Los Alamos NATIONAL LABORATORY

Memorandum

To:	Dr. Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-ESH-21
From:	Joetta Goda, LANL NCSP Task Manager, MS B228 Thanos Stamatopoulos,P-3, MS H805
Symbol:	NEN-2:23-030
Date:	June 30, 2023

Subject: Report on Foreign Travel to Aix-en-Provence, France for participation in the 6th International Workshop on Nuclear Data Evaluation for Reactor Applications (WONDER-2023)

Meeting Details

Attendees on behalf of NCSP from LANL

Thanos Stamatopoulos

Meeting Title

6th edition of the International Workshop On Nuclear Data Evaluation for Reactor Applications (WONDER-2023), organized by CEA IRESNE with the help of the CEA Cadarache center.

Meeting Location

Aquabella Hotel, 2 rue des étuves, 13100 Aix-en-Provence, France

Meeting Dates

June 5th -9th, 2023

Meeting Objective

This workshop is the continuation of a series of workshops held in 2006, 2009, 2012, 2015, and 2018. The main objective of the workshop is to review the current modeling and evaluation methods of nuclear data for reactor applications (operational and future nuclear installations) and to debate possible areas of improvement.

Purpose of Travel

Attendee from Los Alamos National Laboratory traveled from the US to France to attend the workshop in person.

Thanos Stamatopoulos presented as the PI of the ^{149}Sm(n,tot) measurement at LANL, the latest results from the combined (n,tot) and (n,g) R-Matrix analysis on ^{149}Sm.

Meeting Benefits to the NCSP

The conference allowed the attendee to:

i. Advertise the capability that is available at LANL/LANSCE to perform (n,tot) and (n,g) experiments in small amounts of materials relevant to NSCP
ii. Showcase the unique methodology developed at LANL to extract resonance spins, which is important in evaluations.
iii. Gather information on important measurements that need to be executed relevant to reactor applications.
iv. Foster collaborations between LANL and international institutions, as described in the USDOE NCSP Mission and Vision, Five-Year Execution Plan.
v. Publish the presented work in peer-reviewed journal.
vi. Recruit early career professionals.

Meeting Summary

The workshop focused on nuclear data needs for reactor applications, microscopic and integral nuclear data measurements, evaluation of nuclear data including theories, models and codes, uncertainties and covariance matrices and their impact on reactor calculations, processing and benchmarking, thermal scattering laws, decay data and fission including prompt particle emission and fission yields. A visit to the CEA Cadarache Center was included.

Side meetings

Thanos Stamatopoulos met with the following participants:

i. Gilles Noguere of CEA Cadarache, France. A fruitful discussion took place on the resonance analysis of the $^{147/149}$Sm data that were presented in the workshop. The interesting findings of the analysis were discussed thoroughly, and useful advice and creative ideas were proposed to test the analysis procedure.

ii. Gilles Noguere of CEA Cadarache. A potential collaboration was discussed concerning the study of ^{239}Pu and the data evaluation to follow since CEA Cadarache is planning a measurement of ^{239}Pu samples at the Gelina facility in JRC-Geel and LANL will perform a measurement of ^{239}Pu in the coming few months.

iii. Nacho Duran of Universidad de Santiago de Compostela, Spain. A discussion on an evaluation on the recent ^{233}U data taken with the DANCE instrument and funded by NCSP took place. The evaluator showed interest in performing an evaluation in the near future and technical details were discussed on the data analysis and taking.

iv. Carlos Paradela of JRC-Geel, Belgium. JRC-Geel performed an evaluation on ^{95}Mo and published it a few months ago. LANL published a paper on new ^{95}Mo resonance parameters that was funded by NCSP a few months ago. The JRC-Geel work shows discrepancies with the LANL data. Unfortunately, JRC performed the work before LANL published the data. A re-evaluation was discussed.

v. Carlos Paradela of JRC-Geel, Belgium. JRC-Geel is the owner of an R-Matrix code similar to SAMMY, that provides additional modeling. The process of getting the code in addition to training was discussed.

vi. Sotiris Chasapoglou of NTU Athens, Greece. Sotiris is a high-class senior PhD student in neutron physics and will graduate in December. Possible postdoctoral projects, relevant to NSCP were discussed.

Attachment(s): Workshop timetable

Copy: Doug Bowen, ORNL, bowendg@ornl.gov
John Miller, SNL, millerj@sandia.gov
Marsha Henley, ORNL, henleym@ornl.gov
Johnna Marlow, LANL, jmarlow@lanl.gov

MONDAY, JUNE 5

12:00 PM → 2:00 PM **Lunch break** 2h

12:00 PM → 2:00 PM **Registration**

2:00 PM → 2:30 PM **Introduction**

- 2:00 PM **Welcome** 10m
  Speaker: Dr Olivier Serot (CEA)
- 2:10 PM **Overview of CEA Research Institute for Nuclear Systems for Low-Carbon Energy Production** 15m
  Speaker: Ruggieri Jean-michel (CEA, IRESNE)
  Wonder_Ruggieri.pdf

2:30 PM → 4:00 PM **Microscopic and integral nuclear data measurements**
Convener: Carlos Paradela

- 2:30 PM **Recent Nuclear Data Activity at the RPI Gaerttner LINAC Center** 30m
  Speaker: Prof. Yaron Danon (Rensselaer Polytechnic Institute)
  2_DANON_Abstract... WONDER_DANON_...
- 3:00 PM **Total and Double Differential Scattering Cross-Section Measurements of Isotropic Graphite** 30m
  Speaker: Dr ATSUSHI KIMURA (Japan Atomic Energy Agency)
  2_KIMURA_Abstract... Wonder_KIMURA.pp...
- 3:30 PM **Experimental setup of the ^{239}Pu neutron capture and fission cross-section measurements at n_TOF, CERN** 30m
  Speaker: Adrian Sanchez Caballero (CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES))
  2_SANCHEZ-CABAL... WONDER_Sanchez-...

4:00 PM → 4:30 PM **Coffee break** 30m

4:30 PM → 5:50 PM **Microscopic and integral nuclear data measurements**
Convener: Yaron Danon (Rensselaer Polytechnic Institute)

- 4:30 PM **^{50,53}Cr(n,γ) cross section measurement at n_TOF** 20m
  Speaker: Pablo Perez Maroto (Universidad de Sevilla)
  2_PEREZ-MAROTO_... WONDER_Perez_Ma...
- 4:50 PM **Toward the improvement of the 238U level scheme thanks to γ-spectroscopy** 20m
  Speaker: Carole CHATEL (CNRS/IPHC/CNRS)
  2_CHATEL_Abstract... Wonder_Chatel.pptx
- 5:10 PM **Measurement of 242Pu(n,f) in the [1;2MeV] energy range** 20m
  Speaker: Ludovic MATHIEU (CNRS)
  2_MATHIEU_Abstra... WONDER_Mathieu.p...
- 5:30 PM **Investigation of (n,x) reactions with enriched Ge targets at 15.7 MeV at the upgraded facility of NCSR "Demokritos"** 20m
  Speaker: Sotirios Chasapoglou (National Technical Univ. of Athens (GR))
  2_CHASAPOGLOU_... Wonder_chasapogl...

TUESDAY, JUNE 6

9:00 AM → 10:30 AM **Microscopic and integral nuclear data measurements**
Convener: Gilles Noguere (CEA Cadarache)

- 9:00 AM **Study of 149Sm capture and total cross sections for burnup credit applications** 30m
  Speaker: Athanasios Stamatopoulos (National Technical Univ. of Athens (GR))
  2_STAMATOPOULO... Wonder_Stamatopo...
- 9:30 AM **Study of (n,α) reactions of interest for nuclear energy** 20m
  Speaker: Aurélien CHEVALIER
  2_CHEVALIER_Abstr... Wonder_Chevalier.pdf
- 9:50 AM **Validation of the Monte-Carlo efficiency calculation of the LOENIEv2 long counter for delayed neutron measurements** 20m
  Speaker: Pierre LECONTE (CEA)
  2_LECONTE_Abstra... WONDER_Leconte.p...
- 10:10 AM **Sample Worth Measurement of Calcium Hydride** 20m
  Speaker: Prof. Jun-ichi Hori (Institute for Integrated Radiation and Nuclear Science, Kyoto University)
  2_SANO_Abstract_... WONDER_Hori.pptx

10:30 AM → 11:00 AM **Coffee break** 30m

11:00 AM → 12:30 PM **Nuclear fission**
Convener: Olivier Litaize

- 11:00 AM **Dependence of total kinetic energy of fission fragments as functions of excitation energy and neutron excess for U and Pu isotopes** 30m
  Speaker: Satoshi Chiba (Tokyo Institute of Technology)
  3_CHIBA_Abstract_... WONDF2023_Chiba...
- 11:30 AM **Revisiting prompt emission of 252Cf(SF) with focus on post-neutron fragment distributions and different correlations** 30m
  Speaker: Anabella Tudora
  3_TUDORA_Abstrac... Wonder_Tudora.pdf
- 12:00 PM **Energy Dependence of Prompt Fission Neutron Multiplicity in the 239Pu(n, f) Reaction** 30m
  Speaker: Paola Marini (Centre National de la Recherche Scientifique (FR))
  3_MARINI_Abstract... Wonder_Marini.pdf

12:30 PM → 2:20 PM **Lunch break** 1h 50m

2:20 PM → 3:10 PM **Nuclear fission**
Convener: Satoshi Chiba (Tokyo Institute of Technology)

- 2:20 PM **Investigation of the structure of $^{235}U(n_{th},fission)$ prompt gamma energy spectrum by FIFRELIN** 30m
  Speaker: Tatsuhiko Ogawa (Japan Atomic Energy Agency)
  3_OGAWA_Abstract... Wonder_Ogawa.pptx
- 2:50 PM **FIRST RESULTS ON 235U(NTH,F) INDEPENDENT ISOTOPIC FISSION YIELDS USING PROMPT GAMMA RAYS AT FIPPS** 20m

Speaker: Pierre Herran

3_HERRAN_Abstrac... Wonder_Herran.pdf

3:10 PM → 4:00 PM **Theory**

Convener: Rémi Bernard (CEA)

3:10 PM **Microscopic prediction of gamma-ray strength function** 30m

Speaker: Mikael Frosini (CEA, DES, IRESNE, DER, SPRC, LEPh)

5_FROSINI_Abstract... WONDER_Frosini.pp...

3:40 PM **Fisrt study of the 235U multi-chance fission with the FIFRELIN code** 20m

Speaker: Mathias Sabathé (CEA)

5_SABATHE_Abstra... WONDER_Sabathe....

4:00 PM → 4:30 PM **Coffee break** 30m

4:30 PM → 5:10 PM **Theory**

Convener: Rémi Bernard (CEA)

4:30 PM **Assimilating fission-code FIFRELIN using Machine Learning.** 20m

Speaker: Guillaume Bazelaire

5_BAZELAIRE_Abstr... Wonder_Bazelaire.p...

4:50 PM **Fundamentals and progress of theoretical models for the evaluation of photonuclear reaction data in CNDC** 20m

Speaker: Yuan Tian (China Institute of Atomic Energy)

5_TIAN_Abstract_W... Wonder_Yuan_tian....

WEDNESDAY, JUNE 7

9:00 AM → 10:00 AM **Theory**

Convener: Mikael Frosini (CEA, DES, IRESNE, DER, SPRC, LEPh)

9:00 AM **Theoretical study of forbidden non-unique beta transitions** 30m

Speaker: Xavier Mougeot

5_MOUGEOT_Abstr... Wonder_Mougeot.pdf

9:30 AM **Systematic large scale Quasiparticle Random Phase Approximation calculations with Relativistic and Chiral Interactions** 30m

Speaker: Luis González-Miret Zaragoza (Université Paris-Saclay, CEA)

5_GONZALEZ-MIRE...

10:00 AM → 10:30 AM **Coffee break** 30m

10:30 AM → 11:30 AM **Evaluation of nuclear data**

Convener: Helmut Leeb (TU Wien (AT))

10:30 AM **Update of the CIELO U238 resonance evaluation to improve LWR performance with burnup and LEU lattice criticality** 30m

Speaker: Roberto Capote Noy (IAEA)

1_CAPOTE_Abstract... WONDER_Capote.p...

11:00 AM **Looking for one integral reference for the (n,f) reaction in actinides above 1 MeV** 30m
Speaker: Dr Ignacio Duran (Universidad de Santiago de Compostela (Spain))
1_DURAN_Abstract_... WONDER_Duran.pptx

11:30 AM → 2:00 PM **Lunch break** 2h 30m

12:45 PM → 6:30 PM **Visit of CEA Cadarache Center** 5h 45m

7:30 PM → 10:30 PM **Conference dinner** 3h

THURSDAY, JUNE 8

9:00 AM → 10:30 AM **Evaluation of nuclear data**
Convener: Roberto Capote (International Atomic Energy Agency)

9:00 AM **Contribution to the JEFF project** 30m
Speaker: Carlos Paradela
1_PARADELA_Abstr... Wonder_Paradela.pdf

9:30 AM **Direct radiative capture calculations on 56Fe** 20m
Speaker: Georgios Gkatis
1_GKATIS_Abstract... WONDER_Gkatis.pptx

9:50 AM **Ongoing developments at the Decay Data Evaluation Project** 20m
Speaker: Sylvain Leblond (CEA Saclay)
1_LEBLOND_Abstra... Wonder_LEBLOND.p...

10:10 AM **Evaluation of nuclear data using the Half Monte Carlo technique** 20m
Speaker: Erik Andersson Sundén (Uppsala University, Department of Physics and Astronomy, Sweden)
1_ANDERSSON_Abs... Wonder_Andersson ...

10:30 AM → 11:00 AM **Coffee break** 30m

11:00 AM → 12:30 PM **Evaluation of nuclear data**
Convener: Goran Arbanas (ORNL)

11:00 AM **Progress towards the ENDF/B-VIII.1 release** 30m
Speaker: Gustavo Nobre (Brookhaven National Laboratory)
1_NOBRE_Abstract_... WONDER_Nobre.pdf

11:30 AM **A Nuclear Data Evaluation Pipeline for the Fast Neutron Energy Range - using heteroscedastic Gaussian processes to treat model defects** 30m
Speaker: Dr Alf Göök (Uppsala University)
1_GOOK_Abstract_... Wonder-Gook.pdf

12:00 PM **Challenges in Nuclear Data Evaluations of Light Nuclear Systems** 30m
Speaker: Helmut Leeb (Vienna University of Technology (AT))
1_LEEB_Abstract_W... WONDER_Leeb.pdf

12:30 PM → 2:00 PM **Lunch break** 1h 30m

2:00 PM → 2:50 PM **Evaluation of nuclear data**

Convener: David BERNARD (CEA)

- 2:00 PM **Advancing the theory of nuclear data evaluations** 30m
  Speaker: Goran Arbanas (ORNL)
  1_ARBANAS_Abstra... WONDER_Arbanas....
- 2:30 PM **study of (n,2n) reaction cross section of fission product based on neural network and decision tree models** 20m
  Speaker: Xiaodong Sun (China Institute of Atomic Energy)
  1_SUN_Abstract_W... WONDER-Sun.pptx

2:50 PM → 3:40 PM **Uncertainties and covariance matrices**

Convener: Grégoire Kessedjian (CEA Cadarache / IRESNE /DER / SPRC / LEPh)

- 2:50 PM **Development of a new module to process covariances in the IRSN nuclear data processing code GAIA** 30m
  Speaker: Pierre Sole (IRSN)
  7_SOLE_Abstract_W... WONDER_SOLE.pptx
- 3:20 PM **Producing uncertainties and covariance matrix from intermediate data using a Monte-Carlo method.** 20m
  Speaker: Greg HENNING
  7_HENNING_Abstra... WONDER_Henning....

3:40 PM → 4:00 PM **Coffee break** 20m

4:00 PM → 5:40 PM **Processing and benchmarking**

Convener: Oscar Cabellos (Universidad Politecnica de Madrid)

- 4:00 PM **Radiation Safety Information Computational Center (RSICC): An Information Analysis Center for Nuclear Science** 30m
  Speaker: Timothy Valentine (Oak Ridge National Laboratory)
  4_VALENTINE_Timo... WONDER-Valentine....
- 4:30 PM **Integrated, Automated, and Reproducible Nuclear Data Processing at the NEA** 30m
  Speaker: Daniela Foligno (OECD/NEA)
  4_FOLIGNO_Abstra... Wonder_Foligno.pptx
- 5:00 PM **Preliminary investigation of nuclear data sampling for the new Monte Carlo code TRIPOLI-5®** 20m
  Speaker: Coline Larmier
  4_LARMIER_Abstra... Wonder_LARMIER.p...
- 5:20 PM **Recent development in the GALILÉE-1 processing code** 20m
  Speaker: Cédric Jouanne (CEA Saclay)
  4_JOUANNE_Abstra... WONDER_Jouanne....

FRIDAY, JUNE 9

9:00 AM → 9:20 AM **Processing and benchmarking**

Convener: Oscar Cabellos (Universidad Politecnica de Madrid)

- 9:00 AM **Improvements on the damage calculations using evaluated nuclear data and NJOY** 20m
  Speaker: Shengli Chen