

Power efficiency of HEP applications on CPU and GPU

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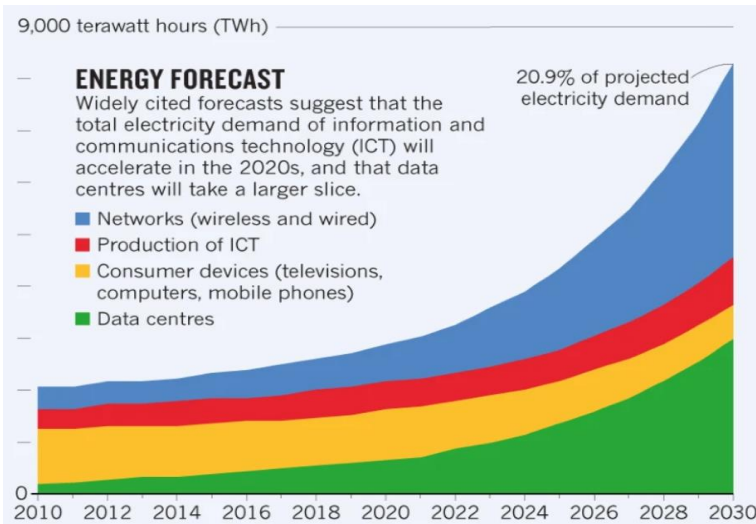
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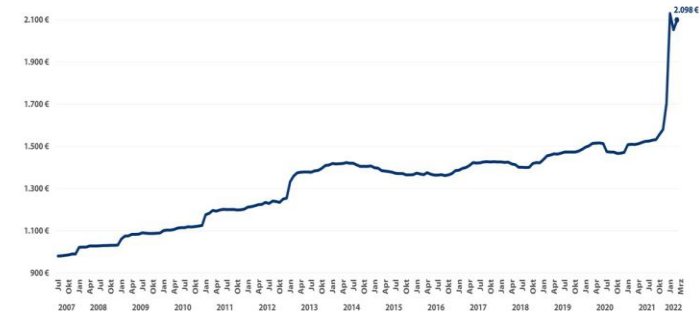
Objective

Measure compute performance and energy consumption of servers with hardware accelerators (GPUs) when running HEP workloads



Worst case prediction of global electrical ICT power consumption
Nature 561, 163-166 (2018), <https://doi.org/10.1038/d41586-018-06610-y>

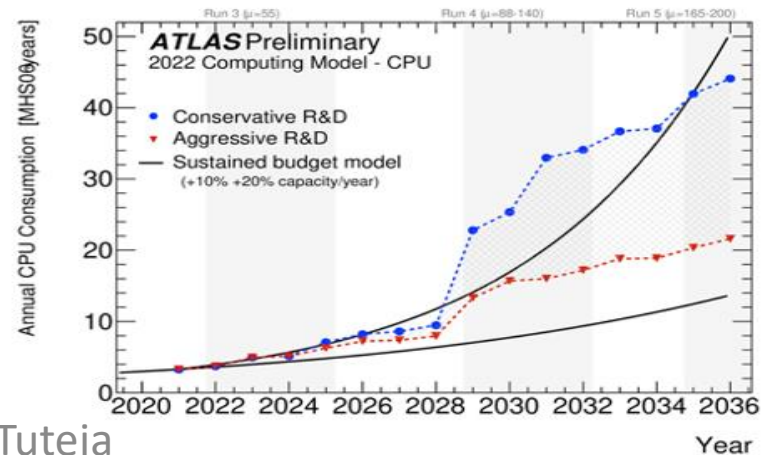
Strompreisentwicklung (5.000 kWh) seit Juli 2007



Quelle: CHECK24 Vergleichsportale Energie GmbH (<https://www.check24.de/strom/>), 089 - 24 24 11 66; Stand: 15.03.2022.

Der CHECK24 Strompreisindex berücksichtigt pro Netzbereich den Preis des Grundversorgungsstarfs, den jeweils günstigsten Tarif des Grundversorgers sowie den je günstigsten Tarif der zehn preiswertesten Alternativanbieter. Die Preisberechnung basiert auf dem durchschnittlichen Jahresverbrauch eines Kleerverbrauchers (5.000 kWh) und erfolgt einmal im Monat. Die Gewichtung wird jährlich anhand des Monitoringberichts der Bundesnetzagentur angepasst.

CHECK24



HEP Applications

- HEP data processing stages

- Event Generation

Output: particles produced in beam collisions

- Simulation + Digitization

Output: Simulated electronic Signals

- Reconstruction

Output: Translate electronic signals to particles passing through the detector

- To understand which architecture is most suitable for certain kinds of workloads, we need to benchmark them

- Compute performance

- Energy consumption

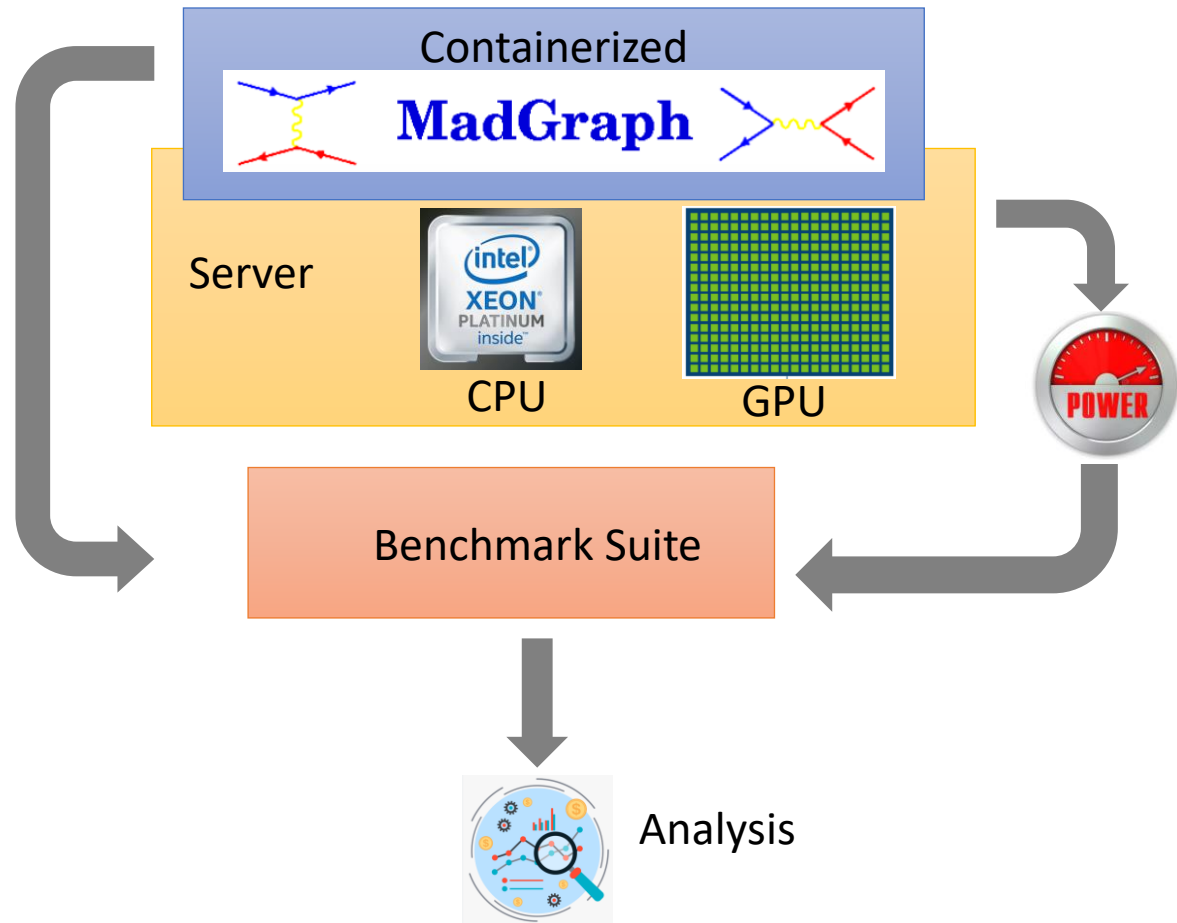
- Application used: Madgraph event generator



Measurement Methodology

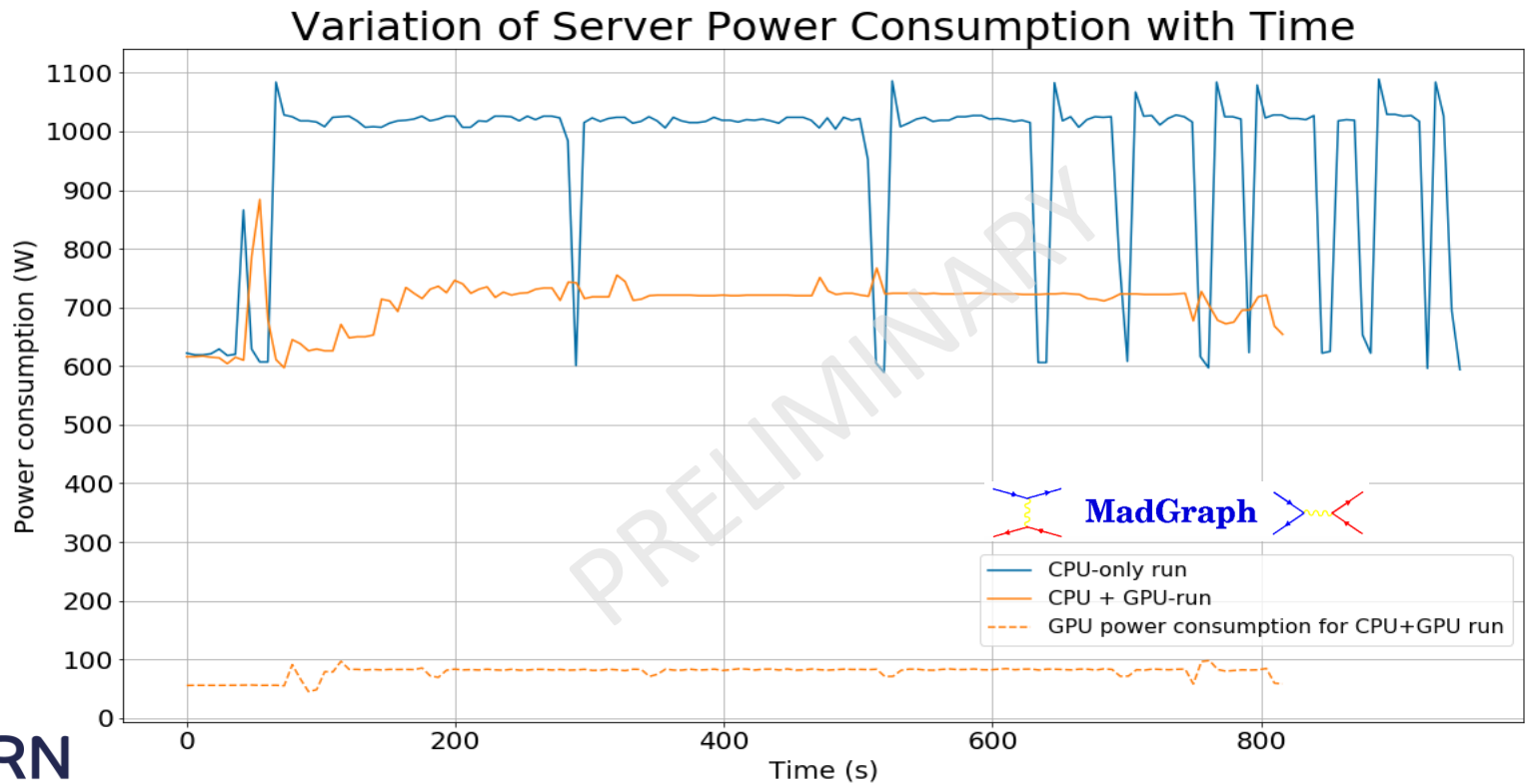
Server Specs:

- **CPU**
Intel Platinum 8362 @ 2.80GHz
Cores per socket: 32
Sockets: 2
- **GPU**
Model name: Nvidia L4
Total board power: 72 W
GPU clocks: 2 GHz (Boost)

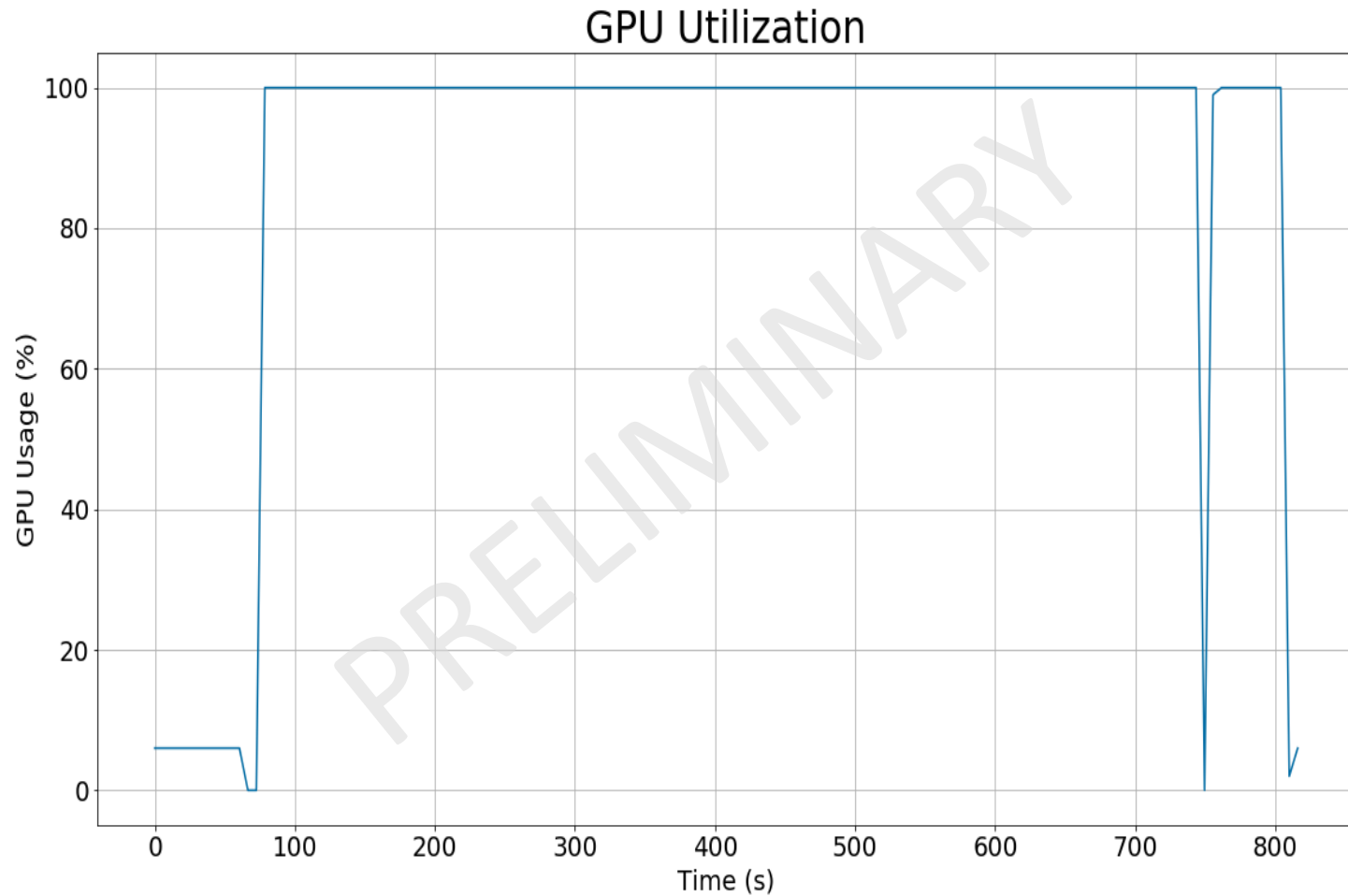


Power Consumption (First results)

- CPU-only run
 - Executes Madgraph using different vect. compiler options (avx2, avx512, sse4,..)
- CPU+GPU run
 - Executes Madgraph on GPU, CPU is just configuring the run



Control plot: GPU Utilization

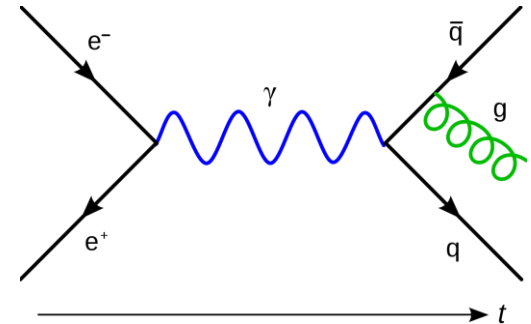


Outlook

- Integrate the upcoming Madgraph container
 - Calibrate with the new data
- Power efficiency: CPU versus GPU
- Extend the analysis to other workloads

Thank you!

Madgraph



- Event generator program used in particle physics.
- Calculates matrix elements representing the probability amplitude
- Used to calculate the cross sections, which represent the likelihood.
- Can be used to simulate event generation.