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**Title:** Open-source Release of CGMF 1.1 and Integration into the MCNP6.3(R)  
Code

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# Open-source Release of CGMF 1.1 and Integration into the MCNP6.3<sup>®</sup> Code

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and Toshihiko Kawano (T-2)

15<sup>th</sup> International Conference on Nuclear Data for Science and Technology (ND2022)

July 24-29, 2022

LA-UR-22-XXXXX

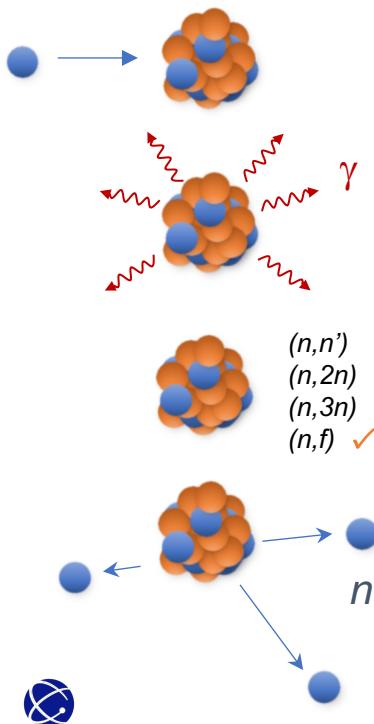
# Overview

- 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



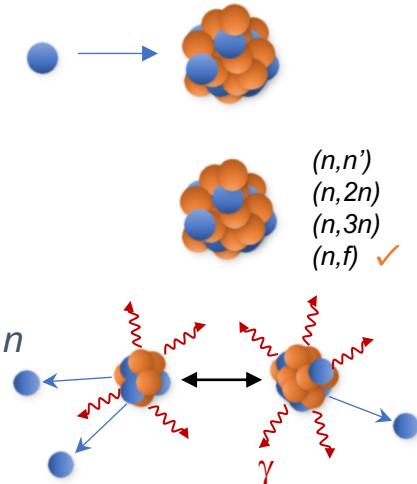
## • Limitations

- 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  $P(v)$  in MCNP
- LLNL fission library
- Detector response simulations in MCNPX-PoliMi

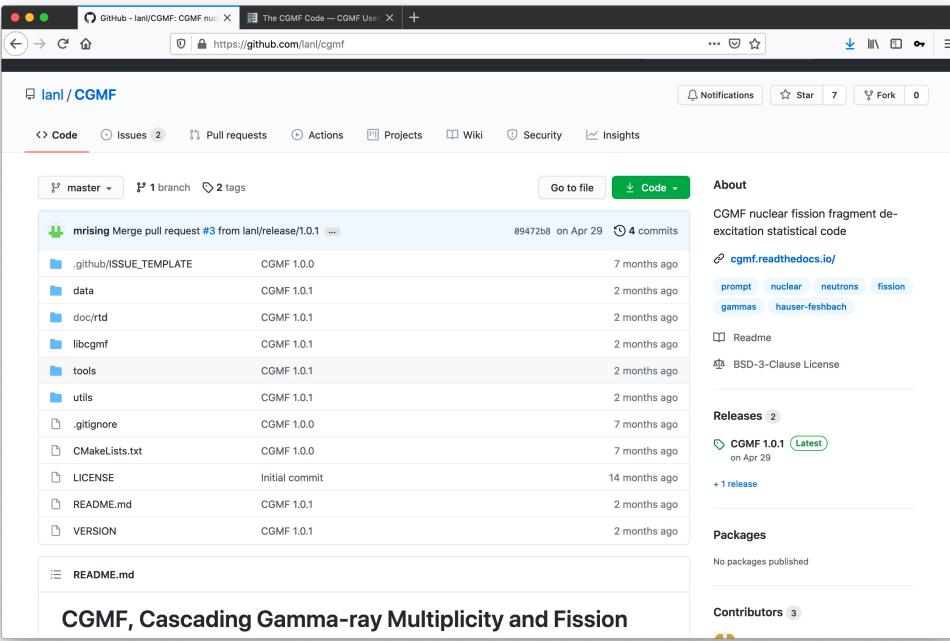
MCNP with CGMF Calculations



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



GitHub - lanl/CGMF: CGMF nuclear fission fragment de-excitation statistical code

Code Issues 2 Pull requests Actions Projects Wiki Security Insights

master 1 branch 2 tags

Go to file Code

**About**

CGMF nuclear fission fragment de-excitation statistical code

**Readme**

**Releases** 2

CGMF 1.0.1 (Latest) on Apr 29

+ 1 release

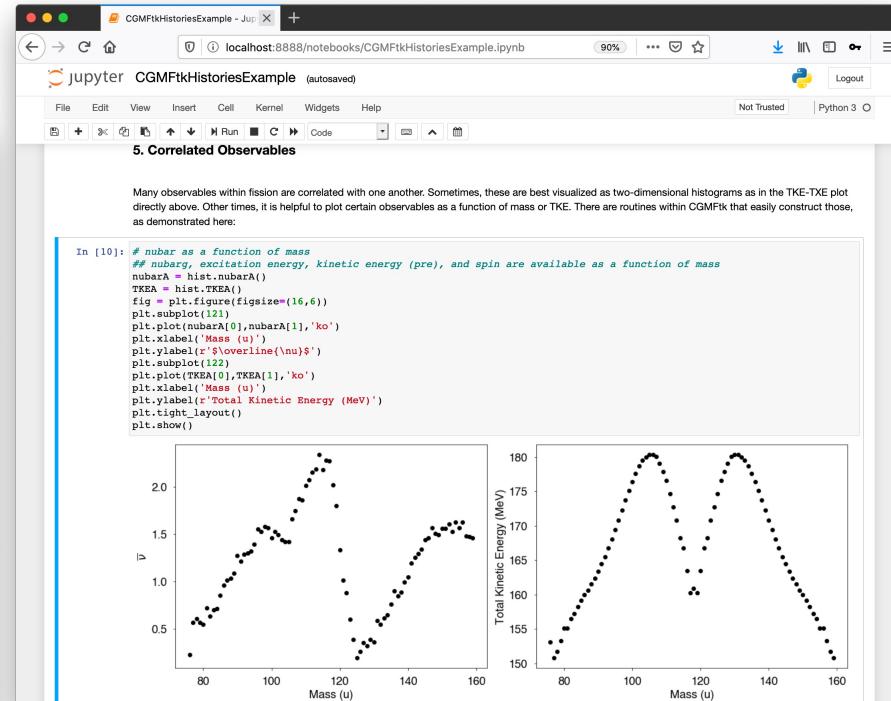
**Packages**

No packages published

**Contributors** 3

README.md

**CGMF, Cascading Gamma-ray Multiplicity and Fission**



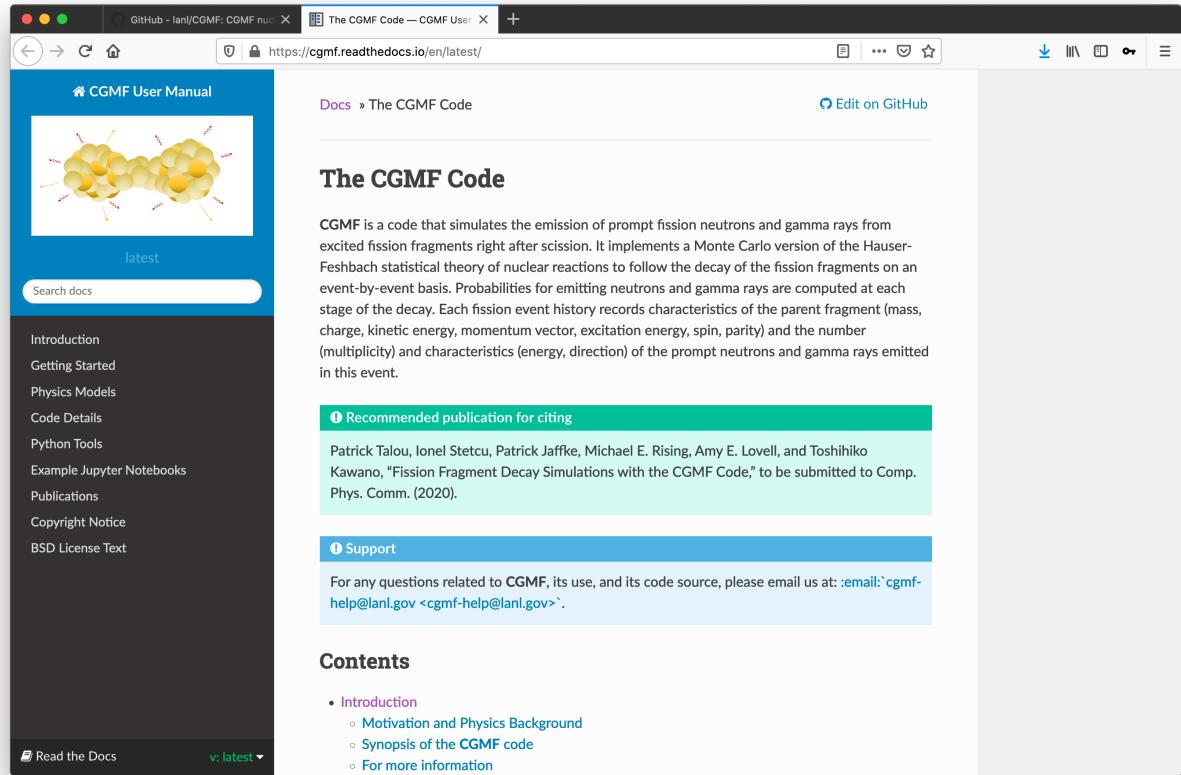
Python Jupyter notebooks distributed

# 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>



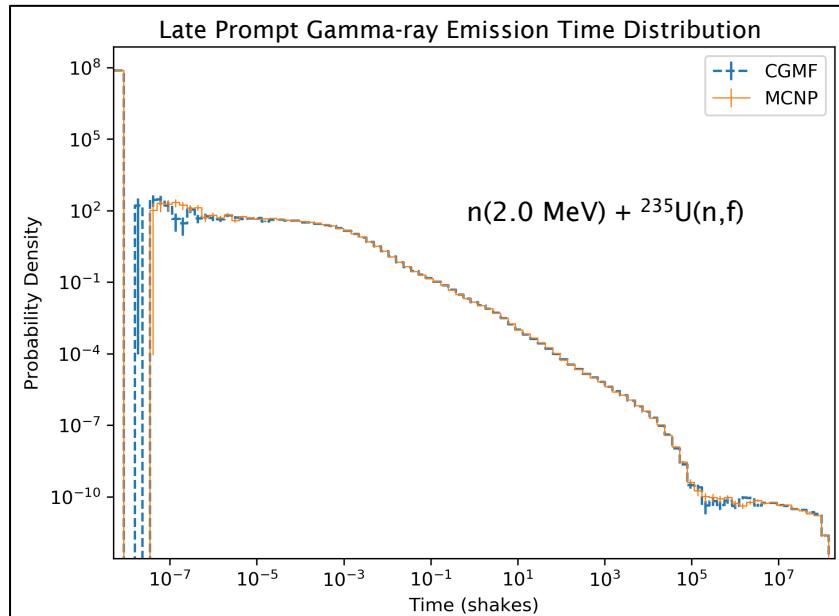
The screenshot shows a web browser displaying the CGMF documentation. The title bar reads "GitHub - lani/CGMF: CGMF nu..." and "The CGMF Code — CGMF User...". The URL in the address bar is "https://cgmf.readthedocs.io/en/latest/". The page content is titled "The CGMF Code". It includes a description of the code, a "Recommended publication for citing" section with the reference "Patrick Talou, Ionel Stetcu, Patrick Jaffke, Michael E. Rising, Amy E. Lovell, and Toshihiko Kawano, ‘Fission Fragment Decay Simulations with the CGMF Code,’ to be submitted to Comp. Phys. Comm. (2020).", and a "Support" section with an email address: "cgmf-help@lanl.gov". The sidebar on the left lists navigation links: Introduction, Getting Started, Physics Models, Code Details, Python Tools, Example Jupyter Notebooks, Publications, Copyright Notice, and BSD License Text. At the bottom of the sidebar, there are "Read the Docs" and "v: latest" buttons.



# Updates for the MCNP6.3 release

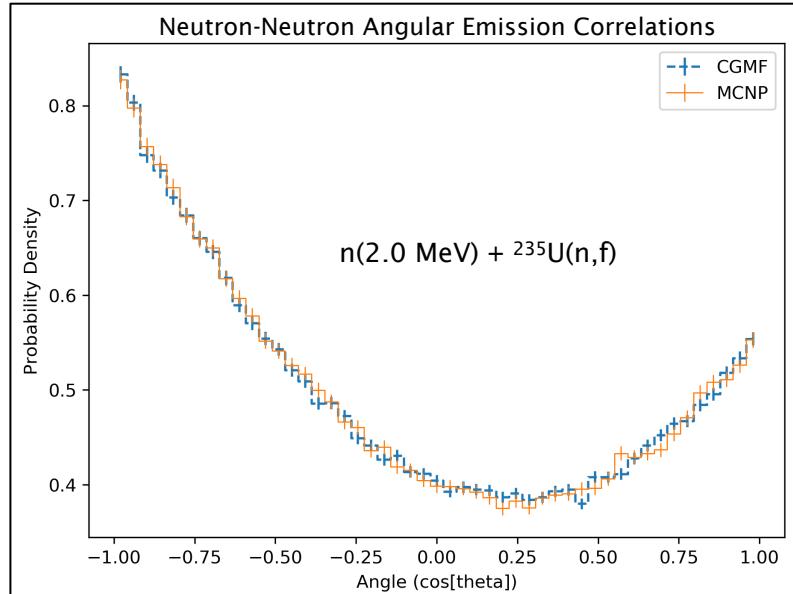
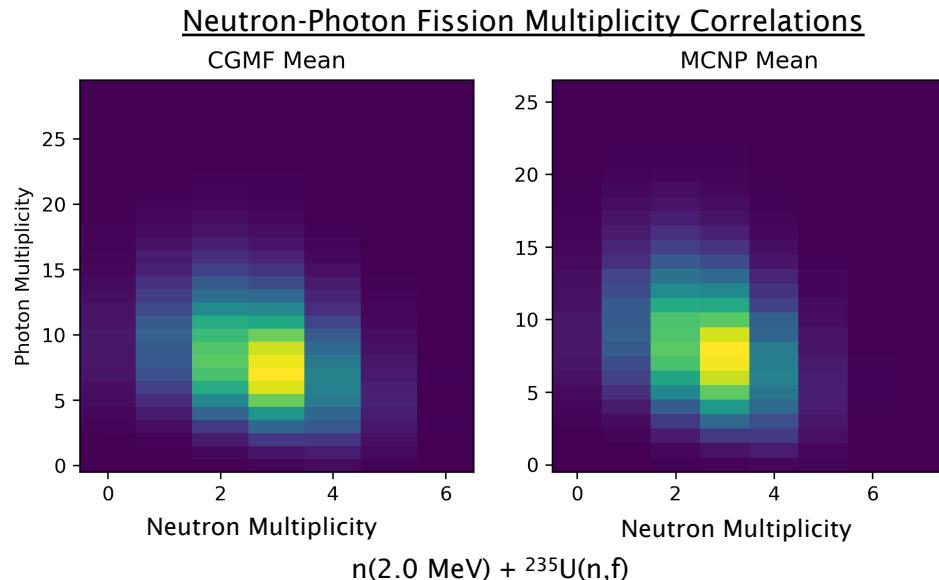
- CGMF updates
  - Spontaneous fission
    - $^{238}$ ,  $^{240}$ ,  $^{242}$ ,  $^{244}$ Pu
    - $^{252}$ ,  $^{254}$ Cf
  - Neutron-induced fission
    - $^{233}$ ,  $^{234}$ ,  $^{235}$ ,  $^{238}$ U,  $^{237}$ Np, and  $^{239}$ ,  $^{241}$ Pu
  - Late-time prompt fission gamma rays
  - Fission fragment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

New Fissionable Systems Compared to MCNP6.2 Release



# 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](mailto: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](mailto:mrising@lanl.gov)

