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# Research on Benchmark Testing Method Based on JUNO Offline Software

To standardize the evaluation of computational capabilities across various hardware architectures in data centers, we developed a CPU performance benchmarking tool within the HEP-Score framework. The tool uses the JUNO offline software as a realistic workload and produces standardized outputs aligned with HEP-Score requirements. Our tests demonstrate strong linear performance characteristics under full CPU utilization, along with high reliability and reproducibility.

Furthermore, this study presents a comparative analysis of different CPU architectures, revealing performance characteristics and workload-specific bottlenecks in the context of HEP applications. Power consumption metrics are also incorporated to evaluate performance-per-watt efficiency, offering a valuable perspective on energy-aware computing. Based on this combined performance and power efficiency evaluation, we provide practical hardware procurement recommendations tailored to the needs of large-scale high-energy physics computing environments. This benchmarking method delivers a robust reference for evaluating, selecting, and optimizing computing resources under both performance and sustainability constraints.

## Significance

This presentation introduces a novel benchmarking approach that integrates the JUNO offline software into the HEP-Score framework, enabling performance evaluation using realistic high-energy physics (HEP) workloads. Unlike generic synthetic benchmarks, our method reflects actual computational patterns in large-scale physics experiments. Beyond a status report, we provide quantitative analysis demonstrating the linear performance scaling and statistical reliability of the method.

Importantly, we contribute new insights by comparing benchmark results across different CPU architectures, revealing performance characteristics and hardware-specific bottlenecks in the context of HEP applications. In addition, we incorporate power consumption measurements to evaluate the performance-per-watt ratio, offering a practical perspective on energy efficiency—an increasingly critical factor in large-scale computing resource planning. These results support informed decision-making in computing resource procurement and optimization, addressing the urgent need for standardized, application-relevant, and energy-aware benchmarking in distributed HEP computing environments.

## References

https://www.benchcouncil.org/bench2023/#schedule-section

## Experiment context, if any

Jiangmen Neutrino Experiment(JUNO)

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