Power efficiency of HEP applications on CPU and GPU

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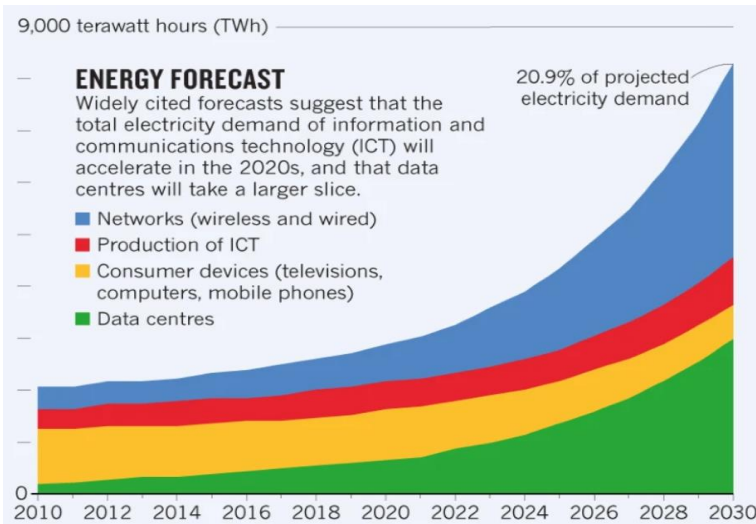
Supervisors:
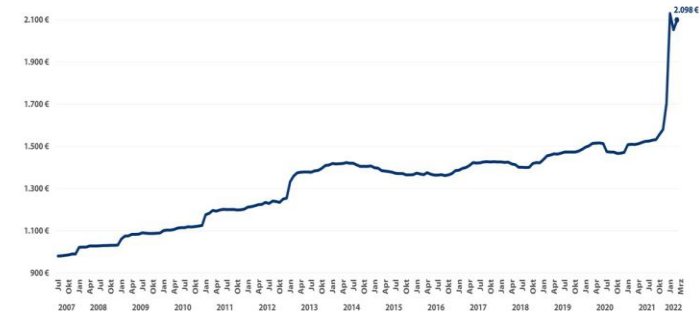
David Southwick   Gonzalo Menendez Borge

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
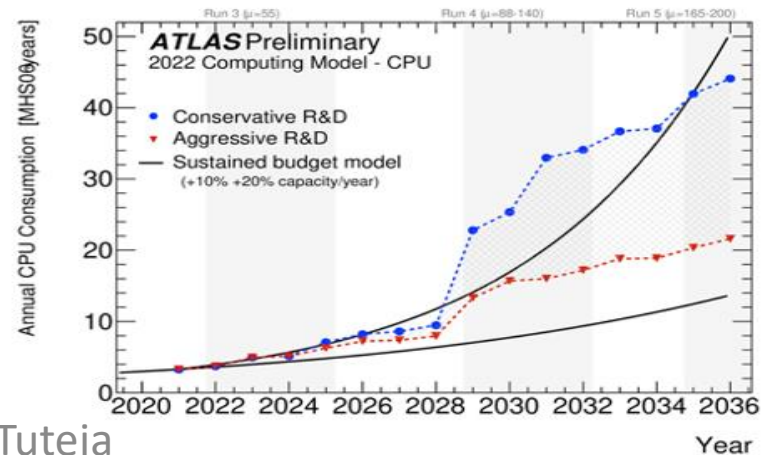Nature 561, 163-166 (2018), *https://doi.org/10.1038/d41586-018-06610-y*

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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
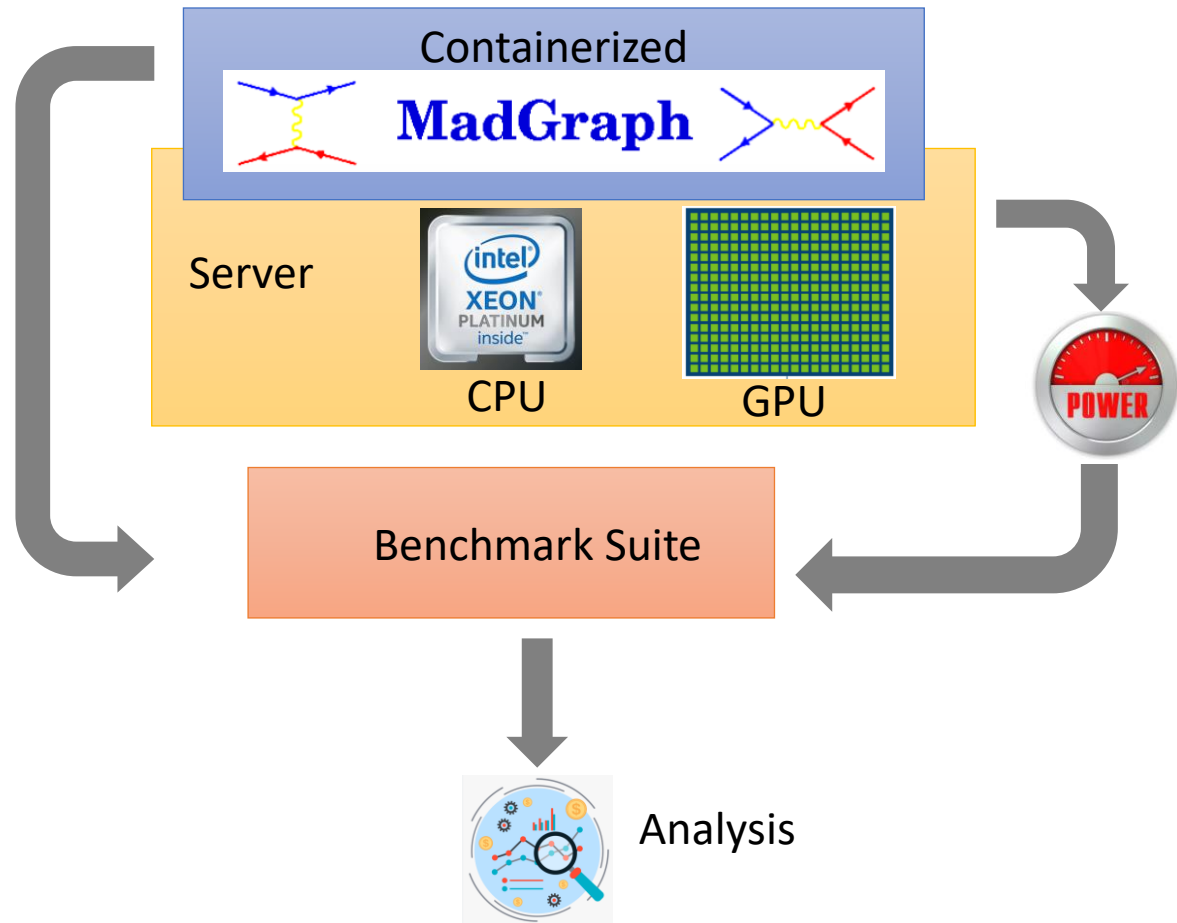
  - Compute performance

  - 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)

Containerized

MadGraph

Server

CPU

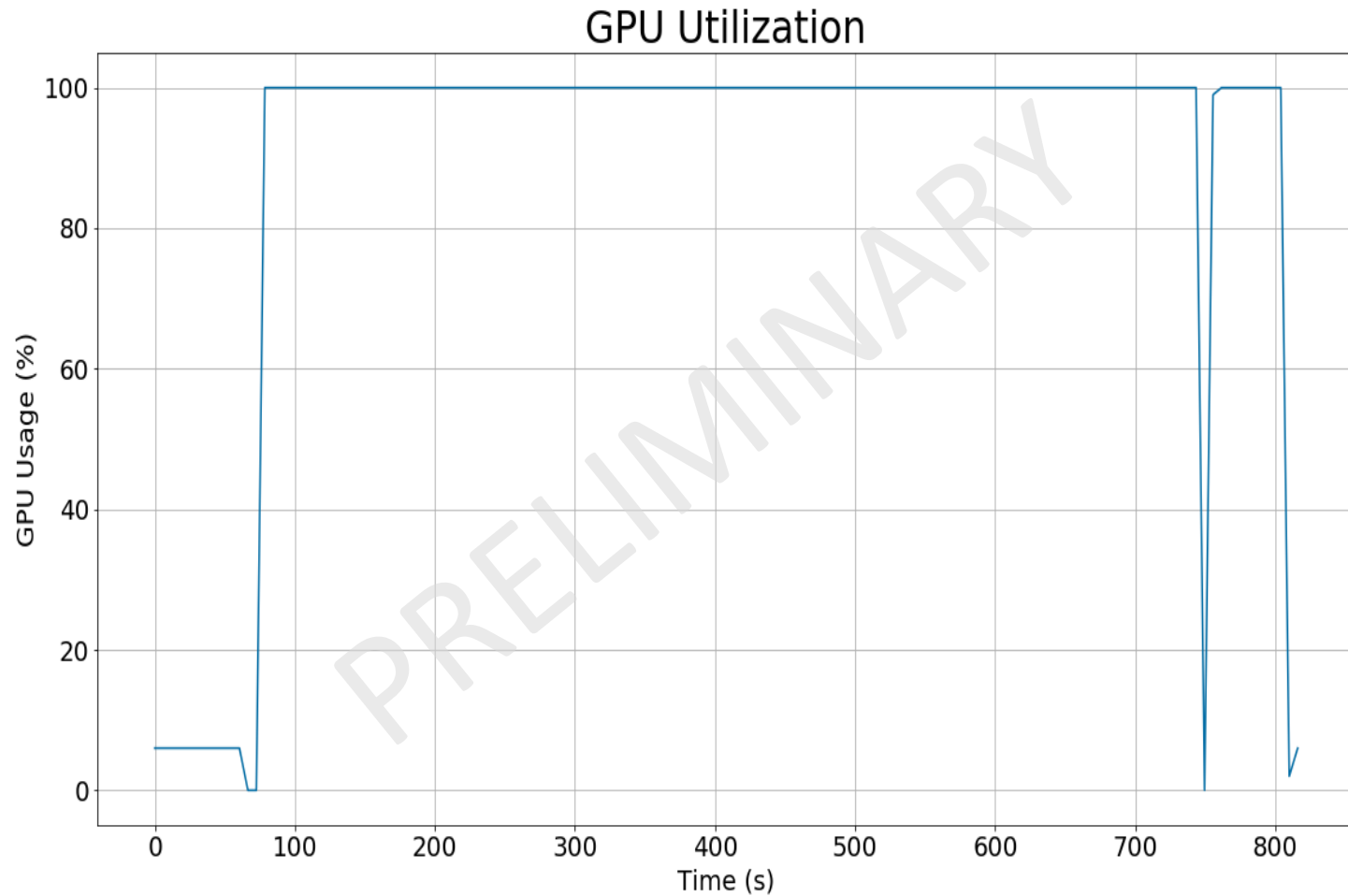GPU

POWER

Benchmark Suite

Analysis

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

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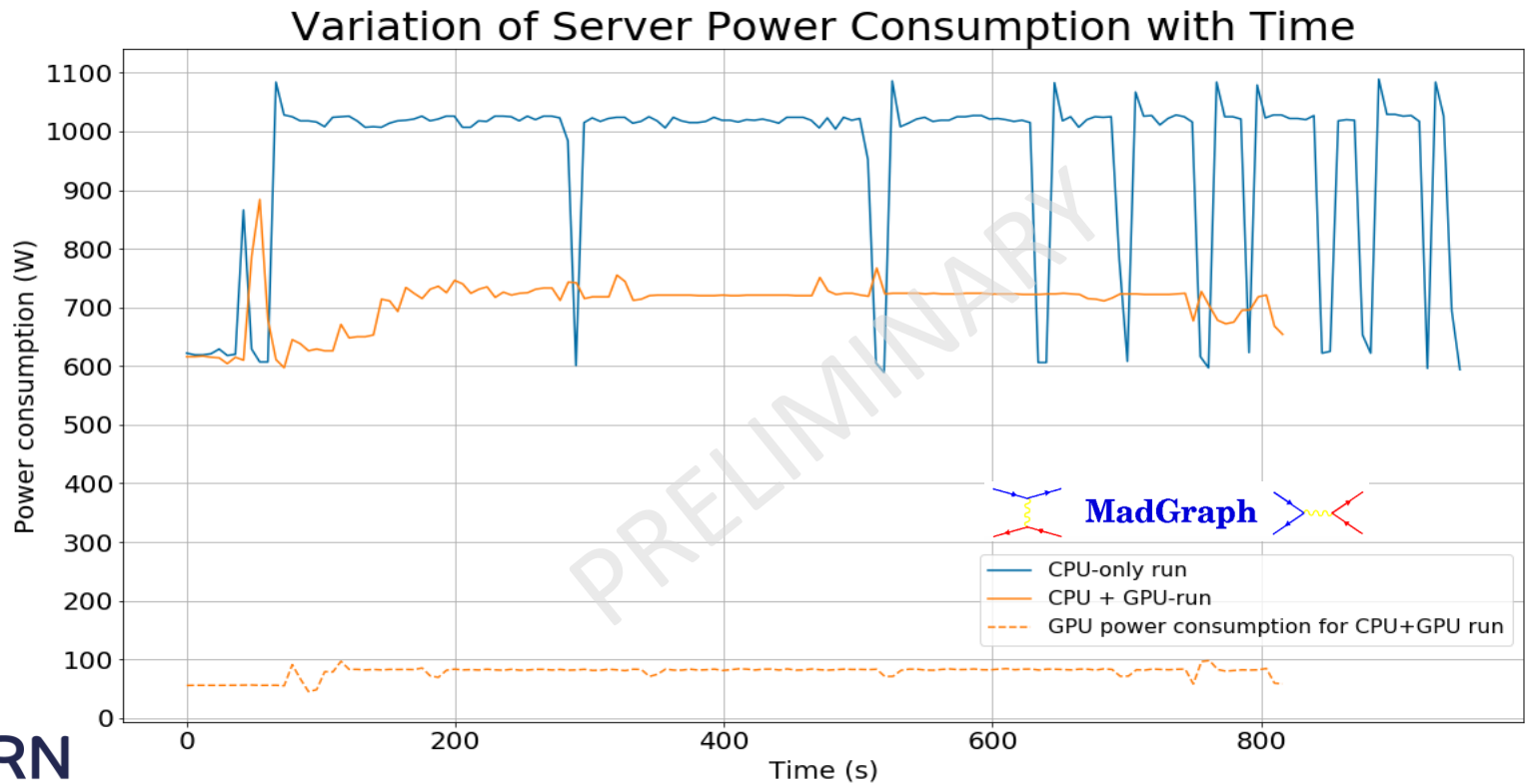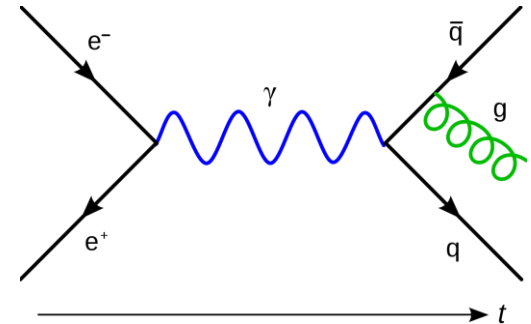
Control plot: GPU Utilization

Outlook

- Integrate the upcoming Madgraph container
  - Calibrate with the new data

- Power efficiency: CPU versus GPU

- Extend the analysis to other workloads

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Thank you!

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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.