WPEC subgroup proposal

Thermal Scattering Kernel S(α,β): Measurement, Evaluation and Application

Justification for a Subgroup

The motivation for the subgroup is the recent interest throughout the world on revisiting and revising the existing thermal neutron scattering data in the existing cross section libraries such as the ENDF, JEFF, JENDL, etc. Many questions emerge from the WPEC sub-group 40 related to the impact of the thermal scattering data on criticality benchmarks. Investigation and production of covariance matrices are also key issues for light and heavy water reactors.

Over the last 40 years new methodologies for measuring and evaluating double differential cross sections have emerged. Better-measured and evaluated data are produced nowadays.

Presently, in the US, developments in the field consist of measuring the double differential cross section at multiple temperatures and pressures using the Spallation Neutron Source (SNS) facility located at the Oak Ridge National Laboratory plus evaluation to develop new S(α,β) kernels.

In Europe, the Neutron Augmented S(α,β) in Cross Sections Alternative Assessment (NAUSICAA) is a Project to measure the double differential cross section and produce an evaluated S(α,β) kernel. The project includes the Institute Laue-Langevin (ILL), the Institut de Radioprotection et de sûreté Nucléaire (IRSN) and the University of Florence. Double differential cross section measurements are planned, starting in 2014, at the ILL.

The common methodology used for generating S(α,β) is based on the use of phonon spectrum which are derived using computer codes for solid state physics applications. While the procedure has been demonstrated acceptable for generating S(α,β) it does not relate directly the information conveyed from the measured experimental cross section. Other approaches such as that based on molecular dynamic simulations have also been identified as a potential source for S(α,β) generation.

In addition to the double differential cross section data another subject of interest is the uncertainties (covariance) on the experimental data and their propagation for practical applications. Issues such as data generation, data storage and formats will be addressed by the subgroup.

Subgroup Monitor:

Albert C. (Skip) Kahler, Los Alamos National Laboratory, USA (ENDF)

Subgroup Coordinator:

Gilles Noguere, CEA Cadarache, France (JEFF)

Subgroup Participants[1]

The persons listed below already expressed some interests in the proposed activities, pending confirmation by the data projects and/or their home institutes.

ENDF	Leal C. Luiz, David V. Baxter, Danila Roubtsov, Ayman Hawari, Emily Liu, Yaron Danon, Goran Arbanas, Franz Gallmeier, Alexander Kolesnikov, Dave Heinrichs
JEFF	Davif Bernard, Sophie Pignet, Wim Haeck, Dimitri Rochman, Yoann Calzavara, Emmanuel Farhi, Oscar Cabellos Young-Sik Cho, Emilio Castro (TBC), Ron Dagan (TBC)
JENDL	TBD
BROND	TBD
CENDL	TBD
IAEA-NDS	Andrej Trkov (TBC)
Other (non-NEA)	Rolando Granada, Jose Ignacio Marquez Damian (Argentina)

Project Definition

The project will be divided in the following phases:

I) Assessing existing methodologies for generating $S(\alpha,\beta)$;
II) Explore other methodologies of potential use for $S(\alpha,\beta)$ generation;
III) Examining existing formats for uncertainty (covariance) generation;
IV) Demonstrate the feasibility of generating $S(\alpha,\beta)$ and uncertainty in a practical application;

Project Justification

The present interest of generating thermal data for reactor and criticality applications justify the creation of a new subgroup. An international collaboration through a NEA/WPEC subgroup will be essential for leveraging efforts allowing sharing of resources needed for achieving the project goal.

Time Schedule and Deliverables

2015-2016: The first period will be devoted to review and collect existing evaluations of $S(\alpha,\beta)$ in ENDF-6 format, and to benchmark these evaluations on integral data of interest.

2016-2017: The second period will be devoted to the definition of methodologies for generating covariance data.

2017-2018: The third period will address issues for improving the evaluation of $S(\alpha,\beta)$ and the corresponding covariance data.

[1] Tentative names only… The data projects will have to identify appropriate participants, which will have to check with their own institution the time that they can devote to this activity.

Detailed time schedule (preliminary version)

year	period	activities
2015	May	Start of SG activities at the NEA: • Review of the experimental facilities and on-going work • Review of the existing/new "evaluation methodologies" • Review of the existing Evaluated Nuclear Data File in ENDF-6 format • Selection of the benchmarks of interest
	May-June	Collect evaluation in ENDF-6 format
	June- Dec.	• Processing and Benchmarking • Status/performance of available data
2016	Jan-May	Begin to reflect on the generation of covariance data
	May	Status of the one-year activity: • Presentation of the experimental programs • Presentation of the benchmark results • Review of the methodologies for producing covariance data • Needs for improving the evaluation
	May-July	Collect experimental data of interest for covariance
	July-Dec.	Applied methodologies for producing covariance data
2017	May	Status of the two-year activities: • Presentation of the experimental results • Presentation of the covariance data • Presentation of the improved evaluations
	May-Dec.	Begin to reflect on the nuclear data format
2018	Jan-May	Monte-Carlo and deterministic uncertainty propagation work
	May	Status of the three-years activities Proposal for a draft version of the final report that includes recommendation for future experimental works, evaluations and covariance

List of participants

Name of the participants	Organisation	Email adress
Albert C. (Skip) Kahler	Los Alamos National Laboratory	akahler@lanl.gov
Gilles Noguere	CEA Cadarache	gilles.noguere@cea.fr
Luiz C. Leal	Oak Ridge National Laboratory	leallc@ornl.gov
Jose Ignacio Marquez Damian	Centro Atomico Bariloche	marquezj@cab.cnea.gov.ar
David V. Baxter	Indiana University	baxterd@indiana.edu
Danila Roubtsov	Atomic Energy of Canada Limited	roubtsovd@aecl.ca
Ayman Hawari	North Carolina University	ayman.hawari@ncsu.edu
Emily Liu	Rensselaer Polytechnic Institute	liue@rpi.edu
Yaron Danon	Rensselaer Polytechnic Institute	danony@rpi.edu
Goran Arbanas	Oak Ridge National Laboratory	arbanasg@ornl.gov
Rolando Granada	Centro Atomico Bariloche	granada@cab.cnea.gov.ar
Franz Gallmeier	Oak Ridge National Laboratory	gallmeierfz@ornl.gov
M. Mattes (retired)	Karlsruhe Institute of Technology	
Young-Sik Cho	Korean Atomic Research Institute	yscho@kaeri.re.kr
Alexander Kolesnikov	Oak Ridge National Laboratory (SNS)	kolesnikovai@ornl.gov
David Bernard	CEA Cadarache	david.bernard@cea.fr
Sophie Pignet	Institut de Radioprotection et de Sûreté Nucléaire (IRSN)	sophie.pignet@irsn.fr
Claude Mounier	CEA Saclay	claude.mounier@cea.fr
Dimitri Rochman	Nuclear Research and Consultancy Group NRG Petten	rochman@nrg.eu
Yoann Calzavara	Institut Laue Langevin (ILL)	calzavara@ill.fr
Emmanuel Farhi	Institut Laue Langevin (ILL)	farhi@ill.fr
Oscar Cabellos	Nuclear Energy Agency (NEA)	oscar.cabellos@oecd.org
Dave Heinrichs	Lawarence Livermore National Laboratory	Heinrichs1@llnl.gov