

Overview of OpenMC

ICTP-IAEA 2022 Advanced Summer School/Workshops on
Computational Nuclear Science and Engineering
May 25, 2022



Objectives

The overarching objectives of the OpenMC project:

- Open source contribution model, freely available
- Extensible for research purposes
- Adopt best practices for software development
- Ease of installation, minimize third-party dependencies
- High performance, scalable on HPC resources
- Use best physics models when possible
- Fun to use, and thriving user and developer community!

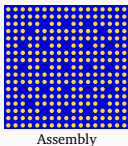
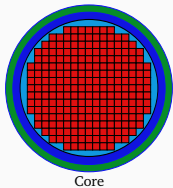
OpenMC: Overview of features

- **Modes:** Fixed source, k -eigenvalue calculations, stochastic volume calculation, geometry plotting
- **Geometry:** Constructive solid geometry, CAD-based, unstructured mesh (tallies only)
- **Solvers:** Neutron and photon transport, depletion
- **Data:** Continuous energy or multigroup cross sections, multipole for Doppler broadening

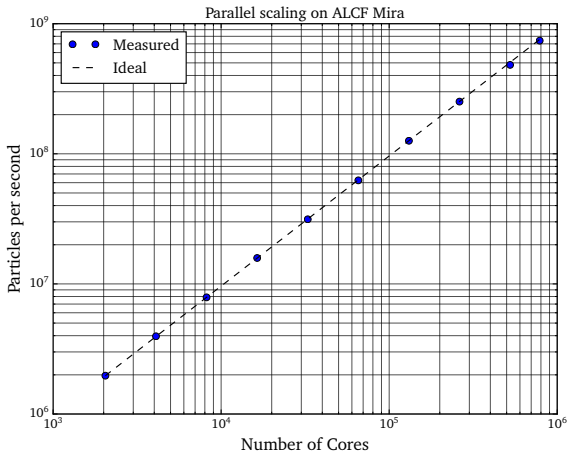
What makes OpenMC unique?

- Programming interfaces (C/C++ and Python)
- Nuclear data interfaces and representation
- Tally abstractions
- Parallel performance
- Development workflow and governance

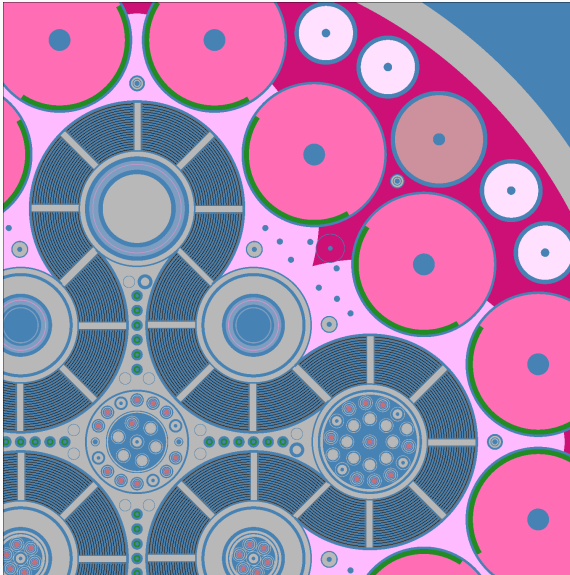
Parallel Performance



- ALCF Mira supercomputer
- 49,152 nodes, 786,432 cores
- 4 hw threads/core = 3,145,728 threads



Example: Advanced Test Reactor



- Mixed **C++** and **Python** codebase
- **CMake** build system for portability
- Distributed-memory parallelism via **MPI**
- Shared-memory parallelism via **OpenMP**
- Version control through **git**
- Code hosting, bug tracking through **GitHub**
- Regression/unit tests run on **GitHub Actions** CI platform

- **Code:** <https://github.com/openmc-dev/openmc>
- **Docs:** <https://docs.openmc.org>
- **Nuclear Data:** <https://openmc.org>
- **Forum:** <https://openmc.discourse.group>
- **Examples:**
<https://github.com/openmc-dev/openmc-notebooks>

Workshop Logistics

- Instructors: Patrick Shriwise, Ben Forget, Carlo Fiorina
- We will provide each of you with a unique URL that lets you connect to a Jupyter Lab instance running on a cloud server with OpenMC preinstalled
 - **URL:** `https://ictp#.openmccourse.org`
 - **Password:** `openmc2022`
 - <https://tinyurl.com/ictp-url-listing>
- We won't be covering Python basics today, but here is a link to a ["cheat sheet"](#)
- Follow along and type the same commands as we go (or not!)
- Feel free to ask questions on (either live or on the chat) at any point!
- Thank you to Paul Romano for setting up our Amazon instances!