

LA-UR-21-26276

Approved for public release; distribution is unlimited.

Title: Upcoming MCNP6.3(R) Release: New Features and Improvements

Author(s): Rising, Michael Evan; Adams, Terry R.; Armstrong, Jerawan Chudoung; Bolding, Simon R.; Brown, Forrest B.; Bull, Jeffrey S.; Forster, Robert Arthur Iii; Josey, Colin James; Kulesza, Joel A.; Zukaitis, Anthony J.; Sweezy, Jeremy Ed; Swaminarayan, Sriram; Casswell, Laura

Intended for: 2021 MCNP(R) User Symposium, 2021-07-12/2021-07-16 (Los Alamos, New Mexico, United States)

Issued: 2021-07-12 (rev.1)

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Triad National Security, LLC for the National Nuclear Security Administration of U.S. Department of Energy under contract 89233218CNA000001. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Upcoming MCNP6.3[®] Release: New Features and Improvements

*Michael E. Rising, Terry Adams, Jerawan Armstrong,
Simon Bolding, Forrest Brown (UNM), Jeffrey S. Bull,
R. Art Forster, Colin Josey, Joel Kulesza, Anthony
Zukaitis, Jeremy Sweezy (XCP-3), Sriram
Swaminarayan (CCS-7), Laura Casswell (WRS-SNA)*

2021 MCNP[®] User Symposium
July 12-16, 2021

LA-UR-21-26276

What have we been up to since the MCNP6.2 release?

- As far as the code, infrastructure, testing efforts, and user outreach, a lot has been done over the past 3+ years.

Research and development

- Methods and algorithms
- Parallel performance
- Physics enhancements

Code maintenance and improvements

- Modernization
- Bug fixes
- Code clean-up
- Standards compliance

Testing

- Continuous regression / behavioral testing
- Verification
- Validation

User Support, Training & Education

- Documentation, website, user forum
- Direct help provided
- Variety of classes offered year-round



User Support

- Hosting this event is one way of remaining connected to the broader MCNP user community
- Hired dedicated User Support Specialist

Welcome to the team
Avery Grieve!

- Initiated efforts to improve several resources
 - MCNP website
 - MCNP user forum
 - MCNP support requests



Thank you all
for attending
and presenting!

Training

- Typical MCNP class offerings
 - Basics, Variance Reduction & Criticality Calculations
 - New and/or improved Intermediate & Unstructured Mesh classes
- Due to Covid-19, moved online in April 2020
 - Taught ~9 different online classes
 - In CY19, taught ~17 different in-person classes
- Working with LANL collaborators to create nuclear safeguards training modules

See Mara Watson's presentation on Thursday

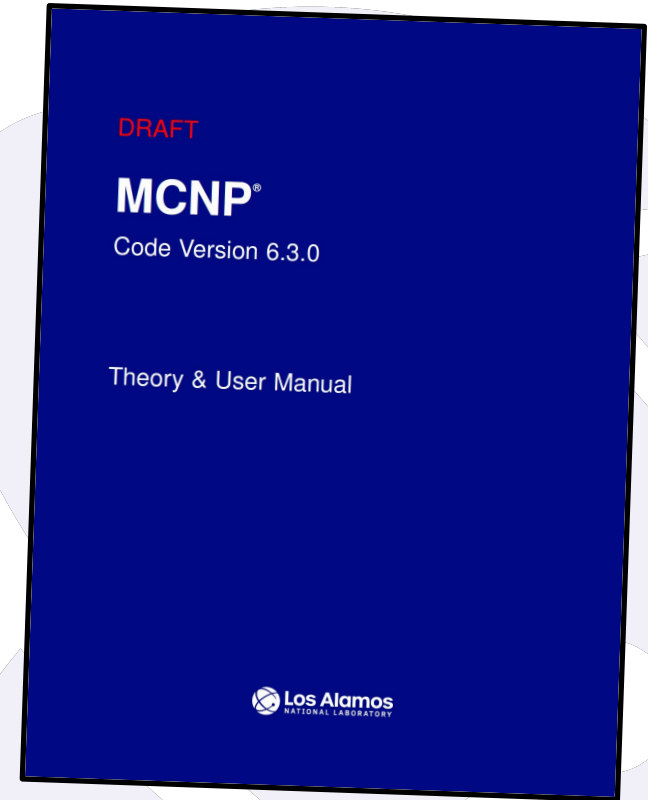
MCNP Classes Going Virtual

	CY 2019 (In-Person)	2020-21 (Online)
Days	75	41
Attendees	200	289
Attendee-Hours	6,300	6,400



Education

- MCNP6.3 manual has undergone an extensive overhaul
 - Both **theory** and **user** manual will be released
 - Theory manual primarily based on MCNP5 theory manual with various updates and additions
 - Many embedded (directly attached to the manual PDF document) text files
 - MCNP input files
 - Response functions
 - Python scripts
- Release notes, build guidance, verification & validation documents all collected under the same documentation repository and system.



Thanks to Joel A. Kulesza
for leading this effort!



Testing

- To continue ensuring the robustness of the code, we continue to improve and expand our testing tools, application coverage, and methodology
 - Regression / behavioral testing (for developers) has been moved to a CTest framework alongside the CMake configuration and build system

See Colin J. Josey, “A Guide to Building the MCNP 6.3 Code from Source” in the Tools session

- Verification and validation testing suites have been converted into a Python-based framework assisting in automated setup, testing, postprocessing and documentation


See Michael E. Rising, “Improved Verification and Validation Testing and Tools” in the Tools session

- Statistical testing has been shown to work well to ensure results are statistically equivalent under specific conditions

See Tony Zukaitis, “Statistical Testing for Monte Carlo simulations” in the Beyond MCNP6.3 session



Code Maintenance and Improvements

- Routine code updates and upgrades
 - Bugfixes, minor improvements, etc., will be listed in the release notes
 - Nearing 100% Fortran 2018 standards compliance
- The goal of the MCNP modernization project is to ultimately make development of new capabilities more efficient and maintainable
- One single example of this effort is the introduction of the Hierarchical Data Format , to replace legacy binary and ASCII files
 - Permits natural organization
 - Parallel input/output can provide substantial performance
 - Intrinsic data-compression capability can provide 10–100× file size savings
 - Accessible via C, C++, Fortran, Python, Matlab, etc.



Research and Development

- Advance Monte Carlo methods for criticality calculations
 - Automated acceleration and robust convergence testing

See Forrest B. Brown, “Advances in Monte Carlo Criticality Methods” in the Criticality session

- New mesh tally options and enhanced parallelism
 - Mesh tally results in HDF5/XDMF (MESHTAL)

See Colin J. Josey, “Improved FMESH Capabilities in the MCNP 6.3 Code” in the Criticality session

- New particle track output capabilities in parallel (MPI and threading)
 - Particle track output in HDF5 (PTRAC)

See Simon R. Bolding, “PTRAC Improvements, Parallelism, and Post-processing” in the Tools session

- Unstructured mesh developments
 - Unstructured mesh input/output model in HDF5/XDMF (EEOUT)

See Jerawan C. Armstrong and Joel A. Kulesza presentations in UM/CAD, Tools, and Accelerators sessions



MCNP Team Talks Happening this Week

Session: Reactors and Criticality

Forrest B. Brown, “Advances in Monte Carlo Criticality Methods”

Colin J. Josey, “Improved FMESH Capabilities in the MCNP 6.3 Code: Performance Improvements, New File Formats, and Visualization”

Session: Unstructured Mesh and CAD

Jerawan C. Armstrong, “MCNP Unstructured Mesh Overview, Improvements, and Verification and Validation (V&V) Testing”

Joel A. Kulesza, “MCNP Unstructured Mesh Elemental Quality Assessment”



MCNP Team Talks Happening this Week

Session: Tools

Simon R. Bolding, “PTRAC Improvements, Parallelism, and Post-processing”

Colin J. Josey, “A Guide to Building the MCNP 6.3 Code from Source”

Avery Grieve, “Compiling MCNP6.2 for ARM Clusters”

Jerawan C. Armstrong, “Python Tool for Writing MCNP UM Input Files”

Michael E. Rising, “Improved Verification and Validation Testing and Tools”

Session: Accelerators and Experiment Design

Joel A. Kulesza, “MCNP Unstructured Mesh Visualization & Post-processing Techniques”



MCNP Team Talks Happening this Week

Session: Data and Physics

Michael E. Rising, “Open-source Release of CGMF and Integration into MCNP6”

Session: LANL Monte Carlo History & Looking Ahead Beyond MCNP6.3

Art Forster, “The History of Monte Carlo and MCNP at Los Alamos”

Tony Zukaitis, “Statistical Testing for Monte Carlo simulations”

Sriram Swaminarayan, “Redesigning the MCNP Plotter”

Michael E. Rising, “Prototype of a New Fixed-source Sensitivity Tally Capability”



MCNP Team Roundtable and Q&A Sessions

Session: Performance of MCNP Parallelism on Various Platforms

Avery Grieve and Jeffrey S. Bull led roundtable discussions and presentations

Session: Question and Answer (Q&A)

Jeffrey S. Bull and Michael Rising led discussions regarding various user questions



Summary

- The latest version of the MCNP6.3 code will be done and released this year.
- Many new features, substantial improvements, and bugfixes have made their way into the code
- Improved documentation, testing, and peripheral tools will also be delivered

Thanks and Enjoy the Sessions!



Questions?

Contact: mrising@lanl.gov

