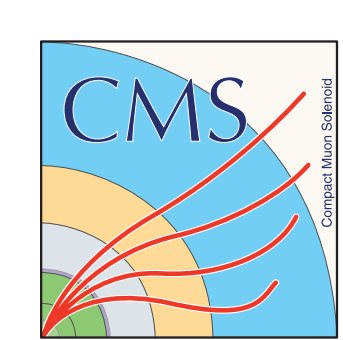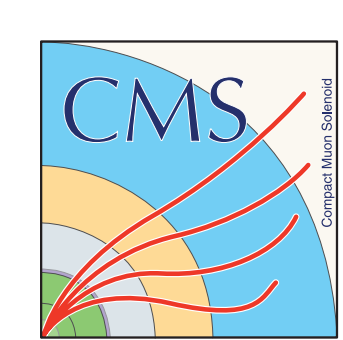# CMS Modernization Needs

CERN openlab Workshop on Compute Platforms and Software
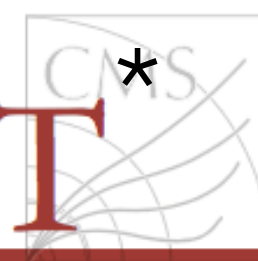Liz Sexton-Kennedy

Meaning of Modernization

- Modernization means different things to different people

  - Move to modern language features that enable complier optimizations - eg. move semantics

  - Recode to take advantage of modern hardware features that the code is incapable of using - e.g. vectorization or hardware data compression

  - Rewrite data structures to better match the needs of algorithms - e.g. use Structure of Arrays instead of Array of Structures

  - Use completely new techniques to solve traditional problems - e.g. machine learning to do pattern recognition or clustering

  - Recode algorithms to eliminate concurrency problems - eg. remove usage of global state
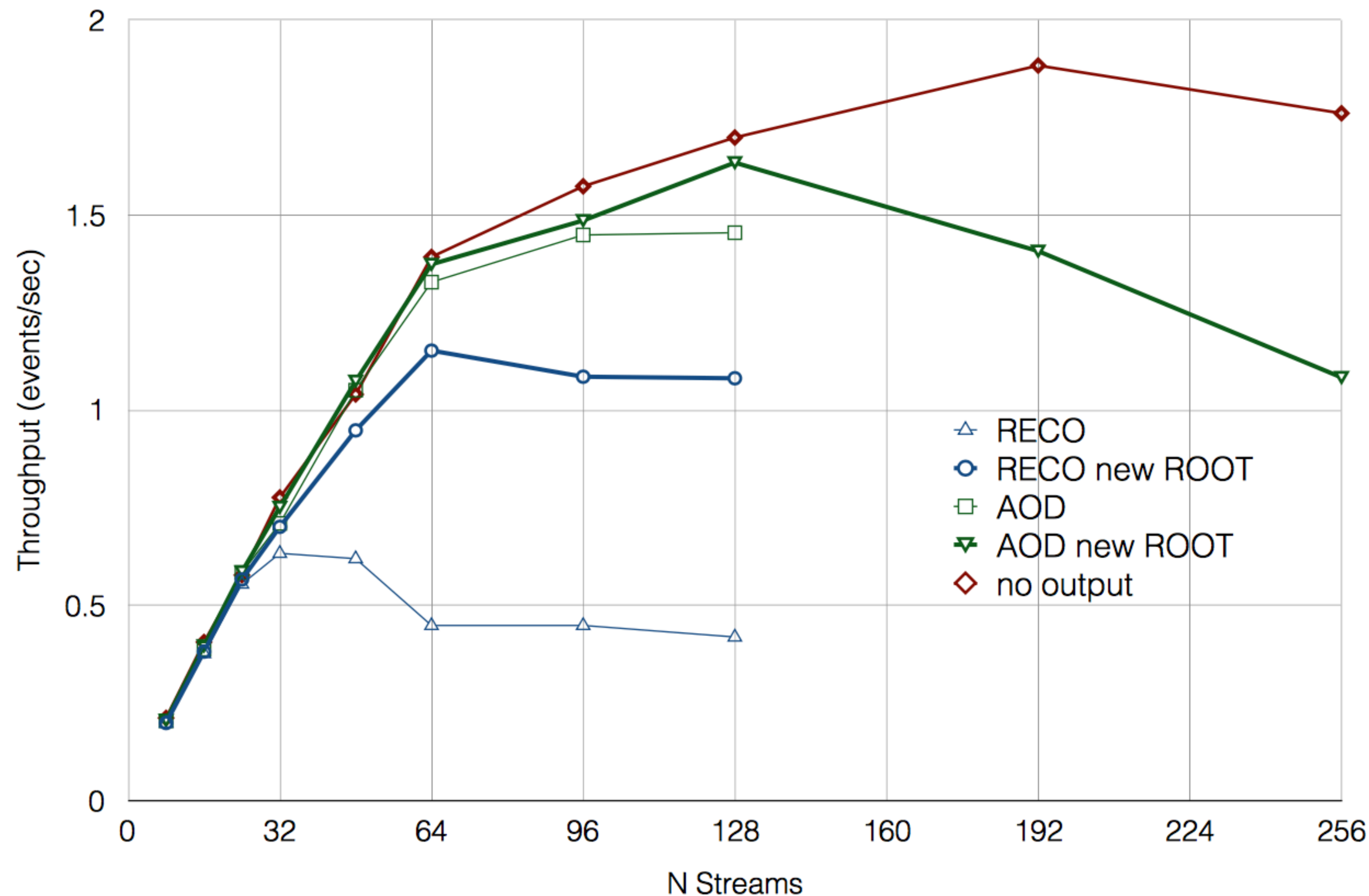
Needs

- CMS welcomes help from openlab on all of these

- At the moment most of our core team efforts have been in investigating our concurrency limits.

- Nour status now: Most limits are coming from community products such as ROOT. On the minus side we have less control of this code, on the plus side improvements we make here have wider impact, benefiting others as well.

Throughput with Modified ROOT *

* modified to allow compressing branches in one TTree in parallel

Legend:
- △ RECO
- ○ RECO new ROOT
- □ AOD
- ▽ AOD new ROOT
- ◇ no output

- Goal: maximize throughput for a given memory budget. Trivial parallelism is still the best parallelism but that strategy is limited by memory.