



CURRICULUM VITAE

DR. SUDEEP KUMARA K

CSIR-Research Associate
Centre for Advanced Research in Environmental Radioactivity (CARER)
Mangalore University
Mangalagangothri – 574199
Karnataka, India

1.0 Personal Data

1	Name	DR. SUDEEP KUMARA. K
2	Date of birth	23.01.1987, 33 years
3	Place of birth & State	KANCHUGARANAHALI, CHIKKAMAGALURU, KARNATAKA
5	Present Position Held	CSIR-Research Associate
6	Address	Address Office CSIR-Research Associate Centre for Advanced Research in Environmental Radioactivity (CARER) Mangalore University Mangalagangothri – 574199 Karnataka, India Address Residence S/O Kalmaradappa K.N D.No#15, Kanchugaranahalli Nagenahalli (P), Sakrepatna (H) Kadur (T) Chikkamagalur-577168
7	Telephone number	Mobile No: +919844174416
8	E-mail	sudeepphy@gmail.com

2.0 Academic Qualifications

Period	Qualification	University	Subject / field
2010-16	Ph. D	Mangalore University	Physics (Title: Studies on ^{222}Rn and ^{220}Rn adsorption characteristics in charcoal and development of a mitigation system for ^{222}Rn and ^{220}Rn in workplaces)
2007-09	M Sc	Mangalore University	Physics (Condensed Matter Physics specialization)
2004-07	B Sc	Sree Siddaganga College (Tumkur) Bangalore University	Physics, Chemistry and Mathematics (PCM)

Additional qualification

Degree	Name of the University	Year of Passing
Diploma in Computer Application (DCA)	NICE Chikkamagalur	2006

3.0 Professional Career

Period	Years	Organization	Designation	Nature of work / responsibility
2018-till date		CARER Mangalore University	CSIR- Research Associate	Research and Teaching for Medical Physics course
2017-2018	1	Department of Studies in Physics Regional Institute of Education (NCERT) Mysuru – 570006	Assistant Professor	Teaching and Research.
2016-to 2017	1	Department of Studies in Physics	Guest Faculty	Teaching and Research. General Physics (Quantum

		Mangalore University		Mechanics, Mathematical Physics)
2009-2010	1	Department of Studies in Physics Mangalore University	Guest Faculty	Condensed Matter Physics Nuclear Physics Practical

Profile of professional career/life sketch

I was born in the rural village of Kanchugaranahalli of Chikkamagalur district in Karnataka. I completed Pre University education from Kalpataru Junior College, Tiptur, and obtained B. Sc. degree from Sri Siddaganga College, Tumkur, and M. Sc., Ph. D. degrees (in Physics) from Mangalore University. I have been a faculty member in the Department of Studies in Physics of Mangalore University in 2009-10 and 2016-17. Also I served as assistant professor in physics at Department of Education in Science and Mathematics (DESM), Regional Institute of Education (**NCERT**), Mysuru. So far I have published 20 papers in national and international journals of repute and presented more than 43 research papers at national and international conferences. Among these publications, 5 research papers are through international collaborations. I have edited 1 conference proceedings/book.

I am instrumental for establishing the **Centre for Advanced Research in Environmental Radioactivity (CARER)** in Mangalore University with state-of-the art nuclear radiation measurement systems. This is the most advanced research centre in India for studies on environmental radioactivity and radiation protection.

As Organizing committee member, I had organized an International Conference at Mangalore University in which the International Atomic Energy Agency (IAEA) along with members from 18 countries participated. As a Organizing committee member, I have also organized the 30th IARP National Conference in the year 2012 and 20th NSRP National Conference in the year 2015 in which 228 and 200 participants from premier research institutions and Universities presented papers.

Received 4 best paper awards in the National/International conferences.

4.0 Areas of Research

My research areas of interest are interdisciplinary in nature as under:

- Radiation Protection, Radioecology, Environmental safety and Instrumentation
 - Gamma spectrometry using HPGe and NaI(Tl) detectors
 - Low Background Beta Counting
 - Radon monitoring - LLRDS, SSNTD, Lucas Cell, AlphaGUARD, SRM, DRPS&DTPS
 - Radiochemical analyses of natural and artificial radionuclides
 - Liquid Scintillation spectrometry, alpha spectrometry
- Studies on transfer factors and transfer coefficients for radioactive and non radioactive elements in the environment with emphasis on transfer factor to food chain around the nuclear facilities and mining regions
- Baseline studies around proposed nuclear facilities and mining regions
- Impact Assessment
- Neutron Activation Analyses
- Development of new techniques for radiation measurements
- Use of radionuclides for studying environment behavior and problems – Application of ^{137}Cs and ^{210}Pb to study the soil erosion and sedimentation rate measurements of reservoirs

5.0 Research Papers/ Publications

	Publications	Numbers
A	Papers published in journals	23
B	Papers published in conferences / seminars	45
C	Articles published in newsletter / bulletin	--
D	Books	1 (edited)
E	Chapters in Books	--
F	Reports	2
G	General / popular articles	4

H	Other types of publications, if any	--
I	Patents granted	A ^{222}Rn and ^{220}Rn mitigation system working on the principle of adsorption of these radioactive gases on activated charcoal has been designed and developed. We are now approaching to patent this system jointly with BARC, Mumbai.

6.0 Development of New Technology

I am directly participated in design and development of a Thoron Mitigation System in collaboration with Bhabha Atomic Research Centre (BARC), Mumbai under a Memorandum of Understanding (MoU) for collaborative research programmes. The development of a simple and inexpensive activated charcoal-based mitigation system will find immense application in the continuous removal of radon and thoron (which are radioactive gases) from off-gas streams of uranium and thorium processing facilities. This new system has the potential to offer numerous advantages over conventional systems for the continuous removal of radon and thoron from air in industrial workplaces. Spin-off applications of the system include remediation of radon and thoron problem in mining and processing industries, site remediation, and reduction of personal radiation exposures due to radon and thoron. Other potential application is recovery and isolation of radioactive Xe & Kr fission gases in workplaces. Development of a prototype system is considered to be of national importance by the Department of Atomic Energy and the system developed is going to find wide application in Uranium and Thorium processing facilities. We are now in the process of patenting this technology (jointly with BARC).

While our research team was responsible for designing and fabricating the system, BARC has provided the necessary support in the theoretical calculation and calibration of the system. Subsequently, experiments were carried out on radon and thoron absorption efficiencies of charcoal, holding capacity, degassing characteristics, and fabrication of the prototype mitigation system.

The technology and the prototype system have now been transferred to BARC and the new system has now been integrated to the processing facilities at BARC.

7.0 Awards & Citations received

Name of the Body/Society	Name of the Award
Nuclear Analytical Chemistry (NAC-5)	Best Paper Award : Thoron mitigation using charcoal based system – presented in Nuclear Analytical Chemistry-V conference 2014 (NAC-V, 2014)
Indian Association for Radiation Physics National Conference – 2014 (IARPNC-2014)	Best Paper Award : Effect of humidity on thoron adsorption in charcoal bed – presented in Indian Association for Radiation Physics National Conference – 2014 (IARPNC-2014).
First National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-I)	Best Paper Award : Study on dependence of breakthrough time on flow-rate of the carrier gas in ²²⁰ Rn adsorber bed - First National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-I), Tehari Garhwal, June 15-17.
Indian Society for Radiation Physics (ISRP) - NUCLEONIX Award	Best Paper Award for Innovative : Design, development and characterization of a Charcoal based thoron mitigation system for Application in thorium processing facilities – National Symposium on Radiation Physics (NSRP) Conference organized by Indian Society for Radiation Physics (ISRP) during Oct. 28-30, 2015, Mangalore University.

8.0 Guidance to Students (PG)

- Guided PG students of different departments of the Mangalore University in their project work/laboratory experiments.
- Guided PG students of different universities and colleges for their project work at CARER.

9.0 Other information on scientific achievements

Sl. No.	Details
1.	Developed new techniques for radon measurement and mitigation
2.	Edited 1 conference proceedings
3.	<p>Research collaboration during my research with other institutes (within the country)</p> <ul style="list-style-type: none"> • Bhabha Atomic Research Centre, Mumbai • Nuclear Power Corporation of India Ltd. • Rare Metals Plant, BARC, Mysore • Indian Institute of Technology, Bombay (IITB) <p>Research collaboration with other institutes (outside the country)</p> <ul style="list-style-type: none"> • Science Program, Texas A&M University, Qatar • Department of Applied Sciences, College of Technological Studies, Public Authority for Applied Education and Training, Kuwait • TTK university of applied sciences, Estonia • National Institute of Radiological Sciences (NIRS), Japan
4.	Worked as a faculty member for training programmes on measurement of environmental radioactivity for research scholars from different Universities/Institutions of the country.
5.	As organizing committee member organized the 20th National Symposium on Radiation Physics (NSRP-20) during Oct. 28-31, 2014 at Mangalore University. 200 participants from different National Laboratories, Institutions, and Universities participated in the conference.
6.	As organizing committee member organized the 2nd International conference on Po and Radioactive Pb Isotopes during Feb. 10-13, 2013 at Mangalore University. 28 participants from USA, Spain, Brazil, France, Korea, China, Turkey, Czech Republic, Portugal, and 58 participants from India participated in this conference.
7.	As organizing committee member organized the 30th IARP National conference on Radiological Protection and Safety in Nuclear Reactors and Radiation Installations during March 15-17, 2012 at Mangalore University. 228 participants from different National Laboratories, Institutions, and Universities participated in the conference.
8.	As organizing committee member organized the 4th Conference of Karnataka Science and Technology Academy during March 15-17, 2012 at Mangalore University.
9.	Actively involved in educating the general public and creating awareness among the general public and college teachers and students about the importance of nuclear power for the development of the country.

	Organized public awareness programmes in association with different colleges and delivered many talks to create awareness about the safety aspects involved in the nuclear energy.
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10.0 Other information on academic achievements

1. Worked as a resource person for the three day workshop under PAC titled "Updating and digitalization of the physics resource material for secondary school teachers-Stage-I" January 8-12, 2018 at RIE, Mysuru.
2. Worked as a resource person for the three day workshop under PAC titled "Updating and digitalization of the physics resource material for secondary school teachers-Stage-I" February 19-21, 2018 at RIE, Mysuru.
3. Worked as a resource person for the three day workshop under PAC titled "Updating and digitalization of the physics resource material for secondary school teachers-Stage-I" March 14-16, 2018 at RIE, Mysuru.
4. Worked as a member for Rapporteurs committee in the "National conference on emerging themes and trends in learning of English in schools (ELT)" at RIE, Mysuru.
5. Worked as a member and resource person for the development of e-content for the NCERT text books (Class VIII-X).
6. Worked as a member for organizing several national and international conference as well as workshops (IARP-30, INCOPoPb-2013, NSRP-20)

11.0 Fellowship/Membership of professional bodies

Name of the Body/Society	Name of Award / Fellowship / Nature of Membership / Editorship
Junior Research Fellowship (JRF)	Bhabha Atomic Research Centre, Mumbai.
Senior Research Fellowship (SRF)	Bhabha Atomic Research Centre, Mumbai.
Life Member	Indian Society for Radiation Physics (ISRP)
Life Member	Indian Association for Radiation Protection (IARP), L.M.No.: 1427
Life Member	Nuclear Track Society of India (NTSI), L.M.No.: 413
Life Member	National Radon Network Society (NRNS)
Life Member	Mangalore University Alumni Association (MAA), Mangalagangothri

12.0 Google Scholar Citations



Sudeep Kumara K

FOLLOWING

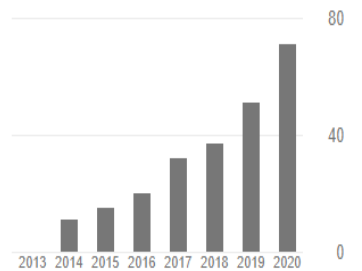
Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore University
Verified email at mu.edu

[Radiation Protection](#) [Environmental Radioactivity](#) [Radiation Dosimetry](#)
[Nuclear Instrumentation](#) [Modelling for Radon and Th...](#)

Cited by [VIEW ALL](#)

	All	Since 2015
Citations	239	226
h-index	7	7
i10-index	5	4

<input type="checkbox"/>	TITLE	CITED BY	YEAR
<input type="checkbox"/>	<p>Assessment of ambient gamma dose rate around a prospective uranium mining area of South India—A comparative study of dose by direct methods and soil radioactivity measurements</p> <p>N Karunakara, I Yashodhara, KS Kumara, RM Tripathi, SN Menon, ... Results in Physics 4, 20-27</p>	58	2014
<input type="checkbox"/>	<p>Soil to rice transfer factors for 226 Ra, 228 Ra, 210 Pb, 40 K and 137 Cs: a study on rice grown in India</p> <p>N Karunakara, C Rao, P Ujwal, I Yashodhara, S Kumara, PM Ravi Journal of Environmental Radioactivity 118, 80-92</p>	51	2013



13.0 ResearchGate (RG) Score



Sudeep Kumara K

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Introduction

Sudeep Kumara K currently works at the Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore university. Sudeep does research in Engineering Physics and Nuclear Physics. Their current project is 'Development of instruments, methods, techniques and analytical tools for radon and thoron measurements'.

Languages

English · Hindi · Kannada

Disciplines

[Engineering Physics](#) [Nuclear Physics](#)

Skills and expertise (30)

[Adsorption](#) [Radiation Detection](#) [Radiation](#) [Radiation Protection](#)
[Radiation Physics](#) [Radiation Dosimetry](#) [Ionizing Radiation](#) [Dosimetry](#)
[Experimental ... Physics](#) [Nuclear Science](#) [View all](#)

Stats overview

[View all](#)

Current affiliation [Edit](#)

Mangalore university

Location
Mangalore, India

Department
Centre for Advanced Research in Environmental Radioactivity (CARER)

Position
Research Associate

Time period
May 2018 - Present

Role
Research and Teaching

Naregundi Karunakara's Lab

Lab head

Naregundi Karunakara

Lab members (24)

+18

Names and Addresses of Referees

Prof. N. Karunakara,
Coordinator,
Centre for Advanced Research in Environmental Radioactivity,
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Prof. Y.S. Mayya,
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Declaration

I, **SUDEEP KUMARA K.** hereby, declare that all the information provided by me in this proforma are true to best of my knowledge. Further I would like to express that I will strive hard and satisfy my superiors to the best of my ability.

Date: 20.10.2020

Place: Mangalagangothri

Signature

Details of Publications

Publication through International Collaboration

3. Comparison of Radon and Thoron Concentration Measuring Systems Among Asian Countries.
Miroslaw Janik, Shinji Tokonami , Kazuki Iwaoka , Naregundi Karunakara ,Shetty Trilochana, Mandya Purushotham Mohan, **Sudeep Kumara**, Indaje Yashodhara, Weihai Zhuo, Chao Zhao, Fangdong Tang, Supitcha Chanyotha, Chutima Kranrod , Darwish Al-Azmi and Osamu Kurihara ([Int. J. Environ. Res. Public Health](#) 2019, 16, 5019)
2. A walk-in type calibration chamber facility for ^{222}Rn and progeny measuring devices and inter-comparison measurements.
Trilochana S, Somashekarappa, H M, **Sudeep Kumara, K.**, Mohan M P, Rashmi Nayak S, Renita Shiny D'Souza, Srinivas S Kamath, BK Sahoo, Gaware J J, Sapra B K, Miroslaw Janik, Darwish Al-Azmi, Y.S. Mayya. Radiation Protection Dosimetry ([Oxford Academic Journal](#)), 29 October 2019
1. Gamma dose rates in the high background radiation area of Mangalore region, India.
Darwish Al-Azmi, **Sudeep Kumara**, M.P. Mohan, N. Karunakara. Radiation Protection Dosimetry ([Oxford Academic Journal](#)), Volume 184, Issue 3-4, October 2019

Publications in other International Journals

15. An innovative technique of harvesting soil gas as a highly efficient source of ^{222}Rn for calibration applications in a walk-in type chamber: part-1
N. Karunakara, Trilochana Shetty, B. K. Sahoo, **K. Sudeep Kumara**, B. K. Sapra Y. S. Mayya (Manuscript communicated to [Nature-Scientific Reports-\(2020\) 10:16547](#))
14. A periodic pumping technique of soil gas for ^{222}Rn stabilization in large calibration chambers: Part 2 – theoretical formulation and experimental validation.
Trilochana Shetty, Y. S. Mayya, **K. Sudeep Kumara**, B. K. Sahoo, B. K. Sapra & N. Karunakara
(Manuscript communicated to [Nature-Scientific Reports-\(2020\) 10:16548](#))

13. Numerical simulation of ^{222}Rn profiling in an experimental chamber using CFD technique.
Tarun Kumar Agarwal., Jitendra J Gaware., Bijay Kumar Sahoo., Balvinder Sapra., Trilochana Shetty., D. Datta., **Sudeep Kumara K.**, Karunakara Naregundi (Journal of Environmental Radioactivity ([Elsevier](#)) Volumes 220–221, September 2020)
12. CFD-based simulation and experimental verification of ^{222}Rn distribution in a walk-in type calibration chamber.
S. Trilochana, H. M. Somashekarappa, **K. Sudeep Kumara**, Y. S. Mayya, N. Karunakara. Journal of Radioanalytical and Nuclear Chemistry ([Springer](#)) 323, 507–513(2020)
11. Influence of rainfall on atmospheric deposition fluxes of ^7Be and ^{210}Pb in Mangaluru (Mangalore) at the Southwest Coast of India.
M.P. Mohan, Renita Shiny D'Souza, S, Rashmi Nayak, Srinivas S. Kamath, Trilochana Shetty, **K. Sudeep Kumara**, Y.S. Mayya, N. Karunakara
Journal of Atmospheric Environment ([Elsevier](#)) 202, 281-295, 2019.
10. Mass exhalation rates, emanation coefficients and enrichment pattern of radon, thoron in various grain size fractions of monazite rich beach placers.
Primal V. Pinto, **Sudeep Kumara K.**, and Karunakara N. Journal of Radiation Measurement ([Elsevier](#)) Volume 130, January 2020, 106220
9. Organically bound tritium: optimization of measurements in environmental matrices by combustion method and liquid scintillation spectrometry.
S. Rashmi Nayak, Renita Shiny D'Souza, S. Srinivas Kamath, M. P. Mohan, S. Bharath, Trilochana Shetty, **K. Sudeep Kumara**, B. Narayana, B. N. Dileep, P. M. Ravi, N. Karunakara.
J Radioanal Nucl Chem ([Springer](#)) 99 1-10, 2019.
8. Temporal variations of ^7Be and ^{210}Pb in South West Coast of India.
Mohan, M P., Renita, Shiny, D'Souza., Rashmi, S. Nayak., Srinivas, S, Kamath., Trilochana, Shetty., **Sudeep Kumara, K.**, Yashodhara, I, Y.S. Mayya., Karunakara N.
Journal of Environmental Radioactivity ([Elsevier](#)) 192, 194-207, 2018
7. Estimation of Air to Grass Mass Interception Factors for Iodine.
N. Karunakara, P. Ujwal, I. Yashodhara, **K. Sudeep Kumara**, M.P.Mohan , K. Bhaskar Shenoy, P.V.Geetha, B.N. Dileep , Joshi P. James , P.M. Ravi.
Journal of Environmental Radioactivity ([Elsevier](#)) 186, 71-77, 2018

6. Thoron Mitigation System based on charcoal bed for applications in thorium fuel cycle facilities (part 2): Development, characterization, and performance evaluation.
Sudeep Kumara, K., B.K. Sahoo, J.J. Gaware, B.K. Sapra, Y.S. Mayya., Karunakara N.
Journal of Environmental Radioactivity ([Elsevier](#)) 172, 249-260, 2017
5. Thoron Mitigation System based on charcoal bed for applications in thorium fuel cycle facilities (part 1): Development of theoretical models for design considerations.
Sahoo, B.K., **Sudeep Kumara, K.**, Karunakara N., Gaware, J.J., Sapra, B.K., Mayya, Y.S.
Journal of Environmental Radioactivity ([Elsevier](#)) 172, 237-248, 2017
4. Evaluation of radon adsorption characteristics of a coconut shell-based activated charcoal system for radon and thoron removal applications.
Karunakara N., **Sudeep Kumara, K.**, Yashodhara I., Sahoo B K, Gaware J. J., Sapra B. K., Sahoo B. K., and Mayya Y. S.
Journal of environmental radioactivity ([Elsevier](#)) 142, 87-95, 2015
3. Assessment of Ambient Gamma Dose Rate around a Prospective Uranium Mining Area of South India - A Comparative Study of Dose by Direct Methods and by Soil Radioactivity.
Karunakara N, Yashodhara I, **Sudeep Kumara, K.**, Tripathi R M, Menon N Sanjeev, Kadam Sonal, Chougankar M P.
Journal of Results in Physics ([Elsevier](#)) 4, 20–27, 2014
2. Soil to rice transfer factors for ^{226}Ra , ^{228}Ra , ^{210}Pb , ^{40}K and ^{137}Cs : a study on rice grown in India.
N. Karunakara, Chetan Rao, P. Ujwal, I. Yashodhara, **Sudeep Kumara, K.**, P. M. Ravi.
Journal of Environmental Radioactivity ([Elsevier](#)) 118, 80-92, 2013
1. Studies on soil to grass transfer factor (F_v) and grass to milk transfer coefficient (F_m) for cesium in Kaiga region.
Karunakara N., Ujwal P., Yashodhara I., Chetan Rao, **Sudeep Kumara, K.**, Dileep B. N. and Ravi P. M.
Journal of Environmental Radioactivity ([Elsevier](#)) 124, 101-112, 2013

Publications in National Journals

5. Grass to cow milk transfer coefficient (F_m) for Iodine for equilibrium and emergency conditions.
Geetha, P.V., Ujwal Prabhu, Yashodhara, I., **Sudeep Kumara, K.**, Rupali Karpe, Ravi, P.M., Nicy Ajith and Swain, K.K., Karunakara, N.
Journal of [Radiation Protection and Environment](#), Vol. 37, Issue 1, pp 14-20. 2015
4. Effect of humidity on thoron adsorption in charcoal bed.

Sudeep Kumara, K., Karunakara N., Yashodhara I., Sapra B. K., Sahoo B. K., Gaware J. J., Kanse S. D., and Mayya Y. S.
Journal of [Radiation Protection and Environment](#), Vol. 37, Issue 2, pp. 77-79, 2014.

3. Estimation of grass to milk transfer coefficient for cesium for emergency situations.
P. Ujwal, N. Karunakara, I. Yashodhara, Chetan Rao, **Sudeep Kumara, K.**, B. N. Dileep, P.D. Nayak and P. M. Ravi.
Journal of [Radiation Protection and Environment](#), Vol. 34, Issue 3, 210-212. 2012.
2. Concentration of ^{222}Rn in drinking water along coastal Kerala and evaluation of ingestion doses.
Primal D'Cunha, Y. Narayana, N. Karunakara, I. Yashodhara, **Sudeep Kumara, K.**,
Journal of [Radiation Protection and Environment](#), Vol. 34, Issue 3, 197-200, 2012.
1. Radiation levels and radionuclide distributions in soils of Gogi region, a proposed uranium mining region in North Karnataka.
Yashodhara, I., Karunakara, N., **Sudeep Kumara, K.**, Rudramurthy., and Tripathi, R. M.,
Journal of [Radiation Protection and Environment](#), Vol. 34, Issue 4, pp. 267-269, 2011.

Papers presented in International Conferences (in Proceedings and Abstract books)

16. Deposition flux, mass interception and air to plant transfer factor for ^{210}Pb for tropical region of West Coast of India.
Mohan, M.P., Sunil Kumar, A.C., Radhakrishna, A.P., Renita Shiny D'Souza, Rashmi Nayak, Srinivas S Kamath, Trilochana Shetty, **Sudeep Kumara, K.**, Mayya, Y.S., Karunakara, N., The 4th International Conference on Polonium and Radioactive Pb isotopes, State Key Laboratory of Estuarine and Coastal Research, Shanghai, China. April 8-11, 2019.
15. Radionuclide Contents in Bananas Imported to Kuwait.
D. Al-Azmi, **Sudeep Kumara**, Mohan M.P., Renita Shiny D'Souza, Rashmi Nayak, and Karunakara N. (2018). Paper submitted to the Fourteen Arab Conference on the Peaceful Uses of Atomic Energy, Sharm El-Sheikh, Arab Republic of Egypt, to be held on 16-20 December 2018.
14. Gamma dose rates in the high background radiation area of Mangalore district, India.
D. Al-Azmi, **Sudeep. Kumara**, M.P Mohan and N. Karunkara (2018).

Abstract accepted in the 9th International Conference on High Level Environmental Radiation Areas - For Understanding Chronic Low-Dose-Rate Radiation Exposure Health Effects and Social Impacts (ICHLERA 2018) to be held in Hirosaki, Japan (24-27 Sept. 2018).

13. Validation of the traceability of radon and thoron facilities among Asian countries.
M. Janik, S. Tokonami, K. Iwaoka, N. Karunakara, D Al-Azmi, S. Trilochana, M.P. Mohan, **K. Sudeep**, I. Yashodhara, W. Zhuo, C. Zhao, S. Chanyotha, C. Kranrod, O. Kurihara (2018).
5th Asian & Oceanic IRPA Congress on Radiation Protection (20-23 May, 2018), Oral Presentation Session 10.2 Existing Exposure, Conference Book of Abstract, page no. 121.
12. Comparison of radon and thoron concentrations in air and soil gas in lateritic and sea shore locations.
D. Al-Azmi, **Sudeep. Kumara**, M.P Mohan and N. Karunkara (2018). The 6th International Geo-hazards Research Symposium, Dresden, Germany (4-9 March 2018). Book of Abstracts, page 32.
11. Calibration of Activated Charcoal Based Passive ²²²Rn Detectors in a Walk-in Type Calibration chamber at CARER, India.
Trilochana Shetty, **K. Sudeep Kumara**, I. Yashodhara, M. P. Mohan, B. K. Sahoo, J. J. Gaware, B. K. Sapra, H. M. Somashekarppa, Y. S. Mayya, and Karunakara N.
Proceedings of the IARPNC-2018, BARC, Mumbai, January 19-21. 2018.
10. Activated Charcoal Adsorber Bed as a ²²²Rn Hold Up System for Application in Uranium Mining Industries.
Sudeep Kumara K., Karunakara, N., Yashodhara, I., Sapra B. K., Sahoo, B. K., Gaware, J. J., Kanse, S. D. and Mayya, Y. S
Proceedings of the IARPNC-2018, BARC, Mumbai, January 19-21. 2018.
9. Correlation between Radionuclide and Stable Elemental Concentrations in the Soils of Uranium Mineralized Zones of Gogi, Karnataka.
I.Yashodhara., **K, Sudeep Kumara.**, M.P.Mohan., N.Karunakara., R.M.Tripathi.
Proceedings of the IARPNC-2018, BARC, Mumbai, January 19-21. 2018.
8. Atmospheric Deposition Fluxes and Mass Interception Factor of ⁷Be and ²¹⁰Pb.
M.P.Mohan, Renita Shiny D'Souza, S. Rashmi Nayak, Trilochana Shetty, Srinivas Kamath, **K. Sudeep Kumara**, I. Yashodhara, and N. Karunakara. Indian Association for Radiation in Physics -International Conference-2018, BARC, Mumbai
7. Air to grass transfer of Iodine- Estimation of dry and wet deposition rates, velocities, and mass interception factors for a postulated accidental scenario.

Karunakara, N., Ujwal, P., Yashodhara, I., **Sudeep Kumara, K.**, Geetha, P.V., Dileep, B.N., Joshi P James., and Ravi, P.M.
Proceedings of the Second International Conference on Radionuclide Process. Seville, Spain. November, 6-9, 2016.

6. The impact of seasonal changes on distribution of natural radioactivity along high background radiation areas.
Primal, V. Pinto., **Sudeep Kumara, K.**, Karunakara, N., and Narayana, Y.
ENVIRA2015 International Conference, Thessaloniki, Greece. 2015.
5. ^{222}Rn and ^{220}Rn removal from workplaces using granular activated charcoal bed.
Sudeep Kumara K., Karunakara N., Yashodhara I., Sapra, B. K., Sahoo, B. K., Gaware, J. J., Kanse, S. D., and Mayya, Y. S.
8th International Conference on High Levels of Natural Radiation and Radon Areas (ICHLNRRRA 2014). September 1–5, Prague, Czech Republic. 2014.
4. Investigation on the influence of grain size in ^{222}Rn and ^{220}Rn concentrations in the monazite deposits of HBRA.
Primal, V. Pinto., **Sudeep Kumara, K.**, Karunakara, N., and Narayana, Y.
8th International Conference on High Levels of Natural Radiation and Radon Areas (ICHLNRRRA 2014). September 1–5, Prague, Czech Republic. 2014.
3. Estimation of grass to milk transfer coefficient for strontium for emergency situations.
Karunakara, N., Ujwal, P., Yashodhara, I., **Sudeep Kumara, K.**, Dileep, B. N., and Ravi, P. M.
Proceedings of the 4th Assian and oceanic congress on Radiation protection (AOCRP), May 12-16 Kuala Lumpur, Malaysia. 2014.
2. Concentration of ^{210}Pb and ^{210}Po in soil samples around Gogi Uranium mining region.
Yashodhara, I., Karunakara, N., **Sudeep Kumara, K.**, and Tripathi, R. M.
2nd International Conference on Po and radioactive Pb isotopes (INCO-PoPb-2013), Mangalore University, February 10-13, 2013.
1. Soil to rice transfer factors for ^{210}Pb : A study on rice grown in India.
Karunakara, N., Chetan Rao, Ujwal P., Yashodhara, I., **Sudeep Kumara, K.**, Somashekarappa, H.M., Bhaskara Shenoy, K. and Ravi, P.M.

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Papers presented in National Conferences (in Proceedings and Abstract books)

29. Determination of indoor air change rate (ACR) in dwellings with ²²²Rn as a tracer.
K.Sudeep Kumara., Trilochana Shetty., M.P.Mohan., Y.S.Mayya., N.Karunakara (2018). 22nd National Symposium on Radiation Physics (NSRP-22), p,160
28. Radon as a Tracer for Estimation of Indoor Air Change Rate (ACR).
K.Sudeep Kumara., Trilochana Shetty., M.P.Mohan., Y.S.Mayya., N.Karunakara (2018). 20th National Symposium on Environment (NSE-20), p,455-456
27. Evaluation of spatial homogeneity of ²²²Rn in a walk in calibration chamber using CR-39 based passive detectors.
S.Trilochana., **K. Sudeep Kumara.**, M.P.Mohan., H.M.Somashekarappa., B.K.Sahoo., J.J.Gaware., B.K.Sapra., Y.S.Mayya., M.Janik., Al-Azmi Darwish., N.Karunakara (2018). 20th National Symposium on Environment (NSE-20), p,453-454
26. Dependence of Solar Activity on Atmospheric ⁷Be concentration.
Mohan. M. P, Renita Shiny D'Souza, Rashmi Nayak, Srinivas S Kamath, Trilochana Shetty, **K. Sudeep Kumara**, Yashodhara. I., Y.S.Mayya and Karunakara. N (2018). 21st National Symposium on Radiation Physics (NSRP-21), p-111.
25. A "Semi-dynamic" technique for achieving temporal stability of ²²²Rn concentration in a walk-in type calibration chamber.
Trilochana Shetty., **K.Sudeep Kumara.**, M.P. Mohan., B.K.Sahoo., J.J.Gaware., B.K.Sapra., H.M.Somashekarappa., Y.S.Mayya and Karunakara (2018). 21st National Symposium on Radiation Physics (NSRP-21), p-156.
24. ⁷Be and ²¹⁰Pb in Soil and Vegetation in the Environment of West Coast of India.
Mohan. M. P, Sunil Kumar. A. C, Radhakrishna A. P, Renita Shiny D'Souza, Rashmi Nayak, Srinivas S Kamath, Trilochana Shetty, **K.**

- Sudeep Kumara**, Yashodhara. I and Karunakara. N (2017). Proceedings of National Conference on Radiation Physics, NCRP-2017, Bangalore University, 120.
23. Beryllium-7 and Lead-210 in West Coast of India.
Mohan. M. P, Renita Shiny D'Souza, Rashmi Nayak, Srinivas S Kamath, Trilochana Shetty, **K. Sudeep Kumara**, Yashodhara. I and Karunakara. N (2017)., National Conference on Reached the Unreached through Science and Technology, Mangalore University.
 22. An Advanced Calibration facility for ^{222}Rn and Progeny Measuring Devices.
Trilochana Shetty, H. M. Somashekarappa, **K. Sudeep Kumara**, I.Yashodhara, M. P. Mohan, B. K. Sahoo, J. J. Gaware, B. K. Sapra and Karunakara N (2017)., 20th National Conference on Solid State Nuclear Track Detectors and Their Applications.
 21. A walk-in type ^{222}Rn calibration chamber for calibration of radon and progeny measuring devices and inter-comparison measurements.
Trilochana Shetty, Somashekarppa H M, **Sudeep Kumara K.**, Yashodhara I., Mohan M. P., Sahoo B.K., Gaware J.J., Sapra B. K. and Karunakara N
Proceedings of the 13th DAE-BRNS Nuclear and Radiochemistry Symposium (NUCAR-2017), KIIT University, Bhubaneswar, February 6-10, 2017. ISBN No 81-8372-080-3, 662-663.
 20. ^7Be and ^{210}Pb concentrations in atmospheric and terrestrial environmental matrices of Kaiga region.
Mohan M. P., **Sudeep Kumara K.**, Yashodhara I., and Karunakara N.
Proceedings of the 13th DAE-BRNS Nuclear and Radiochemistry Symposium (NUCAR-2017), KIIT University, Bhubaneswar, February 6-10, 2017. ISBN No. 81-8372-080-3, 664-665
 19. Condensational behaviour of iodine vapours in presence of aerosols.
Mariam, Manish Joshi, **Sudeep Kumara, K.**, Karunakara, N., and Sapra, B. K.
Proceedings of the 20th National Symposium on Radiation Physics (NSRP-20), Mangalore University, (ISBN 978-93-82845-96-6). 2015.
 18. Natural radioactivity in soils of Challakere region of Karnataka, India.
Mohan, M. P., **Sudeep Kumara, K.**, Yashodhara, I., Karunakara, N., and Chandrashekar, A.

- Proceedings of the 20th National Symposium on Radiation Physics (NSRP-20), Mangalore University, (ISBN 978-93-82845-96-6). 2015.
17. Activity ratios of primordial radionuclides in soils of natural heavy metal mineralized region.
Yashodhara, I., Karunakara, N., **Sudeep Kumara, K.**, Mohan, M.P., and Tripathi R. M.
Proceedings of the 20th National Symposium on Radiation Physics (NSRP-20), Mangalore University, (ISBN 978-93-82845-96-6). 2015.
 16. Design, development and characterization of a Charcoal based thoron mitigation system for Application in thorium processing facilities.
Sudeep Kumara, K., Karunakara, N., Sahoo, B.K., Gaware, J.J., Sapra, B.K., and Mayya, Y.S.
Proceedings of the 20th National Symposium on Radiation Physics (NSRP-20), Mangalore University, (ISBN 978-93-82845-96-6). 2015.) (**ISRP-NUCLEONIX AWARD**). 2015.
 15. Natural radioactivity in soils from Challakere region, Karnataka.
Mohan, M. P., **Sudeep Kumara, K.**, Yashodhara, I., Karunakara, N., and Chandrashekara, A.
First National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-I). Tehri Garhwal, June 15-17. 2015.
 14. Study on dependence of breakthrough time on flow-rate of the carrier gas in ²²⁰Rn adsorber bed.
Sudeep Kumara, K., Trilochana Shetty., Karunakara, N., Sahoo, B.K., Gaware, J.J., Sapra, B.K., and Mayya. Y.S.
First National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-I). Tehari Garhwal, June 15-17. 2015 (**BEST POSTER AWARD**).
 13. Experimental and theoretical considerations for designing an optimal activated charcoal bed for ²²⁰Rn mitigation.
Sudeep Kumara, K., Karunakara, N., Sahoo, B.K., Gaware, J.J., Sapra, B.K., and Mayya, Y.S.
First National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-I). Tehari Garhwal, June 15-17. 2015
 12. Thoron Mitigation Using Charcoal Based System
Sudeep Kumara K., Karunakara, N., Yashodhara, I., Sapra B. K., Sahoo, B. K., Gaware, J. J., Kanse, S. D. and Mayya, Y. S.
5th BRNS-DAE Symposium on Nuclear Analytical Chemistry-V, Mumbai, January 20-24, 2014. (**BEST PAPER AWARD**).

11. Estimation of air to grass dry and wet deposition rates, velocities and mass interception factors for iodine for postulated accidental scenario. Karunakara, N., Ujwal P., Yashodhara I., **Sudeep Kumara K.**, Geetha P. V., Dileep B. N., Joshi P. James and Ravi P. M. 5th BRNS-DAE Symposium on Nuclear Analytical Chemistry-V, Mumbai, January 20-24, 2014.
10. Radiation levels and radionuclide distributions in terrestrial, atmospheric and aquatic environs of Gogi uranium mining region of North Karnataka. Yashodhara, I., **Sudeep Kumara K.**, Karunakara, N., and Tripathi, R. M Proc. 5th BRNS-DAE Symposium on Nuclear Analytical Chemistry-V, Mumbai, January, 20-24, 2014.
9. Development and Characterization of a Charcoal based Thoron Mitigation System for Application in Thorium Processing Facilities. Sahoo, B.K., Gaware, J.J., Sapra, B.K., Babu, DAR. **Sudeep Kumara, K.**, Karunakara, N., and Mayya, Y.S. National Conference on Power from Thorium: Present Status and Future Directions. BARC, Mumbai. December 22-24. 2014.
8. Estimation of radon & thoron adsorption coefficient values for coconut shell based activated charcoal system for application in radon and thoron removal applications. **Sudeep Kumara, K.**, Karunakara, N., Sahoo, B.K., Gaware, J.J., Sapra, B.K., and Mayya. Y.S. National Symposium on Environment-19 (NSE-19). Kottayam, Kerala. December 11-13. 2014.
7. Effect of humidity on thoron adsorption in charcoal bed. **Sudeep Kumara, K.**, Karunakara, N., Yashodhara, I., Sapra, B. K., Sahoo, B. K., Gaware, J. J., Kanse, S. D., and Mayya, Y. S.,. Proceedings of the IARPNC-2014, BARC, Mumbai, March 19-21. 2014. **(BEST POSTER AWARD).**
6. Radon and Thoron concentrations in indoor air of Gogi region, a proposed uranium mining region of north Karnataka. Yashodhara I., **Sudeep Kumara K.**, Rosaline Mishra., Mayya Y S., Tripathi R M and Karunakara N. 18th National symposium on Solid State Nuclear Track Detectors and Their Applications (SSNTDs-18). October 18-20, 2013.
5. Studies on radon and thoron mitigation using charcoal based systems. **Sudeep Kumara, K.**, Yashodhara I., Karunakara N., Sapra B. K., Sahoo B. K., Gaware J. J., Kanse S. D. and Mayya Y. S. 19th National Symposium on Radiation Physics (NSRP-19). 544-546, 2012.

4. Activity concentrations of ^{226}Ra and ^{238}U in water samples and estimation of radiation dose around the proposed uranium mining region in Gogi. Yashodhara I., **Sudeep Kumara, K.**, Tripathi, R. M. and Karunakara N. 19th National Symposium on Radiation Physics (NSRP-19). 525-528, 2012.
3. Estimation of grass to milk transfer coefficient for Strontium for emergency situations. Ujwal P, Karunakara N., Yashodhara I., **Sudeep Kumara K.**, Dileep B. N. and Ravi P.M. 19th National Symposium on Radiation Physics (NSRP-19). 481-483, 2012.
2. Estimation of grass to milk transfer coefficient for Cesium for emergency situations. Ujwal, P., Karunakara, N., Yashodhara, I., **Sudeep Kumara K.**, Dileep, B. N., Ravi, P. M. Proceedings of 30th IARP Conference on Radiological Protection and Safety in Nuclear Reactors and Radiation Installation. March 15-17, 2012. Mangalore University, India.
1. Concentration of ^{222}Rn in drinking water along coastal Kerala and evaluation of ingestion doses. Primal D'Cunha, Y. Narayana, N. Karunakara, I. Yashodhara and **Sudeep Kumara, K.** 30th IARP National Conference (IARPNC-2012), Mangalore University, March 15-17, 2012.

Books

1. Edited the proceedings of the 20th National Symposium on Radiation Physics (NSRP-20), Mangalore University, Oct. 28-30, 2015, ISBN 978-93-82845-96-6.

Editors

N Karunakara, B K Sapra, Y S Mayya, V Kannan

Co-editors

I Yashodhara, **K Sudeep Kumara**, M P Mohan, Renita Shiny D'Souza, S Rashmi Nayak, Srinivas Kamath

Reports/ Popular articles other types publications

1. Study of ^{220}Rn adsorption in charcoal and vegetable oils for ^{220}Rn mitigation application in off-gas stream
N. Karunakara, **Sudeep Kumara, K.**, Sahoo, B. K., Sapra, B. S. and Mayya Y. S.
BARC, DAE, Govt. of India sponsored Research Project Report (2010-13).

2. Baseline radiation levels and radionuclide concentrations in environmental matrices in and around Dodda Ullarathi, Challakere.
Participating Scientist.
BARC-RMP, Mysuru Govt. of India sponsored Research Project Report (2013-15).

Invited Talk/Oral Presentation

1. Delivered oral presentation on "Studies on radon and thoron mitigation using charcoal based systems" in 19th National Symposium on Radiation Physics (NSRP-19). December, 2012.
2. Delivered oral presentation on "Experimental and theoretical considerations for designing an optimal activated charcoal bed for ²²⁰Rn mitigation" in First National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-I). June, 2015.
3. Delivered oral presentation on "Design, development and characterization of a Charcoal based thoron mitigation system for Application in thorium processing facilities" in 20th National Symposium on Radiation Physics (NSRP-20), 2015.
4. Delivered oral presentation on "Activated Charcoal Adsorber Bed as a ²²²Rn Hold Up System for Application in Uranium Mining Industries" in IARPNC-2018, June-2018.
5. Delivered invited talk on "Basics of Radiation and Radioisotopes and their applications" at Sree Siddaganga college of Arts Science and Commerce, Tumkur. February, 2018.

Training / Workshops attended:

1. Participated in "XIV refresher course in experimental physics" conducted by Indian Academy of Sciences, Bangalore, Indian National Science Academy, Delhi, National Academy of Sciences of India, and Mangalore University during June 1-16, 2009.
2. Participated in Radon Training Workshop-2010 organized by DAE-BRNS, BARC Mumbai.
3. Participated in 7th International Conference on High Levels of Natural Radiation and Radon Areas (7HLNRRRA) organized by Bhabha Atomic Research Centre, Mumbai.
4. Participated in tutorial school on Introduction to the Science of Low Energy Nuclear Reaction was held at ICSR Auditorium, IIT Madras.

5. Participated in Radon Training Workshop-2011 organized by DAE-BRNS, BARC Mumbai.
6. Participated in 4th Conference of Karnataka Science and Technology Academy was held at Mangalagangothri, Mangalore University.
7. Participated in 30th National Conference on Indian Association for Radiation Protection (IARPNC-2012) organized by University Science Instrumentation Centre, Mangalore University.
8. Participated and given ORAL presentation in 19th National Symposium of Radiation Physics (19th NSRP-2012) organized by IGCAR, Kalpakam.
9. Participated in 2nd International Conference on Po and radioactive Pb Isotopes (INCO-PoPb-2013) organized by University Science Instrumentation Centre, Mangalore University.
10. Participated in the Training programme on Measurement of Radionuclides in Environmental Samples held at Radioecology Laboratory, University Science Instrumentation Centre, Mangalore University during May 28-June 1, 2013.
11. Participated in the 18th National symposium on Solid State Nuclear Track Detectors and Their Applications (SSNTDs-18) held at Aggarwal College Ballabgarh, Faridabad during October 18-20, 2013.
12. Participated and presented a paper in 5th symposium on Nuclear Analytical Chemistry (NAC-V) organized by BARC, Mumbai.
13. Participated in two day workshop on "Applications of Matlab and Simulink" conducted by Department of Studies and Research in Electronics, Mangalore University during August 26-27, 2014.
14. Participated and presented a paper in 31st IARP conference organized by BARC, Mumbai.
15. Participated in the seminar on Radiation and Radioisotopes: Tools for scientific Research organized by CARRT, Mangalore University.
16. Participated in three day training programme on "Use of the Pyrolyser furnace system" conducted by RADDEC International at CARER, Mangalore University during December 8-11, 2015.
17. Participated and presented a paper in National Symposium on Environment-19 (NSE-19) organized by School of Environmental Science, Mahathma Gandhi University, Kottayam, Kerala.

18. Participated in the UGC sponsored National Seminar on RADIATION AND ENVIRONMENT organized by the Department of Physics, St Philomena College, Puttur.
19. Participated and presented a paper in 1st RADNET conference organized by HNB Garhwal University Badshahi Thaul Campus.
20. Participated in the UGC-DAE sponsored orientation workshop on Radiation-Its applications in Physical, Chemical and Life Sciences organized by the Department of studies in Physics, Mangalore University.
21. Participated and given ORAL presentation in 20th National Symposium of Radiation Physics (NSRP-20) organized by Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore University, India.
22. Participated in the National Seminar on Inter-disciplinary Research: Challenges and Opportunities organized by Association of British Scholars (ABS) Mangalore Chapter, Mangalore University.
23. Participated in the one day workshop on "ICT Module in Research" organized by Mangala Alumini Association (MAA), Mangalore University, Mangalagangothri.
24. Participated and presented paper in 33rd IARP international conference-2018 organized by Bhabha Atomic Research Centre, Mumbai.
25. Participated and served as a faculty member in two day "Workshop on Radon Measurements" organized by Centre for Advanced Research in Environmental Radioactivity (CARER) Mangalore University during 22-23, 2018.
26. Participated in National Conference on Emerging Themes and Trends in Learning of English in Schools (ELT) conducted by, RIE, Mysuru-NCERT during December 4-6, 2017.
27. Participated and presented paper in 20th National Symposium on Environment (NSE-20)-2018 organized by Department of Earth Science, IIT Gandhinagar, Gujarat.
27. Participated in GIAN "Course on Advanced Direct Reading Radon, Thoron and Progeny Sensors" organized by Centre for Advanced Research in Environmental Radioactivity (CARER) Mangalore University during April 22-27, 2019.
28. Participated in GIAN "Course on Applications of Nuclear Techniques in the Investigation of Monsoon Dynamics and Atmospheric Pollutants"

organized by Centre for Advanced Research in Environmental Radioactivity (CARER) Mangalore University during May 14-24, 2019.

29. Participated in GIAN "Energy, Environment and Sustainability: Enabling Advanced Solutions using Aerosol Science" organized by Indian Institute of Technology, Bombay (IITB) during February 04-08, 2019.
30. Participated and presented paper in 22nd National Symposium on Radiation Physics (NSRP)-2019 organized by Jawaharlal Nehru University (JNU), New Delhi.

Research institutions visited

1. Bhabha Atomic Research Centre (BARC), Anushakthi Nagar, Trombay, Mumbai.
2. Indhira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Chennai.
3. Indian Institute of Science (IISc), Bangalore.
4. Indian Institute of Technology, Bombay (IITB).
5. Indian Institute of Technology (IIT) – Madras.
6. Kaiga Atomic Power Station (KAPS) and Environmental Survey Laboratory (ESL), Kaiga etc.
7. Indian Institute of Technology (IIT) – Gandinagar
8. Many universities in India

Expertise in handling following Instruments

1. Scintillation **Radon monitor, Thoron monitors**
2. Ultra Low background n-type 42% relative efficiency **HPGe gamma ray spectrometer**
3. Ultra Low background p-type 38% relative efficiency **HPGe gamma ray spectrometer**
4. Ultra Low background p-type 50% relative efficiency **HPGe gamma ray spectrometer**
5. Low background **NaI(Tl) gamma spectrometer**
6. ZnS(Ag) **Radiation counting** systems with Alpha and Scintillation probes, GM counter
7. Low background **Beta counter**

8. **Laser Fluorimeter** for Uranium Analysis (Uranium Analyser)
9. Sediment **Core** Sampler
10. **AlphaGuard** with accessories
11. High Volume **Air Sampling Units** (PM10 and PM2.5)
12. **Environmental Chamber** for transfer factor studies under simulated conditions (Nuclear Reactor Accidental Scenario studies)
13. **Radon Calibration Chamber** for calibration of radon monitors both active and passive
14. **Spark Counter** and Etching Bath for SSNTDs
15. **Ion-Selective** Electrode (Fluoride measurements)
16. **Conductivity** and **pH** meters
17. Milestone **Microwave Digestion** System
18. **Atomic Absorption Spectrometer** with Graphite Furnace and auto sampler
19. **²²²Rn and ²²⁰Rn mitigation** systems (TMS)
20. **Gamma dosimeter**, survey meter, GPS, TLDs, Pinhole dosimeters, DTSP and DRPS etc.
21. **Aerosol Impactor and APT** (Applied Particle Technology) for measurement of aerosols and air pollution
22. **RIIDEye x** for gamma identifier and dose measurement
23. Alpha Spectrometry (**Alpha Analyst**, Canberra)