ML and RTA for Higgs boson measurements and fleet safety ([GoogleDoc](#))
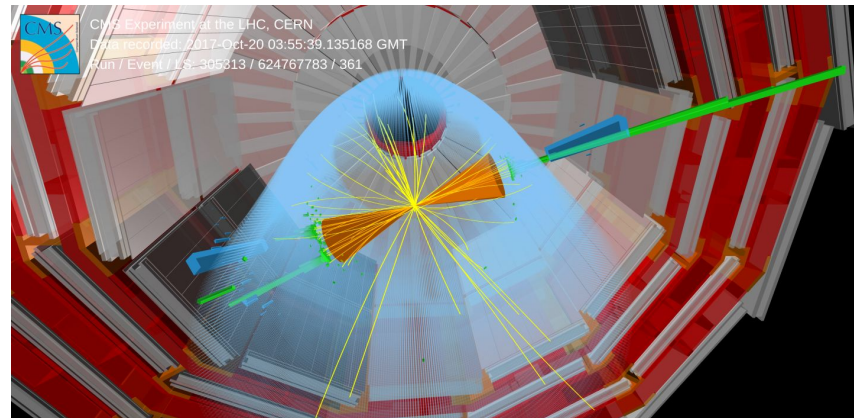
verizon connect
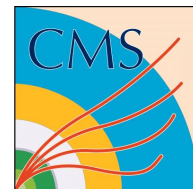
HELSINKI INSTITUTE OF PHYSICS

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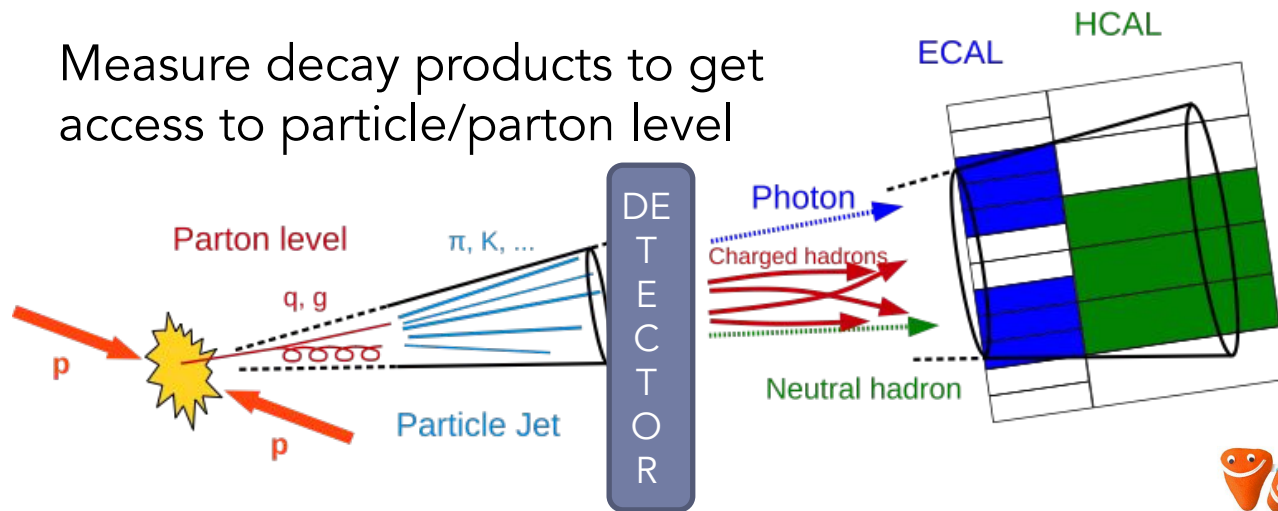Henning Kirschenmann
Mikko Voutilainen

Maurizio Pierini

Jets: Signatures of quarks and gluons (?)

Measure decay products to get access to particle/parton level

More generalised picture: Almost everything becomes a jet:
g/q/t/W/*Z/H*/PU
→ need substructure for identification
→ do it for ~~all~~ 10x more events: scouting

# Project in a nutshell

- Adapt DL frameworks in resource-constrained (embedded) environments for real-time image processing→ Verizon
- Use expertise to optimize resource constrained (HLT) algorithms for Run 3 + HL-LHC with CMS
  - Improve flavor/heavy-object tagging at HLT
  - Validate using Z→ bb/H→ bb
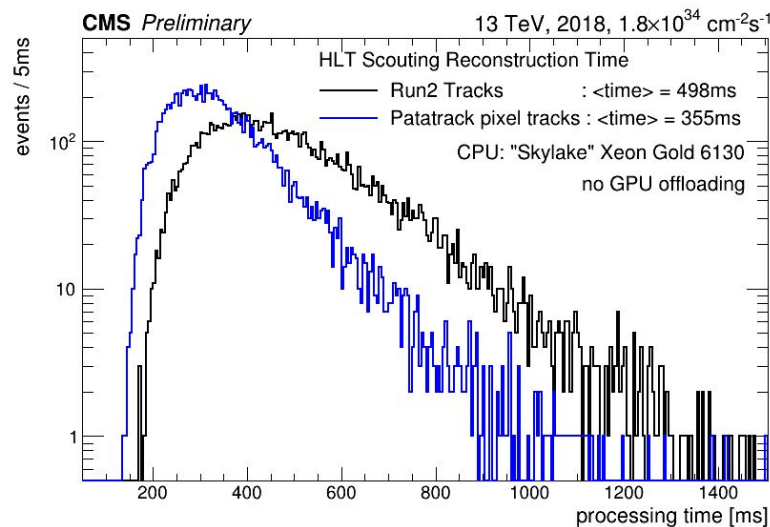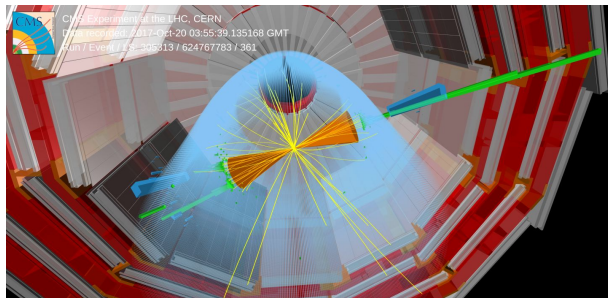
For Run3: GPU-accelerated tracking enables generic scouting stream

Logistics

5 months at CERN

5 months at CERN
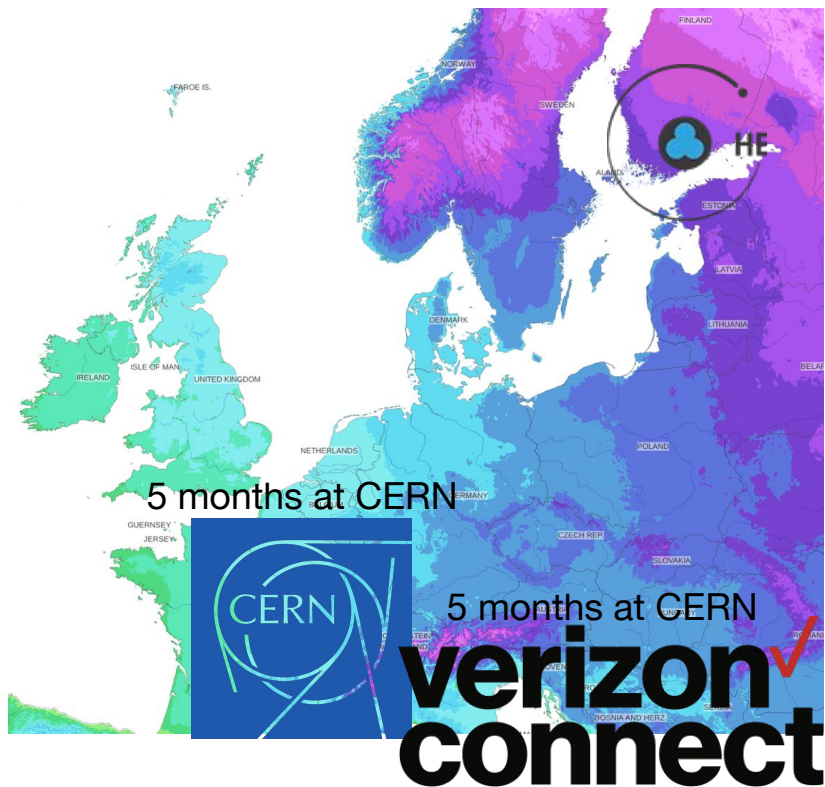
Title: ML and RTA for Higgs boson measurements and fleet safety

Description Deep learning (DL) based algorithms which identify heavy objects (e.g. b quarks) in jets, e.g. DNNs, have been established firmly offline but not yet used in real time analyses. As a first objective, the student in this project will understand the resource cost of these DNNs, improve them if necessary, and adapt them to be used for real time analyses in the general purpose RTA stream for Run3. This will significantly extend the applicability of the RTA stream for analyses. The industrial secondment to VERIZON will have the second objective of adapting DL frameworks, e.g. TensorFlow Lite and Keras, in resource-constrained environments (e.g. embedded platforms), for real-time processing of images captured by embedded mobile devices. This is an instrumental step towards mobile-phone in-vehicle edge embedded computing applications for VERIZON, where the student will be trained in theory and best practices of DL, and will return with expertise in RTA DL frameworks in constrained environments to improve the initial trigger selections towards their application in physics analysis. The third objective of this project is to exploit DL in trigger algorithms to validate the generic RTA stream by measuring the frequent and well understood $Z \rightarrow b\,b$ process, and then apply it to a new measurement of the $H \rightarrow b\,b$ process. The student will also collaborate with CERN expert and work on the monitoring, improvement, exploration, and analysis of the generic RTA stream. The fourth objective towards the end of Run 3 data-taking is to establish the general purpose RTA stream for HL-LHC, exploiting the extended capabilities of the new detector (tracking at L1, highly granular calorimeter, timing information).
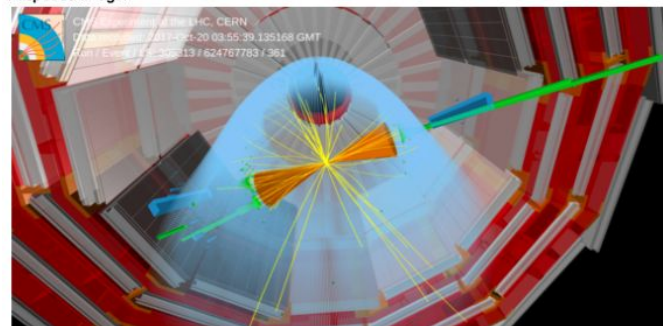
Host country: Finland

Host beneficiary: University of Helsinki

PhD-awarding institution: University of Helsinki
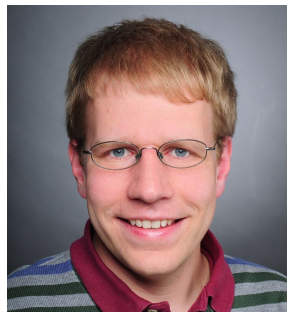
Planned collaborations: VERIZON, CERN

Proposed image:

$H \rightarrow$ bb event display from https://cds.cern.ch/record/2714889

People

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