 450 G

Multichannel V-cavity polarizer – BL15 @ JPARC (2013)

V-cavity design

- Number of serial V: 1
- Number of channels: 25
- Taper angle of V: 1.38°
- Length of V: 154 mm
- Substrate : single crystal Si, *t* = 0.3 mm
- Coating: Fe/Si, *m* = 4.5, double-sided
- Critical wavelength: λ^* = 1.5 Å

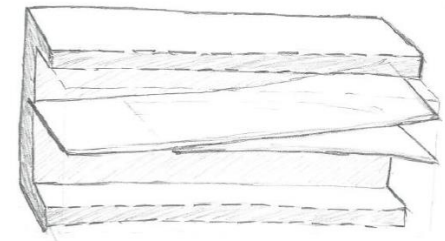
Body design

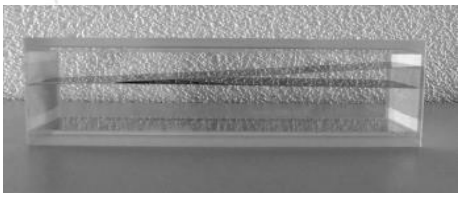
- Cross-section: 60 mm (*w*) × 60 mm (*h*)
- Length: 185 mm
- Coating: TiB

Specials:

- 3 identical cavities were delivered

Logarithmic V-cavity polarizer – SELENE @ PSI (2013)





V-cavity design

- Number of serial V: 1
- Number of channels: 1
- Taper angle of V: logarithmic spiral
- Length of V: 225 mm
- Substrate : single crystal Si, t = 0.3 mm
- Coating: Fe/Si, m = 4.2, double-sided
- Measured reflectivity: R_{ave} = 0.79 @ m = 4.2
- Critical wavelength: λ^* = 2 Å

Body design

- Cross-section: 50 mm (w) × 50 mm (h)
- Length: 225 mm
- Coating: none

Specials:

- Additional Ni coating on top of polarizing supermirror as frame overlap mirror

B2. Customer reference list

Instrument / laboratory	Contact	Type of polarizer	Year
NSE @ SNS	Dr. Michael Ohl M.Ohl@fz-juelich.de	Kink polarizer	2015
ORNL	Dr. Bill Hamilton hamiltonwa@ornl.gov	3-channel double V-cavity polarizer	2015
POLANO @ JPARC	Toshi Karasawa avance@mva.biglobe.ne.jp	Wide Angle Polarization Analyzer	2015
SuperAdam @ ILL	Dr. Alexei Vorobiev avorobiev@ill.fr	Reflection polarizer	2014
PONTA @ JRR-3M	Toshi Karasawa avance@mva.biglobe.ne.jp	2 multichannel V-cavity polarizer	2014
SELENE @ PSI	Dr. Jochen Stahn jochen.stahn@psi.ch	Logarithmic V-cavity polarizer	2013
KOMPASS @ FRM2	Dr. Alexander Grünwald Alexander.Gruenwald@frm2.tum.de	Multichannel V-cavity polarization analyzer	2013
Tomography station @ HZB	Prof. Wolfgang Treimer treimer@helmholtz-berlin.de	Polarizing solid state bender	2013
Tomography station @ HZB	Dr. Nikolay Kardjilov kardjilov@helmholtz-berlin.de	Polarizing solid state bender	2013
BL22 @ JPARC	Toshi Karasawa avance@mva.biglobe.ne.jp	Multichannel V-cavity polarizer	2013
BL05 @ JPARC	Toshi Karasawa avance@mva.biglobe.ne.jp	Si-wafer with polarizing coating $m = 5$	2013
PUMA @ FRM-II	Dr. Vladimir Hutanu vladimir.hutanu@frm2.tum.de	Solid state reflectors	2013
KOMPASS @ FRM2	Dr. Alexander Grünwald Alexander.Gruenwald@frm2.tum.de	Multichannel triple-V-cavity polarization analyzer	2013
FLEX @ HZB	Dr. Klaus Habicht habicht@helmholtz-berlin.de	Heusler analyzer	2013
ZOOM @ ISIS	Dr. Robert Dalgliesh robert.dalgliesh@stfc.ac.uk	Double-V-cavity	2013
LARMOR @ ISIS	Dr. Robert Dalgliesh robert.dalgliesh@stfc.ac.uk	Double-V-cavity polarizer & bender analyzer	2013
VSANS @ NIST	Don Pierce donald.pierce@nist.gov	Double-V-cavity polarizer	2013
NIST	Dr. Jeffrey NIco jeffrey.nico@nist.gov	2 Bender polarizers	2013
NSE @ JCNS, FRM-II	Dr. Olaf Holderer o.holderer@fz-juelich.de	Solid state reflector	2012
MIRA @ FRM-II	Dr. Robert Georgii robert.georgii@frm2.tum.de	Multichannel double-V-cavity polarizer	2012
RESEDA @ HZG, FRM-II	Dr. Jean-Francois Moulin jean-francois.moulin@frm2.tum.de	Double-V-cavity polarizer	2012
IN12 @ ILL	Dr. Karin Schmalzl schmalzl@ill.fr	Double-V-cavity polarizer	2012
LLB	Sylvain Desert sylvain.desert@cea.fr	Double-V-cavity polarizer	2012
NSE @ NIST	Don Pierce donald.pierce@nist.gov	Double-V-cavity polarizer	2012
30mSANS @ NIST	Don Pierce donald.pierce@nist.gov	Double-V-cavity polarizer	2012
BL17 @ JPARC	Toshi Karasawa	Bender for polarization analysis	2011

	avance@mva.biglobe.ne.jp		
BL17 @ JPARC	Toshi Karasawa avance@mva.biglobe.ne.jp	Z-cavity polarizer	2011
RESEDA @ FRM-II	Dr. Wolfgang Häussler wolfgang.haeussler@frm2.tum.de	Multichannel double-V-cavity polarizer	2011
N-REX @ MPI, FRM-II	Dr. Thomas Keller thomas.keller@frm2.tum.de	Transmission polarizer & analyzer	2011
SANS @ HANARO	Dr. Young-Soo Han yshan@kaeri.re.kr	V-cavity polarizer	2011
NIST	Dr. Michael Huber michael.huber@nist.gov	3-channel double-V-cavity polarizer	2011
BL15 @ JPARC	Toshi Karasawa avance@mva.biglobe.ne.jp	Multichannel V-cavity polarizer	2010
MIRA @ FRM-II	Dr. Robert Georgii robert.georgii@frm2.tum.de	Polarizing bandpass monochromator	2010
HYSPEC @ SNS	David Anderson andersondc@ornl.gov	Heusler monochromator	2010
BL04 @ SNS	Dr. Valeria Lauter lauterv@ornl.gov	Reflection polarizer	2010
BL04 @ SNS	Dr. Valeria Lauter lauterv@ornl.gov	Blades for polarization analyzer	2010
SuperAdam @ ILL	Dr. Andrew Wildes wildes@ill.fr	Reflection analyzer	2010
KWS1 @ JCNS, FRM-II	Dr. Henrich Frielinghaus h.frielinghaus@fz-juelich.de	Multichannel V-cavity polarizer	2009
FUND @ SNS	Prof. Geoff Greene greenegl@ornl.gov	Bender polarizer	2009
BL05 @ JPARC	Toshi Karasawa avance@mva.biglobe.ne.jp	Polarizing bender	2008
OFFSPEC @ ISIS	Dr. Robert Dalgliesh robert.dalgliesh@stfc.ac.uk	Reflection @ transmission polarizer, bender analyzer	2008
TAS @ HFIR	Dr. Taylor Brent taylorgb@ornl.gov	Heusler monochromator	2008