Contribution of Thermal Scattering Libraries from the Nuclear Data Group at Centro Atomico Bariloche

J

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Argentina

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OECD- Paris
France

Nuclear Data group at Centro Atómico Bariloche

Rolando Granada

Scattering theory and advanced neutron sources

Florencia Cantargi

Cold moderator materials and neutron filters

Christian Helman

Solid state physics and ab initio methods

Ignacio Marquez

Nuclear reactor applications and benchmarking

Past members: Monica Sbaffoni (currently at IAEA), Victor Gillette (currently at University of Sharjah, U.A.E).

The Neutron Physics Department at Centro Atómico Bariloche has close to 50 years of continuous experience working in neutron scattering applied to nuclear data and nuclear engineering.

As part of the Neutron Physics Department, our main activity is the generation of S(α,β) in ENDF format and thermal neutron scattering cross sections in ACE format for our R&D activity or by demand of other groups from Argentina (CNEA and INVAP) and also from other countries.

Thermal moderators

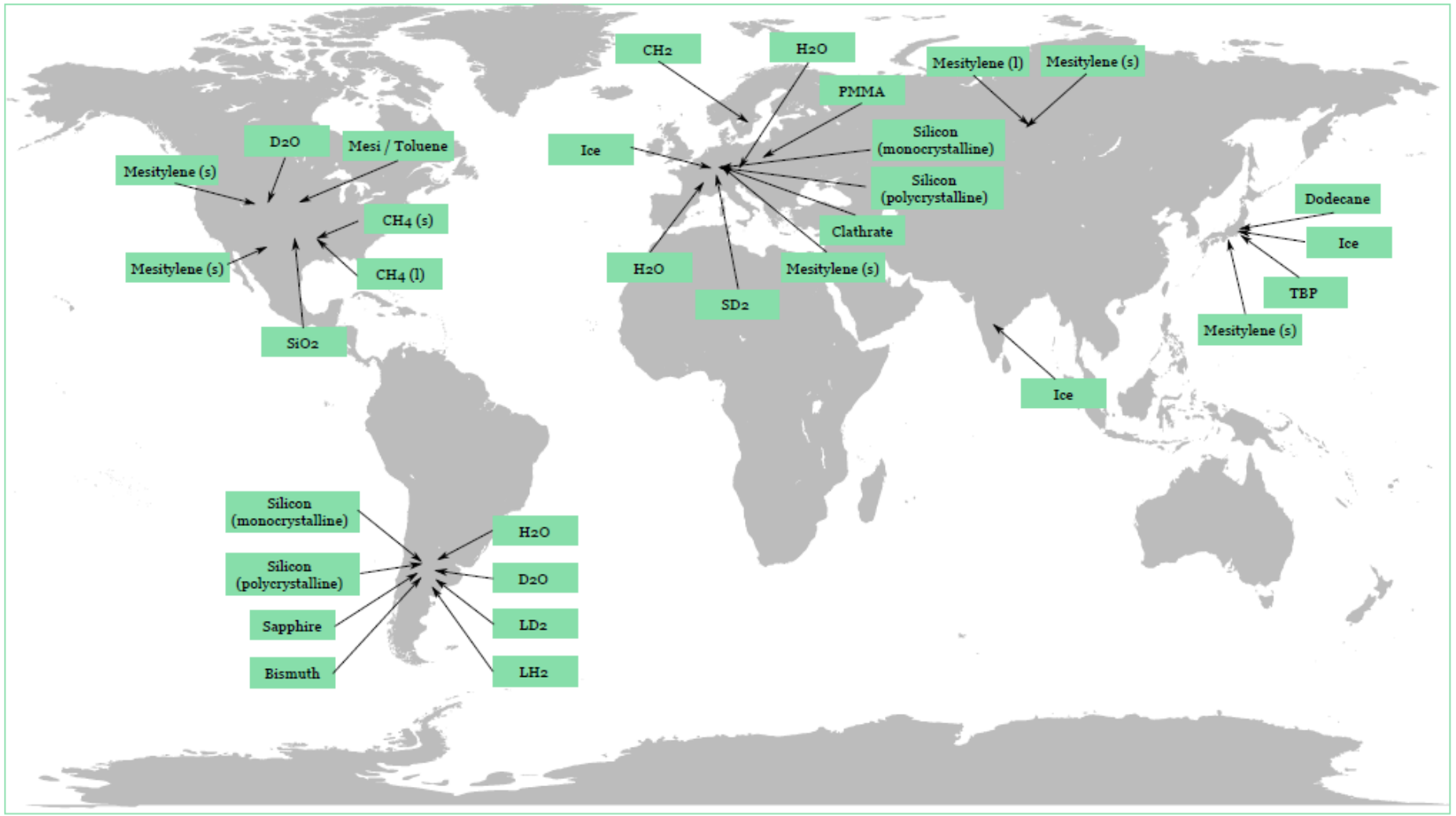
Material	Users and collaborators
H_2O	Slovak University of Technology in Bratislava, Slovakia (S. Cerba, 2011) CEA Cadarache
D_2O	Chalk River Laboratories, AECL (active collaboration)
CH_2	Chalmers Univeristy of Technology, Department of Reactor Physics, Göteborg, Sweden (Prof. Nils G. Sjöstrand, 1988)
C_6H_6	
Plexiglass	Institute of Nuclear Physics, Division of Applications of Physics and Interdisciplinary Research, Krakow, Poland (Dr. U. Woznicka, 1991)
Ethanol	
Dowtherm	
Metal Hydrides	
Dodecane	Century Research Center Corp., Advanced Technology Dept., Engineering Group, Tokyo, Japan (Dr. H. Kadotani, 1988)
Tributylphosphate	Century Research Center Corp., Advanced Technology Dept., Engineering Group, Tokyo, Japan (Dr. H. Kadotani, 1988)
Mesitylene	Joint Institute of Nuclear Physics, Franck Laboratory, Dubna, Russia (E. Shabalin, S. Kulikov, 2006)
Graphite	

Cold moderators

Material	Users and collaborators
Liquid H_2	INVAP S.E., Bariloche, Argentina (O. Lovotti, 2000)
Liquid D_2	INVAP S.E., Bariloche, Argentina (O. Lovotti, 2000) RA-10 project, Argentina (F. Sánchez-A. Márquez, 2014)
Solid D_2	Paul Scherrer Institute, SINQ, Villegen, Switzerland (M. Daum, 2008)
Liquid & Solid. CH_4	Indiana University, LENS, Bloomington, USA (D. Baxter, 2009)
Water Ice	• Bhaba Research Centre, DRUVA Reactor, India (S. Basu, 2008) • Hokkaido University, Japan (Y. Kiyanagi, 2011)
Clathrate	JESSICA Collaboration, FZ Juelich, Germany (F. Conrad, 2007)
Mesitylene	• Joint Institute of Nuclear Physics, Franck Laboratory, Dubna, Russia (E. Shabalin, S. Kulikov, 2006) • JESSICA Collaboration, FZ Juelich, Germany (F. Conrad, 2007) • Hokkaido University, Japan (Y. Kiyanagi, 2007) • TRIUNF, Canada (A. Miller, 2013) • LANL, USA (M. Mocko, 2014) • Savannah River National Laboratory (A. Brand, 2015)
Mesityle:Toluene mix	TRIUNF, Canada (A. Miller, 2013)
Trifenilmethane	Joint Institute of Nuclear Physics, Franck Laboratory, Dubna, Russia (S. Kulikov, 2015)
Ethane	

Neutron filters and other materials

Material	Users and collaborators
Silicon	• RA-10 project, Argentina (A. Cintas, 2013) • Paul Scherrer Institute, Switzerland (E. Rantsiou, 2013) • LAHN (Argentinean Neutron Beams Laboratory Project) (A. Tartaglione, 2017)
Sapphire	• RA-6 reactor, Argentina (F. Sanchez, 2008) • RA-3 6 reactor, Argentina (M. Sztejnberg, 2010) • Paul Scherrer Institute, Switzerland (E. Rantsiou, 2013) • LAHN (Argentinean Neutron Beams Laboratory Project) (A. Tartaglione, 2017)
Bismuth	RA-6 reactor, Argentina (F. Sanchez, 2013)
Silica	ORNL, USA (Luiz Leal , 2010)


CH2
H2O
Mesitylene (l)
Mesitylene (s)
PMMA
Silicon (monocrystalline)
Ice
Silicon (polycrystalline)
Clathrate
Mesitylene (s)
H2O
SD2
D2O
Mesi / Toluene
Mesitylene (s)
CH4 (s)
CH4 (l)
Mesitylene (s)
SiO2
Dodecane
Ice
TBP
Mesitylene (s)
Ice
Silicon (monocrystalline)
Silicon (polycrystalline)
Sapphire
Bismuth
H2O
D2O
LD2
LH2

Within the Gaussian approximation, the conventional route to the calculation of the Scattering Law $S(Q,\omega)$ for a given material involves the characterization of its dynamics through a frequency spectrum (FE)

- Data from experiments
- Combination from both
- Data from theory

The FE is used to feed the LEAPR module of the NJOY which employs a phonon expansion and the incoherent approximation to generate the inelastic cross section

This procedure is able to produce fairly accurate results in the case of hydrogeneous materials, where the incoherent contributions dominate the cross sections

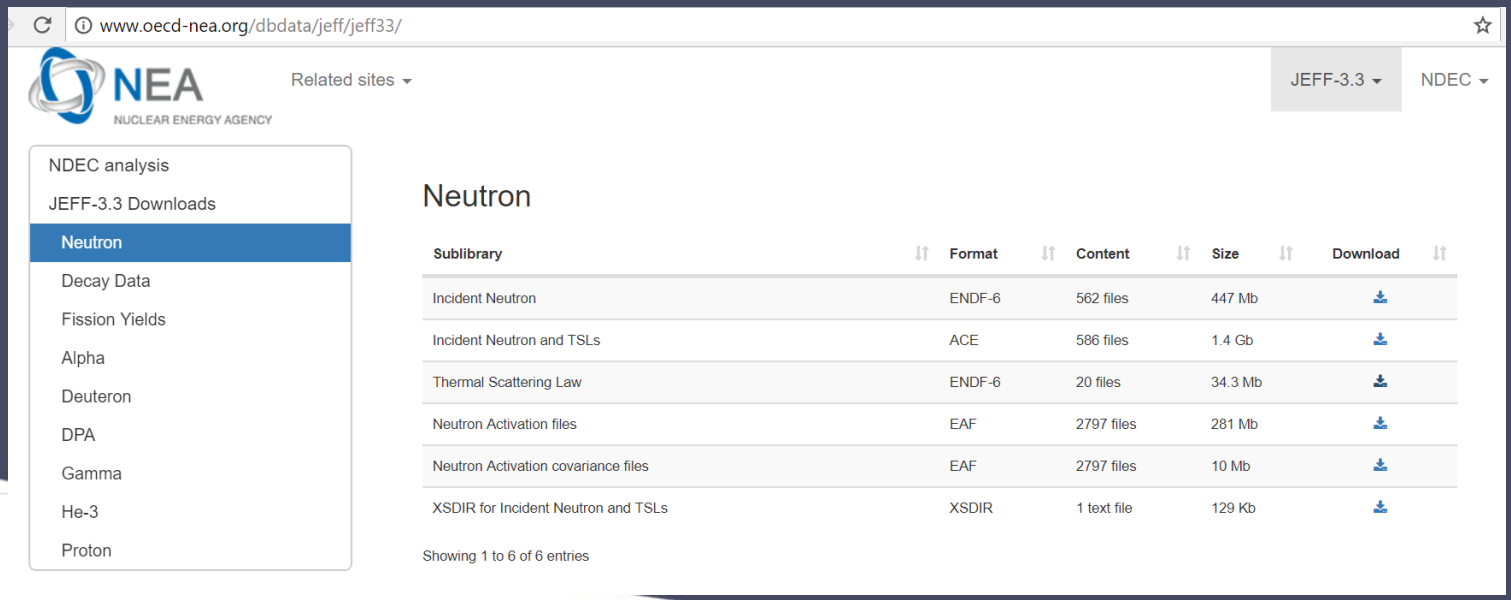
2016: Agreement with OECD/NEA to supply Thermal scattering libraries to JEFF

Filters: Silicon and sapphire

Cold moderators: liquid hydrogen, liquid deuterium, mesitylene, toluene and light water ice

Thermal moderators: light and heavy water

Published in JEFF3.3 (release July 2017)



At the begining of 2018, light and heavy water cross section libraries were published in **ENDF/B-VII.0**

www.nndc.bnl.gov/endf/b8.0/download.html

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Neutron Reaction Sublibrary
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cksum:  1932031310
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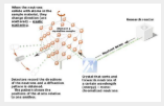

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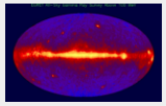

Photonuclear Sublibrary
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Proton Reaction Sublibrary

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Final remarks

At the Nuclear Data Group of the Neutron Physics Department (Centro Atómico Bariloche), we have the capability of producing S(α,β) in ENDF format and thermal neutron scattering cross sections in ACE format.

Our cross section libraries are available in ENDF-6 and ACE format on demand

Thanks for your attention