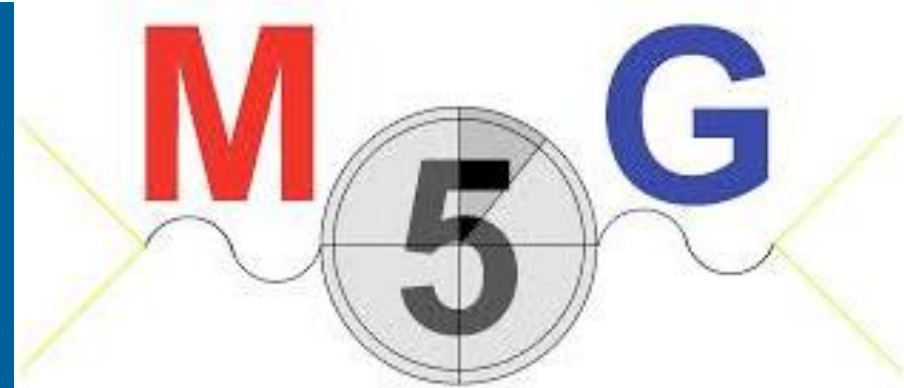


DEVELOPMENT OF GPU BASED MADGRAPH

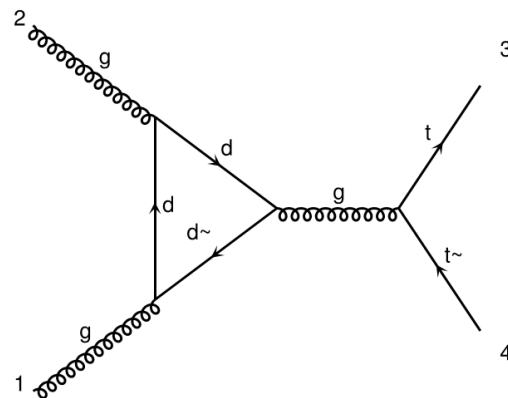
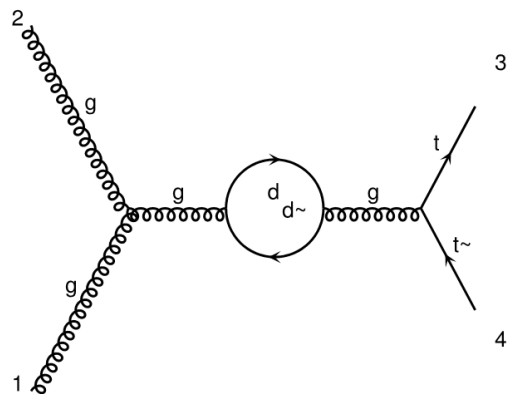
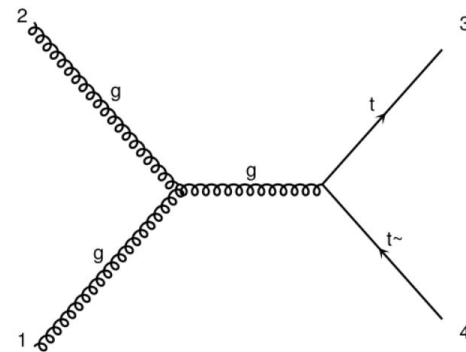


KYLE FIELMAN
ANL Intern

BACKGROUND

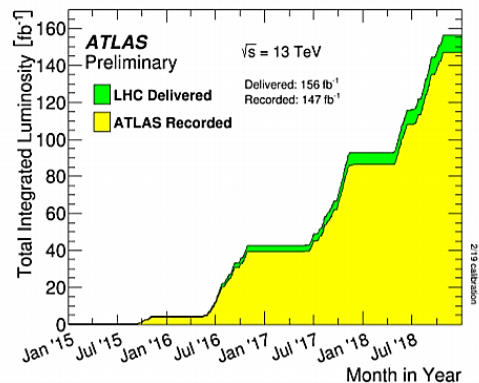
What is Madgraph?

- HEP Phenomenology framework
 - Feynman Diagrams
 - Cross Sections
 - Event Generation
 - Other utilities (MadWeight, MadAnalysis, ...)
 - NLO



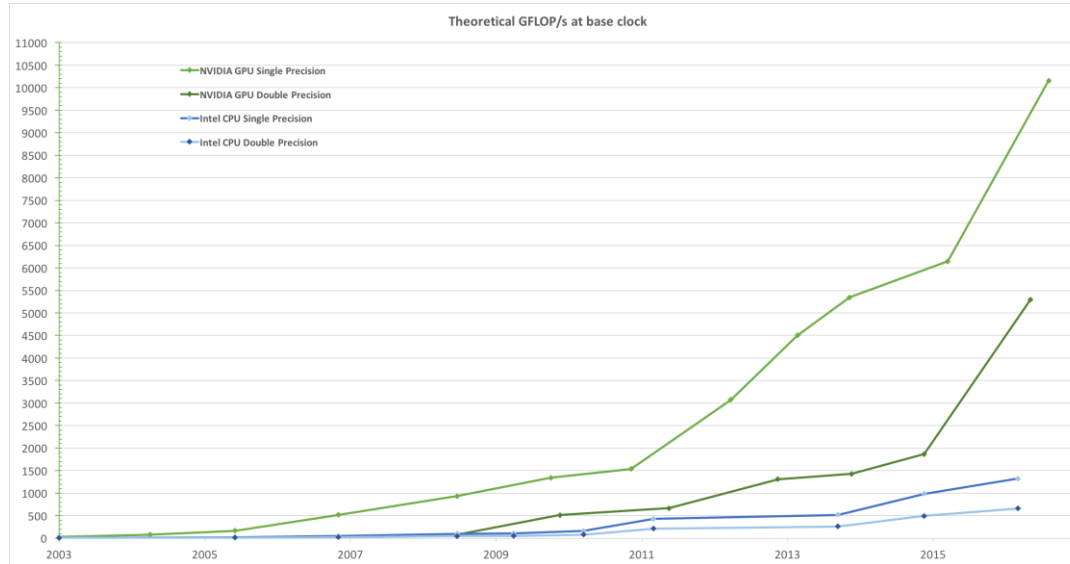
MOTIVATION

- Need for Speed
 - Run1+Run2: $\sim 150\text{fb}^{-1}$ up to 2018
 - And more: 300fb^{-1} until 2022, 3000fb^{-1} until 2035
 - Huge amount of simulation data is necessary to keep reliability of physics analyses.
- Need to utilize high performance computing developments



IMPROVING PERFORMANCE

- GPUs (Graphical Processing Units)
 - Made for accelerated image production
 - Highly parallelized
 - Established development platform with CUDA



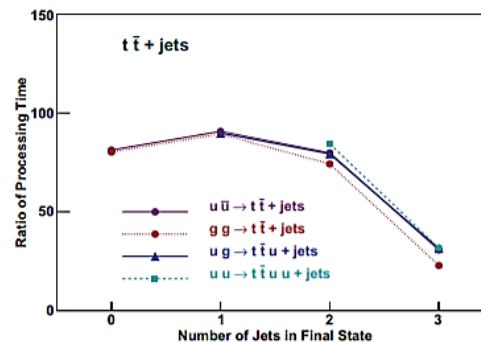
GPU BASED MADGRAPH



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HISTORY

- Development began in 2008
 - Work on parallelizing (HEGET, gVEGAS, gBASES,...)
- “GPU” version of Madgraph created
 - Updated until 2012
- Benchmarking were done for integration
 - J. Kanzaki, Eur. Phys. J. C71 (2011) 1559, e-print arXiv: 1010.2107
- The GPU programs were not fully integrated
 - No CLI integration, event generation

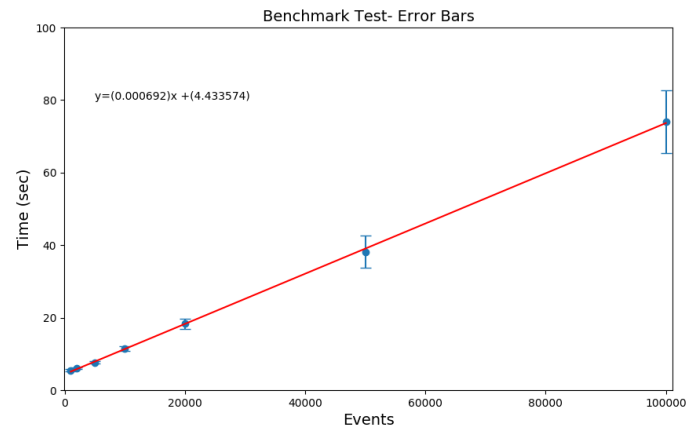
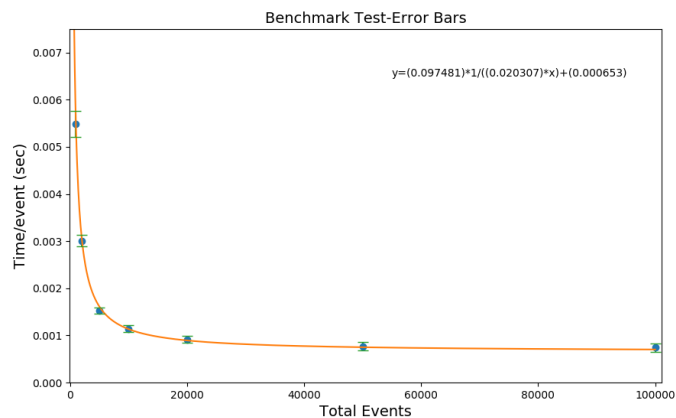


CURRENTLY

- Renewed interested in GPU computing
- Goals:
 - Update GPU code
 - gBASES, gVEGAS, gSPRING
 - Benchmark CPU/GPU integration
 - Release version of MG vs gVEGAS
 - Benchmark event generation
 - gSPRING

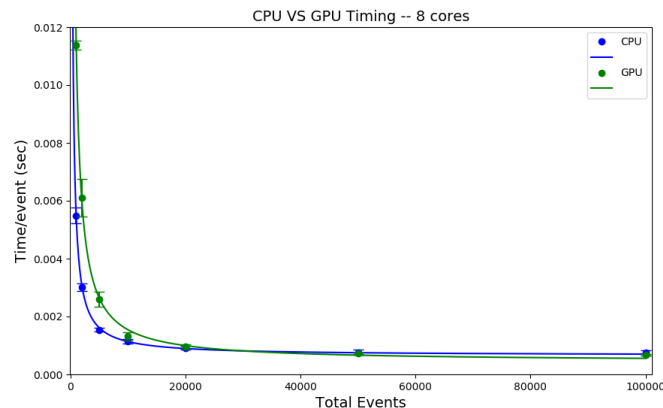
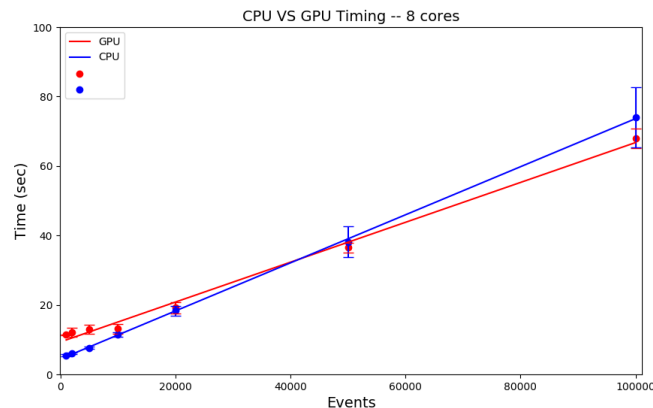
PROGRESS

- Familiarize with release version of MG
 - Established timing method (bash script)
 - Timings taken for $g \gg t$
 - Made python plotting scripts
 - Cores, event dependence



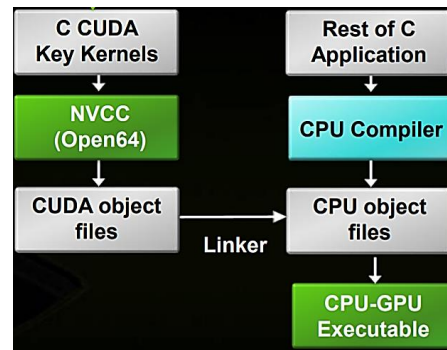
PROGRESS (CONT.)

- Familiarize with GPU version
 - Study GPU code
 - Not fully integrated
 - Produces GPU directory
 - CL standalone plugin
 - Benchmarking
 - Both used CPUs
- Need external programs
 - gVegas, gBases, gSpring



GPU REVIVAL

- Accessed old gVEGAS and gBASES programs
 - Working on updating
 - CUDA 4 -> CUDA 9
 - gSPRING
 - Recently finished updating gVEGAS
 - Integrated test function
 - Working on getting useful integrations
 - Use MG GPU output
 - Benchmarking



PROSPECTS

- End of summer:
 - Fully functional gVEGAS
 - Integration benchmarking
- After Summer:
 - Restore gBASES, gSPRING
 - Event generation benchmarking
- Much later:
 - GPU functionality fully integrated into MG5

THANK YOU. QUESTIONS?



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SULI PRESENTATION ABSTRACT

This talk focuses on the developments of a GPU based version of a high energy particle physics simulator, Madgraph. The importance of utilizing high performance computing advancements is discussed in light of the ever-increasing amount of data taken from the ATLAS experiment. In order to maintain reliable results, more accurate characterizations of background processes are needed, which requires more simulation data. A GPU based Madgraph has the potential to meet these increasing demands. The history of GPU Madgraph is discussed, starting with its conception in 2008, until its last update in 2012. Current efforts to update the integration and event generation programs, gVEGAS and gSPRING, are discussed. Some preliminary timings are depicted with the main focus being on the release version of Madgraph to establish a method of timing. Future plans are discussed with a tentative outline.