

Benjamin S. Collins

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Education

University of Michigan, Ann Arbor, MI

August 2008 – July 2011

- Doctor of Philosophy in Nuclear Engineering, Radiological Sciences, and Scientific Computing
- Dissertation Title: Multiscale Methods for Nuclear Reactor Analysis

Purdue University, West Lafayette, IN

August 2007 – August 2008

- Master of Science in Nuclear Engineering
- Specialization: Computational Engineering
- Thesis Title: Neutronic Modeling of a Fast Boron Injection System

Purdue University, West Lafayette, IN

August 2002 – May 2007

- Bachelor of Science in Nuclear Engineering

Professional Experience

Reactor Physics Nuclear Engineer

2014 – Present Oak Ridge National Laboratory, Oak Ridge, TN

- Software Development and Design for the Reactor Physics code MPACT
- Coupled neutron transport and with other physics

Adjunct Assistant Professor

2014 – Present University of Michigan, Ann Arbor, MI

- Mentored graduate students

Assistant Research Scientist

2012 – 2014 University of Michigan, Ann Arbor, MI

- Software Development and Design for the Reactor Physics code MPACT
- Coupled neutron transport and with other physics
- Mentored graduate students

Postdoctoral Research Fellow

2011 – 2012 University of Michigan, Ann Arbor, MI

- Software Development and Design for the Reactor Physics code MPACT
- Coupled neutron transport and CFD
- Mentored graduate students

Graduate Research Assistant

2008 – 2011 University of Michigan, Ann Arbor, MI

- Steady State Boiling Water Thermal-Fluids Solver for PARCS

- Coupled Multiscale Methods

Undergraduate Research Assistant

2005 – 2007 Purdue University, West Lafayette, IN

- LOCA Analysis of Heavy Water Reactor
- Worked with CFD Codes to Model Bubble Columns

Co-operative Student

2003 – 2006 First Energy Nuclear Operating Company, Various Cities

- Reactor Engineering Co-op at Perry NPP, Davis-Besse NPS, and Beaver Valley NPS
- Core Design and Physics Support Co-op at Corporate Office
- Developed Various Computational Tools
- Assisted in Refueling Activities

Project Oversight

CASL

- **B. Collins.** Improvements to CMFD Methodology. L3:RTM.PRT.P13.02. 2016.
- **B. Collins.** VERA-CS for PWR for analysis of reactor steady-state operation including multi-cycle capability and with CIPS modeling capability. L2:PHI.P11.01. 2015.
- **B. Collins.** CRUD coupling to MPACT. L3:PHI.VCS.P11.01. 2015.
- **B. Collins.** Validate VERA-CS using the industry standard BEAVRS Cycle Depletion Benchmark Problem. L2:PHI.P10.01. 2015.
- **B. Collins.** Expand Capability and Coverage of MPACT Regression Test Harness. L3:RTM.PRT.P10.04. 2014.
- T. Downar, **B. Collins.** Implementation of Transient Capability in MPACT. L3:RTM.SUP.P8.02. 2014.
- **B. Collins,** T. Downar. PWR Full Core 2D Depletion Capability with Pin Resolved Transport. L2:RTM.P8.01. 2013.
- **B. Collins,** T. Downar. Application of MPACT 2D/1D to AMA Benchmark Problem 5. L2:RTM.P6.01. 2013.
- **B. Collins,** T. Downar. Demonstration of Pin-Resolved Method of Characteristics for Neutron Transport. L3:RTM.PRT.P6.01. 2012
- **B. Collins.** Evaluation of AMPX Cross-section Libraries in Subgroup and ESSM based Transport Calculations. L3:RTM.SUP.P5.01. 2012
- **B. Collins.** Demonstrate MPACT Lattice Capability with VERA Input. L3:VRI.PSS.P6.01. 2012
- E. Larsen, **B. Collins.** Develop, Demonstrate, and Evaluate 2D/1D Capability. L3:RTM.PRT.P5.01. 2012
- T. Downar, **B. Collins.** Initial MPACT Integration into VERA, L3:VRI.VERA.P5.08. 2012.
- T. Downar, **B. Collins.** Release MPACT v. 0.2.1, L3:RTM.PRT.P5.05. 2012
- T. Downar, **B. Collins.** Improved Integration of MPACT into VERA, L3:VRI.PSS.P5.09. 2012.
- T. Downar, **B. Collins.** Support for the Modeling of Watts Bar Unit 1 Cycle 1 with DeCART. L3:RTM.PRT.P4.01. 2012.

L# - Level (1, 2, 3, or 4)

Level 1 are CASL wide milestones and Level 4 are Focus Area specific

RTM.PRT – Radiation Transport Methods . Pin Resolved Transport

VRI.VERA – Virtual Reactor Integration . VERA Development

P#.## – Plan of record # . Tracking Number

NEUP

- T. Downar, B. Collins, R. Williamson, L. Swiler. Collocation-based Surrogate Models for Uncertainty Quantification and Validation of Coupled, Multiphysics Fuel Performance Simulation Tools.

Professional Memberships

- American Nuclear Society 2003-Present
Reactor Physics Division
Mathematics and Computation Division

Professional Services

Thesis Co-chair

University of Michigan

- Shane Stimpson – An Azimuthal, Fourier Moment-Based Axial S_N Solver for the 2D/1D Scheme (2015)
- Artem Yankov - Analysis of Reactor Simulations Using Surrogate Models (2015)
- Mitch Young – 2D MOC Informed 3D S_N Calculations (Expected 2016)
- Jipu Wang – Method of Manufactured Solutions for Coupled Systems (Expected 2017)
- Aaron Graham – Capturing Subgrid Heterogeneity in the 2D/1D Method (Expected 2017)

University of Tennessee

- Erik Walker – Nonlinear Coupling Methods (Expected 2017)
- AJ Pawel – Multiscale Depletion Methods (Expected 2017)

Thesis Committee Member

University of Michigan

- Adam Hoffman – A Time-Dependent Method of Characteristics Formulation with Time Derivative Propagation (2013)
- Adam Nelson – Improving Performance of Monte Carlo Scattering Moment Matrix Tallies via Continuous-Energy Data Mining (2014)

Journal and Conference Reviews

- Nuclear Engineering and Design
- Journal of Computational Physics
- PHYSOR 2016
- Mathematics and Computation 2015 (Reactor Physics Track Organizer)
- Mathematics and Computation 2013
- PHYSOR 2012

Honors and Awards

- ORNL Significant Event Award - *High-Fidelity Benchmark of the CASL*

Benjamin Collins

Virtual Environment for Reactor Applications Against Data from the Full Operating History of TVA's Watts Bar Nuclear Power Plant

- Technical Contributor of the Year (CASL Knight) 2015
- Alpha Nu Sigma – Honor Society in Nuclear Engineering 2007 – 2011
- National Academy for Nuclear Training Scholar 2006 – 2007

Computational Experience

MPACT

- Extensive Design, Methods, and Model Development
- Methods Development including Nodal and Thermal Hydraulic Solvers
- Multiphysics Coupling

DeCART

- Method Development for Multiphysics Coupling
- Method Development for Numerical Stabilization
- Model Development and User Support

PARCS

- Extensive Model Development for Various Reactor Types
- Methods Development including Nodal and Thermal Hydraulic Solvers

MCNP

- Model Development for Various Reactor Types
- Interface Design for Multi-Physics Applications

SCALE Package

- Extensive Model Development using TRITON/NEWT for Cross-Section Generation
- Model Development using KENO

HELIOS

- Extensive Model Development for Cross-Section Generation

STAR-CCM+

- CFD Model Development for VHTR
- Interface Design for Multi-Physics Applications

FLUENT/CFX

- CFD Model Development and some User Function Programming

MATLAB

- Methods Development
- Data Post-processing Algorithms

Workshops and Training Courses

Modeling Experimentation and Validation (MeV) Summer School, 2011

- Series of Lectures on Contemporary issues in Reactor Physics

DOE Advanced Computational Software (ACTS) Workshop, 2011

- Overview of DOE ACTS collection used for High Performance Computing

Many-Core Processors Workshop, 2009

- Parallel Programming for Graphics Processing Units

Scaling to Petascale Workshop, 2009

- Parallel Programming for High Performance Computing
- Numerical Libraries

SCALE Lattice Physics and Depletion Course, 2008

- TRITON and NEWT Lattice Physics Sequence
- ORIGEN ARP

Publications

Author or co-author of 8 journal and 40 conference proceeding papers

Journal Publications

1. S. Stimpson, **B. Collins**, T. Downar. "A 2D/1D Transverse Leakage Approximation Based on Azimuthal, Fourier Moments". Nuclear Science and Engineering. (Submitted 2016).
2. B. Kochunas, **B. Collins**, D. Jabaay, S. Stimpson, A. Graham, K.S. Kim, W. Wieselquist, K. Clarno, S. Palmtag, T. Downar, J. Gehin. "VERA Core Simulator Methodology for PWR Cycle Depletion." Nuclear Science and Engineering. (Submitted 2016).
3. **B. Collins**, S. Stimpson, B. W. Kelley, M. T. H. Young, B. Kochunas, E. W. Larsen, T. Downar, and A. Godfrey. "Three-Dimensional Nuclear Reactor Core Simulations of the Boltzmann Transport Equations with the 2D/1D Method Using MPACT," Journal of Computational Physics. (Accepted 2016)
4. Z Liu, **B Collins**, B. Kochunas, Y. Xu, T Downar, H. Wu. Model and Analysis of Performance for the Method of Characteristics Direction Probabilities with Boundary Averaging. Progress in Nuclear Energy. 2015
5. D Walter, B Kendrick , V Petrov, A Manera, **B Collins**, T Downar. Proof-of-Principle of High-Fidelity Coupled CRUD Deposition and Cycle Depletion Simulation. Annals of Nuclear Energy. 2015
6. A Yankov, **B Collins**, M Klein, M Jessee, W Zwermann, K Velkov, A Pautz, T Downar. A Two-Step Approach to Uncertainty Quantification of Core Simulators. Science and Technology of Nuclear Installations. vol. 2012, Article ID 767096, 2012.
7. M Hursin, Y Xu, **B Collins**, T Downar. The Development and Implementation of a 1-D SN Method in the 2D-1D Integral Transport Solution. Nuclear Science and Engineering. 2012.
8. A Ward, **B Collins**, M Madariaga, Y Xu, T Downar. Methods & Model Development for Coupled RELAP5 / PARCS Analysis of the Atucha-II Nuclear Power Plant. Science & Technology of Nuclear Installations. v 2011. 2011.

Refereed Conference Proceedings

1. **B Collins**, R Salko, S Stimpson, K Clarno, A Godfrey, S Palmtag, J Secker, B Kendrick, R Montgomery. Simulation of CRUD-Induced Power Shift using the VERA Core Simulator and MAMBA. PHYSOR 2016.
2. B Aviles, D Kelly, D Aumiller, D Gill, B Siebert, A Godfrey, **B Collins**, R Salko. Coupled MC21 and COBRA-IE Solution to VERA Core Physics Benchmark Problem #6. PHYSOR 2016.

3. A Godfrey, **B Collins**, KS Kim, J Powers, R Salko, S Stimpson, W Wieselquist, K Clarno, J Gehin, S Palmtag, R Montgomery, R Montgomery, D Jabaay, B Kochunas, T Downar, N Capps, J Secker. VERA Benchmarking Results for Watts Bar Nuclear Plant Unit 1 Cycles 1-12. PHYSOR 2016.
4. F Franceschini, D Salazar, M Ouisloumen, A Godfrey, S Stimpson, **B Collins**, C Gentry. AP1000 PWR Cycle 1 HFP Depletion Simulations with VERA-CS. PHYSOR 2016.
5. S Stimpson, **B Collins**, A Zhu, Y Xu. A Hybrid Nodal P3/SP3 Axial Transport Solver for the MPACT 2D/1D Scheme. PHYSOR 2016.
6. A Godfrey, M Jessee, S Stimpson, **B Collins**, T Evans, M Kromar, F Franceschini, D Salazar. VERA Benchmarking Results for KRŠKO Nuclear Power Plant Cycle 1. PHYSOR 2016.
7. A Graham, **B Collins**, R Salko, S Palmtag, T Downar. Assessment of Thermal Hydraulic Feedback Models. PHYSOR 2016.
8. J Wang, W Martin, **B Collins**. Application of the Method of Manufactured Solutions to the 1D SN Equation. PHYSOR 2016.
9. T Downar, B Kochunas, **B Collins**. Validation and Verification of the MPACT Code. PHYSOR 2016.
10. **B Collins**, A Godfrey. Analysis of the BEAVRS Benchmark using VERA-CS. M&C 2015.
11. B Kochunas, **B Collins**, D Jabaay, S Stimpson, A Graham, KS Kim, W Wieselquist, K Clarno, S Palmtag, T Downar, J Gehin. VERA Core Simulator Methodology for PWR Cycle Depletion. M&C 2015.
12. S Stimpson, **B Collins**, T Downar. An Azimuthal, Fourier Moment-Based Transverse Leakage Approximation for the MPACT 2D/1D Method. M&C 2015.
13. S Stimpson, F Franceschini, **B Collins**, A Godfrey, KS Kim, A Graham, T Downar. Improved Diffusion Coefficients for SPN Axial Solvers in the MPACT 2D/1D Method Applied to the AP1000 Start-up Core Models. M&C 2015.
14. K Clarno, R Pawlowski, R Montgomery, T Evans, **B Collins**, B Kochunas, D Gaston, J Turner. High-Fidelity Modelling of Pellet Clad Interaction Using the CASL Virtual Environment for Reactor Applications. M&C 2015.
15. **B Collins**, S Stimpson, B Kochunas, T Downar, W Martin. Assessment of 2D/1D Capability in MPACT. PHYSOR 2014.
16. M Young, **B Collins**, W Martin. 2-D/3-D Coupling Between the Method of Characteristics and Discrete Ordinates. PHYSOR 2014.
17. S Stimpson, **B Collins**, B Kochunas, T Downar. DP0 and P1 Boundary Acceleration Techniques for 2D-MOC. PHYSOR 2014.
18. S Stimpson, **B Collins**, T Downar. Axial Transport Solvers for the 2D/1D Scheme in MPACT. PHYSOR 2014.
19. A Zhu, **B Collins**, B Kochunas, T Downar. Assessment of Depletion Capability in MPACT. PHYSOR 2014.
20. M Young, **B Collins**, W Martin. 2-D/3-D Coupling Between the Method of Characteristics and Discrete Ordinates. Transactions of the American Nuclear Society. Winter 2013.

21. Z Liu, H. Wu, B Kochunas, **B Collins**, Y. Xu, T. Downar. The Method of Characteristics Direction Probabilities and its Accuracy and Performance Models. Science and Technology on Reactor System Design Technology Laboratory Annual Meeting. 2013
22. B Kendrick, V Petrov D Walter, A Manera, **B Collins**, T Downar, J Seker, K Belcourt. CASL Multiphysics Modeling Of PWR CRUD, Proceedings of the 2013 LWR Fuel Performance Meeting 2013.
23. D Walter, **B Collins**, V Petrov, B Kendrick, A Manera, T Downar. High-Fidelity Simulation of CRUD Deposition on a PWR Fuel Pin with Grid Spacers: A Proof-of-principle using the Fully-Coupled MAMBA/DeCART/STAR-CCM+ Code. NURETH-15. 2013.
24. **B Collins**, B Kochunas, T Downar, W Martin. Assessment of 2D MOC Capability in MPACT. M&C 2013.
25. B Kochunas, **B Collins**, T Downar, W Martin. Overview of Development and Design of MPACT. M&C 2013.
26. B Kelley, **B Collins**, E Larsen. 2D/1D approximations to the 3D neutron transport equation. II: Numerical comparisons. M&C 2013.
27. F Gleicher, M Rose, B Spencer, S Novascone, R Williamson, R Martineau, **B Collins**, T Downar. Coupling the Core Analysis Program DeCART to the Fuel Performance Application BISON. M&C 2013.
28. S Stimpson, M Young, **B Collins**, B Kelley, T Downar. Assessment and Improvement of the 2D/1D Method Stability in DeCART. M&C 2013.
29. Y Liu, **B Collins**, B Kochunas, W Martin, K S Kim, M Williams. Resonance Self-shielding Methodology in MPACT. M&C 2013.
30. Z Liu, B Kochunas, **B Collins**, T Downar, H Wang. The Method of Modular Characteristic Direction Probabilities in MPACT. M&C 2013.
31. **B Collins**, Y Xu, V Seker, T Downar. Post-refinement Multiscale Method for Pin Power Reconstruction. PHYSOR 2012.
32. B Kochunas, S Stimpson, **B Collins**, T Downar, R Brewster, E Baglietto. Coupled Full Core Neutron Transport/CFD Simulations of Pressurized Water Reactors. PHYSOR 2012.
33. A Yankov, **B Collins**, M Jessee, T Downar. A Generalized Adjoint Approach for Quantifying Reflector Assembly Discontinuity Factor Uncertainties. PHYSOR 2012.
34. A Yankov, M Klein, M Jessee, W Zwermann, K Velkov, A Pautz, **B Collins**, T Downar. A Two-Step Approach to Uncertainty Quantification of Core Simulators. PHYSOR 2012.
35. **B Collins**, L Li, D Wang, S Stimpson, D Jabaay, A Ward, Y Xu, T Downar. PATHS: A Steady State Thermal Hydraulics Solver for PARCS. NURETH-14. 2011.
36. **B Collins**, V Seker, T Downar. Neutronic Multi-scale Analysis of the Prismatic HTGR. HTR 2010.
37. **B Collins**, A Ward, Y Xu, T Downar. Nodal Expansion Method with Axially Varying Cross-sections. PHYSOR 2010.
38. A Ward, V Seker, **B Collins**, T Downar. Thorium Fuel Utilization in the BWR: Lattice Physics Analysis of Reactivity Coefficients. PHYSOR 2010.

39. **B Collins**, A Ward, B Mount, T Drzewiecki, Y Xu, T Downar, M Bertodano. Modeling of the Fast Boron Injection System for CNA-II. PHYSOR 2008.
40. A Ward, **B Collins**, M Madariaga, Y Xu, T Downar. The Application of the PARCS Neutronics Code to the Atucha-I & Atucha-II Nuclear Power Plants. PHYSOR 2008.

Other Conference Proceedings

1. **B Collins**. Multi-scale Neutronic Methods for Analyzing the Prismatic HTGR. ANS Student Conference 2010.
2. **B Collins**. PATHS: An Advanced Steady State Thermal Hydraulic Solver for PARCS. ANS Student Conference 2010.