Brookhaven National Laboratory
Upton, NY 11973

SUBJECT: Report on Foreign Travel to <destination>
DATE:
TO: Dr. Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511
FROM: David Brown

MEETING TITLE: 5th International Workshop on Nuclear Data Covariances (CW2022)

MEETING LOCATION: Tokyo Institute of Technology (virtually)

MEETING DATES: 26-30 Sep 2022

ATTENDEES ON BEHALF OF NCSP: David Brown

MEETING PURPOSE:
From the meeting flyer:

- Covariances in measured nuclear data
- Evaluation methodology of covariances
- Implication of nuclear data covariances on reactor physics, decommissioning, nuclear security and safeguards, and so on
- Machine / deep learning and AI in nuclear data
- Uncertainty qualification / quantification
- Adjustment of nuclear data by integral data
- Impact of uncertainties on nuclear physics and astrophysical nucleosynthesis
- Related subjects

MEETING BENEFITS TO THE NCSP:
This meeting is a chance to learn about state of the art methods for covariance development and use. As one of the developers of nuclear data funded by the USNDP, it is very useful keep abreast of the latest developments in the field, and learn what evaluation activities are taking place around the world. Many of the techniques we see at this meeting will be used in future data development in NCSP projects.

PURPOSE OF TRAVEL
To attend (virtually) CW2022, learn more about the state of the art in nuclear data covariance development and use and to chair a session.

Persons Contacted at <Location>
No one: This trip was virtual and the time shift between New York and Tokyo was large enough that I did not talk with anyone outside of the scope of the teleconference and, even then, contact was limited to managing my chairing duties.

Presentations, Chair Responsibilities, Etc.:

- I was a coauthor on the last talk on Day 3 (28 Sep 2022) “Bayesian Networks for Nuclear Data Evaluation”
- I chaired the second session on Day 5 (30 Sep 2022)
- I serve on the International Advisory Board of the workshop

Distribution:
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List of paritipants of CW2022, 5th International Workshop on Nuclear Data Covariances, Sept. 26 - 30, 2022, hosted by Tokyo Institute of Technology

First name	Surname	Affiliation	Title of Presentation
Julia Dorottya	Bartos		
David	Brown	Brookhaven National Laboratory	
Roberto	Capote	International Atomic Energy Agency	Experimental spectrum average cross sections in Cf-252(sf) reference neutron field and its impact on evaluation and UQ of neutron standards
Allan	Carlson	NIST and BNL	
Sidi-Mohamed	Cheikh	CEA, DES, IRESNE, DER, SPRC, LEPh	Test of models for isotopic distribution evaluation and their impact on the covariance analysis
Jingde	Chen	Tokyo Institute of Technology	
Satoshi	Chiba	Tokyo Institute of Technology	Uncertainties of nuclear properties of a chloride molten-salt fast reactor system brought by uncertainties in nuclear data of 35Cl studied by a random-sampling method
Go	CHIBA	Hokkaido University	Present status and future perspective of development of an efficient uncertainty quantification method, CV-S
Tomohiro	Endo	Nagoya University	Review of data assimilation using prompt neutron decay constant
Shunsuke	Endo	Japan Atomic Energy Agency	Covariance of resonance parameters ascribed to systematic uncertainties in experiments
Kazuki	Fujio	Tokyo Institute of Technlogy	
Yuhei	Fukui	Nagoya University	Development of a robust nuclear data adjustment method to outliers
Zhigang	Ge	China Institute of Atomic Energy	
Alf	Göök	Uppsala University	
Patrick	Griffin	Sandia National Laboratories	Importance of Cross-Reaction Covariance Data for User Applications
Hiroki	Harada	Hokkaido University	Similarity evaluation between neutron multiplication factors and nuclide inventories during nuclear fuel burnup
Michal	Herman	Los Alamos National Lab.	Empire of covariances - art, strategies and correlations.
Tsunenori	Inakura	Tokyo Institute of Technology	
Chikako	Ishizuka	Tokyo Institute of Technology	
Osamu	Iwamoto	Japan Atomic Energy Agency	Evaluation of covariance data in JENDL
Keegan	Kelly	Los Alamos National Laboratory	The Covariance of PFNS Results from the Chi-Nu Experiment
Grégoire	Kessedjian	CEA /DES/ IRESNE / DER / SPRC / LEPh	Covariance analysis of $^{235}U(n_{th},f)$ independent and cumulative fission yields
ATSUSHI	KIMURA	Japan Atomic Energy Agency	Uncertainty estimation in TOF experiments with ANNRI
Ivan Alexander	Kodeli	UKAEA	XSUN-2022/SUSD3D n/g Sensitivity-Uncertainty Code Package with Recent JEFF3.3 and ENDF/B-VIII.0 Covariance Data
Satoshi	Kunieda	Japan Atomic Energy Agency	Application of R-matrix code AMUR to analysis of J-PARC/ANNRI measurements
Young-owk	Lee	Korea Atomic Energy Research Institute	
donghyuk	lee	Korea Atomic Energy Research Institute	Self-shielded Covariance Generation by Resonance Parameter-based Monte Carlo Perturbation Calculation
Helmut	Leeb	TU Wien, Atominstitut	Nuclear Data Evaluation of Light Nuclear Systems
Amy	Lovell	Los Alamos National Laboratory	Calculated covariance matrices for fission product yields using BeoH
Zerun	Lu	Xi'an Jiaotong University	Generation and Analysis of Independent Fission Yield Covariances Based on GEF Model Code
Shuhei	Maruyama	Japan Atomic Energy Agency	Applicabiliy evaluation of Akaike's Bayesian Information Criterion to covariance modeling in the cross-section adjustment method
Yoshinori	Miyoshi		
Yuta	Mukobara	Tokyo Institute of Technoogy	Uncertainty in prediction of heavy-ion reactions brought by mean-field models studied by Antisymmetrized Molecular Dynamics
Shoji	Nakamura	Japan Atomic Energy Agency	
Yasushi	Nauchi	CRIEPI	
Denise	Neudecker	LANL	Understanding the impact of nuclear-data covariances on various integral responses using machine learning
Sohei	Odani	Osaka University	Discussion on variety of cross-section candidate obtained by cross-section adjustment method
Mark	Paris	Theoretical Division/LANL	Covariances and parameter confidence intervals from light-element R-matrix evaluations
Donald Kent	Parsons	Los Alamos National Laboratory	A Proposed Method for Addressing Large Unphysical Uncertainties in Mubar
David	Regnier	CEA, DAM, DIF	Bayesian inference of the fission prompt neutron observables

Dimitri	Rochman	Paul Scherrer Institute	TENDL-Stars: with and without covariances
Dimitri	Rochman	Paul Scherrer Institut	Covariances from model variation: application to quantities for astrophysics
Juraldo	Rovira	Japan Atomic Energy Agency	
Georg	Schnabel	IAEA	Bayesian networks for nuclear data evaluation
Nicolas	Schunck	Lawrence Livermore National Laboratory	Autoencoders for nuclear density functional theory
LAHAYE	Sebastien	CEA	
Kazuya	Shimada	Tokyo Institute of Technology	
Nengchuan	Shu	China Institute of Atomic Energy	
Henrik	Sjöstrand	Uppsala university	
Donald L.	Smith		
Xiaodong	Sun	China Institute of Atomic Energy	
Yoshihisa	Tahara	Tokyo Institute of Technology	
Pierre	Tamagno	CEA	Marginalization methods for the production of conservative covariance on nuclear data
Katabuchi	Tatsuya	Tokyo Institute of Technology	Fast-Neutron Capture Cross Section Data Measurement of Minor Actinides for Development of Nuclear Transmutation Systems
Mikio	Tokashiki	Nuclear Fuel Industries, Ltd.	Application of the extended bias factor method for highly reliable benchmark suite
Morgan	White	LANL	
Ruirui	Xu	China Institute of Atomic Energy	Covariance Evaluation for Chinese evaluated nuclear data library
Akio	Yamamoto	Nagoya University	
Naoki	Yamano	Tokyo Institute of Technology	Effect of correlation between cross sections and angular distributions in nuclear data of 63Cu on estimation of uncertainty of neutron penetration
Kenji	Yokoyama	Japan Atomic Energy Agency	Development of adjusted nuclear data library for fast reactor application

CW2022 (CW2020) Scientific program at a glance by presenters' name

JST*	EDT	CEST	Sept. 26 (25)**	Sept. 27 (26)**	Sept. 28 (27)**	Sept. 29 (28)**	Sept. 30 (29)**
5:00	16:00	22:00	Opening	Shunck	Rochman	Regnier	S.Chiba
5:10	16:10	22:10	Leeb	Herman			
5:20	16:20	22:20					Yamano
5:30	16:30	22:30			Griffin	Cheikh	
5:40	16:40	22:40	Paris	Tamagno			Mukobara
5:50	16:50	22:50					
6:00	17:00	23:00	Kunieda		**break**	**break**	**break**
6:10	17:10	23:10		Kodeli	Lovell	Parsons	S.Endo
6:20	17:20	23:20	**break**				
6:30	17:30	23:30	Yokoyama				Lee
6:40	17:40	23:40		**break**	Lu	Kimura	
6:50	17:50	23:50		Kelly			Harada
7:00	18:00	0:00	Maruyama		Kessedjian		
7:10	18:10	0:10				Katabuchi	**break**
7:20	18:20	0:20	Odani	T.Endo			Tokashiki
7:30	18:30	0:30			**break**		
7:40	18:40	0:40	Fukui		G.Chiba	**break**	Shunck
7:50	18:50	0:50		**Break**		W.S.Discussion Neudecker	
8:00	19:00	1:00	**break**	Capote			
8:10	19:10	1:10	Iwamoto		Neudecker		Closing
8:20	19:20	1:20					
8:30	19:30	1:30		Inakura			
8:40	19:40	1:40	Xu		Schnabel		
8:50	19:50	1:50					
9:00	20:00	2:00					

*** JST=GMT+9:00**

** date in parenthsi is that for U.S. and Europe

Day 1 : Septermber 26, 2022 (Sept. 25 in U.S. and Europe)

JST	EDT	CEST	Presenter		Title	Length
5:00	16:00	22:00	**Opening session : S.Chiba, D.Neudecker, O.Iwamoto**			(min.)
			Session 1 Covarianes in light nuclei : A. Carlson (chair)			
5:10	16:10	22:10	Helmut	Leeb	Nuclear Data Evaluation of Light Nuclear Systems	25+5
5:20	16:20	22:20				
5:30	16:30	22:30				
5:40	16:40	22:40	Mark	Paris	Covariances and parameter confidence intervals from light-element R-matrix evaluations	15+5
5:50	16:50	22:50				
6:00	17:00	23:00	Satoshi	Kunieda	Application of R-matrix code AMUR to analysis of J-PARC/ANNRI measurements	15+5
6:10	17:10	23:10				
6:20	17:20	23:20	**break**			
			Session 2 Adjustment of nuclear data based on covariance data : H. Sjostrand (chair)			
6:30	17:30	23:30	Kenji	Yokoyama	Development of adjusted nuclear data library for fast reactor application	25+5
6:40	17:40	23:40				
6:50	17:50	23:50				
7:00	18:00	0:00	Shuhei	Maruyama	Applicabiliy evaluation of Akaike's Bayesian Information Criterion to covariance modeling in the cross-section adjustment method	15+5
7:10	18:10	0:10				
7:20	18:20	0:20	Sohei	Odani	Discussion on variety of cross-section candidate obtained by cross-section adjustment method	15+5
7:30	18:30	0:30				
7:40	18:40	0:40	Yuhei	Fukui	Development of a robust nuclear data adjustment method to outliers	
7:50	18:50	0:50				
8:00	19:00	1:00	**break**			
			Session 3 Covariances in evaluated nuclear data libraries : R. Capote (chair)			
8:10	19:10	1:10	Osamu	Iwamoto	Evaluation of covariance data in JENDL	25+5
8:20	19:20	1:20				
8:30	19:30	1:30				
8:40	19:40	1:40	Ruirui	Xu	Covariance Evaluation for Chinese Evaluated Nuclear Data Library	25+5
8:50	19:50	1:50				
9:00	20:00	2:00				

Day 2 : Septerm 27, 2022 (Sept. 26 in U.S. and Europe)

JST	EDT	CEST	Presenter		Title	Length
5:00	16:00	22:00	**Session 4 A brief tribute session for Eric Bauge : N. Shunck**			(min)
			Session 5 Comprehensive computational tools to generate nuclear-data covarianes : D.L. Smith (chair)			
5:10	16:10	22:10	Michal	Herman	Empire of covariances - art, strategies and correlations.	25+5
5:20	16:20	22:20				
5:30	16:30	22:30				
			Session 6 Advanced covariance methodology 1 : S. Lahaye (chair)			
5:40	16:40	22:40	Pierre	Tamagno	Marginalization methods for the production of conservative covariance on nuclear data	25+5
5:50	16:50	22:50				
6:00	17:00	23:00				
6:10	17:10	23:10	Ivan Alexander	Kodeli	XSUN-2022/SUSD3D n/g Sensitivity-Uncertainty Code Package with Recent JEFF3.3 and ENDF/B-VIII.0 Covariance Data	25+5
6:20	17:20	23:20				
6:30	17:30	23:30				
6:40	17:40	23:40	**break**			
			Session 7 Covariances in fission observables 1: T. Kawano (chair)			
6:50	17:50	23:50	Keegan	Kelly	The Covariance of PFNS Results from the Chi-Nu Experiment	25+5
7:00	18:00	0:00				
7:10	18:10	0:10				
7:20	18:20	0:20	Tomohiro	Endo	Review of data assimilation using prompt neutron decay constant	25+5
7:30	18:30	0:30				
7:40	18:40	0:40				
7:50	18:50	0:50	**Break**			
8:00	19:00	1:00	Roberto	Capote	Experimental spectrum average cross sections in Cf-252(sf) reference neutron field and its impact on evaluation and UQ of neutron standards	25+5
8:10	19:10	1:10				
8:20	19:20	1:20				
8:30	19:30	1:30	Tsunenori	Inakura	Uncertainties evaluation of peak energy of giant dipole resonance propagated from uncertainty of parameters of effective interaction	15+5
8:40	19:40	1:40				

Day 3 : September 28, 2022 (Sept. 27 in U.S. and Europe)

JST	EDT	CEST	Presenter		Title	Length
			Session 8 Application of covariance data : D. Parsons (chair)			(min)
5:00	16:00	22:00	Dimitri	Rochman	Covariances from model variation: application to quantities for astrophysics	25+5
5:10	16:10	22:10				
5:20	16:20	22:20				
5:30	16:30	22:30	Patrick	Griffin	Importance of Cross-Reaction Covariance Data for User Applications	25+5
5:40	16:40	22:40				
5:50	16:50	22:50				
6:00	17:00	23:00	**break**			
			Session 9 Covarianes in fission observables 2 : O. Iwamoto (chair)			
6:10	17:10	23:10	Amy	Lovell	Calculated covariance matrices for fission product yields using BeoH	25+5
6:20	17:20	23:20				
6:30	17:30	23:30				
6:40	17:40	23:40	Zerun	Lu	Generation and Analysis of Independent Fission Yield Covariances Based on GEF Model Code	15+5
6:50	17:50	23:50				
7:00	18:00	0:00	Grégoire	Kessedjian	Covariance analysis of ^{235}U(nth,f) independent and cumulative fission yields	25+5
7:10	18:10	0:10				
7:20	18:20	0:20				
7:30	18:30	0:30	**break**			
			Session 10 Covariances in integral systems and evaluation methodology : M. Herman (chair)			
7:40	18:40	0:40	Go	CHIBA	Uncertainty quantification calculations of nuclide number densities of Gd-bearing fuel rods in light water reactors	25+5
7:50	18:50	0:50				
8:00	19:00	1:00				
8:10	19:10	1:10	Denise	Neudecker	Understanding the impact of nuclear-data covariances on various integral responses using machine learning	25+5
8:20	19:20	1:20				
8:30	19:30	1:30				
8:40	19:40	1:40	Georg	Schnabel	Bayesian networks for nuclear data evaluation	25+5
8:50	19:50	1:50				
9:00	20:00	2:00				

Day 4 : September 29, 2022 (Sept. 28 in U.S. and Europe)

JST	EDT	CEST	Presenter		Title	Length
			Session 11 Covariaces in fission observables 3 : S. Chiba (chair)			(min)
5:00	16:00	22:00	David	Regnier	Bayesian inference of the fission prompt neutron observables	25+5
5:10	16:10	22:10				
5:20	16:20	22:20				
5:30	16:30	22:30	Sidi-Mohamed	Cheikh	Test of models for isotopic distribution evaluation and their impact on the covariance analysis	25+5
5:40	16:40	22:40				
5:50	16:50	22:50				
6:00	17:00	23:00	**break**			
			Session 12 Covariances in experimental data : A. Gook (chair)			
6:10	17:10	23:10	Donald Kent	Parsons	A Proposed Method for Addressing Large Unphysical Uncertainties in Mubar	25+5
6:20	17:20	23:20				
6:30	17:30	23:30				
6:40	17:40	23:40	Atsushi	Kimura	Uncertainty estimation in neutron TOF measurements with ANNRI	25+5
6:50	17:50	23:50				
7:00	18:00	0:00				
7:10	18:10	0:10	Tatsuya	Katabuchi	Fast-Neutron Capture Cross Section Data Measurement of Minor Actinides for Development of Nuclear Transmutation Systems	25+5
7:20	18:20	0:20				
7:30	18:30	0:30				
7:40	18:40	0:40	**break**			
			Workshop discussion		D.Neudecker (chair)	
7:50	18:50	0:50	Room 1		The missing link between ND covariances and users : Go Chiba, Patrick Griffin	
8:00	19:00	1:00	Room 2		Going beyond covariances into an uncertain future : Denise Neudecker, Georg Schnabel	
8:10	19:10	1:10	Room 3		FY covariances : Amy Lovell, Nicolas Schunck	
8:20	19:20	1:20				
8:30	19:30	1:30				
8:40	19:40	1:40				
8:50	19:50	1:50				
9:00	20:00	2:00				

Day 5 : September 30, 2022 (Sept. 29 in U.S. and Europe)

JST	EDT	CEST	Presenter		Title	Length
			Session 13 Application of covariance methodology : P. Griffin (chair)			(min)
5:00	16:00	22:00	Satoshi	Chiba	Uncertainties of nuclear properties of a chloride molten-salt fast reactor system brought by uncertainties in nuclear data of ^{35}Cl studied by a random-sampling method	15+5
5:10	16:10	22:10				
5:20	16:20	22:20	Naoki	Yamano	Effect of correlation between cross sections and angular distributions in nuclear data of ^{63}Cu on estimation of uncertainty of neutron penetration	15+5
5:30	16:30	22:30				
5:40	16:40	22:40	Yuta	Mukobara	Uncertainty in prediction of heavy-ion reactions brought by mean-field models studied by Antisymmetrized Molecular Dynamics	15+5
5:50	16:50	22:50				
6:00	17:00	23:00	**break**			
			Session 14 Covariance in resonance region and beyond : D. Brown (chair)			
6:10	17:10	23:10	Shunsuke	Endo	Covariance of resonance parameters ascribed to systematic uncertainties in experiments	15+5
6:20	17:20	23:20				
6:30	17:30	23:30	Dong Hyuk	Lee	Self-shielded Covariance Generation by Resonance Parameter-based Monte Carlo Perturbation Calculation	15+5
6:40	17:40	23:40				
6:50	17:50	23:50	Hiroki	Harada	Similarity evaluation between neutron multiplication factors and nuclide inventories during nuclear fuel burnup	15+5
7:00	18:00	0:00				
7:10	18:10	0:10	**break**			
			Session 15 Advanced covariance methodology 2 : D. Rochman (chair)			
7:20	18:20	0:20	Mikio	Tokashiki	Application of the extended bias factor method for highly reliable benchmark suite	15+5
7:30	18:30	0:30				
7:40	18:40	0:40	Nicholas	Shunck	Autoencoders for Nuclear Density Functional Theory	25+5
7:50	18:50	0:50				
8:00	19:00	1:00				
8:10	19:10	1:10	**Closing: D.L.Smith, D.Neudecker, G.Chiba, S.Chiba**			
8:20	19:20	1:20				