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Los Alamos
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FY23 MCNP® Updates for the Nuclear Criticality Safety Program

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2024 Annual NCSP Technical Program Review

February 20–22, 2024

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Outline

Released!

- **The MCNP6.3.0 code is now available to the public**
- Go request a license for the code from the Radiation Safety Information Computational Center (RSICC) at Oak Ridge National Laboratory
  - MCNP6.3.0 package: https://rsicc.ornl.gov/codes/ccc/ccc8/ccc-870.html
  - Between the initial announcement of the release on Aug. 28, 2023 and Oct. 16, 2023, **RSICC received 2,000+ requests**
- See the How To Get The MCNP Code page on the MCNP website for details.

MCNP6.3 Release Webpage

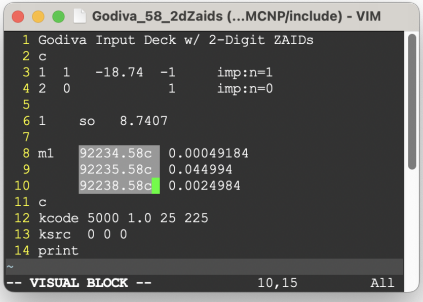
- For the most up-to-date details on the latest release, see the Latest Release (https://mcnp.lanl.gov/release_630.html) page on the MCNP website. Including:
  - All relevant release documents
  - Extended OS-specific build and dependency information
  - MCNP6.3 installation video for Windows users (https://youtu.be/rUSV_apcXh8)
  - And more as needed

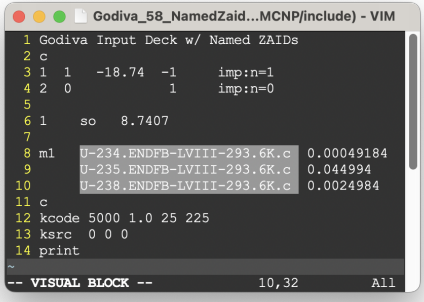
Working Toward MCNP6.3.1 Release

- A significant amount of work on the last release of MCNP6.3.0 was geared toward building a sustainable development process and a more frequent release cadence
- Examples of how this is accomplished:
  - Code review (merge request) regression testing is automated across multiple platforms
  - User manual, release notes, and build documents are embedded in the code repository
  - All verification and validation testing is encapsulated within a framework (`vnvstats`) with easy execution, simulation processing, and documentation capabilities
- This investment in our development processes will make new releases easier and more reliable

Relevant Code Enhancements in MCNP6.3.1

- **Added extended named-ZAID support to code**
  - No longer limited to 2-digit library indentifier to support upcoming ENDF/B-VIII.1 nuclear data library release
  - Hypothetical example: ENDF/B-LVIII
    - In MCNP6.3 and older versions of the code, only 2-digit ZAIDs could be used, i.e., `92238.58c`
    - In MCNP6.3.1+ a more general identifier could be used, i.e., `U-238.ENDFB-LVIII-293.6K.c`



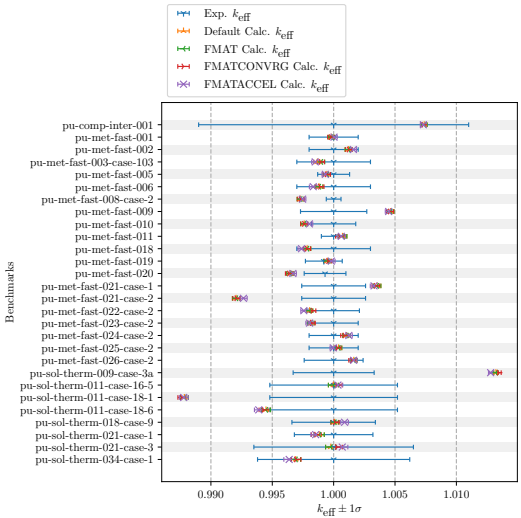


Relevant General Clean-up and Bug Fixes in MCNP6.3.1

- Support for the newer Intel oneAPI compilers
- **Transitioned from Bitbucket to Gitlab for code repository management and issue tracking**
- Improved input checks for tally specifications
  - `T` and `C` options on `FM` cards
  - `FMESH` boundaries and interval consistency
- **Fix underallocated MPI buffer in `KSEN` implementation**
- Fix rare floating-point errors in spontaneous fission sources
- Removed several bounds error and undefined behavior issues
- Error and expire message formatting fixes

Extended Verification and Validation Testing

- More extensive V&V and performance testing for the MCNP6.3.0 code
- Studied the new optional features of the MCNP6.3 code (presented two ICNC papers on criticality and subcritical multiplication V&V):
  - Fission-matrix-based options
    - Convergence and population testing
    - Automated acceleration of the fission source
  - Doppler Broadening Resonance Correction
  - HDF5 Particle Track (`PTRAC`) Output

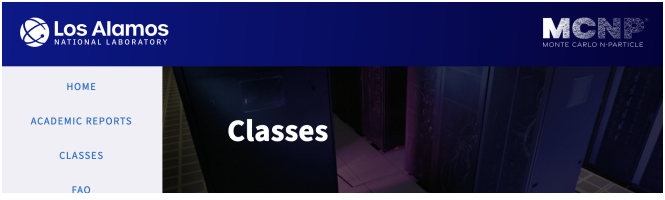


Other NCSP Analytical Methods Efforts

- Variety of Whisper updates in progress (see Alex Clark's talk)
  - Source code and build system changes
  - Nuclear data covariance processing and testing
  - Improvements to V&V framework
- On-the-fly temperature treatment and sampling for thermal neutron scattering (see Camden Blake's talk)
  - Visited LANL in summer of 2023, mentored by XCP-3 and XCP-5 staff
  - Continued thesis work at RPI
- More recently, working on analytic benchmarks and verification of Monte Carlo sensitivity capabilities
  - New staff member, Colin Weaver, with S/U background working on benchmarking
  - See more on this at next year's NCSP TPR

MCNP Classes

- Advanced criticality classes taught in-person at Y-12 and LANL
- Moved back toward in-person classes
  - 6 weeklong full-day classes at LANL (3), OECD/NEA (2), and Y-12 (1)
- Continued fewer virtual classes
  - 3 weeklong full-day classes *from* LANL
- Topics covered
  - Introduction, Intermediate, Criticality, Nuclear Safeguards
- In FY24, the balance between in-person and online classes will remain (see MCNP Classes webpage for all offerings)



MCNP Team Changes

- We have had a few changes to the core team composition over the past year
- A couple folks have left the team (and LANL):
  - Avery Grieve (user support specialist for ~2 years)
  - Stephen Wilson (code development and modernization for ~2 years)
- A couple folks have joined the team:
  - Cole Frederick (developer tooling, infrastructure, Qt plotter)
  - Pablo Vaquer (postdoc working on unstructured mesh R&D)
  - Colin Weaver (code development, analytic benchmark, S/U capabilities)

Updated MCNP Help Resource

- Introduced a new ticketing system for the mcnp_help@lanl.gov help desk

MCNP Help Desk <gitlab.re-git@lanl.gov>
Wed 7/12/2023 10:08 AM
To:Rising, Michael Evan <mrising@lanl.gov>

Thank you for your mcnp_help request!

We are tracking your request and will respond as soon as we can.

If this is a question about how to obtain the MCNP code, more information can be found on the MCNP website here.

If this is a question related to the specifics of how to run the code or how to use certain features, please consider using one of the following resources:

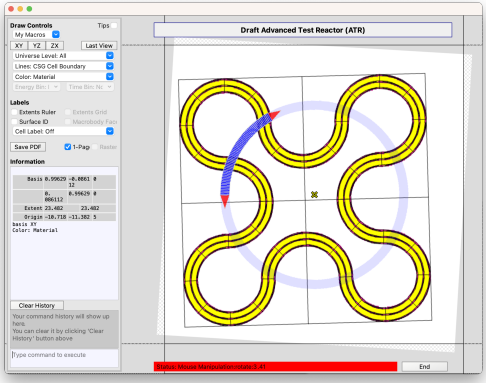
- **MCNP forum**: This highly recommended resource is made up of a large community of users and developers that can provide faster and more diverse responses to a broad set of MCNP questions. More information on signing up for the forum can be found here.
- **MCNP user and/or theory manual**: The current and past user manuals can be found here.
- **MCNP classes**: Ranging from beginner- to advanced-level classes, find more information here on upcoming classes taught by MCNP developers and expert users at LANL.

If your request has been resolved through the use of one of these other resources, please reply back to this email indicating this issue can be closed.

This inquiry generated mcnp_help ticket #9.

LANL Site Support and LDRD efforts for the MCNP Code

- In FY23, we held our third annual MCNP User Symposium
  - See the reference collection on the MCNP website or on the user symposia page.
- The 2024 MCNP User Symposium is scheduled for August 19-22, 2024
- New development efforts through modernization and LDRD projects
  - Modern capabilities
    - Named-ZAID improvement
    - **New Qt-based plotter** →
  - Small Modular Reactor LDRD project
    - Unstructured mesh extensions
    - Delta-tracking in CSG



The Qt plotter will replace the X11 plotter in MCNP6.4

Summary

- Completed the packaging and release of MCNP6.3.0
- Worked on enhancements and fixes for MCNP6.3.1 release
  - Moving toward more frequent releases to get fixes out to the community in a timely manner
  - Responsive to user requests, issues, and bug reports
- Continued work on maintenance/modernization and R&D efforts that will benefit the NCSP community
- As always, we want your feedback: mcnp_help@lanl.gov

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Acknowledgements

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Questions?

contact: mrising@lanl.gov