9–10 November 2023 • Imperial College London

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Nuclear Institute

NUCLEAR MODELLING 2023

6th Annual Modelling in Nuclear
Science and Engineering Seminar

PROGRAMME

Room G41, Department of Earth Science and Engineering, Royal School
of Mines, Imperial College London, Prince Consort Road, London SW7 2BP

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WELCOME

The 6th Modelling in Nuclear Science and Engineering Seminar is to bring together the nuclear community to share innovative and different ways of adopting modelling to help improve design and operation of facilities and protect society by improving safety of nuclear plants and facilities.

The aim of scientific modelling as an activity is to make features and performance of the design easier to understand, quantify, visualise, or simulate by adopting rigorous scientific methods, and is applied across all kinds of industries and walks of life. This seminar will provide a platform to highlight exciting new modelling methods and applications to help industry members and those who may be thinking about a career in modelling for the nuclear industry.

The seminar this year offers a fantastic line-up and a fascinating set of topics and themes to offer scientists and engineers a view on future developments, which will include exploring how AI can be adopted to support modelling in nuclear industry.
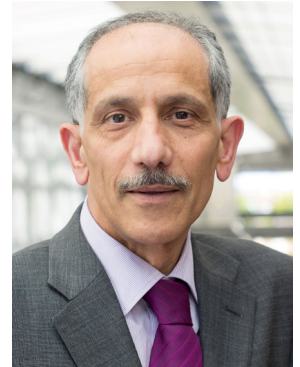
Professor Ali Tehrani, CEng, FNucI, FIMechE

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NUCLEAR MODELLING 2023

6th Annual Modelling in Nuclear Science and Engineering Seminar

9–10 November 2023 • Imperial College London　　**PROGRAMME**

DAY 1 THURSDAY 9 NOVEMBER

9:00 REGISTRATION, NETWORKING, AND REFRESHMENTS

9:45 **Opening and Welcome**
Prof. Ali Tehrani, Chair
Prof. Christopher Pain, Imperial College London

SESSION 1: IMPACT OF MODELLING IN NUCLEAR ENGINEERING AND SCIENCE
Chair: Prof. Ali Tehrani

10:00 **Keynote**

Future prospects of AI in nuclear engineering modelling

Christopher Pain, Ali Tehrani, Claire Heaney, Boyang Chen, Toby Phillips, Linfeng Li, Jiansheng Xiang, Steven Dargaville, Omar Matar, Paul Smith and *Andrew Buchan*, Imperial College London

10:30 **Integrated modelling approaches for SMR core design**

Oliver Hannant, Tom Wright, Ben Cooper, and *Christopher Bennett*

10:50 **Embracing empirical modelling methods in the journey of impactful mechanistic model development**

Eleftherios Vlazakis and *Caroline Pyke*

11:10 BREAK

SESSION 2: MULTI-PHYSICS AND MULTI-SCALE MODELLING
*Chair: **Prof. Paul Smith***

11:20 **Keynote**

IAEA Efforts to Support Member States to Assess and Enhance the Safety of Current and Future Nuclear Installations

Ana Gomez Cobo, Head of Safety Assessment, International Atomic Energy Agency

11:50 **Modelling and Simulation: Fostering international co-operation within the OECD NEA Working Party on scientific issues and uncertainty analysis of Reactor Systems (WPRS)**

Kostadin Ivanov, Hakim Ferroukhi, Michelle Bales, Oliver Buss, Ian Hill and *Tatiana Ivanova*

12:10 **Computation of multi-physical interfacial Newtonian, two-phase dusty (Saffman) and non-Newtonian Eringen micropolar transport in nuclear reactor ducts with a modified Differential Quadrature Method (DQM)**

O. Anwar Bég, R. K. Chandrawat, V. Joshi and *Sireetorn Kuharat*

12:30 **SHOWBIZ: A multi-physics 3D code to simulate a fuel rod cladding embrittlement in normal reactor operation, transport and storage and during LOCA and RIA transients**

Alessandra Del Masto, Marine Guémas, Cédric Leclere, Maxime Salvo and *Tatiana Taurines*

12:50 GROUP PHOTO, LUNCH, POSTER SESSION AND NETWORKING

SESSION 3: AI, INNOVATION AND RECENT DEVELOPMENTS IN REACTOR PERFORMANCE AND SAFETY MODELLING
*Chair: **Dr Amir Nourian***

14:00 **Keynote**

Great British Nuclear Update

Mike Roberts, Head of Technical Delivery, Great British Nuclear

DAY 1 THURSDAY 9 NOVEMBER

14:30 **Technology development for the deployment of high temperature reactors for alternate generation of electrical energy and hydrogen**
Mark Bankhead, *Jorge Wier* and *Christopher Connolly*

14:50 **GMIT: An automation tool for post-closure criticality safety assessments**
Jiejie Wu, *E. Adam Paxton* and *David Applegate*

15:10 **Potential application of quantum computing to Monte Carlo radiation transport**
Paul Smith, *Roberta Rehus*, *Konstantinos Geogopoulos* and *Ines Juvan-Beaulieu*

15:40 **BREAK**

SESSION 4: ALTERNATIVE FUEL, PLANT EXTENSION, END-OF-LIFE STUDIES AND FUEL CYCLE FACILITIES
Chair: **Dr Andrew Buchan**

16:00 **Keynote**
Accelerated licensing of nuclear fuels using mechanistic modelling methods

Prof. Simon Middleburgh, Bangor University

16:30 **PuO2 Modelling relevant to long-term storage**
Nathan Palmer, *Dave Woodhead*, and *Owen Heaton*

16:50 **The last cycle of Tihange 2: reload design, safety evaluation and pool management**
Ruben Van Parys, *Maxime Haedens*, and *Matthias Vanderhaegen*

17:10 **Development of safety analysis and management of residual risk**
Dr John Jones

17:30 **DAY 1 CLOSES**

DAY 2 FRIDAY 10 NOVEMBER

08:00 **COFFEE AND NETWORKING**

SESSION 5: PLANT PERFORMANCE IN ACCIDENT CONDITIONS
Chair: **Prof. Panagiota Angeli**

08:30 **Keynote**
Severe accident modelling: A historic perspective, recent developments and challenges ahead

Prof. Luis Enrique Herranz, Head of Nuclear Safety Research Centre for Energy, Technology and Environmental Research (CIEMAT)

09:00 **Criticality safety and reactor physics modelling in stochastic geometries in the MONK Monte Carlo code**
Paul Smith

09:20 **Modelling of irradiation creep in graphite**
Vadim Zolotarevskiy, *Graham N Hall* and *Abbie N Jones*

09:40 **Multi-Physics Multi-Scale Simulation Framework Based on CTF/CTF Fuel**
Maria Avramova, *Agustin Abarca*, *ascal Rouxelin*, *Gregory Delipei* and *Muhammad Altahhan*

10:00 **BREAK**

DAY 2 FRIDAY 10 NOVEMBER

SESSION 6: REACTOR THERMAL HYDRAULICS, FUEL PERFORMANCE, NEUTRONICS, CRITICALITY AND SHIELDING

Chair: **Prof. Kostadin Ivanov**

10:20 Keynote

Mathematical modelling of intensified flowsheets for spent nuclear fuel reprocessing

Prof. Panagiota Angeli, **Prof. Eric Fraga**
Dept of Chemical Engineering, Faculty of Engineering Science, University College London

10:50 Study of energy deposition in the coolant of LFR

Maria Susini, **Daniele Tomatis**, and **Stefano Argirò**

11:10 A reduced order model discretisation of the space-angle phase-space dimensions of the Boltzmann transport equation with application to nuclear reactor eigenvalue problems

Andrew Buchan

11:30 Finite Element Analysis of the effects of eccentric fuel stringers on the predicted onset of brick cracking

Ahmadreza Farrokhnia, **Abbie Jones**, and **Graham Hall**

11:50 Design and optimisation of a boron-free small modular reactor core

Madinka Bright Mweetwa and **Marat Margulis**

12:10 LUNCH, POSTER SESSION and NETWORKING

SESSION 7: OPTIMISATION TECHNIQUES TO SUPPORT DESIGN AND PROCESS DEVELOPMENTS

Chair: **Dr Mark Bankhead**

13:30 An open-source porous media modelling approach to investigate thermohydraulic features of compact printed circuit heat exchangers

Michael McDermott and **Shuisheng He**

13:50 Modelling the liquid waste operation at the Savannah river site

Andrew Jung, **Tanner Liddy**, **Peter Hill**, **Simon Woodward** and **Jeremy Bas**

14:10 Differential evolution optimization of a nuclear thermal propulsion rocket

Kimberly Gonzalez and **William Culbreth**

14:30 Phase Field modelling of low-cycle fatigue behaviour of nuclear structural materials

MD Zahid Hasan and **Abdullah Al Mamun**

14:50 CLOSING REMARKS AND FEEDBACK

DAY 2 FRIDAY 10 NOVEMBER

POSTERS

POSTER 1

A MECHANOCHEMICAL FORMULATION FOR HIGH STRAIN DISSOLUTION DRIVEN STRESS CORROSION CRACKING

Jason Lee, Mark Wenman, Emilio Martinez-Paneda, Sasa Kovacevic, Maciej Makuch

POSTER 3

VALIDATION OF ACTIVITY DISTRIBUTION RECONSTRUCTION USING MLEM, SART AND BOUNDING CASES

Iona Webster, Paul Hulse, and Joachim Bennett

POSTER 2

ELECTRON CONDUCTIVITY IN UN WITH SI, C AND O IMPURITIES

Cintia Leite Goncalves, Robert Annewandter, Antoine Claisse and Simon C. Middleburgh