

Yuqiao (Joy) Fan

[Linked-in](#) | fany1@ornl.gov | Work: 865-341-1932 | ORCID: 0000-0002-2975-1735

EDUCATION

PhD in Nuclear Engineering (Minor in Mech. Eng.) NC State University (NCSU), Raleigh NC	Jul. 2017-Dec. 2021 <i>summa cum laude</i>
MSE in Nuclear Engineering University of Michigan (UMich), Ann Arbor MI	Aug. 2015-Dec. 2016 <i>cum laude</i>
BE in Nuclear Engineering Xi'an Jiaotong University (XJTU)	Sep. 2011-Jun. 2015 Rank: 1/94
Visiting Student Hong Kong University of Science and Technology (HKUST)	Summer 2013, 2014 Grades: A, A+

EMPLOYMENT EXPERIENCE

Blanket, Fuel Cycle, and Fusion Engineer, R&D Associate Staff Fusion Energy Division, Oak Ridge National Laboratory (ORNL) <i>Supervisor: Dr. Larry Baylor (baylorlr@ornl.gov)</i>	Feb. 2022-
<ul style="list-style-type: none">• Conducting liquid metal (LM) magnetohydrodynamics (MHD) flow study in Dual-Coolant Lead-Lithium blanket, optimizing design of the LM feeding geometry for the breeding blanket.• Integrating various physics (MHD, conjugated heat transfer, mass transfer, two-phase, etc.) to tackle cutting-edge challenges related to plasma-facing components and corrosion issues.• Performing high-fidelity Computational Fluid Dynamics (CFD) simulations on cryogenic hydrogen extruder for leakage-reduced fuel injection into the fusion reactors, which contributes to ITER's success.• Studied the feasibility of a novel blanket candidate, Toroidally Symmetric Lead Lithium blanket, by demonstrating lower MHD pressure drop under significant magnetic fields.• Co-PI on CFD modeling of the helium cooling performance at the heated first wall of the fusion blanket; worked closely with experimentalists and advance manufacturing staff on the design and fabrication of the helium flow channel.• Managing computational servers and coordinate licenses for ANSYS and COMSOL.• Active involvement in hiring committees for recruiting staff members, postdocs, and interns.	

Research Assistant

Multiphase Research Group, NCSU <i>Advisor: Prof. Igor Bolotnov (igor_bolotnov@ncsu.edu)</i>	Jul. 2017-Feb. 2022
<ul style="list-style-type: none">• Integrated proportional–integral–derivative (PID) control with level-set method in PHASTA code; achieved highly scalable, efficient, accurate, and robust two-phase flow rate control• Applied PID flow rate control to study Counter Current Flow Limitation (CCFL) in light water reactor (LWR) debris bed channels; developed correlations and dimensionless numbers to predict CCFL occurrence and for safety analysis in severe accident scenarios• Developed novel gravity control method and added this new capability into existing PID bubble controller; achieved more accurate bubble simulation results for verification and validation (V&V)• Applied bubble controller on closure development of bubble interfacial forces as well as deformation and break-up regimes with validation from experimental research• Conducted pool boiling simulations with multiple nucleation sites; concluded bubble departure behaviors under different nucleation site patterns, site distances, and heat fluxes	

Intern (remote)

Institute of Fluid Dynamics, Helmholtz-Zentrum Dresden-Rossendorf, Germany	Summer 2020
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Advisors: Dr. Dirk Lucas (d.lucas@hzdr.de), Dr. Roland Rzehak (r.rzehak@hzdr.de)

- Conducted high resolution simulations of lift and drag forces on bubbles at high shear rates
- Developed closures of interfacial forces for Eulerian-Eulerian baseline models

Intern

Advanced Reactor Engineering and Development Section & CASL, ORNL

Fall 2019

Advisors: Dr. David Pointer (pointerwd@ornl.gov), Dr. Marc-Olivier Delchini (delchining@ornl.gov)

- Worked on application, model validation, uncertainty quantification, and documentation of Eulerian-Eulerian FY19 CASL boiling models
- Conducted two-phase Reynolds Averaged Navier Stokes (RANS) simulations using Star-CCM+ on departure from nucleate boiling in cylindrical channel
- Performed bug-hunting and solution verification of nek4nuc (integrated Nek5000 into NEAMS Workbench) via turbulent simulations of pipe channel
- Applied nek4nuc in flow characteristics study of High Flux Isotope Reactor (HFIR) cooling channel with high resolution Large Eddy Simulations (LESs)

Graduate Student Research Assistant

Experimental and Computational Multiphase Flow Laboratory, UMich

Aug. 2015-Dec. 2016

- Designed bubble injector for water-air fuel bundle in experiment system
- Programmed 3D data visualization acquired by wire mesh sensor at bubble column facility

EXPERIMENTAL RESEARCH EXPERIENCE

Undergraduate Student Research Assistant

Dec. 2014- Jun. 2015

Laboratory on flow and heat transfer characteristics of steam generator tube bundles, XJTU

Advisor: Prof. Wenxi Tian (wxtian@mail.xjtu.edu.cn)

- Conducted shakedown tests on large-scale experimental facility of partial scaled tube bundles at secondary side in steam generator of nuclear reactor CAP1400
- Studied the flow and heat transfer characteristics by experiments and simulations and developed correlations for friction loss of tube bundles

Research Intern

Centre for Energy and Thermal Systems, HKUST

Summer 2014

Advisor: Prof. Huihe Qiu (meqiu@ust.hk)

- Designed and performed copper cylinder pool boiling experiments and obtained boiling curves
- Improved heat transfer performance by fabricating nanostructures on heated copper surfaces

Undergraduate Student Research Assistant

Sep. 2013-Jul. 2014

Laboratory of Thermal Science and Engineering, XJTU

Advisor: Prof. Yaling He (yalinghe@mail.xjtu.edu.cn)

- Designed and fabricated polymer filled copper plates to rearrange thermal resistance distribution
- Changed heat flow on the plate and improved thermal isolation performance at center volume

Undergraduate Student Research Assistant

Mar. 2013- Aug. 2015

Laboratory of Fluid Machinery, XJTU

Advisor: Prof. Zhongguo Sun (sun.zg@mail.xjtu.edu.cn)

- Designed and fabricated experimental apparatus for bottleneck effect, an **original research** study
- Studied flow instability influenced by inclination angles at the bottleneck of flask-shape container

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FUNDING AWARDS

- Department of Energy, PI** Under review
- Private Facility Research Program, “*Fundamental Study of Liquid First Wall Technology Leveraging EX-Fusion’s High-Repetition Rate Inertial Fusion Energy Facility*”
- Department of Energy, ORNL PI** Feb. 2025-Feb. 2028
- Reaching a New Energy Science Workforce (RENEW) Program, “*Initiatives to Grow New Innovative Talent to Enable Fusion Energy (IGNITE Fusion Energy)*”
- Department of Energy, PI** Jan. 2023-present
- NERSC DOE Mission Science Allocation Award, “*Liquid metal plasma-facing component*”
 - Recipient for the Allocation Years 2023, 2024, and 2025
- Oak Ridge National Laboratory, Co-PI** Jul. 2022-Sep. 2024
- Laboratory Directed Research and Development (LDRD), “*Predictive modeling of Helium flow with validation*”
 - Awarded a third-year extension for fiscal year 2024, recognizing outstanding performance

HONORS & OTHER AWARDS

- Selected participant, ATPESC, Argonne National Laboratory (ANL)** Summer 2025
- Selected through a highly competitive global application process to participate in the prestigious supercomputing training program, **Argonne Training Program on Extreme-Scale Computing** (two weeks, fully funded by ANL)
- Finalist in the Your Science in a Nutshell competition, ORNL** Summer 2023
- Distinguished participant in one of the most prestigious contests for early-career researchers, presenting “*Squeezing better performance out of fusion reactors*”
- Best Talk in Nuclear Energy, ORNL** May 2023
- Received the People’s Choice Award during 2023 ORPA Research Symposium, an annual research symposium for researchers from ORNL and partner universities to share their research, presenting “*Helium Flow Visualization Simulation for Fusion Reactor Blanket First Wall Cooling*”
- Mentored Teaching Fellowship, College of Engineering (COE), NCSU** Jan. 2020
- Offered to only 10 teaching assistants in COE
- Selected participant, Nuclear Innovation Bootcamp, UC Berkeley** Summer 2018
- Completed group project of starting an innovative company utilizing machine learning to reduce redundant labor cost in reactor power plants
- Graduate Merit Award, College of Engineering, NCSU** Jul. 2017
- Offered to only 2-3 entering graduate students per department
- Outstanding Student Pacesetter, XJTU** Nov. 2014
- Only 10 out of ~16,000 undergraduates awarded each year.
 - The highest and the most prestigious honor for the students at XJTU.

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National Scholarship, The Ministry of Education of China

Sep. 2013, Sep. 2014

- Top 0.2%; one of the highest honors for university students in China

Meritorious Winner, Mathematical Contest in Modeling

Consortium for Mathematics & its Applications, USA

Feb. 2014

- Top 9.7%; a three-person team solving an applied math problem by modeling and programming

FEATURING

ORNL Today

- Featured in “DOE awards ORNL grant through RENEW initiative to mentor next generation of fusion researchers” as the PI who initiated the majority of the original concepts for this proposal.

Success Story, Oak Ridge Institute for Science and Education (ORISE)

- Selected as one of very few researches at ORNL to be showcased in the ORISE column "What's it like Being an ORISE STEM Researcher?"

Science Headlines, multiple media (energy.gov, phys.org, ornl.gov, etc)

- Featured in "Fusion Experts Address Cooling Strategies for Fusion Fuel Cycle", contributing to helium flow visualization as a co-PI.

INVITED TALK

“Fusion Energy: Science and Technology research opportunities at Oak Ridge National Laboratory”,
Tennessee State University Nov. 2024

REVIEWER SERVICE

DOE PAMS proposal

ANS journals (Nuclear Science and Engineering | Nuclear Technology | Fusion Science and Technology)

Nuclear Engineering and Design

Annals of Nuclear Energy

International Topical Meeting on Nuclear Reactor Thermal Hydraulics (**NURETH**)

Advances in Thermal Hydraulics (**ATH**)

ANS general Conferences: Annual Meetings, Winter Meetings, Student Conferences

SERVICE IN PROFESSIONAL SOCIETIES

Technical Program Committee member for ISFNT-16, 2025

Track member of the Technical Program Committee for CFD track, NURETH-21, 2025

Proposal team member to host NURETH-22 in Fall 2027, 2024

Judge for GEM Tech Talk Competition, invited by Office of Research Excellence at ORNL, 2023

Member of American Physical Society (APS) since 2023

Member of ORNL Women’s Alliance Council since 2022

Session chairs for American Nuclear Society (ANS) conferences since 2020

Coordinator for the Keynote Speakers, 2020 ANS Student Conference

Member of American Nuclear Society since Mar. 2018

Financial Chair, NCSU Proposal Committee for hosting ANS Student Conference, 2017

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PROFESSIONAL ACTIVITIES

Organization Committee Chair, Fusion Innovation Bootcamp Summer 2026
Tennessee State University, Nashville, TN

- As the ORNL PI, will work with 6 universities to launch the first-ever Fusion Innovation Bootcamp at TSU in Summer 2026

Fusion Fuel Cycles and Blankets Workshop May 2023
Electric Power Research Institute (EPRI), Charlotte, NC

- Played as a presenter and contributor in the workshop, shaping the 10-year roadmap for advancing fusion fuel cycles and blanket research.

Virtual Workshop Series on Fission Battery Initiative Spring 2021
Idaho National Laboratory and the National University Consortium

- Attended workshops on markets and economic requirements and technology innovations for fission batteries

2020 ALCF Computational Performance Virtual Workshop May 2020
Argonne National Laboratory

- Attended trainings to improve utilization of HPCs at ALCF

SKILLS

CFD method: Level-set • Eulerian-Eulerian • DNS • LES • RANS • Finite Element/Volume/Difference

CFD code: PHASTA • ANSYS-FLUENT • ANSYS-Polyflow • Star-CCM+ • Nek5000

MHD code: ANSYS-FLUENT-MHD module • COMSOL Multiphysics • HIMAG

Simulation: ICEM • Ansys Meshing • Cubit • NEAMS Workbench • COBRA-TF • MCNP • SAPPHIRE

Pre & Post processing: Simmodeler • Paraview (parallel) • VisIt • Tecplot

HPC system: FED servers, Libby, Odo (ORNL) • Insight, Henry (NCSU) • Cetus, Cooley, Theta, Polaris (ANL) • Perlmutter (NERSC)

Programming: FORTRAN (MPI) • bash • MATLAB • C • Python

Experiment: AutoCAD • SolidWorks • Machine shop • Calibration

Computer Literacy: Anaconda • Spyder • svn • Git • Latex • Linux • Microsoft Office Suite

TEACHING EXPERIENCE & ADVISING

Brandon Partee, Tennessee State University, Undergraduate Summer 2024-present

Zachary Fusinski, University of Michigan, Undergraduate Summer 2024-present

Lecturer in training, NCSU, NE/MAE 577 Multiscale Two-Phase Flow Simulations Spring 2020

Graduate Student Instructor, UMich, NERS 444 Thermal-hydraulics for Nuclear Systems Fall 2016

JOURNAL PUBLICATION

Yuqiao Fan, Sergey Smolentsev, **Investigation of Anchor Link Magnetohydrodynamic Effects in Toroidally Symmetric Lead-Lithium (TSL) Blanket Concept**, *Fusion Science and Technology* (under review)

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Yuqiao Fan, Larry Baylor, Steven Meitner, **High-Fidelity CFD Modeling Techniques of Cryogenic Hydrogen Isotope Extrusion for Fusion Reactor Pellet Fueling**, *Fusion Science and Technology* (under review)

Yuqiao Fan, Igor Bolotnov, **Counter-Current Flow Limitation Studies in Complex Geometries Utilizing Interface Capturing Simulations coupled with PID Flow Rate Controller**, *Nuclear Science and Engineering* (under review)

Sergey Smolentsev, Sunday Aduloju, Yuqiao Fan, et al, **Overview of magnetohydrodynamic studies for liquid metal systems of a fusion power reactor at Oak Ridge National Laboratory**, *Nuclear Science and Engineering* (under review)

Cody Wiggins, Yuqiao Fan, Chris Crawford, Chase Joslin, **Design Overview of a High-Pressure Helium Flow Visualization Apparatus for Blanket Cooling Studies**, *Fusion Science and Technology* (accepted)

Sergey Smolentsev, Sunday Aduloju, Jin Whan Bae, Yuqiao Fan, et al, **Pre-conceptual design and proof of principle assessments of self-cooled Toroidally symmetric lead-lithium (TSL) blanket**, *Fusion Engineering and Design* Oct. 2024

Yuqiao Fan, Cody Wiggins, Charles Kessel, **Simulation of Helium Flow Visualization Apparatus for Studies of Blanket Cooling in Fusion Reactors**, *IEEE Transactions on Plasma Science* Jun. 2024
- Invited publication by SOFE 2023

Yuqiao Fan, Mengnan Li, William D. Pointer, Igor Bolotnov, **High-fidelity pool boiling simulations on multiple nucleation sites using interface capturing method**, *Nuclear Engineering and Design*
- Invited publication by NURETH 19 conference Dec. 2022

Yuqiao Fan, Jun Fang, Igor Bolotnov, **Complex bubble deformation and break-up dynamics studies using interface capturing approach**, *Experimental and Computational Multiphase Flow* Jul. 2020

Kui Zhang, Yandong Hou, Wenxi Tian, Yuqiao Fan, et al., **Experimental investigations on single-phase convection and steam-water two-phase flow boiling in a vertical rod bundle**, *Experimental Thermal and Fluid Science* Jan. 2017

Kui Zhang, Yuqiao Fan, et al., **Pressure drop characteristics of two-phase flow in a vertical rod bundle with support plates**, *Nuclear Engineering and Design* Aug. 2016

Jun Wang, Yuqiao Fan, et al., **The development of candling module code in module in-vessel degraded analysis code MIDAC and the relevant calculation for CPR1000 during large-break LOCA**, *ASME Journal of Nuclear Engineering and Radiation Science* Feb. 2016

Yuqiao Fan, Xuejun Zhao, et al., **Experimental study on the influence of the incline angle of narrow-necked container on bottleneck effect**, *Journal of Engineering Thermophysics* Aug. 2015

- Invited publication by Chinese Society of Engineering Thermophysics' Academic Conference 2015

Jun Wang, Wenxi Tian, Yuqiao Fan, et al., **The development of a zirconium oxidation calculating program module for Module In-vessel Degraded Analysis Code MIDAC**, *Progress in Nuclear Energy* May 2014

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PATENT

NO. ZL201420436054.8: the experimental system for bottleneck effect, including an adjustable sized bottleneck, the supporting shelf and the driving system. Aug. 2014

PEER-REVIEWED CONFERENCE TRANSACTIONS & FULL PAPERS

Brandon Partee, [Yuqiao Fan](#), **Computational Fluid Dynamics Solver for Liquid Metal Flow Channel Simulations**, *ANS Student Conference 2025* (accepted) Apr. 2025

[Yuqiao Fan](#), Cody Wiggins, **Helium Flow Simulations of Heat Transfer Enhancement Structures for Blanket First Wall Cooling**, *2024 ANS Annual Meeting* Jun. 2024

[Yuqiao Fan](#), Mengnan Li, William D. Pointer, Igor Bolotnov, **Interface Capturing Simulations on Pool Boiling Performance with Multiple Nucleation Sites**, *NURETH-19* Mar. 2022

Marc-Olivier Delchini, [Yuqiao Fan](#), **Comparisons between High-Fidelity and Low-Fidelity Modeling of the Turbulent Flow in the High Flux Isotope Reactor Cooling Channel Using Nek5000-V17 and Star-ccm+**, *NURETH-19* Mar. 2022

[Yuqiao Fan](#), Marc-Olivier Delchini, Robert Lefebvre, **Verification of Nek4nuc (Nek5000 Integrated in NEAMS Workbench) via Turbulent Pipe Flow Simulation**, *2020 ANS Winter Meeting and Nuclear Technology Expo* Nov. 2020

[Yuqiao Fan](#), Igor Bolotnov, **Gravity Controller Capability for Single-Bubble Interface-Resolved Simulations**, *2020 ANS Winter Meeting and Nuclear Technology Expo* Nov. 2020

[Yuqiao Fan](#), Igor Bolotnov, **Investigation on Bubble Deformation and Break-up Dynamics Using Interface Tracking Method**, *2019 ANS Annual Meeting* Jun. 2019

[Yuqiao Fan](#), Jinyong Feng, Igor Bolotnov, **Investigation of Wall Effect on Deformable Bubble Using Interface Tracking Method**, *2018 ANS Annual Meeting* Jun. 2018

CONFERENCE PUBLICATIONS

Sergey Smolentsev, Yuchen Jiang, Sunday Aduloju, Jeremy Lore, [Yuqiao Fan](#), et al, **Use of second coolant in LM open-surface divertor designs**, *2025 US-Japan workshop on liquid metal plasma-facing components (LM PFCs)* Feb. 2025

Jeremy Lore, Sergey Smolentsev, [Yuqiao Fan](#), et al, **Modeling plasma liquid metal plasma surface interactions for open surface divertors**, *2025 US-Japan workshop on LM PFCs* Feb. 2025

Brandon Partee, [Yuqiao Fan](#), **Generating a Flow Field Solver Through Computational Fluid Dynamics using Liquid Metal**, *66th Annual Meeting of the APS Division of Plasma Physics* Oct. 2024

Matt Beidler, et al, and [Yuqiao Fan](#), **Modeling resilience of fusion blankets for tokamak disruptions**, *66th Annual Meeting of the APS Division of Plasma Physics* Oct. 2024

[Yuqiao Fan](#), Steven Meitner, Larry Baylor, **High-Fidelity CFD Modeling of Cryogenic Hydrogen Isotope Extrusion for Fusion Reactor Pellet Fueling**, *26th Technology of Fusion Energy Meeting (TOFE 2024)* Jul. 2024

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Yuqiao Fan, Sergey Smolentsev, **Investigation of Anchor Link Magnetohydrodynamic Effects in Toroidally Symmetric Lead-Lithium (TSL) Blanket Concept**, *TOFE 2024* Jul. 2024

Cody Wiggins, Yuqiao Fan, Chris Crawford, Chase Joslin, **Design and Commissioning of High-Pressure Helium Flow Visualization Apparatus for Blanket Cooling Studies**, *TOFE 2024* Jul. 2024

M. Shahinul Islam, Jeremy Lore, Sergey Smolentsev, Yuqiao Fan, et al, **Modelling of fast flow liquid lithium divertor for next step fusion devices using coupled boundary plasma and liquid metal transport codes**, *26th International Conference on Plasma Surface Interaction in Controlled Fusion Devices (PSI-26)* May 2024

Yuqiao Fan, Sergey Smolentsev, **Optimal Design of the Liquid Metal Feeding System for Fusion Reactor Blankets through High-Fidelity MHD Simulations**, *76th Annual Meeting of the APS Division of Fluid Dynamics* Nov. 2023

Yuqiao Fan, Cody Wiggins, Charles Kessel, **Simulation of Helium Flow Visualization Apparatus for Studies of Blanket Cooling in Fusion Reactors**, *SOFE 2023* Jul. 2023

Sergey Smolentsev, Yuqiao Fan, Shahinul Islam, *et al.*, **Recent and future work on LM PFC at ORNL, 2023 US-Japan Workshop on Liquid Metal PFCs** Feb. 2023

TECHNICAL REPORT & DOCUMENTATION

Yuqiao Fan, **Fusion-Engr-New Server User Guide** June. 2024

Sergey Smolentsev, Yuqiao Fan, Sunday Aduloju, Paul Humrickhouse, **Liquid Metal Blanket Candidate for the US Fusion Pilot Plant**, *ORNL LDRD report* 2023-2024

Cody Wiggins, Yuqiao Fan, Chris Crawford, Brian Post, **Predictive Modeling of Helium Flow with Validation**, *ORNL LDRD report* 2022-2024

Yuqiao Fan, Cheng-Kai Tai, Igor A. Bolotnov, **Multiple Bubble Boiling Simulation Scaling and Evaluation**, *CASL report* Nov. 2020

Yuqiao Fan, Roland Rzehak, **DNS Study of Lift and Drag Forces on Bubbles at High Shear Rates** (HZDR Contract No: 3725-001) Aug. 2020

Yuqiao Fan, David Pointer, **FY19 CASL Two-phase Model User Guide** Dec. 2019

Yuqiao Fan, Igor A. Bolotnov, Nam T. Dinh, **Debris Bed Formation and Coolability Task 4 Final Report** (NRC Contract No: NRC-HQ-60-16-T-001) Jun. 2019