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Title:	Open-source Release of CGMF 1.1 and Integration into the MCNP6.3(R) Code
Author(s):	Rising, Michael Evan Talou, Patrick Stetcu, Ionel Jaffke, Patrick Lovell, Amy Elizabeth Kawano, Toshihiko
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Los Alamos NATIONAL LABORATORY

Open-source Release of CGMF 1.1 and Integration into the MCNP6.3® Code

Michael E. Rising *(XCP-3),* Patrick Talou (XCP-5),
Ionel Stetcu (T-2), Patrick Jaffke (IDA), Amy E. Lovell (T-2),
and Toshihiko Kawano (T-2)

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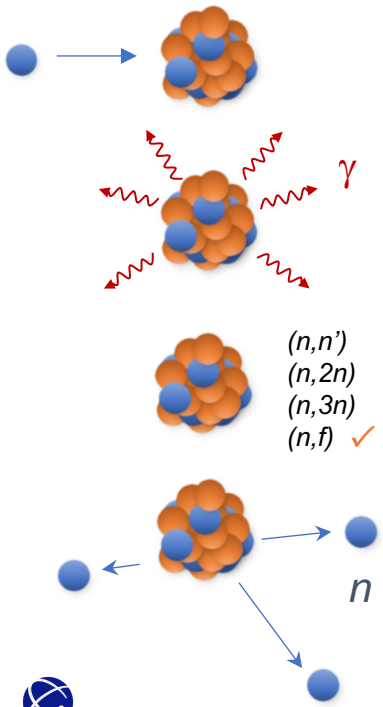
Overview

- Motivation for CGMF in the MCNP6.2 release
- CGMF on GitHub
  - Source code and Python toolkit
  - ReadTheDocs documentation
  - Computer Physics Communications publication
- Updates for the MCNP6.3 release
  - CGMF updates
  - New CGMF-MCNP integration
  - Verification
- Summary and Future Plans

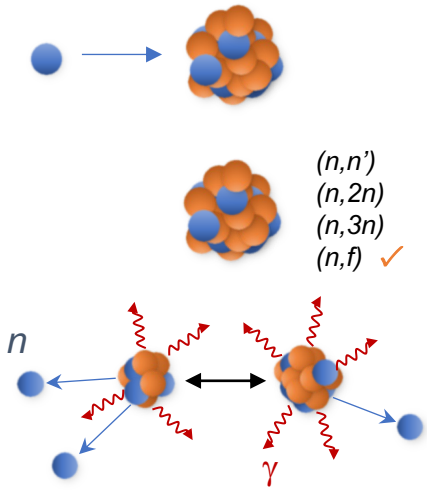
Motivation for CGMF in the MCNP6.2 release

Default MCNP Calculations



- Limitations
  - OK on average → criticality safety, shielding, reactor physics applications, etc.
  - Wrong order for selection of reaction channels and reaction output
  - Cannot perform correlated simulations or time-coincident detector response calculations
- Previous workarounds:
  - Sampling P(ν) in MCNP
  - LLNL fission library
  - Detector response simulations in MCNPX-PoliMi

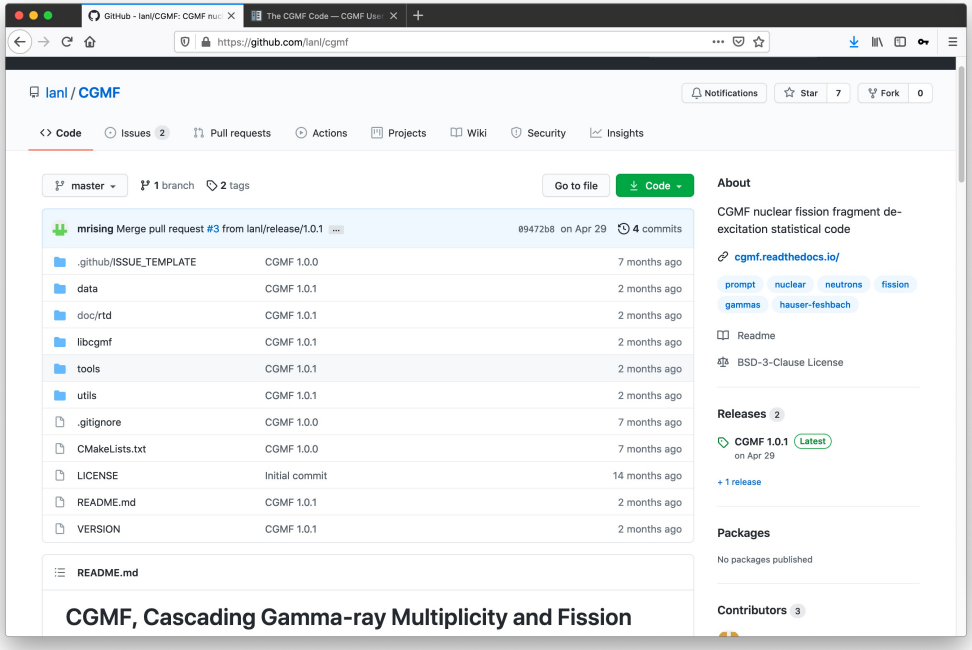
MCNP with CGMF Calculations

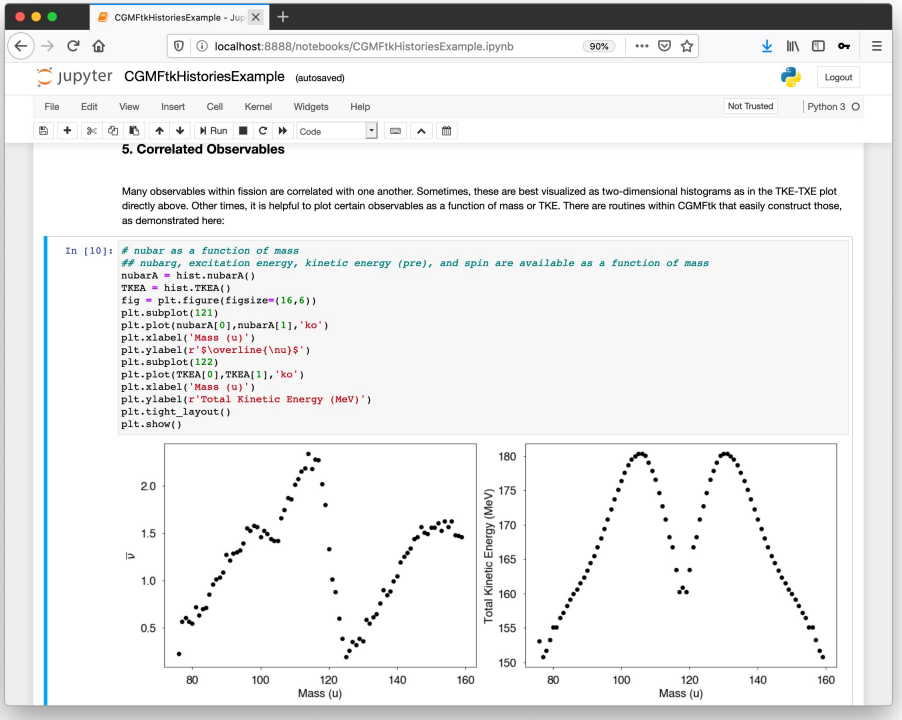


Developed a new paradigm to simulate nuclear reactions on an event-by-event basis for "low-energy" fission physics applications

CGMF on GitHub - https://github.com/lanl/cgmf

Source code, data, and Python tools





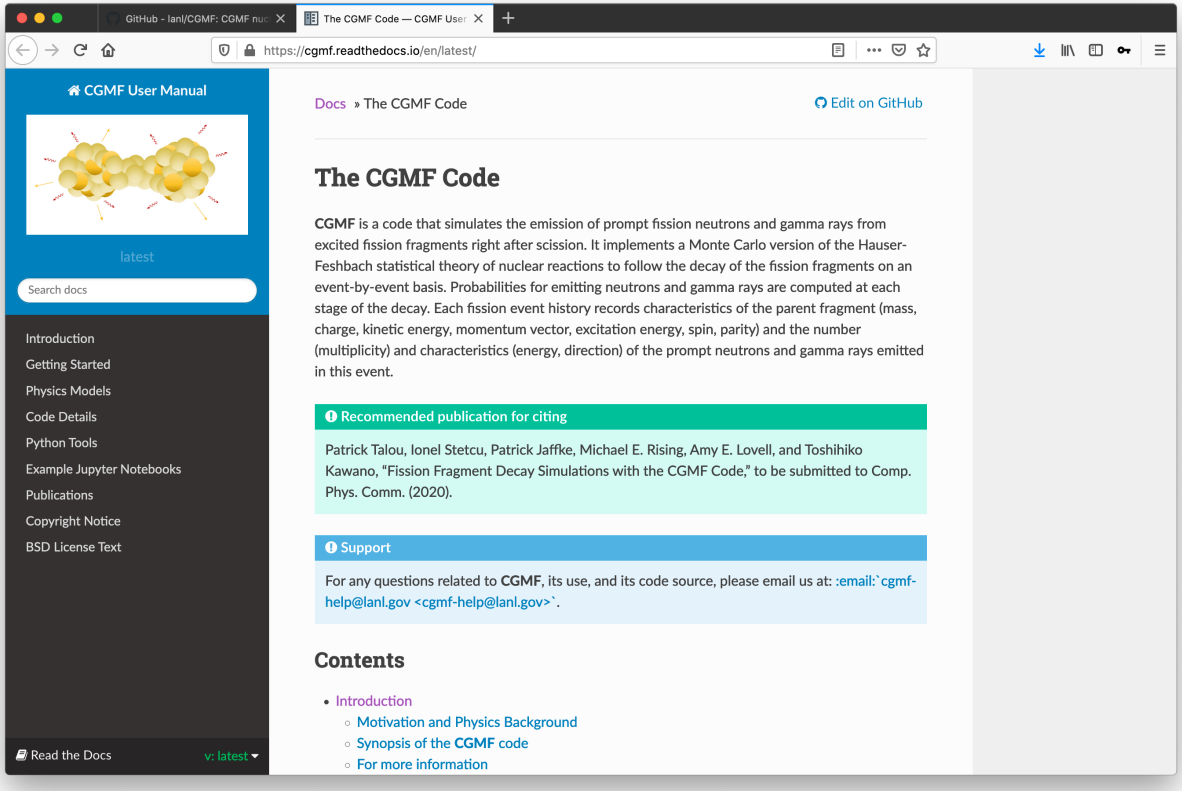
Python Jupyter notebooks distributed

CGMF on GitHub - https://cgmf.readthedocs.io/en/latest/index.html

- ReadTheDocs documentation
- Computer Physics Communications available

Patrick Talou, Ionel Stetcu, Patrick Jaffke, Michael E. Rising, Amy E. Lovell, and Toshihiko Kawano, "Fission Fragment Decay Simulations with the CGMF Code," *Comp. Phys. Comm.*, **269** (2021).

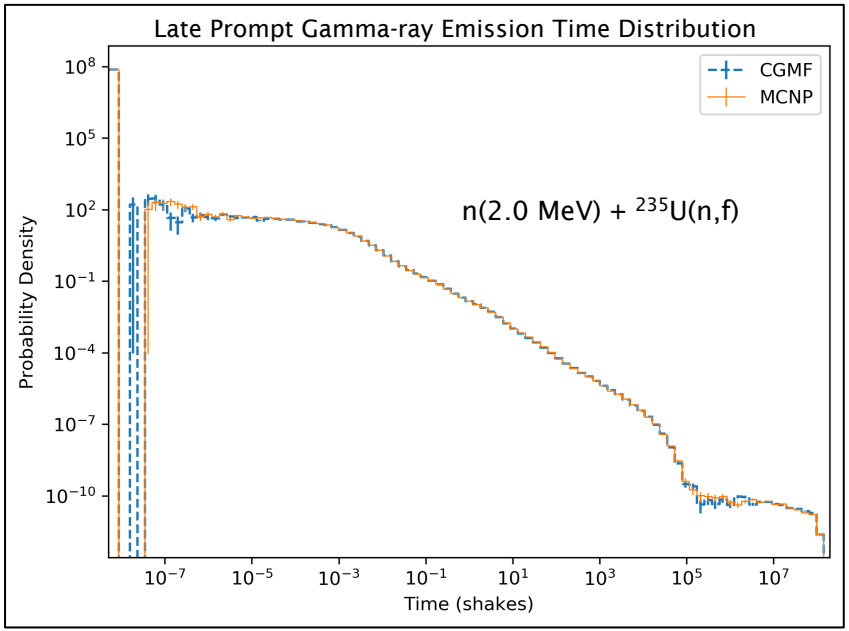
https://doi.org/10.1016/j.cpc.2021.108087



Updates for the MCNP6.3 release

- CGMF updates
  - Spontaneous fission
    - 238, **240**, 242, **244**Pu
    - 252, **254**Cf
  - Neutron-induced fission
    - **233**, **234**, 235, 238U, **237Np**, and 239, **241**Pu
  - Late-time prompt fission gamma rays
  - Fission fragment angular distributions
  - Pre-equilibrium neutron emission

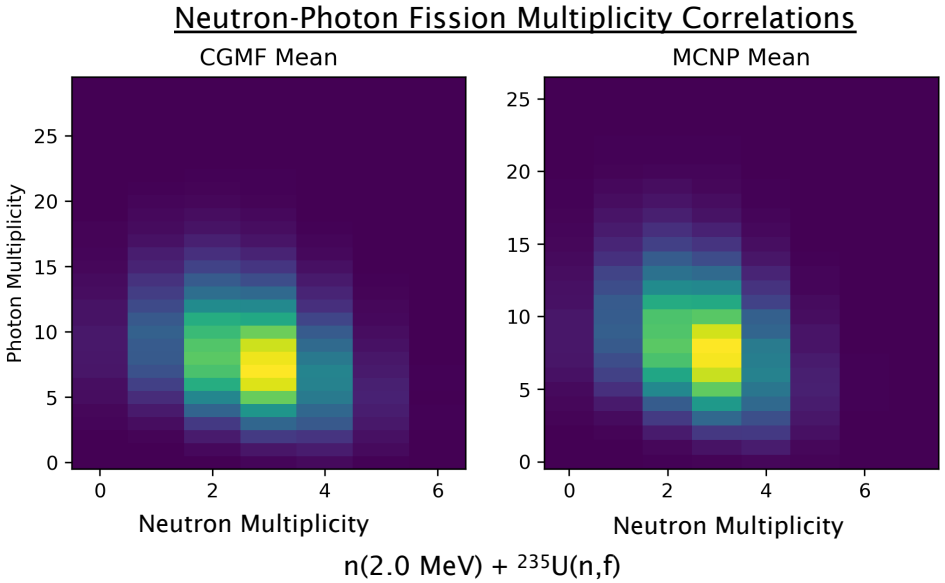
New Fissionable Systems Compared to MCNP6.2 Release

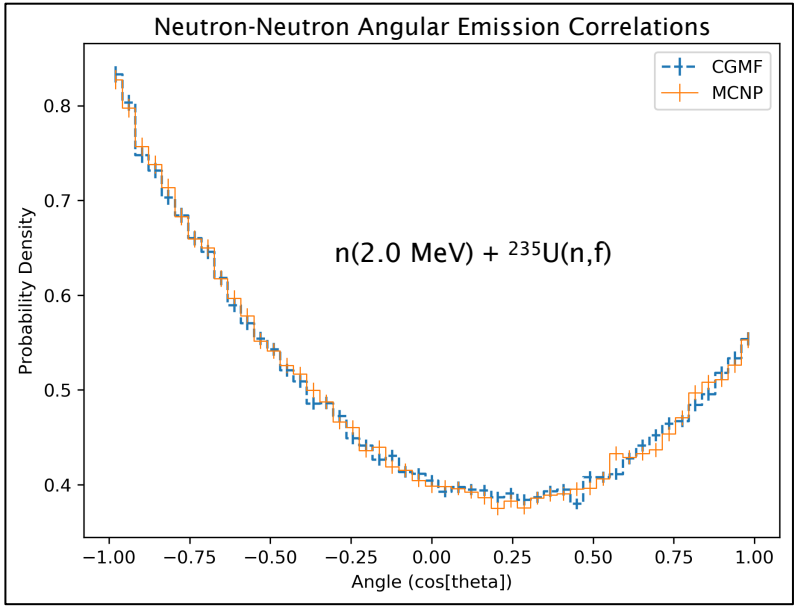


- New CGMF-MCNP integration
  - Through the new MCNP CMake build system (`find_package`)
  - Built as a library, linked to MCNP executable
  - Same library can also be linked to make the CGMF executable

Updates for the MCNP6.3 release

- Verification of the integrated CGMF code and MCNP interface
  - Done with new HDF5 PTRAC and MPI





Note: No change to MCNP input options. To use CGMF → **FMULT METHOD=7**

Additional minor updates

- For MCNP6.3
  - The logic in MCNP6.2 to handle the combination of prompt neutrons from the correlated fission models (CGMF, FREYA, and LLNL Fission Library) and delayed neutrons from ACE data tables is flawed. This has been corrected in MCNP6.3.

- For CGMF 1.1
  - A patch to fix data file reading in mixed Windows/Linux environments (e.g. WSL) was pushed to GitHub. This patch version CGMF 1.1.1 was released in April 2022.

- Moving forward with MCNP6.3 + CGMF 1.1.*x* should be *easy* to manage if you have the MCNP6.3 source code
  - The CGMF 1.1.*x* interface will not change
  - Therefore, future patch releases of CGMF 1.1.*x* should be drop-in replacements without changes required to the MCNP6.3 source code itself

Summary and Future Plans

Contact the LANL CGMF Developers at cgmf-help@lanl.gov

- As a result of a multi-year NA-22 project,
  - CGMF was integrated into MCNP6.2 and publicly released
  - CGMF was open-sourced and publicly released
  - MCNP6.3 was updated to include the latest version and is in the process of being publicly released

- Current and future plans
  - A.E. Lovell was awarded a LANL Early Career LDRD to work on global optimization and uncertainty quantification within CGMF
  - D. Neudecker and A.E. Lovel have been working on model parameter fitting such that CGMF may be used in ENDF/B evaluations
  - T. Kawano and M.E. Rising are collaborating with RPI to improve both standalone and MCNP-integrated CGM (non-fission) simulations

Acknowledgements

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Questions?

Contact: mrising@lanl.gov