A Deep Learning tool for fast simulation

HNSciCloud Pilot Phase Final Public session

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Deep Learning for fast detector simulation

Detailed simulation of subatomic particles interactions is essential

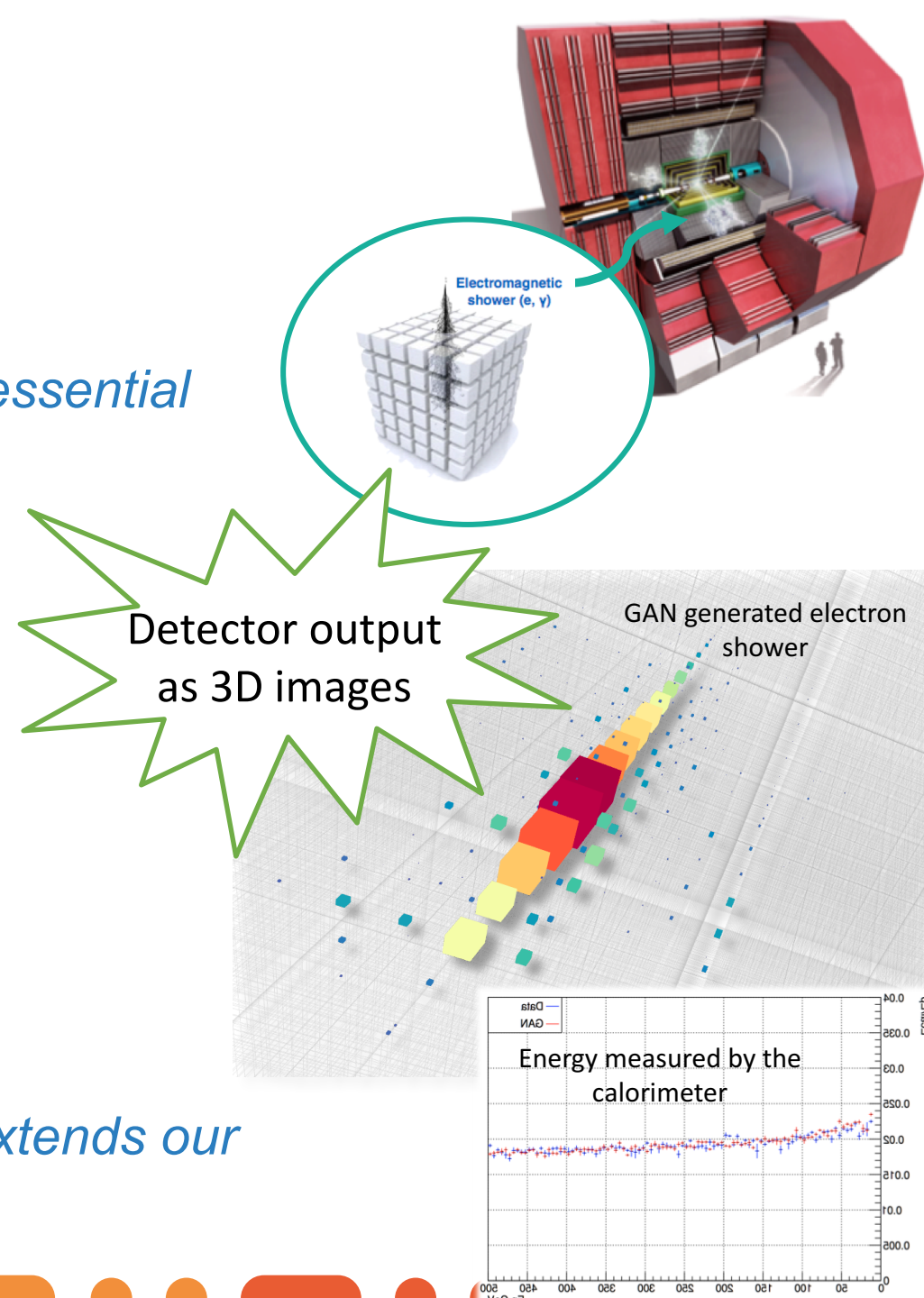Monte Carlo approach is not fast enough for HL-LHC needs

- 3D convolutional GAN generate realistic detector output
- >2000x faster than Monte Carlo on a Intel Xeon processor

Training takes ~1 day on NVIDIA P100

- Use parallel approach to distribute training across multiple nodes

Optimized training and access to cloud facilities extends our range of applications

Electromagnetic shower (e, γ)

Detector output as 3D images

GAN generated electron shower

Energy measured by the calorimeter
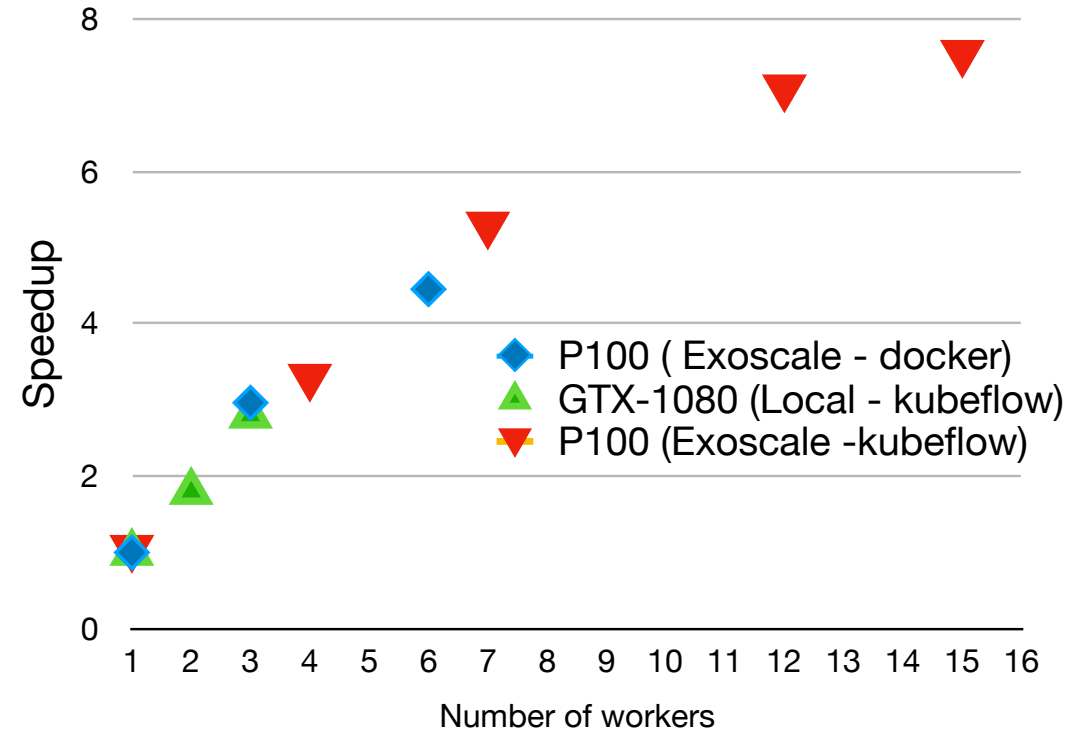
Distributed training on T-Systems cloud

Introduce mpi based data parallel training

- First results on 8x NVIDIA V100 (BMS)

- 8 processes run in parallel on the same BMS
  - Better scaling than HPC

- Added values:
  - Access to powerful cluster
  - Simple and efficient instance creation

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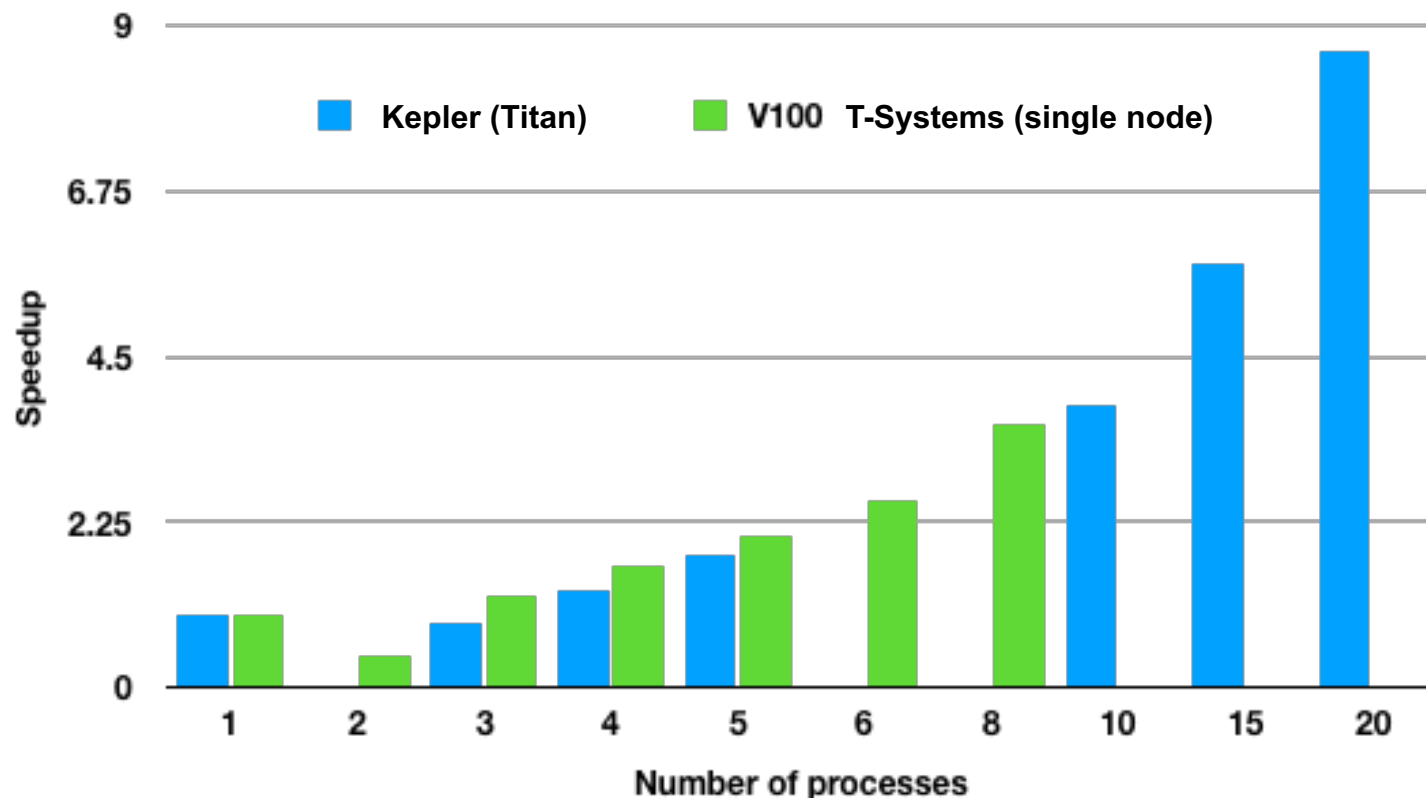
Distributed training on Exoscale cloud

- Failed attempts:
  - docker + HTCondor
  - Nuvla SLURM-based script

- Move to docker + Kubernetes/Kubeflow (K. Samaras-Tsakiris and R. Brito da Rocha from CERN IT-CM)
  - First results on 18x NVIDIA P100 (VMs)
  - Direct comparison to on-site GPUs in openStack

- Added values:
  - Large3 number of VMs
  - S3 storage solution available. Possibility to define shared FS across VMs?

Legend:
- P100 (Exoscale - docker)
- GTX-1080 (Local - kubeflow)
- P100 (Exoscale -kubeflow)

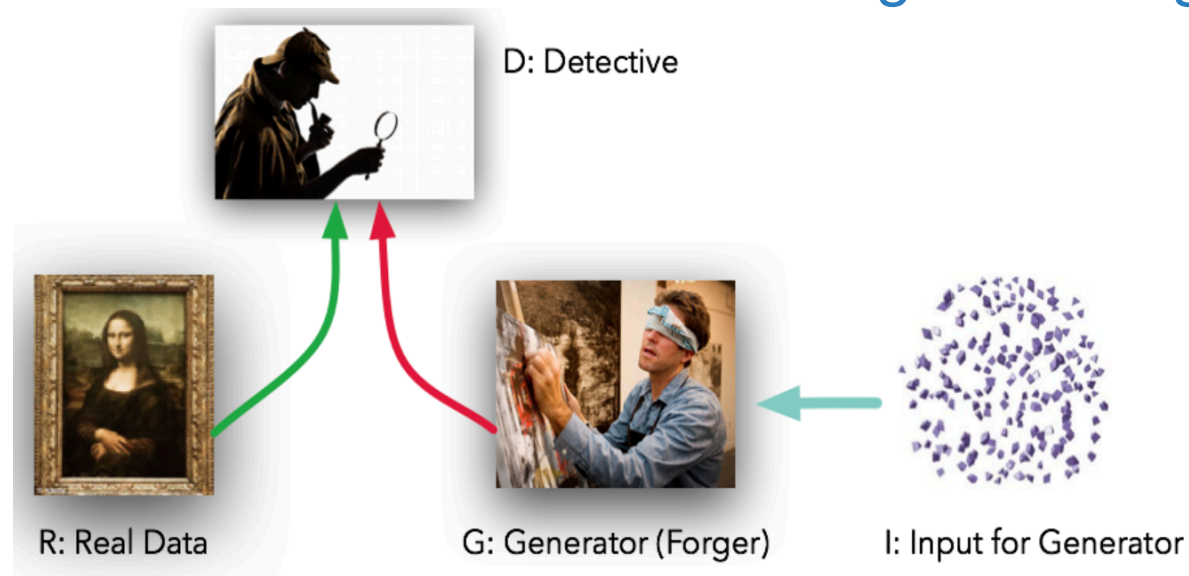Axis: Speedup vs Number of workers

Thanks!

Questions?

Generative adversarial networks

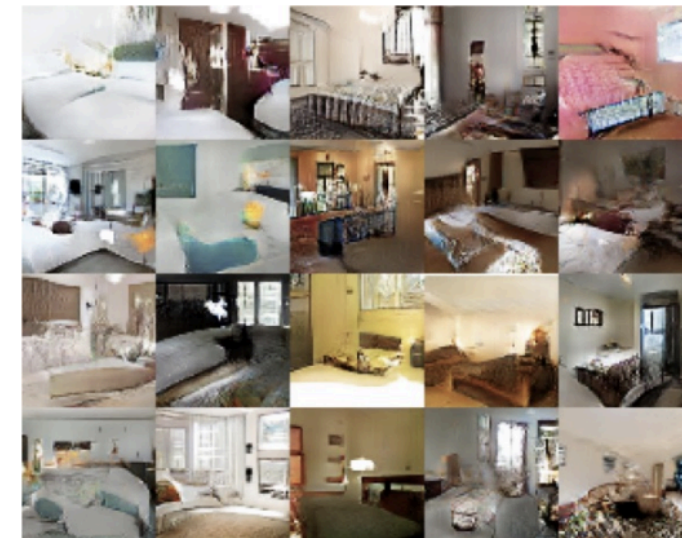*Generative methods from computer vision generate detector output!*

Simultaneously train two networks that compete and cooperate with each other:

Generator G generates data from random noise

Discriminator D learns to distinguish real/generated data

D: Detective

R: Real Data

G: Generator (Forger)

I: Input for Generator

Image source:

https://arxiv.org/pdf/1701.00160v1.pdf

The counterfeiter/detective case

Counterfeiter shows the Monalisa

Detective says it is fake and gives feedback

Counterfeiter makes new Monalisa based on feedback

Iterate until detective is fooled

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