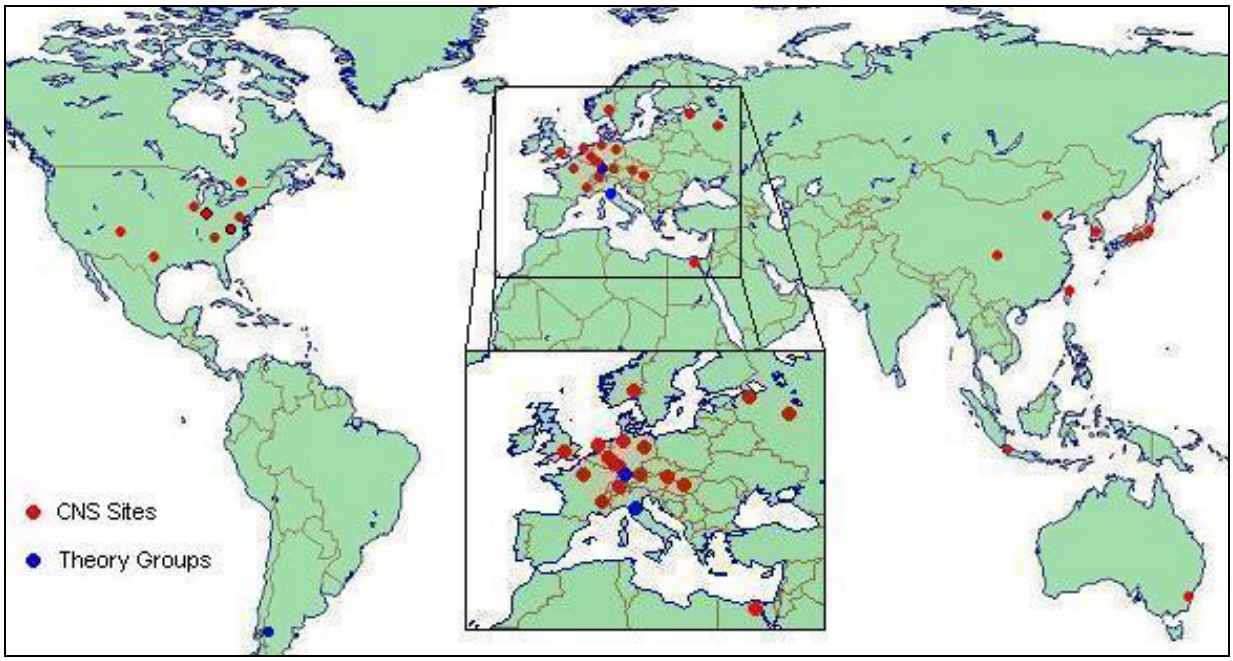
World Directory of
Cold and Ultra-cold Neutron Sources

compiled by Klaus H. Gobrecht



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note for word 2000+ users: by clicking on the site name in the content list you arrive directly at the site page.

Preface

The first time, to my knowledge, that an effort has been undertaken to collect all possible information about the many cold neutron sources (CNS) in the world was by Guy Gistau (then L'Air Liquide) at the occasion of the **IGORR**6 meeting in Taejon (now Daejeon), Korea.

His findings, however, have never been really divulged. Having been involved in the gestation and birth of quite a number of CNS myself, I thought to compile from my own files, and Guy Gistau's data base, a first version of the "World Directory of CNS".

In view of the growing activity in the field of ultra-cold neutrons (**UCN**), from version 3 on this document has been renamed

"**World Directory of Cold and Ultra-cold Neutron Sources**".

The CNS are presented in alphabetical order of the sites. Today (2007) I identified 36 operating CNS, 6 under construction, and about 6 planned.

Some of the planned CNS are mentioned at sites which are already in the list for other reasons, like ISIS Second Target Station at Chilton, PIK at Gatchina, IBR-2M at Dubna.

The following sites used for some time a CNS which has been shut down since (with the year of shut down):

Aldermaston	1988	Grenoble (Siloette)	1970
Argonne (ZING-P)	1975	Saclay (EL3)	1977
Argonne (ZING-P')	1980	Karlsruhe	1981
Helsinki	1984 (?)	Harwell	1990
Beijing (HWRR)	1995 (?)	Brookhaven	1999
Risoe	2000	Garching (FRM)	2000
Cornell	2001	Juelich	2005

Dedicated existing or planned sources of **UCN** have been included in the site list below. They developed until now essentially at places which also exploit a classical cold source, but in future this may no longer be true (e.g. Mainz, CERN, PSI, LANL).

The last pages contain a **Glossary** of used and useful terms, and a list of **people** mentioned in this document.

A lot of useful links (site information, proceedings and transactions of conferences, workshops, meetings), click into the underlined blue text.

On the site www.ottosix.com you can also find an extended bibliography on CNS and UCN sources.

The following site lists all interesting neutron sources in general:

http://neutron.neutron-eu.net/n_about/n_where/worldwide.

I wish to thank all former colleagues & al. who contributed and helped me with their comments to write and edit this directory.

K. H. Gobrecht, HYERES, France, (e-mail: klaus@ottosix.com), June 2007

Argonne IPNS

Organisation:	Argonne National Laboratory
Installation:	IPNS (since 1981)
Type:	spallation source, 450 MeV, 30 Hz, beam power 8 kW, target: depleted uranium
Address:	9700 South Cass Ave Argonne, IL 60439, USA
Home page:	http://www.anl.gov
Contact:	John ("Jack") M. Carpenter
Phone / fax:	+1 630-252-5519 , fax: -4163
e-mail:	jmcarpenter@anl.gov
Secretary:	Diane Hoffmann –6485

CNS:	one liquid CH_4 ("F"), two solid CH_4 ("C" and "H")		
temperature:	110 K ("F") / 25 K ("C" and "H")	power:	50 W each
total power available:	300 W	volume:	0.5 L each
heat removal:	direct He cooling ("C" and "H"), circulating ("F")		
remarks:	"C" and "H" contain ~10v% Al foam, are decoupled and fixed, "C" is grooved; "H" is poisoned; "F" is decoupled, and poisoned		

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projects: IPNS studies cold moderators for **SNS** (see site Oak Ridge SNS in this document)

recent publications: **ICANS**-XVI (Neuss DE 2003): on irradiated H_2 (proc. p.707), on liquid and solid CH_4 (proc. pp. 719 and 783)
ICANS-XVIII (China 2007): Bradlley J. Micklich reports about "Metal hydrides as moderators for pulsed spallation neutron sources", Id18.
Also at **ICANS**XVIII : : Prospects for a Very Cold Neutron Source (on a long pulse linear accelerator), by Bradley J. Micklich and John M. Carpenter, Id17

see also: Workshop on "Applications of a Very Cold Neutron Source" at ANL, Aug.'05
Workshop on "Present Status and Future of Very Cold Neutron Applications" at PSI Villigen, Switzerland Feb. '06

A nice introduction to neutron moderation by Jack Carpenter:
www.**neutron**.anl.gov/**Neutron**Production.pdf

Austin, Texas

Organisation:	The University of Texas at Austin
Installation:	Nuclear Engineering Teaching Laboratory, NETL
Type:	TRIGA Mark II reactor, LEU, 1.1 MW since 1992, up to 1.5 GW in pulsed mode
Address:	J.J.Pickle Research Campus, Building 159 Austin, TX 78712, USA
Home page:	http://www.me.utexas.edu
Contact:	Donna J. O'Kelly
Phone / fax:	+1 512-232-4174 , fax: -471-4589
e-mail:	djokelly@mail.utexas.edu

CNS:	"Texas Cold Neutron Source" TCNS		
moderator:	mesitylene	pressure:	~ 0 kPa
temperature:	40 K	cooling power needs:	16 W (12 W ambient)
total power available:	22 W	moderator volume:	88 ml
heat removal:	liquid neon thermal siphon		
remarks:	new cryo-refrigerator in 2004		

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projects: PGNAA

recent publications: K. Ünlü, C. Rios-Martinez, and B. W. Wehring, "The University of Texas Cold Neutron Source" Nucl. Instr. and Meth. in Phys. Res. A353, 397 (1994).

Donna J. O'Kelly "INIE AT UT" Proc. of **IGORR**10, NIST 2005

UCN: This TRIGA reactor could be a perfect candidate for the installation of a UCN source

Beijing CARR

Organisation: China Institute of Atomic Energy (CIAE)

Installation: CARR

Type: pool reactor (60 MW LEU), $Ø_{th}=8\cdot10^{14}$ n/cm²s, under construction

Address: PO box 275(33), Beijing 102413, China,

Home page: http://www.ciae.ac.cn/

Contact: Prof. Yuan Luzheng

Phone / fax: +86 10-69358140, fax: -69357008

e-mail: yuanluzheng@iris.ciae.ac.cn

Co-workers: Dr. Feng Shen (e-mail: shenf@iris.ciae.ac.cn)

Dr. Quing Feng Yu (qingfengyu@hotmail.com)

CNS Project :

moderator:	H_2	phase:	2-phase liquid/gas
volume:	~1 L	temperature:	23 K
pressure:	24 kPa	heat removal:	gravity (single tube) *)
power:	800 W	refrigerator:	?

material: Al 6061

*) + direct cooling

to be built in collaboration with the Cryogenic Laboratory Xi'an Jiao Tong University, start end 2007.

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remarks: The actual reactor HWRR has operated a CNS from 1988 to 1990

recent publications:

"CARR-CNS with Crescent-shape Moderator Cell and Sub-cooling Helium Jacket around Cell" by Qingfeng Yu, Quanke Feng, Takeshi Kawai, Feng Shen, Luzheng Yuan, Liang Cheng at the Symposium in Commemoration of the 10th Anniversary of HANARO in Daejeon, Korea, April 2005. http://hanaro2005.kaeri.re.kr/data/proceeding/CN-O-13.pdf.

"Development of CNS in CARR" by Quanke Feng & Feng Shen at the 5th **UCN/CNS** Workshop, St. Petersburg 2005:

The Chinese Academy of Sciences plans a spallation neutron source with cold source (project CSNS), cf **ICANS**17_Id70, 2007: "Neutronics study of the coupled para-hydrogen moderator for CSNS" by Wen Yin, Tianjiao Liang, and Qiwei Yan.

Berlin HMI

Organisation:	Hahn-Meitner-Institut / BENSC
Installation:	BER-2
Type:	pool reactor,10 MW, LEU, Be-reflector, critical in 1991, unperturbed $Ø_{th}$= $3 \cdot 10^{14}$ n/cm²s,
Address:	Glienicker Str. 100 14109 Berlin, Germany
Home page:	http://www.hmi.de
Contact:	Dr. Herbert Krohn
Phone / fax:	+49-30 8062–2740 fax: -2999
e-mail:	krohn@hmi.de
Secretary:	Antje Thomas –2742

CNS:	one, operating since 1991		
moderator:	H_2	phase:	super-critical
volume:	1 L	temperature:	27 – 30 K
pressure:	1.3 / 1.9 MPa	heat removal:	forced (circulator)
power:	1800 W	refrigerator:	AL, screw,
material: chamber:	AlMg3	vacuum thimble:	AlMg3
performance:	90 % reliability, if not stopped during reactor shut-down		

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remarks: reactor does not need to shut down in case of CNS failure (room temperature cooling loop).

recent publications: CNS gain curve in Neutron News 3/93 p.17

nothing more recent ?

Bloomington LENS

Organisation:	Indiana University Cyclotron Facility
installation:	LENS (Low Energy Neutron Source)
type:	accelerator based neutron source, target Be, H^+ 50 mA, >11 MeV (upgraded)
address:	IUCF, 2401 Milo B. Simpson Ln, Bloomington, In 47408
home page:	http://www.iucf.indiana.edu
contact:	David V. Baxter
phone / fax:	+1-812-855-8337 fax: -5533
e-mail:	baxterd@indiana.edu
co-workers:	Mike Snow (phone: -7914), Mark Leuschner (phone: 812-856-1721)

Cold source: Installation on the PL-7 proton beam line (operation 2005)

(variable pulse width up to 1.5 ms) :

Cold moderator solid CH_4 at 22K or less.

UCN: for testing new moderators

recent publ.: Proc. **UCN-CNS** 4th Workshop (PNPI 2003) by M. Leuschner

"LENS: a new pulsed neutron source for research and education" by M. Leuschner et al. in J. Res. Natl. Inst. Stand. Technol. 110, 153-155 (2005)]

"LENS produces its first “cold” neutron beam" by Mark Leuschner April 26, 2005, see www.iucf.indiana.edu/news/news.php?story=24

ICANSXVIII_Id181, 2007
"Slow Neutron Sources: Cold, Very Cold, and Ultracold"
by W. M. Snow.

Budapest KFKI

Organisation:	AEKI
Installation:	WWR at KFKI (new operation licence until 2013)
Type: pool reactor 10 MW, LEU, $Ø_{th}$=2.5·10^{14} n/cm²s,	
Address:	KFKI, P.O.Box 49 H-1525 Budapest, Hungary
Home page:	http://www.kfki.hu/brr/reactdpt.html
Contact:	Sándor Tözsér
Phone / fax:	+36 1 395-9139, fax: -9162
e-mail:	tozser@sunserv.kfki.hu
Co-workers:	Laszlo Rosta (rosta@szfki.hu), fax +36 1 392-2501 István Vidovszky (vidov@sunserv.kfki.hu)

CNS:	operating since Feb. 2001		
moderator:	H_2	temperature:	20 K
volume:	0.5 L	phase:	sub-cooled liquid
power:	250 W	heat removal:	directly cooled
material: chamber:	AlMg5	vacuum thimble:	AlMg5
refrigerator:	Linde, Brayton cycle, 1 turbine, 2 screw-compr. 18+37 kW(el.)		

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remarks: reactor does not need to shut down in case of CNS failure (room temperature cooling loop).
CNS has been built in collaboration with PNPI Gatchina.

recent publications: **ICNS** 2001 (Munich), proceedings in Appl. Phys. A (Suppl.1), 2002 (L. Rosta et al.)

IGORR9 to 11 (I. Vidovszky)

6th Workshop on "**Ultra Cold & Cold Neutrons**. Physics & Sources" in Russia 7/07: "Performance and operation of LH2 CNS at the Budapest Research Reactor" by T. Grosz.

Cairo_ETRR2

Organisation:	ATOMIC ENERGY AUTHORITY OF EGYPT
Installation:	ETRR-2, built by INVAP, Argentina, still not commissioned
Type:	pool reactor 22 MW, $Ø_{th}=2.7 \cdot 10^{14}$ n/cm²s, since 1997
Address:	INSHAS Nuclear Research Center, 13759 CAIRO, Egypt
Home page:	http://www.etrr2-aea.org.eg/
Contact:	Dr. Mohammed K. Shaat (shaat@etrr2-aea.org.eg)
Phone / fax:	+2-02-4691753 fax -1754
e-mail:	m_shaat30@hotmail.com
Other contacts:	

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reactor state: not operating due to nuclear safety issues

CNS: call for tender Oct.1999, no official news since

moderator: probably LH_2 ,

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most recent serious publication: Neutron news Vol. 11, No. 2, 2000

more news ?

Chalk River

Organisation: Atomic Energy of Canada Ltd (AECL)
and National Research Council (NRC)

Installation: NRU (first operation in 1957, continuing until 2012)

Type: 120 MW, D_2O coolant and moderator, $Ø_{th}=4 \cdot 10^{14}$ n/cm²s

Home page: http://www.nrureactor.ca/

Contact: Ian_P._Swainson

Secretary: Niki_Schrie

Address: Chalk River Laboratories, Chalk River Ontario, K0J 1J0, Canada

Phone/fax: (613) 584 8293 or -3995, fax: (613) 584 4040

Co-workers at NRC: John_Root (613) 584 8297
Eric_C._Svensson,

project team at AECL: Albert Garland Lee (leeA@aecl.ca)
Raguy M. Rabbat (rabbatr@aecl.ca), head of project group CNS
Denis Seehoye (seehoyed@aecl.ca)

CNS: none existing, but at least one CNS is proposed in the new Canadian Neutron Facility (CNF), a joint AECL/NRC project, which will be based on a new reactor as replacement of the NRU. Funding problems actually postpone the government decision.

More news ?

Chilton ISIS

Organisation:	Council for the Central Laboratory of the Research Councils
Installation:	ISIS Facility
Type:	spallation source (800 MeV, 0.2 mA, 50 Hz)
Address:	Rutherford Appleton Laboratory
	Chilton, Didcot, Oxon OX11 0QX, UK
Home page:	http://www.isis.rl.ac.uk/
Contact:	Tim Broome
Phone / fax:	+44 1235 44 6255, fax: +44 1235 44 5607
e-mail:	t.a.broome@rl.ac.uk

CNS:	two (hydrogen and methane), since 1985		
Moderator:	H_2 / CH_4	volume:	0.5/0.8 litre
temperature:	22 / 100 K	phase:	liquid
pressure:	1 / 0.4 MPa	power:	300 W each
refrigerator	Sulzer / Philips	cycle:	Brayton / Stirling
heat removal:	forced convection (circulator)		
performance:	the hydrogen source works with a 25 Hz beam.		

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remarks: Second Target Station design and construction is in progress, incorporating two cold moderators.

recent publications: **ECNS**'99 in Budapest: EPL3 (A.D. Taylor),

Proc. **AcoM-V** Workshop at HMI (March 2001)
published in J. of Neutron Research

ICNS 2001 (Munich): proceedings in Appl. Phys. A (Suppl.1), 2002 (T.A. Broome)

ICANSXVIII: "Re-design of the ISIS first target station for improved neutronics"
by S. Ansell - Id111, 2007

ICANSXVIII: "Second coupled moderator for the ISIS second target station"
by S. Ansell - Id110, 2007
New design with composite moderator substance (H_2/CH_4).

Daejeon HANARO

Organisation:	KAERI
Installation:	HANARO
Type:	open pool reactor, 30 MW (LEU), $Ø_{th}$=5·10^{14} n/cm²s, D_2O reflector
Address:	P.O. Box 105, Yuson, Daejeon, 305-600 Korea
Home page:	http://hanaro.kaeri.re.kr/
Contact:	Kye Hong Lee
Phone / fax:	+82 42 868-2277, fax:-8610
e-mail:	khlee@kaeri.re.kr
Co-workers:	Jungwoon Choi (jwchoi@kaeri.re.kr)

CNS:	under construction (operational in 2008)		
Moderator:	H_2	phase:	liquid
volume:	1.3 L	pressure:	160 kPa
material: chamber:	Al6061 T6	vacuum thimble:	Zircaloy
heat removal:	gravity, two-phase thermal siphon		
power:	about 1000 W		

Remarks: the CNS Vertical hole and beam tube are already built new shielding plug (design MTF) with 5 neutron guides

recent publications

Proc. **IGORR**8 (Munich 2001): C.O. Choi et al. p.103

Proc. **ICEC**19 (Grenoble 2002): C.O. Choi et al. p.123

"HANARO Cold Neutron Research Facility Project" by Y.-J. Kim in Proc. **UCN-CNS** 4th Workshop (PNPI 2003)

Proc. **IGORR**10 (NIST 2005): Y.J. Yu, K.H. Lee, H.R. Kim "Current Status of the HANARO CNS"

Proc. **IGORR**2007 : "Measurement of Void Fraction in Hydrogen Moderator Used for Moderator Cell of HANARO Cold Neutron Source" by Myong-Seop Kim, Jungwoon Choi, et al.

Delft HOR

Organisation:	TU-Delft, Interfaculty Reactor Institute
Installation:	HOR
Type:	pool reactor 2 MW, operation since 1963, $Ø_{th}=0.25 \cdot 10^{14}$ n/cm²s,
Address:	Mekelweg 15 2629 JB Delft, The Nederlands
Home page:	Reactor Institute Delft
Contact:	Prof. Adrian Verkooijen
Phone / fax:	+31 15 278-6614, fax: +31 15 278-8430
e-mail:	a.h.m.verkooijen@iri.tudelft.nl

CNS:	in the design phase		
Moderator:	H_2	phase:	liquid
heat removal:	directly cooled ?	pressure:	??

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remarks: CNS to be built in collaboration with PNPI Gatchina in the frame of a HOR upgrade

recent publications: **IGORR**8 (Munich 2001), **IGORR**9 (Sydney 2003)
"Options for the Delft Advanced Neutron Source"
by A.H.M. VERKOOIJEN, & al.

Dubna JINR

Organisation:	Joint Institute for Nuclear Research (JINR), Frank Lab. of Neutron Physics (FLNP)
Installation:	IBR-2, fuel: PuO_2, peak unperturbed $Ø_{th}=270 \cdot 10^{14}$ n/cm²s,
Type:	pulsed reactor since 1977, average power 2 MW
Address:	141980 Dubna, Russia
Home page:	http://nfdfn.jinr.ru/flnph/
Contact:	A.A.Beliakov, E.P.Shabalin
Phone / fax:	+7-09621-65657 or -65253, fax -65085 or -65882
e-mail:	beliakov@nf.jinr.ru

CNS:	one, operational since 1999		
Moderator:	CH_4	temperature:	30 - 70 K
volume:	1.2 L	phase:	solid
specific power:	100 mW/g	working pressure:	0.6 MPa
heat removal:	directly cooled		
performance:	gain factor = 20		

Remarks: strong radiolysis effects

recent publications: **ACoM** IV in 2/99, and **ICANS**-XV (Tsukuba 2000): 21.5

E.P.Shabalin studies cold moderators for ESS

Project: Modernization programme **IBR-2M** with three CNS (operational in 2010)

ICANS18_Id147: "Complex of moderators for the IBR-2M reactor"
by V. Ananiev, A. Belyakov, & al.

ICANS18_Id178: "Experimental Study of Swelling of Irradiated Solid Methane during Annealing" by E. Shabalin, & al.

ICANS18_Id213: "The experimental and calculated density of vibrational states and UCN loss coefficients of **perflu**" by Yuri Pokotilovski, & al.

Gaithersburg NIST

Organisation:	National Institute of Standards and Technology
Installation:	NBSR, operational since 1967
Type:	pool reactor, 20 MW, HEU, D_2O reflector, $Ø_{th}=4\cdot10^{14}$ n/cm²s,
Address:	100 Bureau Drive Gaithersburg, MD 20899, USA
Home page:	http://rrdjazz.nist.gov
Contact:	Dr. Robert ("Bob") E. Williams
Phone / fax:	+1 301-975-6876, fax: +1 301-921-9847
e-mail:	robert.williams@nist.gov

CNS:	operating since 1995		
moderator:	H_2	temperature:	20 K
effective volume:	5 L	phase:	liquid
pressure:	100 kPa	power:	1200 W
material: chamber:	Al 6061	vacuum thimble:	Al 6061
refrigerator:	CVI (Columbus OHIO),1 screw,		
heat removal:	gravity (thermal siphon)		
performance:	see http://www.ncnr.nist.gov/coldgains/ (April 2002)		

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remark: reactor does not need to shut down in case of CNS failure (room temperature cooling loop).

recent publications: Proc. **IGORR9** (Sydney 2003): SNS-04 (session 4)

Symposium in Commemoration of the 10th Anniversary of **HANARO** - Daejeon, Korea, April 2005: "Issues in the Design of a Cold Neutron Source" by Mike Rowe (now retired).

UCN group around M. Scott Dewey and Geoffrey Greene, P.R. Huffman

On a cold neutron beam: Superfluid ^{4}He, cooled below 1K, magnetic confinement,

Home page: http://www.itl.nist.gov/div898/pubs/ar/ar2000/node18.html

recent publication: "Measurement of the neutron lifetime by counting trapped protons in a cold neutron beam" by M. Scott Dewey at the 5th UCN/CN Workshop in Peterhof (RU) 2005

See also "Progress towards Precision Measurement of the Neutron Lifetime using Magnetically Trapped Ultracold Neutrons" by L. Yang at same workshop 2005.

Garching FRM2

Organisation:	Technische Universität München
Installation:	FRM-II, started operation in 03/2003
Type:	pool reactor, 20 MW compact core (HEU), $Ø_{th}=8\cdot10^{14}$ n/cm²s, D_2O-reflector
Address:	Reaktorstation 85748 Garching, Germany
Home page:	http://www.frm2.tu-muenchen.de/
Contact:	Dr. Ingo Neuhaus
Phone / fax:	+49 89 289 1-2183, fax: -2191
e-mail:	ingo.neuhaus@frm2.tum.de
Secretary:	-2154

CNS:	one, operation scheduled in 2003		
moderator:	D_2 + 5% H_2	temperature:	25 K
eff. volume:	15 L	phase:	liquid
pressure:	150 kPa	power:	5000 W
material: chamber:	Al 6061	vacuum thimble:	Zircaloy
refrigerator	Linde, 2 turbines, 1 screw compressor,		500 kW(el.)
heat removal:	gravitational (single tube thermal siphon)		
remarks:	N_2 liner, low pressure metal hydride storage reactor has to stop in case of CNS failure		

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recent publications: **ICANS**-XV (Tsukuba 2000): 21.8 and 23.18,
Proc. **IGORR**8 (Munich 2001): E. Gutsmiedl et al. p.175, 297,

IGORR10 (at NIST): "The FRM-II Hot and Cold Neutron Source"
by Christian Müller, Erwin Gutsmiedl, A. Röhrmoser, A. Scheuer, & al.

Symposium in Commemoration of the 10th Anniversary of HANARO
Daejeon, Korea, April 2005: "Commissioning of the Cold Source at the FRM-II"
by E. Gutsmiedl, &al.

"Special Constructional Design Features of Cold and Hot Neutron Source and Confirmation/Verification during Commissioning of the Hot and Cold Neutron Source at the FRM-II" by E. Gutsmiedl, C. Müller, D. Päthe, and A. Scheuer. at IGORR10 (NIST 2005)

Garching UCN and VCN

UCN group around Prof. Stephan Paul (stephan.paul@physik.tu-muenchen.de):

Project "mini-D_2": Solid deuterium cooled to He-temperature, now (2006) no longer on a cold neutron beam position close to the CNS, but in a through-going beam tube (SR6), contact: Dr. Erwin Gutsmiedl (erwin.gutsmiedl@frm2.tum.de)

co-workers: Igor Altarev, Joachim Hartmann, Wolfgang Schott, et al.

Home page: http://www.e18.physik.tu-muenchen.de/research/ucn/minid2/

recent publications: **ECNS**2007 (Lund): "Production and Physics with Ultra Cold Neutrons" by Axel Müller, Igor Altarev, Erwin Gutsmiedl, Joachim Hartmann, & al.

"PENeLOPE and AbEx - towards a precise neutron lifetime measurement" by I. Altarev, & al. at the 5th UCN/CN Workshop in Peterhof (RU) 2005.

"Constructional design of the Ultra cold Neutron source of the FRM II" by A. Scheuer et.al. at the 5th UCN/CN Workshop in Peterhof (RU) 2005.

"The very cold beam on MIRA at the Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II)" by R. Georgii (private communication, bibliography on ottosix site).

"Fundamental Neutron Physics at the Eastern Neutron Guide Hall of the FRM-II" by I. Altarev, A. Frei, E. Gutsmiedl, F.J. Hartmann, & al., 2006 (private communication, bibliography on ottosix site).

"PENeLOPE: On the way towards a precise neutron lifetime measurement" by R. Picker at the 6th UCN/CN Workshop in Russia 2007.

Gatchina PNPI

Organisation:	PNPI (Russian Academy of Sciences)
Installation:	WWM-R (operation license until 2015)
Type:	pool reactor 14 to 16 MW, Be-reflector, $Ø_{th}$=0.8·10^{14} n/cm²s,
Address:	Gatchina, Leningrad District, 188350, Russia
Home page:	http://www.pnpi.spb.ru/
Contact:	Anatoli Serebrov
Phone and fax:	+7 812 71 300 72
e-mail:	serebrov@pnpi.spb.ru
Co-workers:	Victor Mityukhlyaev (vicmit@pnpi.spb.ru) Arcady Zakharov (arcady@pnpi.spb.ru)

CNS:	one vertical since 1986, not operating these days one horizontal in a beam tube for testing cold moderators		
moderator:	D_2+ X% H_2	temperature:	20 K
volume:	0.5 L	phase:	sub-cooled liquid
power:	4000 W, used for either the vertical or the horizontal CNS		
refrigerator	Brayton cycle, 2 turbines, piston compressors		
heat removal:	gravity thermal siphon + direct cooling		

Remarks: vertical source was used for polarised VCN and UCN production.
There is also a horizontal solid D2 source.
There are plans for a new CNS + guide hall

recent publications: A.P. Serebrov in N-News 2/93, and with
I.S. Altarev in Journal of Neutron Research Vol.1, N°4.

PIK reactor (100 MW, $Ø_{th}$=3·10^{14} n/cm²s) under construction with at least one CNS
see proceedings **IGORR9** (Sydney 2003)

UCN: Solid deuterium cooled to below 10 K

Home page: http://www.pnpi.spb.ru/nrd/ucn/first/general.htm

PNPI Gatchina organizes a series of international **UCN/CNS** Workshops, 6 already,
For proceedings see for instance http://cns.pnpi.spb.ru/5UCN/proceed.html ..

See also the page forthcoming events at the ottosix website

other publications: **UCN** Workshop Los Alamos 2000 (see Los_Alamos)

Geesthacht GKSS

Organisation:	GKSS Forschungszentrum
Installation:	FRG2
Type:	MTR - pool reactor, 5 MW, HEU, compact, $Ø_{th}$= $1.3 \cdot 10^{14}$ n/cm²s
Address:	GKSS, Postfach 1160, 21495 Geesthacht, Germany
Home page	http://www.gkss.de/
Contact:	Dr. Wolfgang Knop
Phone / fax:	+49 41 52 87-1234 fax: -1338
e-mail:	knop@gkss.de

CNS:	one, operating since 1988		
moderator:	H_2	temperature:	25 - 35 K
volume:	0.8 L	phase:	super-critical
pressure	1.3 - 1.7 MPa	power:	1355 W
material: chamber:	AlMg3	vacuum thimble:	AlMg3
heat removal:	forced (cold circulator), can work with natural convection		
refrigerator	AL, 1 turbine, 1 screw compressor		160 kW(el.)

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remarks: reactor does not need to shut down in case of CNS failure (room temperature cooling loop).

In **2007**: Installation of a new moderator chamber (hemispherical instead of lenticular).
60 % increase of CN output is expected, new cooling power demand should be 1625 W

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recent publications: "New Moderator Chamber of the FRG-1 Cold Neutron Source for the Increase of Cold Neutron Flux" by P. Schreiner, W. Knop at **IGORR**2007 (Lyon 2007)
Same authors at ECNS4 in Lund (SE) 2007

Grenoble ILL

Organisation:	Institut Laue-Langevin (ILL)
Installation:	HFR
Type:	pool reactor 57 MW, HEU, D_2O reflector, $Ø_{th}=15\cdot10^{14}$ n/cm²s,
Address:	6 rue Jules Horowitz, BP 156 38042 Grenoble Cedex 9, France
Home page:	http://www.ill.fr
Head of reactor:	Hervé Guyon
Contact:	Jean Marie Astruc
Phone / fax:	+33 476-207220, fax -961143
Secretary:	–207237

CNS: two, one vertical (SFV3), operating since 1985,
one horizontal (SFH), operating since 1987

moderator:	D_2	temperature:	25 K
volume:	27 L (SFV3), 6 L (SFH)	phase:	liquid
material: chamber:	Al99%	vacuum thimble:	Zircaloy
power:	6500 W (SFV3),	3000 W (SFH)	
refrigerator	AL, 2 turbines, 1 screw compressor		625 kWel.
heat removal:	gravity, thermal siphon (SFV3),	bubble pump (SFH)	

---

remarks: reactor has to stop in case of CNS failure.
One vertical guide in SFV3 for VCN and UCN production.
SFV1 was operating from 1972 to 1985.

A **third CNS** is planned (H. Guyon, private communication) see also **IGORR**2007, session 1.

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recent publications: K. Gobrecht in Proc. Workshop on Cold Sources at LANSCE, Los Alamos, 1990, p.19
H. Guyon on various workshops

UCN Group around Peter Geltenbort

Steyerl turbine + 3 UCN guides

recent publications: **ICANS**-XV (Tsukuba 2000): 22.2,
V.V. Nesvizhevsky et al. in Nature 415, 297 (2002),
UCN_6 Workshop 2007 in Russia (see Gatchina)

Jülich FZ

Organisation:	Forschungszentrum (FZ) Jülich (former KFA)
Installation:	reactor FRJ-2 now definitely shut down
Type:	DIDO 23MW, D_2O reflector, $Ø_{th}=3\cdot10^{14}$ n/cm²s
Address:	52425 Jülich, Germany
Home page:	http://www.jcns.info/about_jcns/
Contact:	Dr. Gunter Damm (Johannes Wolters retired)
Phone / fax:	+49 2461 61-3011 fax: -3841
e-mail:	g.damm@fz-juelich.de
Status:	the reactor was definitely shut down in May 2006

CNS:	one, operating since 1971		
moderator:	H_2	phase:	sub-cooled liquid
pressure:	250 kPa	temperature:	19 K
volume:	1 L	heat transfer:	gravity (thermal siphon)
power:	700 W	refrigerator:	Linde
remark:	reactor does not need to shut down in case of CNS failure (room temperature cooling loop).		

New project:

ESS (Jan. 2003 : realization postponed sine die)
European **S**pallation **S**ource, project group hosted by FZ Jülich (home page: http://www.fz-juelich.de/ess/), contact Dr. Günter Bauer.....but:

JESSICA: Target/Reflector Mock-up and Cold Moderator Test Facility
"Solid Cold Moderators for High Power Neutron Sources" by G. Bauer at the 5th UCN/CN Workshop in Peterhof (RU) 2005.

contact: H. Conrad, H. Stelzer (cold moderators)

phone: +49 (0)2461 61 3680, Fax: +49 (0)2461 61 6816

recent publications: Proc. **ACoM** Workshop in Juelich (Sept. 2002)

ICANS-XVI (Neuss 2003)

11th Int. Conf. on Nuclear Engineering in Tokyo, JAPAN, 04/03 (ICONE11-36422): "JESSICA, THE TEST FACILITY FOR AN ADVANCED COLD MODERATOR SYSTEM FOR ESS" by H. Stelzer, & al.

Kjeller_JEEP2

Organisation:	INSTITUTT FOR ENERGITEKNIKK
Installation:	Jeep-2
Type:	pool reactor 2 MW, D_2O-reflector, $Ø_{th}=0.2\cdot10^{14}$ n/cm²s,
Address:	P.O. BOX 40, 2007 Kjeller, Norway
Home page:	http://www.ife.no/
Contact:	K. H. Bendiksen,
Phone/fax:	+47-63-806000, -806275, fax: -816356
e-mail:	kjell.bendiksen@ife.no
Co-worker:	Kenneth D. Knudsen (e-mail: knudsen@ife.no)
Phone/fax:	+47-63-806084, fax: -810920

CNS:	one, operating since 1975		
moderator:	H_2	phase:	liquid
volume:	0.5 L	power:	60 W
refrigerator:	Philips	heat transfer:	gravity (thermal siphon)
temperature:	21 K	pressure:	150 KPa

Remarks: reactor does not need to shut down in case of CNS failure

recent publications: Neutron News Vol. 11, No. 4, 2000

Kyoto_RRI

Organisation:	Research Reactor Institute, Kyoto University
Installation:	KUR, **shut down in 2005** for 2 years ?
Type:	pool reactor 5 MW (HEU), $Ø_{th}$=0.3·10^{14} n/cm²s, may reopen with only 1 MW power
Address:	Kumatori-cho, Sennan-gun, Osaka, 590-0494 Japan
Home page:	http://www.rri.kyoto-u.ac.jp
Contact:	Takeshi_Kawai moved to China
Phone / fax:	+81-724-51-2371, fax:+81-724-51-2600
other contacts :	Yuji Kawabata (kawabata@rri.kyoto-u.ac.jp) Fumihiro Yoshino (yoshino@rri.kyoto-u.ac.jp)

CNS:	one, operating from 1987 to 2005		
moderator:	D_2	phase:	liquid
pressure:	200 kPa	temperature:	25 K
volume:	4 L	power:	240 W (100 W nucl.)
heat removal:	gravity (thermal siphon)		
refrigerator	Sulzer + Nippon Sanso Co.		

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recent publications: **ICANS**-XV (Tsukuba 2000): 23.19 (T. Kawai et. al.),
IGORR9 (Sydney 2003) session 4.

"Cold neutron production in solid and liquid CH_4 moderators" by N. Morishima and T. Mitsuyasu in Nucl.Inst&Meth. in Physics **A**, Volume 517,1-3, **2004**, 295-300.

"Cold neutron production in solid and liquid CH_4 moderators. II: on the reentrant-hole configuration" by T. Mitsuyasu, N. Morishima, & al. in Nucl.Inst&Meth. in Physics **A**, Volume_537,3, **2005**, 610-613.

UCN activity:

N. Morishima et al.: superfluid ^{4}He (**ICNS**_2001 (Munich): poster C-2)

VCN Workshop in PSI Feb. 13-14, 2006:
"Very Cold Neutron Radiography for High Contrast Imaging" by Yuji Kawabata

Los Alamos LANSCE

Organisation:	Los Alamos National Laboratory
Installation:	LANSCE
Type:	spallation source
Address:	Manuel Lujan Jr. Neutron Scattering Center, Mail Stop H805 Los Alamos, NM 87545, USA
Home page:	http://lansce.lanl.gov/
Contact:	Gary J. Russell ✉
Phone / fax:	1-505 667 2937, fax: 1-505 665 2676
Secretary:	1-505 667-5005

CNS:	one, operating since 1985		
moderator:	H_2	phase:	supercritical
temperature:	20 K	pressure:	1.4 MPa
volume:	1 L	power:	160 W
heat removal:	forced (cold circulator)		
refrigerator:	PSI (Koch), piston expander, screw, 185 kW(el.)		

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recent publications: **ICNS** 2001 (Munich): poster C-7 (A.J. Hurd).
Proc. **AcoM** Workshop at HMI (March 2001)
(to be published in J. of Neutron Research).

Los Alamos UCN

LANL **UCN** group at P25, MS H846:

Solid deuterium cooled to He-temperature (in collaboration with Caltech)

home page: http://www.lanl.gov/projects/UCN2000/ (a new one under construction)
contact: Alexander Saunders ✉
Tel: +1 505 665 3090 Fax +1 505 665 7920

or: Thomas J. Bowles (tjb@lanl.gov)
phone: +1 505 667-3937 Fax: +1 505 665-4121
recent publication: **UCN**_3 Workshop 2001 in Pushkin (see Gatchina)

recent overview publication:

"Fundamental Physics with Cold Neutrons" by
C.D. Bass, & al. at LANL 2006 (see ottosix website)

FP12 has the highest pulsed cold neutron intensity for nuclear physics in the world (http://p23.lanl.gov/len/npdg/).

"New Pulsed Cold Neutron Beam Line for Fundamental Nuclear Physics at LANSCE" by P.-N. Seo, J. D. Bowman, & al. in J.Res Natl.Inst.Stand.Technol. **110** (2005)145.

ICANS18_Id44
"Scoping study for an electric dipole moment beam line at the Materials Test Station" by G. Muhrer and Eric Pitcher

"The NPDGamma Experiment" by W. Scott Wilburn at the 5th UCN/CN Workshop in Peterhof (RU) 2005 (http://cns.pnpi.spb.ru/5UCN/proceed.html)

Lucas Heights_OPAL

Organisation:	ANSTO (Australian Nuclear Science & Technology Organisation)
Installation:	OPAL
Type:	pool reactor, (20 MW, LEU, D_2O reflector, $Ø_{th}=5 \cdot 10^{14}$ n/cm²s)
Address:	ANSTO, New Illawarra Rd, Lucas Heights PMB 1, Menai NSW, 2234, Australia
Home page:	http://www.ansto.gov.au
Contact:	Dr. Ross Miller
Phone / fax:	+61 2 9717-3334, fax: -3606
e-mail:	rmx@ansto.gov.au
Co-worker:	Dr. Robert A. (Rob) Robinson, phone -9204, fax -3606 e-mail: rro@ansto.gov.au

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CNS:	one, developed in collaboration with PNPI Gatchina		
moderator:	D_2	temperature:	20 K
eff. volume:	15 L	phase:	subcooled liquid
pressure:	150 kPa	power:	4000 W
material: chamber:	AlMg5	vacuum thimble:	Zircaloy
heat removal:	gravity (thermal siphon) and direct cooling		
refrigerator	AL, 1 turbine, 2 screw compressors, 2 X 250 kW(el.)		
remark:	reactor will not need to shut down in case of CNS failure (room temperature cooling loop).		

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recent publications: **IGORR9** (Sydney 2003), Session 4 (V. Mityukhlyaev)
IGORR10 (NIST 2005)
IGORR2007 (LYON) "The OPAL Reactor" by R. Miller and T. Irwin (ANSTO), and J.P. Ordoñez (INVAP), see bibliography on the ottosix site.

"Design of OPAL CNS, for ANSTO, Australia" by N. Masriera et O. Lovotti (INVAP) at the 5th UCN/CN Workshop in Peterhof (RU) 2005.

"General Approach to Safety and Protection of a Cold Neutron Source" by N. Masriera (INVAP) at the 5th UCN/CN Workshop in Peterhof (RU) 2005.

Lungtan

Organisation:	Institute of Nuclear Energy Research (INER)
Installation:	TRR-2, refurbishing cancelled in 2002
Type:	pool reactor, (goal: 20 MW, $Ø_{th}=2\cdot10^{14}$ n/cm²s)
Address:	1000, Wenhua Road, Chiaan Village, Lungtan, Taoyuan, Taiwan, 325 Republic of China
Home page:	www.iner.gov.tw
Contact:	Tsun-Neng Yang
Phone / fax:	+886 3 4711-400- fax: -408
e-mail:	tnyang@iner.gov.tw
Co-worker:	Yu-Hao Huang, C.H. Lee

CNS: (goal: LH2, 3.6 l, 3kW, thermal siphon)

recent publ.:
Proc. **ICANS**-XV (Tsukuba 2000): 21.1, and 23.19
Proc. **IGORR**8 (Munich 2001): C.H. Lee et al. p.159
http://hanaro2005.kaeri.re.kr/data/proceeding/CN-O-17.pdf
by CH Lee and T. Kawai

Mainz TRIGA

Organisation:	JOHANNES GUTENBERG UNIVERSITÄT Mainz
Installation:	FRMZ operating since 1965
Type:	TRIGA II reactor, 0.1 MW steady state, 250 MW peak (pulsed), $5 \cdot 10^{14}$ n/cm²s pulsed
Address:	Institut für Kernchemie Fritz-Strassmann-Weg 2, D-55128 Mainz, Germany
Home page:	http://www.kernchemie.uni-mainz.de/
Contact:	Norbert G. Trautmann
Phone / fax:	+49 6131 39-25847 fax: -24488
e-mail:	norbert.trautmann@uni-mainz.de
Co-worker:	Klaus Eberhardt (klaus.eberhardt@uni-mainz.de), phone: -25846

No **CNS**, but

UCN: A group around Werner Heil (wheil@mail.uni-mainz.de) and Stephan Paul (stephan.paul@physik.tu-muenchen.de) uses the TRIGA reactor (possibly in the pulsed mode) for testing successfully new methods of UCN-production (solid D_2 and CD_4) and UCN storage. An upgraded UCN source will be in operation from 2008 on at the radial channel D with its factor of 6 higher neutron flux.

recent publ.: "A solid Deuterium UCN Source at the research reactor TRIGA Mainz" by S. Paul, W. Heil, J.V. Kratz, I. Altarev, K. Eberhardt, et al. in annual report 2004 Kernchemie Uni-Mainz.

"A Prototype of the Mini-D2 Source for Ultra-Cold Neutrons" by I. Altarev, A. Frei, E. Gutsmiedl, F.J. Hartmann, et al., 2006, see bibliography on the ottosix site.

"First results with the solid deuterium UCN source at the reactor TRIGA Mainz" by W. Heil at the 6th UCN/CN Workshop in Russia 2007.

Mianyang

Organisation:	China Academy of Engineering Physics Institute of Nuclear Physics and Chemistry
Installation:	CMRR under construction
Type:	pool reactor 20 MW, $Ø_{th}$ = $3.4 \cdot 10^{14}$ n/cm²s,
Address:	P.O. Box 919-211 Mianyang, Sichuan, 621900, P.R. China
Home page:	http://www.caep.ac.cn/ ???
Contact:	Prof. Zhao Peng Ji
Phone / fax:	+86-816-2493842 fax: +86-816-2281598
e-mail:	zhaozhen@my-publie.s.c.cninfo.net (general e-mail: npc@caep.ac.cn)
Co-workers:	Prof. Dai Jun-long, Eng. Hu Chun-ming (chunming@caep.ac.cn), Prof. Shen Wen-de (phone: +86-816-2485272)

CNS:	one, operation planned for 2007		
moderator:	H_2	phase:	liquid (subcooled)
volume:	~1 L	temperature:	18 K
pressure:	250 kPa	heat removal:	thermal siphon (vertical)
material: chamber:	Al alloy	vacuum thimble:	Al alloy
power:	1500 W	refrigerator:	??

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remarks: reactor behavior in case of CNS refrigeration failure:

The reactor can continue operation with CNS emergency cooling at room temperature.

recent publications: "COLD NEUTRON SOURCE AT CMRR" by Hu Chunming, & al. (CMRR), and V. Kouzminov, & al. (PNPI) in Proc. **IGORR**9 2003

V. Mityukhlyaev in Proc. **UCN-CNS** 4th Workshop (PNPI 2003)

Oak Ridge HFIR

Organisation:	Oak Ridge National Laboratory (DOE)
Installation:	HFIR
Type:	high flux compact core reactor, 85 MW, $Ø_{th}=15 \cdot 10^{14}$ n/cm²s,
Address:	ORNL, P.O.Box 2008 Oak Ridge, TN 37831-6430, USA
Home page:	http://www.ornl.gov
Contact:	Douglas ("Doug") L. Selby
Phone / fax:	+1 865 574 6161 fax: +1 865 241 1887
e-mail:	selbydl@ornl.gov

CNS:	one, operation planned for 2007		
moderator:	H_2	phase:	supercritical
volume:	505 ml	temperature:	20 K
pressure:	1.5 MPa	heat removal:	forced (cryogenic circulator)
material: chamber:	Al 6061	vacuum thimble:	Al 6061
power:	3000 W	refrigerator:	2 M$

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remarks: reactor does not need to shut down in case of CNS failure (80 K (LN_2) cooling loop).

recent publications: Proc. **IGORR**10 (NIST 2005):" HIGH FLUX ISOTOPE REACTOR COLD SOURCE SAFETY ANALYSIS" by D.H. Cook

IGORR2007 (Lyon, FR, 2007): "Status of the High Flux Isotope Reactor and the Reactor Scientific Upgrades Program" by D. L. SELBY (and more, see transactions rrfm2007)

Oak Ridge SNS

Organisation:	Oak Ridge National Laboratory + 5 partner labs (DOE)
Installation:	SNS (operational with 1.4 MW since 2006)
Type:	spallation source, 2 MW, 1 GeV protons, $Ø_{th}=15\cdot10^{14}$ n/cm²s (peak),
Address:	project office: 701 Scarboro Road Oak Ridge, TN 37830, USA
Home page:	http://www.sns.gov/
Contact:	Ian Anderson (experimental facilities)
Phone / fax:	+1 865-574-0548 fax: +1
e-mail:	andersonian@sns.gov
CNS contact:	Eric B. Iverson (iversoneb@sns.gov)

CNS:	two, operational in 2007		
moderator:	H_2	phase:	supercritical
volume:	2X1 L	temperature:	20 K
pressure:	1.5 MPa	heat removal:	forced (cryogenic circulator)
power (total):	3500 W	refrigerator:	by AL

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remarks:

recent publications: **ICANS**-XVI (Neuss 2003): M31 (A.Crabtree)

ACNS 4, June 2004: "Technical Concepts for a Long-Wavelength Target Station for the Spallation Neutron Source" by J. M. Carpenter

ICANS18- Id169, 2007: "First Moderator Performance Calculations for a SNS Second Target Station" by F.X. Gallmeier

ICANS18-Id171, 2007: "SNS Hydrogen Moderator System - A Year in Review" by J. A. Crabtree.

UCN project status and activities on the **Fundamental Physics Beam Line FPBL** see http://www.phy.ornl.gov/nuclear/neutrons/ProjectStatus.pdf

"Status of the Fundamental Neutron Physics Beamline at the SNS" by M. Cooper at 5th UCN/CN Workshop in Peterhof 2005

ICANS-18-Id182 2007: "Fundamental Neutron Physics Beam at the Spallation Neutron Source" by W. M. Snow,

Raleigh NCSU

Organisation:	North Carolina State University
installation:	Pulstar
type:	TRIGA reactor, light water, 1 MW, 4% LEU, 10^{12} n/cm² s (< 10meV)
address:	NCSU Raleigh, NC 27695 7909, USA
home page:	http://www.ne.ncsu.edu/NRP/pulstar.html
contact:	Prof. Bernard W. Wehring
phone / fax:	+1-919-515-4599 fax: -513-1276
e-mail:	bwwehrin@ncsu.edu
co-workers:	Chris Gould (Chris_Gould@ncsu.edu), Albert Young (Albert_Young@ncsu.edu)

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planned installation in the thermal column:

Cold pre-moderator	solid CH4
UCN moderator	solid D_2 < 20 K

recent publ.:

Proc. **UCN-CNS** 4th Workshop (PNPI 2003) by A. Young

"A Preview of Research Projects at NC State University PULSTAR Reactor" by A. Cook at **IGORR10** at NIST, Sept. 2005.

Saclay CEA

Organisation:	CEA Saclay
Installation:	**Orphée**, operating since 1980, since 2003 with fewer cycles/yr, due to budget problems.
Type:	pool reactor, 14 MW, HEU, D_2O reflector, $Ø_{th}=3\cdot10^{14}$ n/cm²s,
Address:	91191 GIF SUR YVETTE, France
Home page:	www-llb.cea.fr/
Contact:	Mr. J. Estrade
Phone / fax:	+33 169 08-4611, fax: -8320
Co-worker:	Mr. Burdon (burdon@drnsac.cea.fr), ext. -4040

CNS: two, refurbished in 1995

moderator:	H_2	phase:	liquid
volume:	1 L each	temperature:	20 K
pressure:	90 kPa	heat removal:	gravity (thermal siphon)
material: chamber:	AlMg3	vacuum thimble:	AlMg3
power:	650 / 500 W	refrigerator:	AL, screw, 250 kW(el.)

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remarks: reactor has to stop in case of CNS failure

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recent publications: www-llb.cea.fr/spectros/pdf/neutron-source-llb.pdf

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Experimental facilities: Pierre Monceau at Laboratoire Léon Brillouin (LLB), monceau@llb.saclay.cea.fr

Serpong

Organisation:	NATIONAL NUCLEAR ENERGY AGENCY (BATAN)
Installation:	"G.A.Siwabessy" reactor, operating since 1987
Type:	pool reactor, 30 MW, H_2O moderated, $Ø_{th}$=2.5·10^{14} n/cm²s
Address:	P2TRR-BATAN, PUSPIPTEK COMPLEX, OB NO. 31 SERPONG, TANGERANG 15310, Indonesia
Home page:	http://www.batan.go.id/p2trr
Contact:	Hudi Hastowo (member of **IGORR**)
Phone / fax:	+62 21 7560-908, fax: -573
e-mail:	prsg@cbn.net.id

CNS: none installed, but still planned “to be installed one day”

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recent publications: **ICANS**-XV (Tsukuba 2000): status: 3.3

Tokai-mura JRR

Organisation:	JAERI
Installation:	JRR-3M
Type:	pool reactor, 20 MW LEU, D_2O-reflector, $Ø_{th}=2\cdot10^{14}$ n/cm²s,
Address:	Jaeri, Tokai-mura, Naka-gun Ibaraki-ken 319-1195, Japan
Home page:	http://neutrons.tokai.jaeri.go.jp/eng/
Contact:	Dr. Yukio Morii
Phone / fax:	81-292 82 6093 fax 81-292 82 5922
e-mail:	morii@neutrons.tokai.jaeri.go.jp

CNS:	one, operating since 1990		
moderator:	H_2	phase:	liquid
volume:	1 L	temperature:	20 K
pressure:	120 kPa	heat removal:	gravity (thermal siphon)
power:	350 W		
refrigerator	TAISAN, Brayton, one screw, 320 kW(el.)		

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recent publications: M.Utsuro in Proc. Workshop on Cold Sources at LANSCE, Los Alamos, 1990, p.105

"Cold neutron production in solid and liquid CH_4 moderators" by N. Morishima and T. Mitsuyasu in in Nucl.Inst&Meth. in Physics **A**, Volume 517,1-3, **2004**, 295-300.

"Cold neutron production in solid and liquid CH_4 moderators. II: on the reentrant-hole configuration" by T. Mitsuyasu, N. Morishima, & al. in Nucl.Inst&Meth. in Physics **A**, Volume_537,3, **2005**, 610-613.

Tokai-mura JSNS

Organisation:	JAERI	
Installation:	JSNS in J-PARC	
Type:	spallation source, 3 GeV, 0.333 mA, Hg target, Be reflector	
Address:	JAERI, Tokai-mura, Naka-gun Ibaraki-ken 319-1195, Japan	
Home page:	http://jkj.tokai.jaeri.go.jp/	
Contact:	Dr. Yujiro Ikeda	
Phone / fax:	81-292	fax 81-
e-mail:	ikeda@cens.tokai.jaeri.go.jp	

Cold Moderators: three, under construction, ready in 5/2008

moderator:	H_2	phase:	supercritical
volume:	ca. 1 L ea.	temperature:	20 K
pressure:	2 MPa	heat removal:	forced circ. ?

refrigerator power needed 5 kW

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recent publications: Y. Ikeda in Proc. **ICANS**XVI (Neuss 2003) (about JSNS)

Y. Kiyanagi in Proc. UCN-CNS 4th Workshop (PNPI 2003)

Tsukuba KEK

Organisation:	Tsukuba National Laboratory for High Energy Physics
Installation:	KENS
Type:	spallation source, 500 MeV,
Address:	KEK, 1-1 Oho, Tsukuba-shi, Ibaraki 305-0801, Japan
Home page:	http://neutron-www.kek.jp/
Contact:	Susumu Ikeda
Phone / fax:	+81 298 64 56 18 / +81 298 64 32 02
e-mail:	susumu.ikeda@kek.jp
Co-worker:	Masayoshi Kawai (masayoshi.kawai@kek.jp)

CNS:	one, since 1980		
moderator:	CH_4	phase:	solid
mass:	0.378 kg	temperature:	27 K
pressure:	0 MPa	power:	7 W
refrigerator	Stirling 70 W	heat removal:	directly cooled

Remarks: target-moderator-reflector assembly renewed in 2001

recent publications: **ICANS**-XV (Tsukuba 2000): status: 2.4,
ICNS 2001 (Munich): poster C-9 (M. Kawai)

UCN group around Yasuhiro Masuda (e-mail: yasuhiro.masuda@kek.jp)

using superfluid ^{4}He cooled below 1 K

recent publications: **ICANS**-XV (Tsukuba 2000): 22.1, 22.4,
UCN_3 Workshop 2001 in Pushkin (see Gatchina)

New spallation neutron source project with **CNS**: JAERI-KEK Joint Project "**j-parc**",
home page: http://j-parc.jp/MatLife/en/index.html

Vienna (Wien)

Organisation:	**Austron**
Installation:	cancelled
Type:	spallation source (0.5 MW, 1.6 GeV, 10 Hz, $370 \cdot 10^{14}$ n/cm²s peak)
Address:	Austron c/o Atominstitut Stadionallee 2 1020 Wien, Austria
Home page:	http://www.austron.at/
Contact:	Helmut Rauch
Phone / fax:	+43 1 58 801 141-00, fax: -99
e-mail:	rauch@ati.ac.at

CNS: studies cancelled

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remarks: Atominstitut Vienna runs a Triga reactor (0.25 MW) famous for its work in neutron optics.

UCN: This TRIGA reactor could be a perfect candidate for the installation of a **UCN** source

Villigen SINQ

Organisation:	Paul Scherrer Institut (**PSI**)
Installation:	**SINQ**
Type:	spallation source (steady state), $Ø_{th}=0.8 \cdot 10^{14}$ n/cm²s, 590 MeV,1.2 mA
Address:	Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland
Home page:	http://www.psi.ch
Contact:	Harald Spitzer
Phone / fax:	+41 56 310-2582 fax: -3131
e-mail:	harald.spitzer@psi.ch
Secretary:	Renate Bercher (bercher@psi.ch), phone -3402

CNS:	one, operating since 1996		
moderator:	LD_2	phase:	boiling
volume:	20 L	temperature	25 K
pressure:	150 kPa	heat removal:	thermal siphon
material: chamber:	AlMg3	vacuum thimble:	AlMg3
power:	800 W @ 1.2 mA + 165 W heat loss without proton beam		
refrigerator:	Linde , 2 turbines , Sulzer reciprocating compressor available refrigeration power 3500W		

Remarks:	CNS refurbished by 2003 with re-entrant hole proton beam has to stop in case of CNS failure
recent publications:	**ICANS**-XV (Tsukuba): status: 2.6 (G.S. Bauer) **ICANS**-XVI (Neuss 2003) Poster H. Spitzer

Villigen SUNS

Organisation:	Paul Scherrer Institut (PSI)
Installation:	**SUNS** (at the old Piotron site)
Type:	spallation source (pulsed) for UCN production, $Ø_{th}=0.8 \cdot 10^{14}$ n/cm²s, 590 MeV,1.2 mA
Address:	Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland
Home page:	http://ucn.web.psi.ch/
Contact:	Manfred Daum
Phone / fax:	+41 56 310-3668 fax: -
e-mail:	manfred.daum@psi.ch
Secretary:	Anita van Loon (anita.vanloon@psi.ch), phone: -3254
co-workers:	Reinhold Henneck -5157, Klaus Kirch -3278

UCNS:	one, under construction		
moderator:	D_2	phase:	solid
volume:	2 L	temperature	5 K
pressure:	0 kPa gas	heat removal:	forced convection, He
material: chamber:	AlMg3	vacuum thimble:	AlMg3
power:	800 W @ 1.2 mA + 165 W heat loss without proton beam		
refrigerator:	Linde / Sulzer, available refrigeration power 3500W		

Remarks: project in collaboration with PNPI Gatchina

recent publications: Proc. UCN-CNS Workshop 4 (PNPI 2003) (M. Daum)

see also International Workshop on "Present Status and Future of Very Cold Neutron Applications" at Paul Scherrer Institute - Switzerland in February 2006.

Theory and Computation Groups

(those not attached to a CNS site)

Bariloche

CAB (CNEA) at Instituto Balseiro

Address: Av. Bustillo km 9500
8400 Bariloche, Argentina

Contact: Rolando Granada (granada@cab.cnea.gov.ar)

tel. / fax: +54 2944 4452-23, fax -99

develops scattering kernels for cold moderator substances

recent pub.: **IGORR** 7 (Bariloche 1999),
ICANS-XV (Tsukuba 2000): 18.11.
ICANS18- Id_117 and Id_119

Florence

CNR, Instituto di Elettronica Quantistica,

Address: Via Panciatichi 56/30, 50127 Firenze, Italia
M. Zoppi (zoppi@ieq.fi.cnr.it) et al. study and
measure scattering kernels for cold moderators at ISIS
recent publication: **ICNS**2001 (Munich): Poster C-58
Proc. **ILL** Millennium Symposium (4/2001) p. 95

Stuttgart

Universität Stuttgart, IKE RP

Address: Pfaffenwaldring 31
70550 Stuttgart

Contact: Dr. Wolfgang Bernnat

tel./ fax: +49 711 685-2118, fax: -2010

e-mail: bernnat@ike.uni-stuttgart.de

studies "Scattering Laws and Cross Sections for Moderators and Structure Materials for Calculation of Production and Transport of Cold and Ultra-cold Neutrons", does Monte-Carlo simulations.

recent publication: ND2001 (International Conference on Nuclear Data for Science and Technology) in Tsukuba, Japan, Oct.2001

Organisations, Meetings

ACoM

Organisation:	International Collaboration on **A**dvanced **Co**ld **M**oderators
goals:	investigating and developing alternative routes for employing methane and searching for similarly adequate alternative moderators.
Address:	Forschungszentrum Jülich, IFF Postfach 19-13 52425 Jülich, Germany
home page:	http://www.fz-juelich.de/
Contact:	Dr. Harald Conrad or Dr. Günter Bauer
phone / fax:	+49 2461 61-6740, fax: -2610
e-mail:	h.conrad@fz-juelich.de or guenter.bauer@fz-juelich.de
meetings:	e.g.: **ACoM** IV in 2/99 in Jülich, **ACoM** V in 3/01 in Berlin, **ACoM** VI in 9/02 in Jülich, **ACoM** VII in 4/06 in Bariloche (AR)

ECNS, ICNS, and ACNS

ECNS

The "European Conference on Neutron Scattering" (**ECNS**) series is organized every four years by the European Neutron Scattering Association **ENSA** (home page: http://neutron.neutron-eu.net/n_ensa/).

The Chairman of ENSA is now Peter Allenspach, PSI.

The first of this series was held in Interlaken (CH) in 1996,

the second **ECNS** in Budapest (HU) in 1999,

the third **ECNS** took place in Montpellier (FR) in Sept. 2003,

ECNS 4 happened in Lund (SE) in June 2007

ENSA awards every two years the prestigious Walter Hälg Prize.

ICNS

The "International Conference on Neutron Scattering" series was organized every three years by the local Neutron Scattering Association of the place where it takes place. From 1997 on it is held every four years in alternation with the ECNS.

There is an International Advisory Committee of about 26 members.

The last meetings:

ICNS'82 in Hakone (JP), **ICNS**'85 in Sante Fe (USA),

ICNS'88 in Grenoble (FR), **ICNS**'91 in Oxford (GB),

ICNS'94 in Sendai (JP), **ICNS**'97 in Toronto (CA),

ICNS 2001 in Munich (DE), proceedings in Appl. Phys. A (Suppl.1), 2002

ICNS 2005 was be held in Sydney (AU),

ICNS 2009 will be held in Knoxville, TN (USA).

ACNS

The first "American Conference on Neutron Scattering" (ACNS) was organized by the Neutron Scattering Association of America (NSSA), in conjunction with the SNS-HFIR User Group (SHUG), in Knoxville, Tennessee, in June 2002.

Chairman is Rob Briber (UMD) (e-mail: rbriber@eng.umd.edu),

ACNS home page: http://www.sns.gov/acns/

ACNS2008 (American Conference on Neutron Scattering, n°4) to be held in Santa Fe, NM in Mai 2008.

IAEA

International Atomic Energy Agency
Physics Section, NAPC
Dept. of Nuclear Sciences and Applications
P.O. Box 100
Wagramer Strasse 5
International Atomic Energy Agency
A-1400 Vienna, Austria

Contact: Gunter Mank (g.mank@iaea.org)

Home page: http://www.iaea.or.at/worldatom/rrdb

Data from the **IAEA**'s Research Reactor Database (RRDB) provides information with respect to the status of the world's research reactors.

Each year the **IAEA** sends out questionnaires to the owners and operators of research reactors requesting an update on information relating to each facility. This information is fed into the **IAEA**'s database and comprises the Research Reactor Database (RRDB).

The research reactor web site also contains a calendar of research reactor meetings and activities. Previous conference: 11/2003 in Santiago de Chile. Amongst the publications: "Safety Aspects of Cold Neutron Sources" by J.M. Astruc and K.H. Gobrecht.

Next International Conference on Research Reactor Utilization: see www.ottosix.com/events.htm

In **IAEA**'s "SUBPROGRAMME ON RESEARCH REACTORS: TECHNOLOGY AND NON-PROLIFERATION" talk given at **IGORR**2007 in Lyon by P. Adelfang, et al., you can read :

3.2. Project D.2.0.2: Supporting RR Modernization and Innovation

> Member States, especially developing Member States, involved in planning or carrying out refurbishment and modernization of RRs often look to the **IAEA** for advice and assistance and to exchange information and ideas. Similarly, **IAEA** assistance is requested when new RRs or major innovative systems, such as in-core loops or **cold sources**, are being planned or constructed. Regional and interregional thematic collaborations, networking and centres of excellence are being increasingly considered worldwide as an appropriate way to enhance utilization of RRs. This project is designed to fulfil these needs by collecting and sharing relevant information, including best practices and lessons learned.

Two important safety guides have been published earlier by **IAEA**:

"SAFETY GUIDE ON SAFETY ASSESSMENT OF RESEARCH REACTORS AND PREPARATION OF THE SAFETY ANALYSIS REPORT" (Safety Series 35-G1)

and **"SAFETY GUIDE ON SAFETY IN THE UTILIZATION AND MODIFICATION OF RESEARCH REACTORS"** (Safety Series 35-G2)

more recent publications: **ICANS**18_Id74
An **IAEA** Coordinated Research Project on "Improved production and utilization of short pulsed, cold neutron beams", presented by F. Mulhauser, G. Mank, and M. Furusaka.

ICANS

International Collaboration on Advanced Neutron Sources

Home page: http://www.pns.anl.gov/related/icans.shtml

ICANS is an informal network of laboratories whose scientists are involved in developing pulsed neutron sources and accelerator based spallation neutron sources. The attention of the Collaboration is on the subjects of accelerator development, source (target) and moderator development, and neutron scattering instrumentation development.

Meetings:

ICANS I - Argonne National Laboratory, December 12-15, 1977

ICANS II - Rutherford Laboratory, July 10-14, 1978

ICANS III: Conference on Target Stations and Accelerator Technology. Los Alamos Scientific Laboratory, March 19-22, 1979.

ICANS IV at KEK, Tsukuba, October 20-24, 1980.

ICANS V in Jülich, June 22-26, 1981.

ICANS VI at Argonne National Laboratory, June 29-July 2, 1982

ICANS VI at Chalk River Nuclear Laboratories, September 13-16, 1983.

ICANS VIII at Keble College, Oxford, 8-12 July 1985.

ICANS-IX at PSI, Villigen, September 22-26, 1986.

ICANS-X at Los Alamos, 3-7 October, 1988.

ICANS-XI at KEK, Tsukuba, October 22-26, 1990.

ICANS-XII at the Cosener's House, Abingdon, Oxfordshire, UK, May 24-28, 1993.

ICANS-XIII at PSI, Villigen, Switzerland, October 11-14, 1995.

ICANS XIV in Utica, Illinois, USA, June 14-19, 1998.

ICANS-XV in Tsukuba, Japan, November 6-9, 2000

ICANS-XVI in Neuss, Germany, May 12-15, 2003

ICANS-XVII in Santa Fe, NM, USA, April 24-29, 2006

ICANS-XVIII in Guangdong, CN, April 23-27, 2007

IGORR

International Group on Research Reactors

IGORR Charter:

The International Group on Research Reactors was formed to facilitate the sharing of knowledge and experience among those institutions and individuals who are actively working to design, build, and promote new research reactors or make significant upgrades to existing facilities.

Home page: http://www.igorr.com/

Actual chairman: **Joel GUIDEZ by interim since June 2006**

IGORR1	in Knoxville, Tennessee	in 3/90
IGORR2	in Saclay	in 5/92
IGORR3	in Tokai, Ibaraki,	in 9/93
IGORR4	in Gatlinburg, TN	in 5/95
IGORR5	in Aix-en-Provence	in 11/96
IGORR6	in Taejon, Korea	in 5/98
IGORR7	in Bariloche, Argentina	in 10/99
IGORR8	in Munich, Germany	in 4/2001
IGORR9	in Sydney, Australia	in 3/2003
IGORR10	in Gaithersburg, USA	in 9/2005 (jointly with TRTR)
IGORR2007	in Lyon, France	in 3/2007 (jointly with RRFM)
IGORR2009	in Beijing, China	in ?/2009 (jointly with RRFM)

Proceedings of **IGORR** 6 to 11: see home page http://www.igorr.com/

no **IGORR** Newsletters any more

People

Altarev, Igor	Garching FRM2
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Geltenbort, Peter	Grenoble
Gistau, Guy	Preface
Gobrecht, Klaus	OTTOSIX
Gould, Chris	Raleigh NCSU
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Zoppi, M.	Theory (Florence)

Glossary

for the World Directory of Cold and Ultra-cold Neutron Sources

Cold Neutron Source (CNS)	a facility producing cold neutron beams from the thermal neutrons generated by a neutron source.
Cold Neutrons	free neutrons in the energy range below 20 meV
Cold Neutron Wave Length	from 0.2 nm (energy 20 meV) to more than 2 nm (0.2 meV)
Cold Neutron Velocity	from 2000 m/s (energy 20 meV) to less than 200 m/s (0.2 meV)
Cold Neutron Temperature	from 220 K (energy 20 meV) to less than 3 K (0.2 meV)
Cold Neutron Moderator	a liquid or solid which is cooled to below 100 K in order to shift the spectrum of incoming thermal neutrons to lower energies. A good moderator has a high scattering cross section combined with low absorption cross section (examples: liquid hydrogen, solid methane).
Cold Neutron Gain	a measure of the performance of the CNS, in fact the ratio of the neutron flux given by the operating CNS to the flux if the CNS were not there. This ratio is wavelength dependant. It can reach values well above 100 at very long wavelengths.
Heat Removal	a lot of heat is deposited by nuclear radiation in the cold neutron moderator, the latter being usually close to the radioactive neutron source. Powerful refrigeration at very low temperatures and efficient heat transport from the moderator to the refrigerator are needed, see thermal siphon.
Neutron Source	a neutron generator like the core of a nuclear fission reactor (mostly giving a steady state neutron output), or the target of a high energy proton accelerator (mostly for pulsed neutron beams), see Spallation Source.
Neutron Guide	an evacuated channel, up to 100 m long, containing and confining the neutron beam. The colder the neutrons the better they are transported in such a guide.
Spallation Source	a dedicated target station at a high power proton accelerator for neutron production by spallation of heavy nuclei like Zr, W, Pb, Hg, or U. Cold neutron beams are obtained by placing a cold moderator in the vicinity of the target.
Thermal Siphon	the heat developed in the cold moderator by nuclear radiation can be removed either by direct contact with the refrigerator gas (usually He) or by convection in the moderator fluid, the latter extending from the active moderator volume to a heat exchanger. The convection can be forced (circulator) or natural. The natural convection loop is called a thermal siphon.
Ultra-cold Neutrons (UCN)	neutrons with energies below about 1 meV. They totally reflect at certain walls, i.e. one can keep them in a bottle until they decay.
Ultra-cold Neutron Source	although UCN are present in CNS (at a very low density), dedicated UCN Sources are nowadays developed, the cold moderator being e.g. solid deuterium below 10 K or superfluid helium below 1 K.