OMB Number: 4040-0004
Expiration Date: 11/30/2025

Application for Federal Assistance SF-424

*** 1. Type of Submission:** ○ Pre-application ◉ Application ○ Changed/Corrected Application	*** 2.Type of Application:** *If Revision, select appropriate letters(s): ◉ New ○ Continuation ○ Revision * If Revision, select appropriate letter(s): * Other (Specify):
*** 3.Date Received:** 2024-04-01	**4.Applicant Identifier:** AM241072
5a. Federal Entity Identifier:	**5b. Federal Award Identifier:**

State Use Only:

6. Date Received by State:	**7. State Application Identifier:**

8. APPLICANT INFORMATION:

***a. Legal Name:** Louisiana State University

***b. Employer/Taxpayer Identification Number (EIN/TIN):** 72-6000848	***c. UEI:** ECQEYCHRNKJ4

D. Address:

* Street 1: 202 Himes Hall
Street 2:
* City: Baton Rouge
County:
* State: LA: Louisiana
Province:
* Zip/Postal Code: 70803-0001
* Country: USA: UNITED STATES

e. Organization Unit:

Department Name: LSUAM | Col of Coast and Envir	Division Name:

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:
*First Name: Darya
Middle Name: Delaune
* Last Name: Courville
Suffix:

Title: Executive Director-Nonacademic Area

Organizational Affiliation:
Louisiana State University

* Telephone Number: (225)578-2760	Fax Number:

* Email: osp@lsu.edu

9. Type of Applicant 1: Select Applicant Type:
H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

*Other (specify):

*10. **Name of Federal Agency:** Nuclear Regulatory Commission

11. Catalog of Federal Domestic Assistance Number: 77.008	CFDA Title U.S. Nuclear Regulat
***12. Funding Opportunity Number:** 31310024K0001	* Title U.S. Nuclear Regulat
13. Competition Identification Number:	* Title

14. Areas Affected by Project(Cities, Counties, States, etc.):

Add Attachment

***15. Descriptive Title of Applicant's Project:**

Risk Assessment from Climate-Change-Induced Variation of Radiation in the United States

Attach supporting documents as specified in agency instructions.

16. Congressional Districts Of: *a. Applicant LA-006	*b. Program/Project LA-006

Attach an additional List of Program/Project Congressional Districts is needed.

Add Attachment

17. Proposed Project: *a. Start Date 2024-09-01	*b. End Date 2027-08-31

18.Estimated Funding($):

*a. Federal	500000
*b. Applicant	0
*c. State	0
*d. Local	0
*e. Other	0
*f. Program Income	0
*g. TOTAL	500000

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

a. This application was made available to the State under the Executive Order 12372 Process for review on.

b. Program is subject to E.O. 12372 but has not been selected by the State for review.

c. Program is not covered by E.O. 12372.

*** 20. Is this Applicant Delinquent On Any Federal Debt? (If "Yes", provide explanation below.)**

Yes No

Add Attachment

21.*By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that and false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties.(U.S. Code, Title 18, Section 1001)**

**I AGREE

**The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix:	
* First Name:	Darya
Middle Name:	Delaune
* Last Name:	Courville
Suffix:	

* Title: Executive Director-Nonacademic Area

* Telephone Number: (225)578-2760	Fax Number:
* Email: osp@lsu.edu	
* Signature of Authorized Representative: Completed on submission to Grants.gov	*Date Signed: Completed on submission to Grants.gov

OMB Number: 4040-0006
Expiration Date: 02/28/2022

BUDGET INFORMATION - Non-Construction Programs

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
31310024K0001	77.008	$	$	$ 179,180.00	$	$ 179,180.00
31310024K0001	77.008			161,648.00		161,648.00
31310024K0001	77.008			159,172.00		159,172.00
5.Totals		$	$	$ 500,000.00	$	$ 500,000.00

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total
	(1) 31310024K0001 Year 1	(2) 31310024K0001 Year 2	(3) 31310024K0001 Year 3	(4)	(5)
a. Personnel	$ 68,656.00	$ 68,656.00	$ 68,656.00	$	$ 205,968.00
b. Fringe Benefits	13,429.00	13,429.00	13,429.00		40,287.00
c. Travel	4,437.00	4,437.00	4,437.00		13,311.00
d. Equipment	7,167.00				7,167.00
e. Supplies	14,110.00	7,200.00	5,549.00		26,859.00
f. Contractual					
g. Construction					
h. Other	19,870.00	19,870.00	19,870.00		59,610.00
i. Total Direct Charges (sum of 6a-6h)	127,669.00	113,592.00	111,941.00		353,202.00
j. Indirect Charges	51,511.00	48,056.00	47,231.00		146,798.00
k. TOTALS (sum of 6i and 6J)	$ 179,180.00	$ 161,648.00	$ 159,172.00	$	$ 500,000.00
7. Program Income	$	$	$	$	$

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
8. 31310024K0001 Year 1	$	$	$	$
9. 31310024K0001 Year 2				
10. 31310024K0001 Year 3				
11.				
12. Totals (sum of lines above)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 179,180.00	$ 44,795.00	$ 44,795.00	$ 44,795.00	$ 44,795.00
14. Non-Federal					
15. TOTAL (sum of lines 13 and 14)	$ 179,180.00	$ 44,795.00	$ 44,795.00	$ 44,795.00	$ 44,795.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
16. 31310024K0001 Year 1	$ 161,648.00	$ 159,172.00	$	$
17. 31310024K0001 Year 2				
18. 31310024K0001 Year 3				
19.				
20. TOTAL (sum of lines above)	$ 161,648.00	$ 159,172.00	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: $353,202	22. Indirect Charges: $146,798 (50% * MTDC)
23. Remarks:	

CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grand, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of lobbying Activities," in accordance with it's instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contract under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

If any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the Unites States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions. Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

* APPLICANT'S ORGANIZATION: Louisiana State University and A&M College

* PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

Prefix:	
* First Name:	Darya
Middle Name:	
* Last Name:	Courville
Suffix:	
* Title:	Executive Director

* SIGNATURE:	* Date:
Completed on submission to Grants.gov	Completed on submission to Grants.gov

ATTACHMENTS FORM

Instructions: On this form, you will attach the various files that make up your grant application. Please consult with the appropriate Agency Guidelines for more information about each needed file. Please remember that any files you attach must be in the document format and named as specified in the Guidelines.
Important: Please attach your files in the proper sequence. See the appropriate Agency Guidelines for details.

1) Please attach Attachment 1	Kim et al final.pdf	Delete Attachment · Original · Transform
2) Please attach Attachment 2	Add Attachment	
3) Please attach Attachment 3	Add Attachment	
4) Please attach Attachment 4	Add Attachment	
5) Please attach Attachment 5	Add Attachment	
6) Please attach Attachment 6	Add Attachment	
7) Please attach Attachment 7	Add Attachment	
8) Please attach Attachment 8	Add Attachment	
9) Please attach Attachment 9	Add Attachment	
10) Please attach Attachment 10	Add Attachment	
11) Please attach Attachment 11	Add Attachment	
12) Please attach Attachment 12	Add Attachment	
13) Please attach Attachment 13	Add Attachment	
14) Please attach Attachment 14	Add Attachment	
15) Please attach Attachment 15	Add Attachment	

EXECUTIVE SUMMARY

Risk Assessment from Climate-Change-Induced Variation of Radiation in the United States

Yong-Ha Kim (PI),[1] Supratik Mukhopadhyay (co-PI),[2] Edward Laws (co-PI),[3] Wei-Hsung Wang (co-PI)[4,5]

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[3] Department of Environmental Sciences, Louisiana State University, Baton Rouge, LA 70803. Email: edlaws@lsu.edu; Telephone: 225-578-8800.
[4] Center for Energy Studies, Louisiana State University, Baton Rouge, LA 70803. Email: weihsung@lsu.edu; Telephone: 225-578-2743.
[5] Radiation Safety Office, Louisiana State University, Baton Rouge, LA 70803.

Total Funding Requested: $500,000 (for 3 years)

Local and national radon potential maps of the United States (US) may vary in the coming decades due to climate change, which affects environmental conditions of radon-containing media (e.g., temperatures in soil, air, and building materials) and also leads to the degradation of radon-trapping permafrost. This project is aimed at developing and combining theoretical/analytical models for radon and radon progeny as well as an Artificial Intelligence (AI)-guided framework in order to assess and project climate-change-induced variations of indoor and occupational exposure to the radionuclides and to unveil potential radon precautionary areas in the US. Experimental and modeling investigations will be carried out to develop and verify the models. A local context-sensitive, high-resolution, mechanistic model will be developed for the AI framework analysis. Comprehensive and extensive databases including historical radon map changes will be built for the AI analysis of radon potential variation. The microphysical models will be coupled with the AI analysis and projection to gauge the climate-change-driven radiation risk variation in the US.

This proposed work will offer novel microphysical indoor radon models that combine radiological, microphysical, and indoor processes, as well as an innovative, high-fidelity AI framework targeting radionuclides of interest. The radon models and the AI-aided framework can be coupled to assess potential variations of radon in the North American and Northern Hemisphere domains. The coupled approaches can also be used for the assessment of radiation-induced health risks as well as the post-analysis of severe nuclear accidents focusing on environmental and health effects after updating radionuclide data. The work will also advance the current understanding of the behavior of radon and radon progeny in indoor media and will offer a novel pathway to apply AI methodology in nuclear and nuclear-related fields.

The proposed work will contribute to the development of an ethnically and academically diverse nuclear workforce. Highly qualified students matriculated in nuclear and nuclear-related fields of study at Louisiana State University and Southern University and A&M College at Baton Rouge (SUBR) will be recruited for the proposed work and will be mentored by the multidisciplinary team members with diverse academic backgrounds. SUBR is a minority-serving institution with an ethnically diverse student pool.

PROJECT DESCRIPTION

1. BACKGROUND. Radon-222 is a natural radionuclide generated by the decay of radium-226 embedded in rocks, soil, and building materials. ^{222}Rn can enter indoor environments via various pathways (see Fig. 1) and undergoes radioactive decay, generating a series of progenies.[1] Radon and its progenies in the air can lead to exposure via inhalation that can cause a variety of respiratory diseases, including lung cancer.[1-3] Indeed, radon-induced exposure to radiation has been a major cause of lung cancer in the United States[3] and can be more detrimental when the radionuclides are inhaled with other indoor air pollutants such as those in cigarette smoke.[4] To protect public health as well as nuclear workers from unnecessary radiation exposure, it is therefore vital to accurately assess health risks associated with radon-containing indoor air.

The reliability of radiation-induced health risk assessments depends on the accuracy of radiation dose estimates. For typical dose models, radiation exposure from inhaled radionuclides is converted into a radiation dose, and the distributions of radionuclides in gas and aerosol phases are important for that estimated dose.[5] For reliable risk assessments, it is therefore essential to precisely predict the concentrations of radon and radon progenies and their distributions in indoor environments.

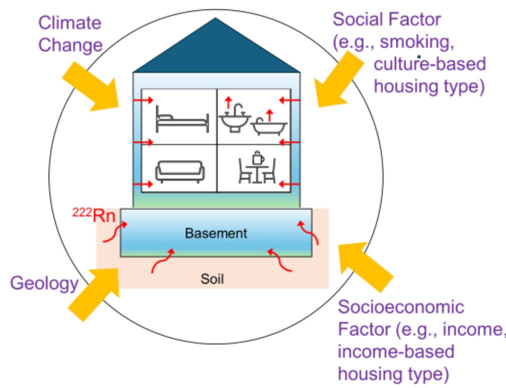

Fig. 1. Radon entry pathways[1] and indoor air pollution factors.

Accurate prediction of indoor concentrations of radon and its decay products requires consideration of the influence of radon sources:[1] radon-containing soil, building materials, and water (see Fig.1). In radon precautionary regions where source strengths are high, more radon can enter indoor environments and thereby increase indoor radioactivity concentrations. In the coming decade, these regions are likely to expand in the US, as well as in the Northern Hemisphere,[6] because of climate change and degradation of permafrost that traps radon in soil.[6-8] Recent US climate trends show changes in extreme temperatures,[9] drought,[9,10] humidity,[11] and precipitation days.[11,12] Such changes of climate parameters can influence adsorption and desorption capacities of radon-containing soil and building materials[1,13-14] and thereby facilitate radon exhalation and increase the flux of radon toward indoor air. In permafrost areas, field observations in 2021 have demonstrated that radon flux from the ground surface was more than 8 times greater in thawed soil than frozen soil.[7] Glover and Blouin have also shown that indoor air concentrations can increase more than 100-fold due to continued permafrost degradation.[8] These findings suggest that as climate change continues, radon potential maps representing its source strengths in both the US and the Northern Hemisphere are likely to change. In order to precisely assess radon exposure for the US population and project its variation due to climate change effects, it is vital to first identify radon-prone types of dwellings and building materials under projected climate change conditions as well as veiled radon precautionary areas that may become high radon potential zones (e.g., areas at borderline radon concentrations) as a result of the overall effects of climate change on the source strengths.

Extensive and comprehensive databases can play a major role in identifying and projecting potential changes of radon concentrations. There are multiple national-level databases, including (i) the EPA map of radon zone,[15] (ii) the CDC Environmental Health Tracking Network (EHTN),[16] (iii) the NOAA Climate Data, [17] (iv) the CDC United States Cancer Statistics,[18] and (v) the United States Census Bureau (USCB).[19] The EPA map of radon zone developed in 1993 includes mean indoor radon levels obtained with indoor and outdoor ^{222}Rn concentrations, geological conditions, and foundation types,[15] while the CDC EHTN provides local, timely radon measurements obtained from several states and national laboratories since 1993.[16] The other three databases include time-series data for climate, rates of lung cancer, cultural hazards (e.g., smoking), and housing patterns in the US.[17-19] However, these databases have rarely been combined, in particular, for the geographical and temporal analysis of radon potential because the relationships between numerous, short-term radon measurements and long-term radon measurements are inconsistent.[20] However, a recent epidemiological study performed with a national dataset has demonstrated that long-term radon variations can be predicted by analyzing short-term radon measurements with statistical techniques.[20] The implication is that the databases can be integrated to predict the impact of climate change on radon potential.

Accurately predicting the impact of climate change on radon-induced health risks will require two key tools for (i) task-based complex data processing and (ii) mathematical modeling of indoor radon and radon progenies. Estimating the impact of climate change on indoor radon concentrations can be a complex task because radon is a natural radionuclide that cannot be controlled and because the concentrations can be affected by numerous factors, including climatic factors (e.g., temperature), geological factors (e.g., soil composition and qualify of groundwater where there are houses), social factors (e.g., culture-based housing types and lifestyles), and socioeconomic factors (e.g., income-based housing maintenance) (see Fig.1). In particular, these factors can vary widely, and if they are unexpectedly linked together, they can simultaneously affect other factors in ways that can significantly change the estimation. In such cases, although data-science-based approaches may misrepresent the estimation, state-of-the-art Artificial Intelligence (AI) models can automatically make corrections to unveil the links and thereby correctly estimate the concentrations.[21,22] An AI model can therefore be a tool for the prediction. Mathematical modeling of indoor radon and radon progenies can be conducted with kinetic and equilibrium models combined with measurements and empirical coefficients to better understand the behavior of the radionuclides.[1,23-25] However, current modeling approaches can be time-consuming, and empirical coefficients are rarely valid for variable indoor and inhalation conditions. In particular, aerosol charging can be important in predicting post-inhalation behavior, but it is typically neglected. During nasal passage, radionuclide-containing aerosols can be charged/discharged by triboelectric charging on nasal hair surfaces.[26,27] During bronchial passage, radon progenies may be discharged, but charging of radioactive aerosols can be strongly enhanced because ionization of air molecules is restricted.[28,29] The location in the respiratory tract where the aerosols are deposited and hence the location where respiratory diseases develop are thereby affected. The implication is that deterministic and microphysical modeling approaches are needed to accurately predict radon-induced health risks.

<u>As a proactive effort to protect the public and nuclear workers from the elevated exposure to radon caused by climate change, we propose to carry out experimental and modeling investigations to assess the potential impact of climate change on indoor and occupational radiation risks in the U.S. We will develop AI-based and microphysical approaches for the assessments. Although there have been recent attempts to use AI models for radon mapping,[30,31] we are aware of no effort to use both AI and indoor radon modeling to assess the effects of climate change on radon-induced health risks in the U.S. This proposed work is in line with the following technical area of NRC's interest: "*Characterization of natural hazards including but not limited to flooding, high winds, hurricanes, wildfires, climate change*"</u>.

2. PROPOSED APPROACH. <u>The main goal of the proposed work is to develop and combine theoretical/analytical models of indoor radon and radon progenies and an AI-guided framework to estimate the effects of climate change on radon-induced health risks in the U.S.</u> To achieve this goal, 3 experimental tasks and 7 modeling tasks involving 4 AI tasks will be performed within a 3-year period. Experimental tasks will be focused on investigating triboelectric charging of indoor aerosols. Modeling tasks will be focused on developing two tools: (i) microphysical approaches to predict the behavior of radon and radon progenies in indoor media and respiratory tract and (ii) an AI-guided framework for AI-driven mapping of U.S. radon potential changes. The tools will be combined for risk assessment from climate-change-induced radiation variation in the United States. Detailed tasks of the proposed work are described as follows.

Task 1 (Y1)	Preparation of Experimental Apparatus for Charge Measurement
Task 2 (Y1)	Triboelectric Charging of Indoor Aerosols
Task 3 (Y1-Y3)	AI Dataset Creation for Mapping Variations of Radon Risk
Task 4 (Y1-Y2)	Development of Approaches to Predict Behavior of Radon and Radon Progenies
Task 5 (Y1-Y2)	Development of a Mechanistic AI Model to Predict Radon Release
Task 6 (Y2-Y3)	Case Study: Impact of Climate Change on Radon Risk in Alaska
Task 7 (Y2-Y3)	Effects of Relative Humidity on Triboelectric Aerosol Charging (Years 2 & 3)
Task 8 (Y3)	Simulation of Radionuclide Transport and Deposition in Respiratory Tract
Task 9 (Y3)	AI-driven Mapping of U.S. Radon Potential
Task 10 (Y3)	Assessment of Impact of Climate Change on Inhaled Radon Dose in U.S.

Task 1: Preparation of Experimental Apparatus for Charge Measurement (Y1). The objective of this task is to prepare a particle levitation system for measuring the electrical charge of single particles (Fig. 2). An experimental apparatus will be newly installed in the LSU Radiation Research Laboratory on the basis of the radiological worker training and research experience of the PI at the Oak Ridge National Laboratory (ORNL). The apparatus will consist of an electrodynamic balance chamber that will include two electrodes, a light source, a microscope, a humidity controller, a charge neutralizer, and a power supply. When a particle is injected into the chamber, electrical potential will be applied to the electrodes to create an electric field to levitate the particle. The movement of the particle in the electric field will be observed using the microscope, and its upward velocity will be measured. With the measured upward velocity, the electric charge carried by the particle will be determined according to Davis and Schweiger[32]. The particle mass and size will also be obtained by measuring its terminal settling velocity in the chamber without an electric field. The shape factor and the Cunningham correction factor will be considered for measurements according to Hinds and Zhu[33]. A preliminary test has been performed with the apparatus installed at ORNL without the humidifier. The test showed that at a relative humidity of ~18%, the charge of micron-size dust particles could be measured using the system.

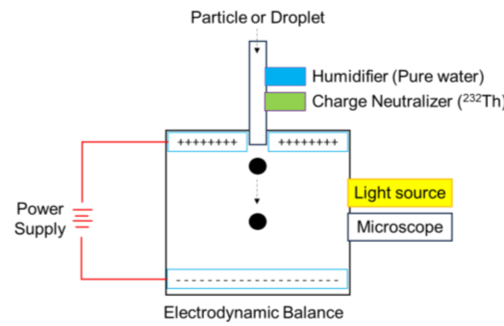

Fig. 2. A particle levitation system

Task 2: Triboelectric Charging of Indoor Aerosols (Y1). For residential and workplace environments (e.g., basements in radon-prone areas and coal and uranium mining facilities) with poor indoor air quality, the concentrations of particles in the air can be high. The concentrations can further increase by seasonal variations (e.g., pollen seasons). If a person breathes in the air without proper personal protective equipment (e.g., a mask), many particles carrying radon progenies can be inhaled via narrow nasal and oral airways. During inhalation, particles can collide with each other as well as nasal hairs, and they can be strongly charged by triboelectrification.[26,27] This task will therefore focus on investigating triboelectric charging characteristics of various indoor particles that can carry radon progenies. The investigation will be performed using the experimental system prepared in Task 1. Particles that can be potential radionuclide carriers (e.g., urban dust, pollen, soil, and smoke)[34,35] will be sampled at LSU and mechanically shaken to induce triboelectric charging. Typical shaking conditions will be taken from the literature.[36,37] This methodology is normally used to study aerosol triboelectrification.[36] The particles will then be injected into the levitation system. Their size and charge will be measured. For comparison, measurements will be repeated without mechanical shaking.

A preliminary test has been performed by injecting mechanically shaken dust particles into the ORNL apparatus. The test showed that the particles could be triboelectrically charged.

Task 3: AI Dataset Creation for Mapping Radon Risk Variation (Y1-Y3). AI combines extremely large datasets, human-like data processing algorithms, and statistical approaches for machine/deep learning.[21,22] However, AI analysis can often lead to unreliable outcomes when datasets are small and their quality is low. For AI-driven mapping, maps generated with low-resolution grid data are inaccurate. The implication is that it is vital to obtain high-quality datasets for reliable AI analysis. <u>The focus of this task will thus be on creating local, context-sensitive and high-resolution-grid-based datasets for mapping historical changes in radon risks in the US.</u> The AI datasets will be built with diverse raw and treated open data including but not limited to climate data, radon maps, geological surveys, housing data, building materials, annual statistics, and epidemiological cohort data on lung cancer. Such data will be collected via open databases of federal agencies such as the EPA,[15] CDC,[16,18], NOAA[17], and USCB[19], as well as state departments, and scientific papers and reports. These data will be continuously curated to enlarge the database size and range, and to enhance the quality of the data.

Task 4: Development of Approaches to Predict Behavior of Radon and Radon Progenies (Y1-Y2). The concentrations of radon and radon progenies and their distributions in gas and aerosol phases are critical parameters for radiation dose estimation.[5] Accurately predicting the radionuclide concentrations and distributions in indoor media depends on understanding their behavior, which can be investigated using various models.[1] Our preliminary investigations for the proposed work (submitted)[38], as well as Hu et al.[24], have demonstrated that kinetic models may be more accurate than other models and can be readily incorporated into health risk assessments. <u>This task will therefore aim at developing various approaches that precisely predict the evolution of the concentrations and distributions of radon and radon progenies in indoor media and the respiratory tract.</u>

Subtask 4.1: Deterministic Approaches to Predict Radionuclide-Aerosol Attachment. That typical radon models include empirical radionuclide-aerosol attachment coefficients that may be only valid for specific environmental conditions adds uncertainties to predicting the radon progeny distributions in the air (e.g., see Zarcone et al.[25]). Deterministic coefficients can be used to reduce the uncertainties resulting from variations of indoor and respiratory tract conditions. <u>In this subtask, with population balance (PB), various deterministic approaches will therefore be developed to forecast the attachment of radon progenies to indoor aerosols.</u> Radioactive decay, radionuclide-aerosol attachment, ionizing radiation, and aerosol charging will be coupled in the approaches. One approach will include multivariate PB equations that fully describe the processes. The other approaches will be developed with monovariate PB equations that can significantly reduce computational costs. The developed approaches will be verified with numerical analysis, steady-state analysis, and measurements available in the literature.[1,23-25] The PI has the experience needed to conduct such approach development processes (see Kim et al.[28]). A preliminary investigation has been performed by developing PB approaches for radioactive aerosols and radioactive gases (Fig. 3). Predictions obtained from the approaches agreed well with measurements and analytical solutions available in the literature [Fig 3(a)-(b)]. The approaches will be coupled to simulate the attachment of radionuclides to charged aerosols.

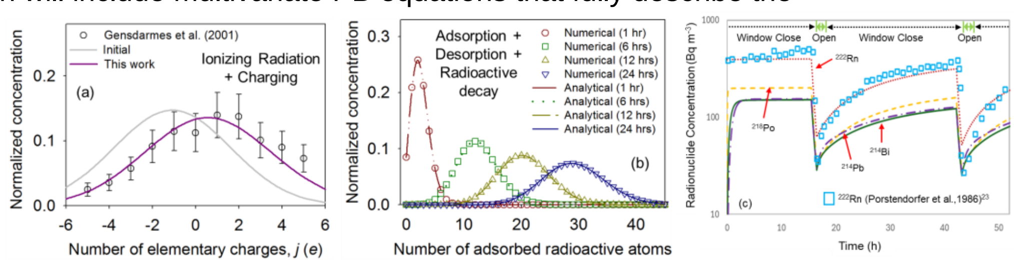

Fig. 3. Preliminary investigations using population balance [(a)-(b)] and theoretical/ analytical approach[38] (c).

Subtask 4.2: Theoretical Approaches to Predict the Behavior of Radon and Radon Progenies. <u>This subtask will be focused on developing theoretical approaches of typical room models that</u>

describe the behavior of radon and radon progenies in well-mixed air. To include changes of radionuclide-aerosol attachment coefficients by variable indoor conditions, the most efficient approach developed in subtask 4.1 will be coupled with the theoretical approaches. A preliminary attempt has been made to develop a theoretical/analytical approach for a well-mixed house containing monodisperse aerosols. For case studies providing the empirical attachment coefficients, the predictions obtained by the approach agreed well with the measurements made during the studies [Fig. 3(c)]. The developed approach will be extended to cover polydisperse aerosols. Attempts will be made to develop analytical approaches for multiple-story buildings.

Task 5: Development of a Mechanistic AI Model to Predict Radon Release (Y1-Y2). AI analysis with limited local context can be inaccurate because AI uses misrepresented local mechanisms and factors for its learning. Thus, it is essential to develop a high-resolution predictive framework to accurately understand local factors that affect radon potential. This task will aim at developing an AI-guided framework to characterize local indicators of radon and its environmental distributions at high fidelity. For the development, we have already built an AI-based framework that can use geophysical/spatio-temporal/remote sensing data (Fig. 4). We will further develop a local context-sensitive, high-resolution-grid-based mechanistic model to predict the conditions underlying radon release at local levels and the consequent radon distributions in the environment. We will couple the model with an AI-driven spread model that will predict the dispersion of the released radon and help estimate the radiation risks for the local population. The grid-based spread model will consider weather data, elevation above sea-level, topographic factors, land cover, population statistics, etc., to characterize the dispersion of radon and its health risks for a given population at a local level. The datasets created in Task 3 will be linked to the framework for its analysis.

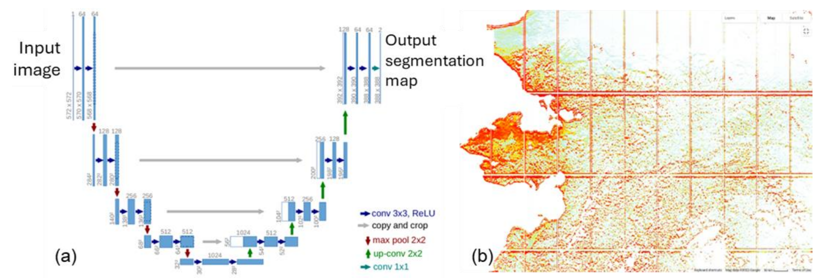

Fig. 4. LSU AI model: (a) structure and (b) preliminary investigation to predict permafrost degradation in Alaska.

Task 6: Case Study: "Perma-AI: Artificial Intelligence Driven Understanding of Permafrost Degradation" (Y2-Y3). To test the mechanistic AI model developed in Task 6, a case study will be performed for Alaska in this task. The AI database created in Task 3 will be enhanced with high-resolution grid data. With the dataset linked to the AI framework, we will predict the conditions underlying permafrost degradation at local levels and the consequent radon distributions in thawed soil. We will use geophysical/spatio-temporal/remote sensing data to generate heat maps of permafrost degradation and radon soil distributions in residential areas. Fig 4.(b) shows a preliminary test result to predict permafrost degradation in Alaska that will be overlayed for mapping radon potential using AI. We will couple the map with an AI-driven spread model that will predict the transport of radon in outdoor air and help estimate the radiation risks for the local population.

Task 7: Effects of Relative Humidity on Triboelectric Aerosol Charging (Y2-Y3). Indoor air humidity can vary because of weather, heating, ventilation, and humidification.[27] Those variations can influence the moisture content of breathed air. [27] Change in the moisture content of breathed air can lead to charging and discharging of inhaled particles in the respiratory tract via condensation and evaporation.[39] This task will thus be focused on investigating the effects of relative humidity on the charging of single particles carrying radon progenies. The particle levitation system shown in Fig. 1, radioactive particle surrogates, and the particles sampled in Task 2 will be used for the investigation. In comparison with radioactive particles, the interactions of their surrogates and water vapor can be similar.[40] Water droplets containing radionuclide surrogates such ^{209}Bi will be injected into the system. When the droplets are injected, they will be quickly evaporated and transformed into single, solid particles. For example, at 50% relative humidity, a 10-µm droplet can be evaporated within 0.1 second.[33] The evaporation of the droplets containing $^{209}Bi(NO_3)_3$ will lead to the formation of single bismuth(III) nitrate particles. Its relative humidity will then be changed from 0 to 80 %, and the particle charge at each relative humidity will be measured. In addition, the $^{209}Bi(NO_3)_3$ solution will be sprayed onto the sampled particles, which will be subsequently dried and mechanically shaken to induce triboelectric charging. Then, the sampled particles containing ^{209}Bi will be injected into the levitation system. The particle charge will be measured in a range of relative humidities. The effects of typical aerosol components such as ammonium sulfate and sodium nitrate on the measurements will also be investigated. Ultrapure water will be used to synthesize all solutions and to control the humidity of the system to minimize the effects of unknown dissolved components on the investigation. Measurements will also be repeated for triboelectrically charged particles used in Task 2 to assess the effects of humidity on initially charged particles. Young et al. have reported that there are linear relationships between relative humidity and the discharging of triboelectrically charged particles.[41] Thus, attempts will also be made with statistical techniques to find empirical charging/discharging coefficients of the particles used in this task.

A preliminary test with the ORNL apparatus has shown that an aqueous droplet of 100 µm can be quickly transformed via evaporation into a 1.5-µm particle in dry air.

Task 8: Simulation of Radionuclide Transport and Deposition in the Respiratory Tract (Year 3). The objective of this task will be to predict transport and deposition of radon progeny in the human respiratory tract. A new size-resolved microphysical model will be developed to simulate the behavior of inhaled radionuclides in the human respiratory tract. This microphysical model will be based on the approaches developed in Task 4 and will include various processes such as coagulation, electrostatic dispersion, condensation, evaporation, mixing, transport, and deposition. The descriptions of these processes are available in Hickey and da Rocha,[27] Hinds and Zhu,[33] and Kim et al.[28] The empirical coefficients obtained in Task 7 will be used to include the effects of triboelectric charging. Various scenarios will be used for computational simulations, including inhalation of triboelectrically charged radioactive particles carrying radon progenies.

Task 9: AI-driven Radon Potential Mapping (Y3). On the basis of Tasks 3, 5, and 6, which will develop the AI-guided framework linked to the high-resolution grid datasets, attempts will be made to obtain time-dependent changes of radon potential maps for the U.S. Because the datasets will include time-series data of environmental parameters (e.g., air and soil temperature) and past and current radon maps, statistical techniques will be used to project the variation of radon concentrations that respond to the environmental changes. In addition, according to IPCC Climate Change reports,[42] various scenarios will be made to assess the effects of radon release from permafrost areas on U.S. radon zones. In particular, the assessments will be focused on states at borderline radon concentrations (e.g., between Zone 2 and Zone 3), as well as states with high background radon concentrations.

Task 10: Assessment of Impact of Climate Change on Inhaled Radon Dose in U.S. (Y3). This task will be focused on assessing the variation of radon-induced health risks due to climate change. The models developed in Tasks 4 and 8 will be used to estimate radiation dose in indoor and work environments. Typical radon concentrations given by Task 9 will be used for the assessments. Workplaces with high aerosol/radon concentrations or with limited ventilation will be assumed. Diverse scenarios will be assumed to project the effects of variation of climate-change-driven radon potential on human health.

3. MAJOR GOALS/MILESTONES. The major goals/milestones of the proposed project include: FY 2025: Prepare experimental apparatus for charge measurements. Use the apparatus to obtain fundamental data on triboelectric charging. Develop deterministic approaches to predict radionuclide-aerosol attachment. Create a high-quality AI dataset for radon mapping.

FY 2026: Develop approaches to predict radionuclide behavior in indoor air and the respiratory tract. Develop a mechanistic AI model. Begin the AI model test for Alaska. Investigate triboelectric charging under various indoor conditions.
FY 2027: Complete the AI model test. Obtain empirical charging coefficients. Develop a microphysical model to track radionuclides in the respiratory tract. Simulate radon progeny transport and deposition. Create AI-driven Radon Map. Project variations of radon map due to climate change. Assess change of radon risk due to climate change.

4. SIGNIFICANCE AND INNOVATION. This proposed work will offer novel microphysical indoor radon models that combine radiological, microphysical, and indoor processes, as well as an innovative high-fidelity AI framework for radionuclides. These radon models and the AI-aided framework may be used to assess radon potential variation in the North American and Northern Hemisphere domains. The coupled approach can also be used for the assessment of radiation-induced health risks as well as the post-analysis of severe nuclear accidents focusing on environmental and health effects after updating radionuclide data. The work will further advance the current understanding of the behavior of radon and radon progenies in indoor media and will offer a new pathway to apply AI methodology in nuclear and nuclear-related fields.

6. PRINCIPAL INVESTIGATORS. Dr. Yong-Ha Kim of Environmental Sciences (ES) will be the PI of this project and will coordinate all research and reporting activities. Dr. Kim obtained his Ph.D. in aerosol microphysics and has published 8 journal articles studying charging and microphysics of radioactive aerosol. Dr. Supratik Mukhopadhyay of ES will lead the AI tasks. Dr. Mukhopadhyay has 4 AI-related patents and his team was among 10 semifinalists in the 2020 AI XPRIZE global competition. Dr. Edward Laws of ES will support statistical analysis in experimental tasks. Dr. Laws has expertise in statistics and has published over 100 refereed articles involving statistical analysis. Dr. Wei-Hsung Wang of LSU Radiation Safety Office (RSO) will provide support on the experimental work and dose estimation. Dr. Wang is the only faculty member who earned a certified health physicist title at LSU. Highly qualified graduate students of LSU and Southern University and A&M College at Baton Rouge (SUBR) will be recruited for this project and conduct modeling and experimental tasks. The key personnel and students will have bi-weekly meetings to discuss their research activities.

7. EVALUATION PLAN. The proposed work will be evaluated using the following parameters: (1) annual project report submission and its feedbacks; (2) annual goal completion; (3) scholarly achievements of key personnel (e.g., the numbers of peer-reviewed publications, presentations at professional conferences, patents, and academic awards and honors); (4) the number of graduate students supported via this project and their scholarly and academic achievements (e.g., the numbers of publications and presentations, GPAs, etc); and (5) the career path of the students in nuclear-relevant fields upon graduation.

8. INVOLEMENT OF MINORITY SERVIVING INSTUTITIONS. Involving minority serving institutions can be beneficial to develop diverse nuclear workforces because the institutions can have an ethnically diverse student pool. To recruit graduate students for the project, we will accept applications of highly qualified SUBR students (a minimum 3.3 major and cumulative GPA) matriculated in nuclear-related fields, as well as LSU students. SUBR students can be hired by LSU. SUBR is one of the largest historically black universities in the US and has the largest pools of highly qualified ethnic minority applicants in Louisiana. We will conduct several recruiting activities with marketing strategies (e.g., traditional advertising and online and social media advertising) targeting student communities of SUBR. Because LSU and SUBR have an institutional agreement (https://catalog.lsu.edu/content.php?catoid=27&navoid=2419), SUBR students can take courses needed for the project without additional tuition fees. Because SUBR is physically close to LSU, SUBR students recruited for this project can easily visit LSU facilities and laboratories to perform experiments and to attend the team meetings.

9. COST-SHARING AND MATCHING: Not applicable.

10. Organizational Conflict of Interest (OCOI): Not applicable.

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*** Accessed on March 31, 2024**

Budget and Budget Narrative

TITLE: Risk Assessment from Climate-Change-Induced Radiation Variation in the United States

PI: Yong-Ha Kim
Co-PI: Edward Laws, Wei-Hsung Wang, Supratik Mukhopadhyay

	Year 1	Year 2	Year 3	Total
Personnel	$68,656	$68,656	$68,656	$205,968
Fringe Benefits	$13,429	$13,429	$13,429	$40,287
Travel	$4,437	$4,437	$4,437	$13,311
Supplies	$14,110	$7,200	$5,549	$26,859
Other	$19,870	$19,870	$19,870	$59,610
Equipment	$7,167	$0	$0	$7,167
Direct Cost	$127,669	$113,592	$111,941	$353,202
Indirect Cost	$51,511	$48,056	$47,231	$146,798
Total	$179,180	$161,648	$159,172	$500,000

A. Personnel $205,968

Yong-Ha Kim; Assistant Professor
The University is requesting funds to support Yong-Ha Kim for 1 month each summer. His summer rate has been calculated at 1/9 of his academic salary.

Academic year salary: $90,476
Summer rate: $90,476 / 9 mos = $10,053

Yr. 1: 2025 summer rate: $10,053; for 1 month = $10,053
Yr. 2: 2026 summer rate: $10,053; for 1 month = $10,053
Yr. 3: 2027 summer rate: $10,053; for 1 month = $10,053
Total: $30,159

Edward Laws; Professor
The University is requesting funds to support Edward Laws for 1/4 month each summer. His summer rate has been calculated at 1/9 of his academic salary.

Academic salary: $199,042
Summer rate: $199,042 / 9 mos = $22,116

Yr. 1: 2025 summer rate: $22,116; for 1/4 month = $5,529
Yr. 2: 2026 summer rate: $22,116; for 1/4 month = $5,529
Yr. 3: 2027 summer rate: $22,116; for 1/4 month = $5,529
Total: $16,587

Wei-Hsung Wang; Professor-Research
The University is requesting funds to support Wei-Hsung Wang for 1/4 month each year. His monthly rate has been calculated at 1/12 of his annual salary.

Annual salary: $151,947
Monthly rate: $151,947 / 12 mos = $12,662

Year. 1: 2025 monthly rate: $12,662; for 1/4 month = $3,166
Year. 2: 2026 monthly rate: $12,662; for 1/4 month = $3,166
Year. 3: 2027 monthly rate: $12, 662; for 1/4 month = $3,166
Total: $9,498

Supratik Mukhopadhyay; Professor
The University is requesting funds to support Supratik Mukhopadhyay for 1/4 month each summer. His summer rate has been calculated at 1/9 of his academic salary.

Academic salary: $140,691
Summer rate: $140,691 / 9 mos = $15,632

Yr. 1: 2025 summer rate: $15,632; for 1/4 month = $3,908
Yr. 2: 2026 summer rate: $15,632; for 1/4 month = $3,908
Yr. 3: 2027 summer rate: $15,632; for 1/4 month = $3,908
Total: $11,724

<u>Graduate Assistants:</u>
Support for two (100% appointment) graduate students is requested in the amount of $23,000 per academic year. The graduate students will be focused on four tasks: (1) to design and conduct experiments, (2) to analyze, and interpret measurements, (3) to assist modeling investigations, and (4) to prepare manuscripts for publication in peer-reviewed journals. The rate was determined according to LSU's Graduate Stipends Increase Initiation Plan (https://www.lsu.edu/graduateschool/files/grad_stipends_increase_initiation_plan.pdf) setting graduate assistants' minimum academic year stipends to $23,000.

Year 1: Academic year rate: $23,000 x 2 Graduate Assistants = $46,000
Year 2: Academic year rate: $23,000 x 2 Graduate Assistants = $46,000
Year 3: Academic year rate: $23,000 x 2 Graduate Assistants = $46,000
Total: $138,000

B. Fringe Benefits $40,287
The federally approved fringe rate for the Louisiana State University faculty is currently 44% of direct labor, corresponding to $16,300/year x 3 years = $48,900.

Yr 1: Yong-Ha Kim: $10,053*44% = $4,423
Edward Laws: $5,529*44% = $2,433
Wei-Hsung Wang: $3,166*44% = $1,393
Supratik Mukhopadhyay: $3,908*44% = $1,720
Graduate assistants: $1730 per student x 2 students = $3,460
Total: $13,429

Yr 2: Yong-Ha Kim: $10,053*44% = $4,423
Edward Laws: $5,529*44% = $2,433
Wei-Hsung Wang: $3,166*44% = $1,393
Supratik Mukhopadhyay: $3,908*44% = $1,720
Two graduate students: $1730 per student x 2 students = $3,460
Total: $13,429

Yr 3: Yong-Ha Kim: $10,053*44% = $4,423
Edward Laws: $5,529*44% = $2,433
Wei-Hsung Wang: $3,166*44% = $1,393
Supratik Mukhopadhyay: $3,908*44% = $1,720
Two graduate students: $1730 per student x 2 students = $3,460
Total: $13,429

C. Travel $13,311

Support funds are requested in the amount of $4,437 for year 1, $4,437 for year 2, and $4,437 for year 3 for travel cost associated with this project. The requested funds will be used to attend NRC annual meeting, and/or domestic conferences (e.g., annual meetings of American Nuclear Society and Health Physics Society) or for professional meetings.

Year 1: The total includes estimated airfare ($1,274; $637 x 2 people x 1 trips), hotel stay ($648; $108 x 2 people x 3 days), per diem allowance ($720; $120 x 2 people x 3 days), registration ($1,495; $1,045 for faculty and $450 for a student), and miscellaneous incidentals including ground transportation, parking, and luggage fees ($300).

Year 2: The total includes estimated airfare ($1,274; $637 x 2 people x 1 trips), hotel stay ($648; $108 x 2 people x 3 days), per diem allowance ($720; $120 x 2 people x 3 days), registration ($1,495; $1,045 for faculty and $450 for a student), and miscellaneous incidentals including ground transportation, parking, and luggage fees ($300).

Year 3: The total includes estimated airfare ($1,274; $637 x 2 people x 1 trips), hotel stay ($648; $108 x 2 people x 3 days), per diem allowance ($720; $120 x 2 people x 3 days), registration ($1,495; $1,045 for faculty and $450 for a student), and miscellaneous incidentals including ground transportation, parking, and luggage fees ($300).

The above travel costs were estimated from the following assumptions:

Conference and registration: 2024 ANS Annual Meeting, Las Vegas, NV (https://www.ans.org/meetings/ac2024/).

Airfare: Delta, Baton Rouge, LA – Las Vegas, NV

Hotel rate and per diem allowance: LSU University Travel Regulations (https://www.lsu.edu/administration/ofa/oas/acctpay/travel.php).

D. Supplies $26,859

Year 1: Supplies are requested in the amount of $16,888 to cover the costs of general supplies. The costs are based on historical data.

- $4,000 is required for preparing a particle levitation system. The cost includes an electrodynamic balance, a rod base, steel rod, digital multimeter, power supply, and camera microscope.
- $2,888 is required for the cost of general chemicals, power particles, meters/pumps, and consumables to operate the particle levitation system.
- $2,500 is requested for purchasing laptop and/or desktop and computer peripherals (e.g., monitor, cables, external drives, keyboard, mouse, etc) to control the experimental system.

- $7,500 is requested for purchasing a workstation and/or desktop and computer peripherals (e.g., monitor, cables, external drives, keyboard, mouse, etc) for simulation.

Year 2: Supplies are requested in the amount of $9,200 to cover the costs of general supplies. The costs are based on historical data.

- $2,000 is required for repairing and managing the particle levitation system (e.g., replacement of the parts).
- $5,700 is required for the cost of general chemicals, power particles, meters/pumps, and consumables to operate the particle levitation system.
- $1,500 is requested for purchasing computer peripherals (e.g., monitor, cables, keyboard, external drives, mouse, etc) to control experimental systems and for simulation.

Year 3: Supplies are requested in the amount of $5,549 to cover the costs of general supplies. The costs are based on historical data.

- $4,549 is required for the cost of general chemicals, power particles, and consumables to operate the particle levitation system.
- $1,000 is requested for purchasing computer peripherals to control experimental systems and for simulation (e.g., monitor, cables, external drives, keyboard, mouse, etc).

E. Equipment $7,170

Year 1: Support funds are requested in the amount of $7,170 to purchase a water purification system to produce Type I water. The costs are based on catalog pricing. Type I water is deionized water and will be used to synthesize all solutions needed for experimental investigations as well as to control the humidity of the system to minimize the effects of unknown dissolved components on the investigations.

F. Other $59,610

Tuition Remission $52,440
Tuition Remission is requested for the graduate students for each year of the project. The amount is calculated at a rate of 38% of the total amount requested for the graduate students. https://www.lsu.edu/osp/proposals/policies-procedures/current-rates.php) This rate has been used for Federal Awards (https://www.lsu.edu/administration/ofa/oas/spa/pdfs/fy23-24-fringerates.pdf).

Year 1: $23,000 x 2 students x 38% = $17,480
Year 2: $23,000 x 2 students x 38% = $17,480
Year 3: $23,000 x 2 students x 38% = $17,480

Publication Costs $7,170
$7,170 is requested in Year 1, Year 2 and Year 3 for manuscript publication.

Year 1: $2,390 x 1 manuscript = $2,390
Year 2: $2,390 x 1 manuscript = $2,390
Year 3: $2,390 x 1 manuscript = $2,390

The above publication costs were estimated from the following assumptions:

Scientific Reports (publication fees: $2,390 per manuscript)
https://www.nature.com/srep/open-access

G. Indirect Cost $146,798

Indirect costs are calculated using Modified Total Direct Costs and applying our federally negotiated rate of 50%. Tuition remission is not subject to indirect costs. The indirect cost base is $293,595. The indirect rate agreement is attached.

Year 1: $103,022 x 50% = $51,511
Year 2: $96,112 x 50% = $48,056
Year 3: $94,461 x 50% = $47,231

Current and Pending Support

1. Current Grants and Contracts

Yong-Ha Kim

Principal Investigator (PI): Electrochemical and Biological Remediation of Radioactively Contaminated Water. US Nuclear Regulatory Commission (NRC), 03/2024-present

PI: LSU Nuclear Multidisciplinary Scholarship Program. US NRC, 05/2022-present

Co-PI: LSU Expanded Nuclear Science and Engineering Graduate Fellowship Program. US NRC, 08/2019-present

Supratik Mukhopadhyay

PI: Artificial Intelligence-driven Selection of Safe CO_2 Injection Sites in Louisiana. Institute for Energy Innovation, Louisiana State University (LSU), 08/2023-present

PI: LSU Climate Resilient Innovations for Sustainable Production of RICE (CRISP-RICE). National Institute of Food and Agriculture, 04/2022-present

Co-PI: FMCSA HP-CMV Highway Safety Improvement Implementation Plan. Federal Motor Carrier Safety Administration (FMCSA), 07/2022-present

Edward Laws

Co-PI: Electrochemical and Biological Remediation of Radioactively Contaminated Water. US NRC, 03/2024-present

Wei-Hsung Wang

Co-PI: Electrochemical and Biological Remediation of Radioactively Contaminated Water. US NRC, 03/2024-present

Co-PI: LSU Nuclear Multidisciplinary Scholarship Program. US NRC, 05/2022-present

Co-PI: LSU Expanded Nuclear Science and Engineering Graduate Fellowship Program. US NRC, 08/2019-present

2. Pending Grants and Contracts

Yong-Ha Kim

PI: Modelling inhaled radionuclide deposition in human respiratory systems, Louisiana Board of Regents (LA BOR), 06/2024-06/2027.

PI: Capacitive Deionization Device to Clean up Radioactive Spills, LA BOR, 06/2024-06/2025.

PI: Electrochemical and Biological Processes for Membrane-based Desalination Pretreatment, Bureau of Reclamation (BOR), 09/2024 – 28/2026.

Supratik Mukhopadhyay

Co-PI: HP-CMV – Understanding Driver Behavior Inside a Commercial Vehicle Using Video Analytics for High-Fidelity Crash Models, FMCSA, 09/2024 - 09/2026.

Edward Laws

Co-PI: Electrochemical and Biological Processes for Membrane-based Desalination Pretreatment, BOR, 09/2024 – 28/2026.

Wei-Hsung Wang

Co-PI: Capacitive Deionization Device to Clean up Radioactive Spills, LA BOR, 06/2024-06/2025.

Curriculum vitae of Yong-Ha Kim

Louisiana State University, 1261 Energy, Coast, and Environment Building, Baton Rouge, LA 70803
Phone: 225-578-4295, Fax: 225-578-4286, Email: yonghakim1@lsu.edu

Present Title and Affiliation

Assistant Professor of Environmental Sciences, Louisiana State University, Baton Rouge, LA

Education

- Jeju National University, Jeju, South Korea, BS, 2007, Civil and Environmental Engineering
- Seoul National University, Seoul, South Korea, MS, 2009, Environmental Engineering
- Seoul National University, Seoul, South Korea, PhD student, 2009-2011, Environmental Engineering
- Georgia Institute of Technology, Atlanta, GA, PhD, 2016, Environmental Engineering

Professional and Academic Experience

- Assistant Professor of Environmental Sciences (2018-pres), Louisiana State University
- Visiting Scholar (2019-2020), Georgia Institute of Technology
- Lecturer (2018), Jeju National University
- Postdoctoral Fellow (2016-2018), Georgia Institute of Technology
- Rad Worker I & II, Oak Ridge National Laboratory, 2015 – 2019
- Graduate Research Assistant (2012-2015), Georgia Institute of Technology
- Graduate Research Assistant (2007-2011), Seoul National University

Selected Honors and Awards

- Excellent Paper Award, 2023 Korean Society of Radiology Fall Conference, 2023
- LSU Service-Learning Faculty Scholar, LSU, 2023
- Best Paper Award, 2022 Korean Society of Radiology Fall Conference, 2022
- Excellent Paper Award, 2022 Korean Society of Radiology Fall Conference, 2022
- Encouragement Award, 2022 Korean Society of Radiology Fall Conference, 2022
- Bronze Award (Excellent Paper Competition in Faculty Session), 2022 Korean Society of Radiology Spring Conference, 2022
- Human Resources Cultivation Scholarship, Jeju Special Self-Governing Province, 2012
- Excellent Paper Presentation Award, Korean Society of Water and Wastewater, 2011
- Excellent Paper Presentation Award, International Water Association (IWA)-SIR BK21, 2009
- Third Prize, IWA Student Poster Competition, IWA, 2007
- Excellent Paper Award, Korean Society of Water Quality, 2007

Patent

- Apparatus for Treating Waste Water. Han, M.Y.; Kim, T.I.; Kim, Y.-H. (South Korea Patent No. 1011899120000).
- Decentralized Fire-Fighting Water Management System for Wide Area Disaster Prevention. Han, M.Y.; Kim, Y.-H. (South Korea Patent No. 1012696990000).

Research and Education Grants and Contracts

Funded (Focusing on Application of Radiation Chemistry and Physics in Environmental Science and Engineering)

- Principal Investigator: Electrochemical and Biological Remediation of Radioactively Contaminated Water. US Nuclear Regulatory Commission (NRC), 03/2024-present
- Principal Investigator: Modelling inhaled radionuclide deposition in the human lung, LSU Provost's Fund for Innovation in Research, 06/2023-08/2023.

- Principal Investigator: LSU Nuclear Multidisciplinary Scholarship Program. US Nuclear Regulatory Commission, 05/2022-04/2024.
- Co-Investigator: LSU Expanded Nuclear Science and Engineering Graduate Fellowship Program. US Nuclear Regulatory Commission, 08/2019-06/2023.
- Co-Investigator: Early-time Signatures of a Nuclear Detonation in Urban Areas. Defensive Threat Reduction Agency, 04/2018-03/2021.
- Collaborator: Radioactive Particle Levitator to Study the Effects of Radioactivity on the Particle Charging Behavior, Oak Ridge National Laboratory, 10/2014-09/2016.

Selected Publications (Focusing on Charging and Microphysics of Radioactive Aerosol and Radioactivity Transport Modeling; from 18 peer-reviewed papers)

1. Wiechert, A.I., Ladshaw, A.P., Kim, Y.H., Tsouris, C. and Yiacoumi, S., 2023. Simulation of radioactive plume transport in the atmosphere including dynamics of particle aggregation and breakup. Journal of Environmental Radioactivity, 263, p.107167.
2. Jang, G.G., Wiechert, A.I., Kim, Y.-H., Ladshaw, A.P., Spano, T., McFarlane, J., Myhre, K., Yiacoumi, S. and Tsouris, C., 2022. Charging of Radioactive and Environmental Airborne Particles. J. Environ. Radioact., 248, 106887.
3. Ladshaw, A.; Wiechert, A.I.; Kim, Y.H.; Tsouris, C.; Yiacoumi, S. 2020. "Algorithms and Algebraic Solutions of Decay Chain Differential Equations for Stable and Unstable Nuclide Fractionation. Computer Physics Communications 246, 106907.
4. Vasilakos, P.; Kim, Y.H.; Pierce, J.R.; Yiacoumi, S.; Tsouris, C.; Nenes, A. 2018. "Studying the Impact of Radioactive Charging on the Microphysical Evolution and Transport of Radioactive Aerosols with the TOMAS-RC v1 Framework." Journal of Environmental Radioactivity 192, 150-159.
5. Kim, Y.-H.; Yiacoumi, S.; Nenes, A.; Tsouris, C. 2017. "Incorporating Radioactive Decay into Charging and Coagulation of Multicomponent Radioactive Aerosols." Journal of Aerosol Science 114, 283-300.
6. Kim, Y.-H.; Yiacoumi, S.; Nenes, A.; Tsouris, C. 2016. "Charging and Coagulation of Radioactive and Nonradioactive Particles in the Atmosphere." Atmospheric Chemistry and Physics 16, 3449-3462.
7. Kim, Y.-H.; Yiacoumi, S.; Tsouris, C. 2015. "Surface Charge Accumulation of Particles Containing Radionuclides in Open Air." Journal of Environmental Radioactivity 143, 91-99.
8. Kim, Y.-H.; Yiacoumi, S.; Lee, I.; McFarlane, J.; Tsouris, C. 2014. "Influence of Radioactivity on Surface Charging and Aggregation Kinetics of Particles in the Atmosphere." Environmental Science & Technology 48, 182-189.

Selected Conferences and Symposia

- Invited Presentation, 232nd Electrochemical Society Meeting (2017)
- Speaker, 87th-90th ACS Colloid and Surface Science Symposiums (2013-2016)
- Speaker, 2013-2016 AIChE Annual Meetings (2013-2016)
- Speaker, 2022 Southwest Regional Meeting of the ACS (2019, 2022)
- Speaker, 2022 Conferences of the Korean Society of Radiology (2022)

Professional Memberships/Activities

- Member, American Chemical Society
- Member, Health Physics
- Review Editors, Frontiers in Chemical Engineering, 2020 – present

Curriculum vitae of Supratik Mukhopadhyay

Louisiana State University, 2067 Energy, Coast, and Environment Building, Baton Rouge, LA 70803

Phone: 225-578-1469, Fax: 225-578-4286, Email: mmukho1@lsu.edu

Present Title and Affiliation

Professor of Environmental Sciences, Louisiana State University, Baton Rouge, LA

Education

- Jadavpur University, India, BS, 1994, Electrical Engineering
- Indian Statistical Institute, India, MS, 1996, Computer Science
- Max Planck Institute for Informatics and University of Saarland, Germany, Ph.D., 2001, Computer Science

Professional and Academic Experience

- Professor of Environmental Sciences (2022-pres), Louisiana State University
- Associate Professor of Computer Sciences, (2015-2021), Louisiana State University
- Occidental Chemical Corporation Career Development Professorship (2013-2015), Louisiana State University
- CEO (2015 – 2017), AutoPredictiveCoding
- Cofounder and Chief Scientist (2017 – pres), Ailectric LLC
- Assistant Professor of Computer Sciences, (2009-2015), Louisiana State University
- Assistant Professor of Computer Sciences, (2006-2009), Utah State University
- Assistant Professor of Computer Sciences, (2002-2006), West Virginia University
- Postdoctoral Scholar (2001-2002), University of Pennsylvania

Relevant Teaching at Current Institution

- Instructor, CSC 4762 Blockchain & Cryptocurrency, 2021-2022.
- Instructor, CSC 3380 Object-Oriented Design, 2007-2021.
- Instructor, CSC 4101 Programming Languages, 2020-2021.
- Instructor, ENGR 4200 Autonomous Vehicles, 2015-2019.
- Instructor, CSC 7150 Program Analysis & Model Checking, 2010-2017.
- Instructor, CSC 4330 Software Development, 2012-2013.

Selected Honors and Awards

- Best Paper Award, 20th International Conference on Runtime Verification, 2020
- Among 10 semifinalists in AI XPRIZE global competition out of 142 teams, 2020
- Dean’s Scholarship Award, College of Engineering, Louisiana State University, 2016
- LSU Alumni Association Rising Faculty Research Award, 2014
- Dean’s Scholarship Award, College of Engineering, Louisiana State University, 2013
- Winner of Phi Kappa Phi Nontenured Faculty Award, Louisiana State University for Natural and Physical Sciences, 2011

Patent

- Supratik Mukhopadhyay, Saikat Basu 2, Robert diBiano, Malcolm Stagg, Manohar Karki, Jerry Weltman: COMPUTER IMPLEMENTED SYSTEM AND METHOD FOR HIGH PERFORMANCE VISUAL TRACKING," US Patent Number 10,757,369, issued 2020.
- Supratik Mukhopadhyay and S. S. Iyengar: Continuation Patent: System and Architecture for Robust Management of Resources in a Wide-Area Network," US Patent Number 9,240,955, issued January 2016.

- Supratik Mukhopadhyay and S. S. Iyengar: System and Architecture for Robust Management of Resources in a Wide-Area Network", US Patent Number 8,572,290, issued October 2013

Research and Education Grants and Contracts

- HP-CMV Project to Improve the Safety of CMVs by Identifying Factors that lead to CMV Crashes (FMCSA, USDOT, $773,000, Co-PI)
- Vitamin C: A Deductive Framework for Generating Analyzers for C Programs ($259,998, NSF, PI)
- Automatic Techniques for Inferring Actionable Information from WAMI data ($815,000, PI, ARO)
- Tree-cover delineation in 1-m NAIP Imagery ($105,276, PI, NASA/BAER)

Selected Publications (from 37 journal publications and 92 conference presentations):

1. Basu, S., Ganguly, S., Mukhopadhyay, S., DiBiano, R., Karki, M., & Nemani, R. (2015, November). Deepsat: a learning framework for satellite imagery. In Proceedings of the 23rd SIGSPATIAL international conference on advances in geographic information systems (pp. 1-10). (Cited more than 400 times).
2. Basu, S., Ganguly, S., Nemani, R. R., Mukhopadhyay, S., Zhang, G., Milesi, C., ... & Li, S. (2015). A semiautomated probabilistic framework for tree-cover delineation from 1-m NAIP imagery using a high-performance computing architecture. IEEE Transactions on Geoscience and Remote Sensing, 53(10), 5690-5708.
3. Rajasekaran, M., Sajol, M S I., Berglind, F., Mukhopadhyay, S, & Das, K. (2024). COMBOOD: A Semiparametric Approach for Detecting Out-of-distribution Data for Image Classification, In Proceedings of Siam International Conference on Data Mining, 2024.
4. Basu, S., Mukhopadhyay, S., Karki, M., DiBiano, R., Ganguly, S., Nemani, R., & Gayaka, S. (2018). Deep neural networks for texture classification—A theoretical analysis. Neural Networks, 97, 173-182. (Among the most downloaded articles in January 2018)
5. Chokwitthaya, C., Zhu, Y. and Mukhopadhyay, S., 2021. Robustness analysis framework for computations associated with building performance models and immersive virtual experiments. Advanced Engineering Informatics, 50, p.101401.
6. Chokwitthaya, C., Zhu, Y., Mukhopadhyay, S., & Collier, E. (2020). Augmenting building performance predictions during design using generative adversarial networks and immersive virtual environments. Automation in Construction, 119, 103350.
7. Bess, A., Berglind, F., Mukhopadhyay, S., Brylinski, M., Griggs, N., Cho, T., ... & Wasan, K. M. (2021). Artificial intelligence for the discovery of novel antimicrobial agents for emerging infectious diseases. Drug discovery today.

Selected Conferences and Symposia/ Professional Memberships/Activities

- Associate Editor, IEEE Transactions on Artificial Intelligence 2020-Present
- Served as a member of the Multidisciplinary Expert Group of the Innovation Facility, United Nations Environmental Program
- Associate Editor – Remote Sensing Letters (2020-present)
- Program Committee Member Association for the Advancement of Artificial Intelligence (AAAI) (2021-24)
- Track Chair, IEEE Services Computing Conference, AI at Scale track, 2020
- General Chair, AIMLSystems, 2024
- Co-chair, IEEE SERVICES Symposium on Services Computing (SSC) 2019
- Program Committee Member – IEEE Services Computing Conference (SCC), 2022
- Campus advisor for NCWIT, LSU

Curriculum vitae of Edward Laws

Louisiana State University, 3141 Energy, Coast, and Environment Building, Baton Rouge, LA 70803
Phone: 225-578-8800, Fax: 225-578-4286, Email: edlaws@lsu.edu

Present Title and Affiliation

Professor of Environmental Sciences, Louisiana State University, Baton Rouge, LA

Education

B.A. in Chemistry, Harvard University, Cambridge, Mass., 1967, Magna Cum Laude
Ph.D. in Chemical Physics, Harvard University, Cambridge, Mass. 1972

Professional and Academic Experience

- Research Assistant, Battelle Memorial Institute, Columbus, Ohio, summer, 1967
- Instructor, Oceanography Department, Florida State University, 1971- 1974
- Assistant Professor, Oceanography Department, University of Hawaii, 1974 -1979
- Associate Professor, Oceanography Department, University of Hawaii, 1979 - 1984
- Professor, Oceanography Department, University of Hawaii, 1984 – 2005
- Dean, School of the Coast and Environment, Louisiana State University, 2005-2008
- Professor, Department of Environmental Sciences, Louisiana State University, 2008 – present

Selected Honors and Awards

- Fellow, American Association for the Advancement of Science, 2024
- Outstanding Limnology and Oceanography Reviewer, 2022
- Greater Houston Alumni Chapter Endowed Alumni Professor, 2022
- LSU Distinguished Faculty Award, 2020
- Tiger Athletic Foundation Undergraduate Teaching Award, 2020
- Joseph and Richard Lipsey Excellence in Teaching Award, 2014
- Tyge Christensen Prize for best algal paper in Phycologia, 2007
- Best Paper Award, Organic Geochemistry Division, Geochemical Society, 1995

Research and Education Grants and Contracts (Focusing on Microalgae Cultivation)

- National Science Foundation (OCE 1536581)—$189,806. Effects of multiple stressors on marine phytoplankton. 10/1/15—3/31/20.
- National Science Foundation (49100421C0039)—$208,000. Advancing innovative convergence between fisheries and offshore energy to drive adaptive stewardship of fisheries habitat in a dynamic blue economy (co-PI). 09/15/2021 – 09/14/2022
- National Science Foundation—$239,098. A Critical Examination of the Relationship between Marine Phytoplankton Growth Rates and Phosphate Concentrations: Monod or Not. 3/15/05 – 2/28/12.
- BP Exploration and Production, Inc. —$77,121. Physiological Effects of Deepwater Horizon Oil on Phytoplankton and Microbial Communities from the Coastal/nearshore Waters of Louisiana. 4/6/11– 12/31/12.
- National Science Foundation – $321,500. Controls on the production and isotopic compositions of N2O. (co-PI). 10/1/98-9/30/01.
- Louisiana Board of Regents — $136,000. Recruitment of Superior Graduate Students in Earth, Ocean and Environmental Sciences (co-PI). 8/1/07 – 7/31/12.
- Environmental Protection Agency — $237,298. Observational and Modeling Studies on Environmental Determinants for the Abundance and Distribution of Pahtogenic Vibrios in Breton Sound (co-PI). 4/1/10 – 3/31/14.

Selected Publications (Papers including statistical analysis; from 238 peer-reviewed papers)

1. Laws, E. A., and McClellan, S. A. 2022. Interactive Effects of CO2, Temperature, Irradiance, and Nutrient Limitation on the Growth and Physiology of the Marine Cyanobacterium Synechococcus (Cyanophyceae). J. Phycol. 58:703–718.
2. Laws, E. A., and K. Maiti. 2021. Temperature affects the time required to discern the relationship between primary production and export production in the ocean. Water 13: 3085. https://doi.org/10.3390/w13213085
3. Laws, E. A. and K. Maiti. 2019. The relationship between primary production and export production in the ocean: effects of time lags and temporal variability. Deep-Sea Research I 148: 100-107.
4. Laws, E. A. and S. Taguchi. 2018. The 1987–1989 phytoplankton bloom in Kaneohe Bay. Water 10(6), 747; https://doi.org/10.3390/w10060747.
5. Laws, E. A. 2013. Evaluation of In Situ Phytoplankton Growth Rates: A Synthesis of Data from Varied Approaches. Annual Review of Marine Science 5: 247–268.
6. Laws, E. A., S. Pei, and P. Bienfang. 2013. Phosphate-Limited Growth of the marine diatom Thalassiosira weissflogii: Evidence of non-Monod Growth Kinetics. Journal of Phycology 49(2): 241–247.
7. Laws, E. A. 2012. Risks from exposure to toxic chemicals. Encyclopedia of Sustainability Science and Technology.
8. Laws, E. A., S. Pei, P. Bienfang, and S. Grant. 2011. Phosphate-limited growth and uptake kinetics of the marine prasinophyte Tetraselmis suecica (Kylin) Butcher. Aquaculture 322-323: 117-121.
9. Laws, E.A. 2000. Aquatic Pollution: An Introductory Text. 3rd edition. Wiley-Interscience. New York. 639 pp.
10. Laws, E. A. 1997. Mathematical Methods for Oceanographers: An Introduction. Wiley-Interscience. New York. 343 pp.

Selected Conferences and Symposia

- Huang, B., Qiu, Y., Liu, X., Laws, E. A., and Xie, Y. 2020. POC Export Regulated by Plankton Community Structure in the Contrasting Ecosystems of a Marginal Sea. Ocean Sciences Meeting, San Diego, 16–21 February.
- Laws, E. A. 2019. Evaluation of in situ phytoplankton growth rates: a synthesis of data from varied approaches. Aoshan Forum, Qingdao, China, September 23.
- Laws, E. A. 2011. Oceans and Human Health: The Urgent Need for Sustainable Resource Management. Vetlesen Lecture, University of Rhode Island. March 1 (invited).
- Laws, E. A. 2012. Use of Indicator Organisms to Assess Public Health Risks Associated with Recreational Use of Natural Waters. November 14. Institute of Medicine of the National Academies of Sciences, Washington, DC. (invited).
- Laws, E. A. 2007. Phytoplankton nutrient utilization: the challenge of translating information from the molecular scale to ecosystems. American Society of Limnology and Oceanography Aquatic Sciences Meeting, February 4-9, Santa Fe, NM (invited).

Professional Memberships/Activities

- American Geophysical Union
- American Association for the Advancement of Science
- Journal of the World Mariculture Society, Contributing Editor, 1988 – present
- Forum on Public Policy, Editorial Advisory Board, 2010 – present
- Water, editorial board, 2021–2023

Curriculum vitae of Wei-Hsung Wang

Louisiana State University, 125 Nuclear Science Building, Baton Rouge, LA 70803
Phone: 225-578-2743, Fax: 225-578-2094, Email: weihsung@lsu.edu

Present Title and Affiliation

Professor-Research, Center for Energy Studies, and Director, Radiation Safety Office, Louisiana State University, Baton Rouge, LA

Education

- National Taiwan University, Taipei, Taiwan, BS, 1986, Geology
- Northwestern University, Evanston, IL, MS, 1992, Environmental Health Engineering (Health Physics Concentration)
- Purdue University, West Lafayette, IN, PhD, 2000, Health Physics

Board Certification

- American Board of Health Physics, 1999-present.
- Board of Laser Safety, 2005-present.
- Board of Safety Professionals, 2013-present.

Selected Professional and Academic Experience

- Senior Health Physicist (2000-2003), Radiological & Environmental Management Department, Purdue University, West Lafayette, IN.
- Assistant Professor (2001-2003), School of Health Sciences, Purdue University, West Lafayette, IN.
- Director (2003-present), Radiation Safety Office, Louisiana State University, Baton Rouge, LA.
- Assistant Professor-Research (2003-2008) and Associate Professor-Research (2008-2015), Center for Energy Studies, Louisiana State University, Baton Rouge, LA.

Selected Honors and Awards

- William A. McAdams Outstanding Service Award, American Board of Health Physics and American Academy of Health Physics, 2022.
- Fellow Award, Health Physics Society, 2015.
- Herman Cember Memorial Lecturer, American Industrial Hygiene Conference & Exposition, May 18-23, 2013, Montreal, Canada.

Relevant Teaching at Current Institution

- Instructor, MEDP 4331 Radiation Protection and Exposure Evaluation, 2003-present.
- Instructor, NS 4570 Nuclear Facility Safety, 2010-present.
- Instructor, NS 4352 Environmental Radiological Evaluation and Remediation, 2011-present.

Funded Research and Education Grants and Contracts

- Co-Investigator: Electrochemical and Biological Remediation of Radioactively Contaminated Water (PI: Y-H Kim). U.S. Nuclear Regulatory Commission, 03/2024-present
- Co-Investigator: LSU Nuclear Multidisciplinary Scholarship Program (PI: Y.-H.. Kim). U.S. Nuclear Regulatory Commission, 05/2022-present.
- Co-Investigator: LSU expanded nuclear science and engineering graduate fellowship program (PI: M.R. Gartia). U.S. Nuclear Regulatory Commission, 08/2019-present.
- Co-Investigator: LSU faculty development program in Health Physics (PI: W.D. Newhauser). U.S. Nuclear Regulatory Commission, 07/2016-06/2019.

Selected Publications

1. Wang W.-H., Zelac R.E. The performance of Al_2O_3:C thermoluminescent dosimeters in compliance with the American national standard specifications for environmental applications. Radiat Protect Management 14:60-64; 1997.

2. Wang W.-H. Development of an indirect room air sampling strategy for $(U,Th)O_2$ particles. Radiat Protect Management 19(5):15-31; 2002.
3. Wang W.-H. Validation of the integrity of a HEPA filter system. Health Phys 85 (Suppl 2):S101-S107; 2003.
4. Wang W.-H., McGlothlin J.D., Smith D.J., Matthews II K.L. Evaluation of a radiation survey training video developed from a real-time video radiation detection system. Health Phys 90 (Suppl 1):S33-S39; 2006.
5. Wang W.-H., Matthews II K.L. Simulating gaseous iodine-131 distribution in a silver zeolite cartridge using sodium iodide solution. Health Phys 90 (Suppl 2):S73-S79; 2006.
6. Wang W.-H., Matthews II K.L., Teague R.E. Dose rates of a cobalt-60 pool irradiator measured with Fricke dosimeters. Health Phys 94 (Suppl 2):S44-S50; 2008.
7. Marceau-Day M.L., Teague R.E., Wang W.-H. The use of photographic film to pin-point accelerator beam losses. Health Phys 101 (Suppl 2):S121-S123; 2011.
8. Wilson IV C.W., Matthews II K.L., Pulsipher A.G., Wang W.-H. Using geographic information systems to determine site suitability for a low-level radioactive waste storage facility. Health Phys 110(Suppl 1):S17-S25; 2016.
9. Wilson IV CA, Hendrickson KR, Hamideh AM, Matthews II KL, Wang W-H. Visualizing high-order decay after disequilibria. *Health Phys* 115:791-796; 2018.
10. Wilson IV CA, Hamideh AM, Wang W-H. Establishment of a NORM baseline for selected seafood in the Gulf of Mexico. *Mar Pollut Bull* 145:448-454; 2019.
11. Wilson IV CA, Hamideh AM, Matthews II KL, Wang W-H. Determination of uranium series activity before secular equilibrium is established. *Heal Phys* 117:443-448; 2019.

Selected Conferences and Symposia

- U.S. Environmental Protection Agency Science Advisory Board Radionuclide Cancer Risk Coefficients Review Panel; Panel Member (10/2022-present)
- U.S. Environmental Protection Agency Science Advisory Board and Radiation Advisory Committee; Member (08/2021-09/2026)
- U.S. Environmental Protection Agency Science Advisory Board Radiation Advisory Committee augmented MARSSIM (revision 2) Review; Panel Member (09/2020-03/2021).
- Health Physics Society Professional Development School: Radiation Safety in Medicine: Co-Academic Dean, Session Chair, and Speaker. (02/09-13/2014; Baton Rouge, LA).
- U.S. National Oceanic and Atmospheric Administration Radiological Ideas Workshop: Explore Ideas to Assess Impacts to the Marine Environment from the Fukushima Nuclear Incident; Radiological Expert (2011).
- U.S. Nuclear Regulatory Commission (NRC) Radiation Protection Standards Workshop: Potential Changes to the NRC's Radiation Protection Regulations and Guidance in Light of Recommendations in International Commission on Radiological Protection Publication 103; Invited Panelist (11/08-09/2010; Houston, TX).

Professional Memberships/Activities

- Health Physics Society; Member (1993-present).
- Academic Education Committee; Member (2007-2010; 2011-2022); Chair (2018-2022).
- American Board of Health Physics Part II Panel of Examiners; Member (2008-2018; 2024-2027); Vice Chair (2015); Chair (2016).
- American Board of Health Physics; Board Member (2019-2023); Vice Chair (2020); Chair (2021).

Past NRC Funding and Summary of Results from Past NRC Funding

The below table shows past NRC funding grants involving the key personnel of this proposal, and the summary of the funding results.

Grants	Key personnel	Periods	Results
LSU undergraduate scholarships in Health Physics	Wei-Hsung Wang	2015-2017	○ Supported 17 undergraduate students
LSU graduate fellowships in Health Physics	Wei-Hsung Wang	2015-2019	○ Supported 6 graduate students
LSU Faculty Development Program in Health Physics	Wei-Hsung Wang	2016-2019	○ Hired two faculty members, including Yong-ha Kim (PI)
LSU Expanded Nuclear Science and Engineering Graduate Fellowship Program	Yong-Ha Kim Wei-Hsung Wang	2019-present	○ Supported 3 graduate students ○ Receiving applications
LSU Nuclear Multidisciplinary Scholarship Program	Yong-Ha Kim Wei-Hsung Wang	2022-present	○ Supported 7 undergraduate student ○ Receiving applications
Electrochemical and Biological Remediation of Radioactively Contaminated Water	Yong-Ha Kim Edward Laws Wei-Hsung Wang	2024-present	○ Preparing experimental apparatus for electrosorption and microalgae cultivation ○ Receiving applications (graduate assistant and student workers)

LOUISIANA LEGISLATIVE AUDITOR

MICHAEL J. "MIKE" WAGUESPACK, CPA
LOUISIANA LEGISLATIVE AUDITOR

June 7, 2023

Ms. Darya Courville, Executive Director
Office of Sponsored Programs
Louisiana State University and A&M College
Baton Rouge, Louisiana

Transmitted via Email Only:
ddcourv@lsu.edu

Dear Ms. Courville:

The Louisiana Legislative Auditor performs an annual single audit of the basic financial statements and the major federal award programs for the State of Louisiana. The audit of the basic financial statements is conducted in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States. The audit of major federal award programs complies with the Single Audit Act as amended in 1996 and the Office of Management and Budget's (OMB) Uniform Guidance. The single audit covers the state's basic financial statements, Schedule of Expenditures of Federal Awards, internal controls, and compliance. An audit report on the basic financial statements is included in the 2022 Annual Comprehensive Financial Report. Audit reports on the Schedule of Expenditures of Federal Awards, internal controls and compliance are included in the 2022 Single Audit Report.

These reports meet the requirements of the Single Audit Act and OMB Uniform Guidance for each state agency and university. No additional single audit or report is required of each state agency or university, even if the agency's or university's federal award programs were not specifically reviewed during the audit year.

The audit of Louisiana State University (LSU) and A&M College is included in the 2022 Single Audit Report for the State of Louisiana. This report did not include any audit findings related to the financial statements or directly related to the administration of federal awards by the LSU and A&M College.

There were no financial statement unresolved prior audit findings; however, there was one prior audit finding relating to the administration of federal award programs by LSU and A&M College included in the 2022 Single Audit Report.

The 2022 Single Audit Report and the Annual Comprehensive Financial Report have been distributed to our federal cognizant agency for audit, the United States Department of Health and Human Services. Our contact person at the United States Department of Health and Human Services is Ms. Tammie Brown, and she can be reached at (816) 426-3204.

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If you have any questions concerning the audit or the reports, please contact Leslie Normand, Audit Manager, at (225) 336-5063 or by email at LNormand@lla.la.gov.

Sincerely,

Beth Q. Davis

Beth Q. Davis, CPA
First Assistant Legislative Auditor

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