# Showcase

## ExaSMR: NekRS Performance on Ponte Vecchio

**Ponte Vecchio with Intel OneAPI DPC++ implementation**

### 1.5x performance lead

***ExaSMR:*** *Small modular reactors (SMRs) and advanced reactor concepts (ARCs) will deliver clean, flexible, reliable, and affordable electricity while avoiding the traditional limitations of large nuclear reactor designs,*
https://www.exascaleproject.org/research-project/exasmr/

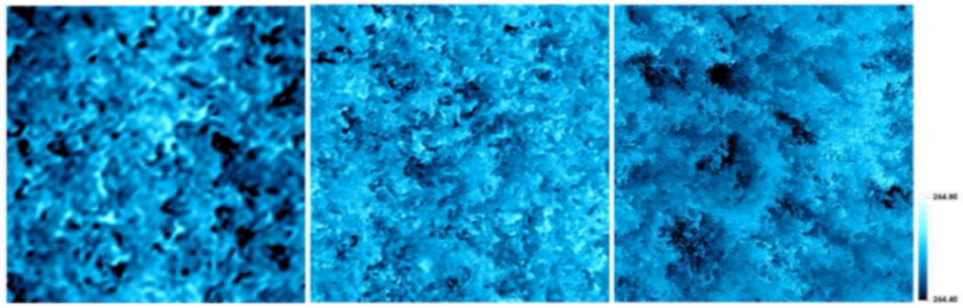
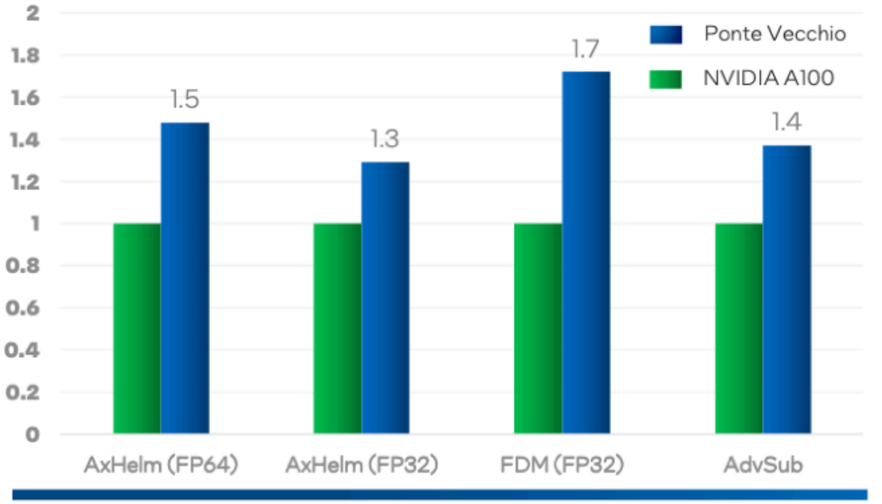


**Figure 10:** NekRS: potential temperature distributions in [K] at time 6h and $z$=100m on different resolutions of $\Delta x$= 3.12m (left), 1.56m (center), and 0.78m (right) corresponding to the number of grid points, $n$=$128^3$, $256^3$, and $512^3$, respectively. $\Delta x$ represents the average grid-spacing for the spectral elements, $E = 16^3$, $32^3$ and $64^3$ and the polynomial order $N = 8$ on the domain 400m×400m×400m.

https://ceed.exascaleproject.org/docs/ceed-ms38-report.pdf

Relative Performance of NekRS Benchmarks w/ problem size of 8196 (Averaged throughput, higher is better)




**Application Summary:**

**NekRS** is an open-source Navier Stokes solver based on the spectral element method targeting classical processors and accelerators like GPUs. The code started as a fork of libParanumal in 2019. For API portable programming OCCA is used.
https://github.com/argonne-lcf/nekRS/

**OCCA** is an open-source library which aims to make it easy to program different types of devices (e.g. CPU, GPU, FPGA). It provides a unified API for interacting with backend device APIs (e.g. OpenMP, CUDA, OpenCL), uses just-in-time compilation to build backend kernel, and provide a kernel language, a minor extension to C, to abstract programming for each backend.
https://libocca.org

HOT CHIPS

- See backup for workloads and configurations. Results may vary.
- Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.



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H. Jiang, "Intel's Ponte Vecchio GPU : Architecture, Systems & Software," *2022 IEEE Hot Chips 34 Symposium (HCS)*, 2022, pp. 1-29, doi: 10.1109/HCS55958.2022.9895631.

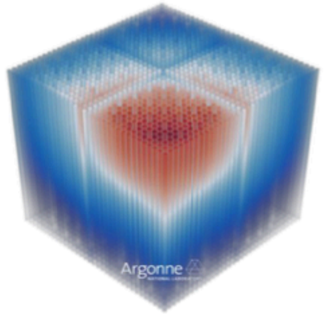
# Showcase

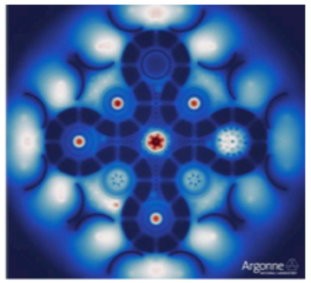
## ExaSMR: OpenMC Performance on Ponte Vecchio

Monte Carlo particle transport code for exascale computations

**Ponte Vecchio with OpenMP Target offload**

**2x performance lead**

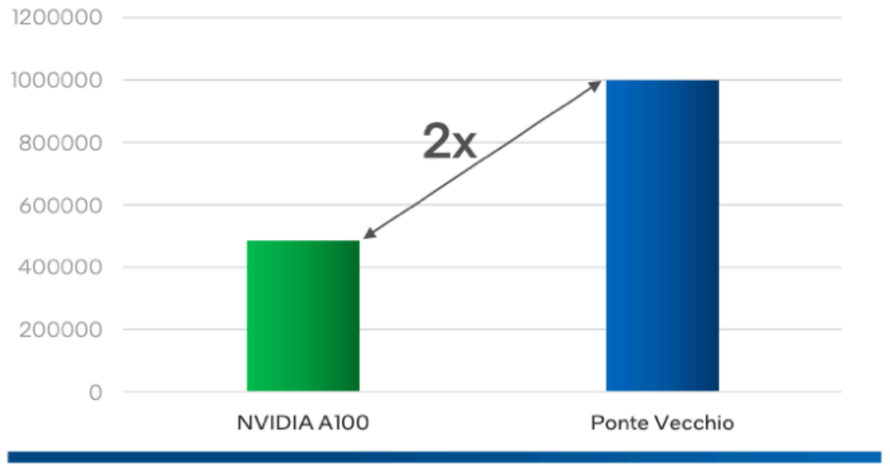



**Exascale Compute Project Annual Meeting 2022 presentation:**
https://www.alcf.anl.gov/events/2022-ecp-annual-meeting
**International Conference on Physics of Reactors 2022 presentation:**
https://www.ans.org/meetings/physor2022/session/view-976/

https://docs.openmc.org

OpenMC Depleted Fuel Inactive Batch Performance on HM-Large Reactor with 40M particles (particles/second, Higher is better)




**Application Summary:** OpenMC is a Monte Carlo particle transport application that has recently been ported to the OpenMP target offloading programming model for use on GPU-based systems. The Monte Carlo method employed by OpenMC is considered the "gold standard" for high-fidelity simulation while also having the advantage of being a general-purpose method able to simulate nearly any geometry or material without the need for domain-specific assumptions. However, despite the extreme advantages in ease of use and accuracy, Monte Carlo methods like those in OpenMC often suffer from a very high computational cost. The extreme performance gains OpenMC has achieved on GPUs, as compared to traditional CPU architectures, is finally bringing within reach a much larger class of problems that historically were deemed too expensive to simulate using Monte Carlo methods. The leap in performance that GPUs are now offering carries with it the potential to disrupt a number of engineering technology stacks that have traditionally been dominated by non-general deterministic methods. For instance, faster MC applications may greatly expand the design space and simplify the regulation process for new nuclear reactor designs -- potentially improving the economics of nuclear energy and therefore helping to solve the world's climate crisis.

HOT CHIPS

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H. Jiang, "Intel's Ponte Vecchio GPU : Architecture, Systems & Software," *2022 IEEE Hot Chips 34 Symposium (HCS)*, 2022, pp. 1-29, doi: 10.1109/HCS55958.2022.9895631.