9–10 November 2023 • Imperial College London

**ni**
**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.
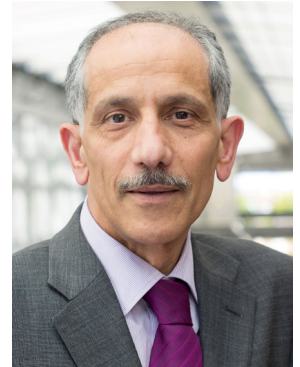
**Professor Ali Tehrani, CEng, FNucI, FIMechE**

## Thank you to our gold sponsors

## 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**

*Simon Richards, Jessica Fildes* and *Brian Jones*

**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 2**

## ELECTRON CONDUCTIVITY IN UN WITH SI, C AND O IMPURITIES

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

**POSTER 3**

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

*Iona Webster*, *Paul Hulse*, *and Joachim Bennett*

**POSTER 4**

## TBC