

References for Neutron guides

MIRROTRON Ltd Company was founded by physicists and engineers of the former Central Research Institute for Physics (KFKI Budapest) in 1991. Its activities are centered on scientific instrumentation, primarily related to neutron scattering. The company has been in good position to take advantage of Hungary's rapid move to market economy and to draw on the experience as well as the achievements of the Hungarian school of neutron scattering. A good example is the installation of a new cold source and supermirror neutron guide system as well as a set of neutron beam experimental stations at the 10 MW Budapest Research Reactor (BRR) in the past few years. The first supermirrors were produced and tested at KFKI by *F. Mezei* in 1974.

Together with the K.J. Lesker Co. (USA) two dual target magnetron sputtering system designed and built for small scale production (total area 0,2m²) of supermirror or other multilayer devices - as a major application - for neutron scattering research was installed at the Budapest plant in 1995/96.

Based on the experience from the existing sputtering machine MIRROTRON completely designed, built and installed the 1st large scale sputtering machine (total area 1,2m²) at year 2000.

For response to the increased demand for supermirror coating and to reduce the production delivery leadtime new investment decided for the 2nd large scale sputtering machine (total area 1,2m²). It is completely re-designed (3D) and built by MIRROTRON based on the most up-to-date knowledge on supermirror coating. Current status: under assembly at MIRROTRON's site and the production is scheduled to early 2011.

MIRROTRON has installed also - in collaboration with the Budapest Neutron Centre - a neutron reflectometer (co-financed by MIRROTRON) on a neutron guide at BRR in order to improve its quality control capacities and insure the direct neutron beam testing of its multilayer products.

At the moment, MIRROTRON is working with 30 full time employees and regularly helped by about the same number of scientific expert consultants (by case by case contracts).

Title:	Nr.	Qualification profile:
- Manager:	5 person	engineers
- Scientist:	2 person	PhD
- Mechanical Designer:	10 person	mechanical engineers
- Electrical Designer:	2 person	electrical engineers
- Technician:	12 person	technician

MR's personnel and associated partners have long experience in instrument development, since the Company was formed by those scientists at the Budapest Research Reactor (BRR) who had been involved in many important neutron instrumentation projects in Europe. Some of the Company's leading persons spent several years at various outstanding laboratories such as ILL Grenoble, HMI Berlin, LLB Saclay or FLNP Dubna. The successful reactor and neutron scattering instrumentation upgrading at BRR has been also partly lead by this team. MIRROTRON's scientists have had a dominant involvement in instrument construction for

about 16-20 neutron scattering spectrometers at 6 different European laboratories. Concerning neutron guides, MR has delivered neutron optical components or entire guide systems to the following laboratories:

ANSTO - Australian Nuclear Science and Technology Organisation; SNS - Oak Ridge, US; Berlin Neutron Scattering Center; Budapest Neutron Centre; Frank Laboratory of Neutron Physics, Dubna; ISIS T2 Rutherford Appleton Laboratory; Instiut Laue Langevin, Grenoble; Laboratoire Léon Brillouin, Saclay; Los Alamos National Laboratory; Argonne National Laboratory; JAEA Japan; CARR Beijing; INPC Mianyang.

Neutron Guides

In years 2000 - 2010 Mirrotron received awards for several large contracts for delivery of entire guides or guide systems (these contracts have only a partial overlap and a suitable sequence with the current task/proposal), thus the company's capacity has been considerably extended.

For reference examples, the following finished projects are listed below:

- **SNS PSU Cold Neutron Chopper Spectrometer (CNCS) Guide System.**

Year of award: 2003

Contact Person: Dr. Georg Ehlers

The complete system with Core Vessel Insert and Shutter Insert, Straight and curved guide sections have been completed.



- **LANL FP13 Shutter Guide Assembly and In-Pile Neutron Guide**

Year of award: 2001 and 2002

Contact Person: Dr. Margarita Russina

The complete system is installed and commissioned.



- **LANL FP12 In-Pile Neutron Guide and Neutron Guide System**

Year of award: 2000

Contact person: Dr. Seppo Pentilla

The complete system is installed and commissioned.



- **BNC Construction (up-grading) of the complete neutron guide system**

3 neutron guides of total length of 71 meters.

Year of award: 1999

Contact person: T. Hargitai

The complete system is installed and commissioned.



- **ANSTO Tapered Neutron Guide for the Quasi Laue Diffractometer**

Year of Award: 2004

Contact Person: Roland Moore

The complete system is installed and commissioned.



- **HMI EXED Elliptical neutron guide**

Year of Award: 2005

Contact Person: Dr. Judith Peters



The guide system with exchange collimator is installed and commissioned.

- **SNS FNPB Neutron Guide System**

Year of Award: 2006

Contact Person: Dr. Geoff Greene

The complete guide system with Bender and Straight neutron guide sections with chopper housings, monochromator housing and rotating secondary shutter is installed and commissioned.



- **SNS TOPAZ Neutron Guide System**

Year of Award: 2006

Contact Person: Dr. Christina Hoffman

The complete guide system with 10m Tapered and Curved Bender guide and 6m Tapered and Curved guide sections are delivered and installed.



- **SNS NOMAD Neutron Guide System – 16m**

Year of Award: 2006

Contact Person: Dr. Neufeind Joerg

The complete guide system is delivered.



- **ISIS TS2 POLREF, OFFSPEC, INTER - Three guide system with in-pile sections**

Year of Award: 2006

Contact Person: Dr. Robert Dalglish

The complete guide system for the three reflectometers with in-pile sections for POLREF and OFFSPEC are installed and commissioned.



- **J-PARC BL-3 Neutron Guide System with automatized re-alignment system**
(patented development)

Year of Award: 2007

Contact Person: Dr. Ichiro Tanaka

The complete system is installed and commissioned.



- **J-PARC BL-19 Neutron Guide System**

Year of Award: 2007

Contact Person: Dr. Soyama

The complete neutron guide system is delivered.



- **CARR CNGA, B, C, D In-pile system and shutter guides**

Year of Award: 2007

Contact Person: Prof. Hongli Wang

The complete In-pile system with four channel cassette and supermirror neutron guides, as well as the shutter guides with housings are installed.



- **CARR CNGA, B, D Out-of-pile guide system**

Total length of 84m

Year of Award: 2007

Contact Person: Prof. Hongli Wang

The complete CARR supermirror neutron guide system is installed.



- **JAEA JRR-3 In-pile and Out-of-pile Neutron Guides (16m)**

Year of Award: 2007 and 2009

Contact Person: Dr. Tamura

The neutron guides with He injected free-standing in-pile supermirror guides are delivered.



- **HMI VSANS Exchange Collimation system with Neutron Guides**

Year of Award: 2007

Contact Person: Dr. Daniel Clemens

The complete VSANS Collimation system with four channel exchange channels and neutron guides is installed.



- **CARR SANS Collimation system with Neutron Guides and Velocity Selector**

Year of Award: 2007

Contact Person: Prof. Charles Han

The complete system is installed.



- **HZB BioRef Neutron guides (5m) and frame-overlap-mirror**

Year of Award: 2008

Contact Person: Dr. Marcus Strobl

The complete system is installed.



- **J-PARC BL-02 Shutter and In-pile Neutron Guides**

Year of Award: 2009

Contact Person: Dr. Shibata and Takahashi

The special neutron guides are delivered.



- **BNC FSANS-PGAA Splitter-bender neutron guide system**

Curved bender and straight neutron guides (3-3m) in vacuum housing.

Year of award: 2009

Contact person: Dr. Janos Füzi, Tamas Belgya

The complete system is installed and commissioned.



- **SNS HYSPEC Complete Instrument with Neutron guides and other beamline components – in- pile section and 30m guide**

Year of Award: 2008

Contact Person: Dr. Mark Hagen

The guides and beamline components with Fermi and two disk choppers, vacuum boxes and supermirror guides are delivered and successfully commissioned.



- **J-PARC BL-11 Elliptical Neutron Guides (12m)**

Year of Award: 2009

Contact Person: Dr. Arima Hiroshi

The gapless metal-glass free-standing guide system is installed and commissioned.



- **HZB BioRef Neutron guides (16m) Beam Shutter and Slit system**

Year of Award: 2009

Contact Person: Dr. Marcus Strobl

The complete system is delivered and successfully commissioned.



- **HZB Renewal Project Lot 6/NL2old Neutron guides (35m)**

Year of Award: 2009

Contact Person: Dr. Thomas Krist

The free-standing guides delivered and successfully commissioned.



- **SNS MaNDI Neutron guides (16m)**

Year of Award: 2009

Contact Person: Dr. Leighton Coates

The guide system in special vacuum housing is delivered and successfully commissioned.



- **J-PARC BL-12 Elliptical Chopper Neutron Guides (8m)**

Year of Award: 2009

Contact Person: Prof. Ito and Dr. Sato

The gapless metal-glass free-standing guide is delivered.



- **J-PARC BL-18 Elliptical Neutron Guides (18m)**

Year of Award: 2010

Contact Person: Dr. Arima

The gapless metal-glass free-standing guide is delivered.



- **ILL -H-122 Beamline Part 4 (12,5 m long)**

Year of Award: 2009

Contact Person: Dr. Michael Kreutz

The polished borkron glass guide system built from 2,5m long curved guide assemblies are delivered and installed.



- **HZB NL4 Multi-Spectral Extraction Optical System (4m)**

Year of Award: 2010

Contact Person: Dr. Daniel Clemens

The two 2,5 m long optical guide assemblies with QC=3 tapered extraction guides is delivered.



- **JAERI JRR-3 In-pile and Out-of-pile Neutron Guides (10+10m)**

Year of Award: 2010

Contact Person: Dr. Tamura

The neutron guides including He injected free-standing supermirror Guide units are delivered.



- **INPC TPNR - Time-of-Flight Polarizing Neutron Reflectometer**

Contact Person: Prof. Chen Bo

Year of order: 2007

Components: TURN-KEY INSTRUMENT

The complete instrument is installed including 7m of tapered neutron guides and 2m of guides between choppers.



- **LLB SANS Neutron guide**

Year of Award: 2011

Contact Person: Dr. Frederic Legendre

The two 1,5m long vacuum tight subassemblies with vacuum ports are delivered.



For reference examples, the following projects in-progress are listed below:

- **HZB NEAT Neutron guides (40m)**

Year of Award: 2010

Contact Person: Dr. Margarita Russina

The free-standing guide section (16m) is installed. Section 1: the guides located inside vacuum housing is installed, Section 2 is delivered.



- **ISIS TS2 LARMOR Neutron Guide System**

Year of Award: 2011

Contact Person: Dr. Robert Dalglish

The complete guide system for the LARMOR reflectometer with in-pile guide and insert section are under manufacturing.



- **JAEA JRR-3 In-pile and Out-of-pile Neutron Guides (12m)**

Year of Award: 2011

Contact Person: Dr. Tamura

The neutron guides including He injected free-standing supermirror guide units and tapered end sections manufacturing are in-progress.



- **JAEA JRR-3 AGNES Supermirror Collimation System**

Year of Award: 2011

Contact Person: Dr. Tamura

The collimation guide including supermirror top/bottom part and B₄C sideplates manufacturing are in-progress.



- **INPC SANS – Small Angle Neutron Scattering Spectrometer**

Contact Person: Prof. Chen Bo

Year of order: 2006, *Delivered:* 2008

Components: TURN-KEY INSTRUMENT





Appendix E/1 References on Neutron Guides



Pre and post selector guides and guides inside exchange collimation chamber are delivered and under installation – 20m neutron guide.