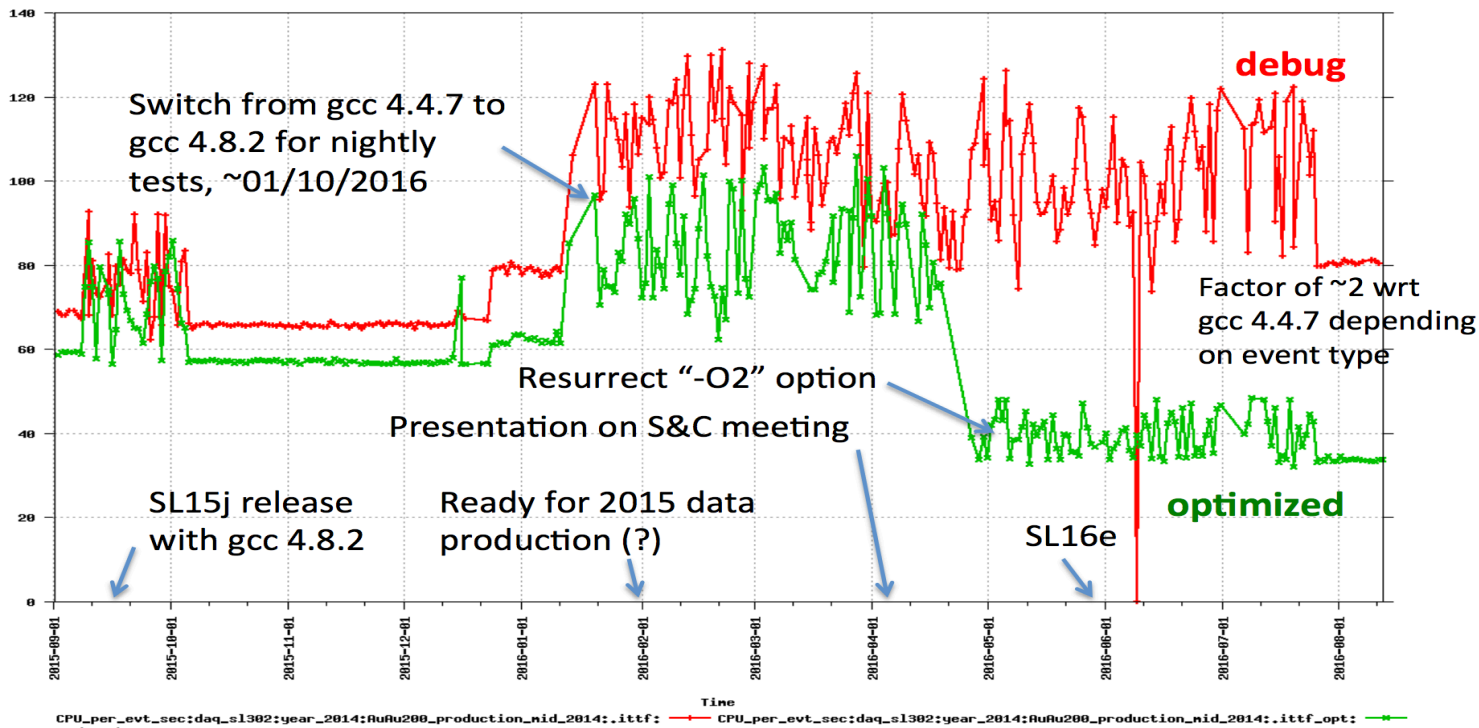


Current STAR Big Full Chain Performance

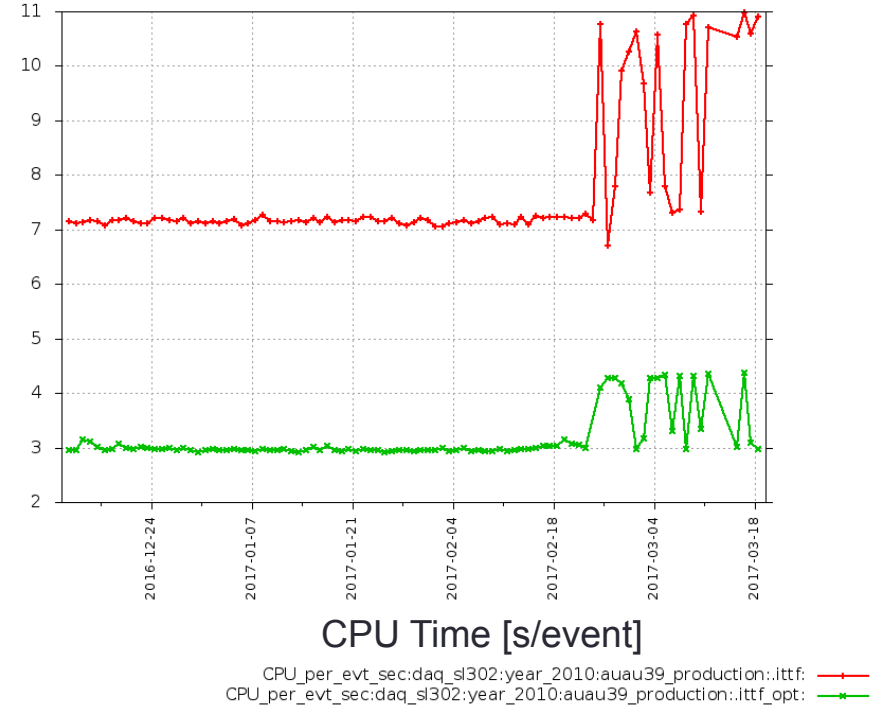


- Au+Au @ 200GeV
- ~40s per event
- Au+Au @ 62GeV
- ~7s per event
- ~39GeV during BES-II ?
- 70+% time spend on tracking, CA tracking finding + Sti track fitting

STAR Big Full Chain Time Profiling

```
Sat Mar 11 02:06:44 EST 2017
QA :INFO - QAInfo:Run is finished at Date/Time 20170311/20644; Total events processed :500 and not completed: 0
QA :INFO - Run completed
QA :INFO - =====
QA :INFO - QAInfo:Chain          StBFChain::bfc          Ast =20881.73          Cpu =20693.58
QA :INFO - QAInfo:Maker      StRtsReaderMaker::rts_reader  Ast = 1.03( 0.0%) Cpu = 1.01( 0.0%)
QA :INFO - QAInfo:Maker      StAnalysisMaker::analysis    Ast = 5.44( 0.0%) Cpu = 5.45( 0.0%)
QA :INFO - QAInfo:Maker      StTreeMaker::outputStream    Ast =512.72( 2.5%) Cpu =470.40( 2.3%)
QA :INFO - QAInfo:Maker      StEventQAMaker::EventQA      Ast = 63.36( 0.3%) Cpu = 62.78( 0.3%)
QA :INFO - QAInfo:Maker      StPicoDstMaker::PicoDst      Ast = 46.29( 0.2%) Cpu = 45.84( 0.2%)
QA :INFO - QAInfo:Maker      StMuDstMaker::MuDst          Ast =788.82( 3.8%) Cpu =781.25( 3.8%)
QA :INFO - QAInfo:Maker      StStrangeMuDstMaker::strangeMuDst  Ast = 2.89( 0.0%) Cpu = 2.73( 0.0%)
QA :INFO - QAInfo:Maker      StTagsMaker::tags            Ast = 2.05( 0.0%) Cpu = 1.94( 0.0%)
QA :INFO - QAInfo:Maker      StHighPtTagsMaker::HighPtTags  Ast = 1.82( 0.0%) Cpu = 1.87( 0.0%)
QA :INFO - QAInfo:Maker      StHeavyTagMaker::HeavyTag     Ast = 2.94( 0.0%) Cpu = 2.84( 0.0%)
QA :INFO - QAInfo:Maker      StEventCompendiumMaker::StEventCompendiumMaker  Ast = 2.39( 0.0%) Cpu = 2.28( 0.0%)
QA :INFO - QAInfo:Maker      StMtdMatchMaker::MtdMatch     Ast = 5.78( 0.0%) Cpu = 5.84( 0.0%)
QA :INFO - QAInfo:Maker      StBTofCalibMaker::btofCalib   Ast = 2.32( 0.0%) Cpu = 2.28( 0.0%)
QA :INFO - QAInfo:Maker      StBTofMatchMaker::btofMatch   Ast =115.70( 0.6%) Cpu =114.73( 0.6%)
QA :INFO - QAInfo:Maker      StEdxY2Maker::dEdxY2         Ast =2360.45(11.3%) Cpu =2345.63(11.3%)
QA :INFO - QAInfo:Maker      StiMaker::Sti                Ast =14888.34(71.3%) Cpu =14794.25(71.5%)
QA :INFO - QAInfo:Maker      StGenericVertexMaker::GenericVertex  Ast = 1.89( 0.0%) Cpu = 1.91( 0.0%)
```

STAR BFC Performance @ 39GeV



Available HLT Resources

✧ Total Computing Resources

- 1192 CPU logical cores
- 45 Xeon Phi 7110P Coprocessors (2 per node, each has 240 hardware threads, 16GB RAM)
- Up to 48T disk storage for online calibration, QA and etc.

✧ During BES-II

- ~200 CPU cores for real time processing, e.g. PV monitoring
- ~1000 CPU cores + Xeon Phi for BFC chain
- Continuous running without sync. to DAQ
- need a large buffer
- need to develop a job management system, including job monitoring, submission, bookkeeping, error handling ant etc.
- Expect low luminosity, especially TPC space charge will not be a problem

Potential Speed Improvements

- (An ambitious) HLT goal for BES-II is to provide offline quality data practically online. STAR cannot afford ~5 years of data reconstruction and analysis before publishing the first BES-II results. For that we need speed up calibration and reconstruction.
- New compiler
- Pure 64bit code
- Use AVX instructions in CA
- CA sector-by-sector track finding on Xeon Phi
- Full CA tracking including track fitting
- KFParticle finder on Xeon Phi
- Physics analysis on Xeon Phi
- Hopefully 3-5x speedup
- Need more realistic timing and profiling with iTPC
- Single event processing time budget depends on DAQ running time.

Coprocessor Offloading Infrastructure

CPU

```
COIEngineGetHandle(COI_DEVICE_MIC, 0, &engine);
COIProcessCreateFromFile(/*MIC Native Binary*/);
COIPipelineCreate(
    proc,           // Process to associate the pipeline with
    NULL,          // Do not set any sink thread affinity for the pipeline
    0,             // Use the default stack size for the pipeline thread
    &pipeline       // Handle to the new pipeline
);
COIProcessGetFunctionHandles(
    proc,          // Process to query for the function
    1,            // The number of functions to look up
    &func_name,    // The name of the function to look up
    func          // A handle to the function
);
COIPipelineRunFunction(
    pipeline, func[0], // Pipeline handle and function handle
    0, NULL, NULL,    // Buffers and access flags
    0, NULL,         // Input dependencies
    misc_data, strlen, // Misc Data to pass to the function
    return_value, strlen, // Return values that will be passed back
    &completion_event // Event to signal when it completes
)
```

Xeon Phi (native code)

```
int main(int argc, char **argv)
{
    COIPipelineStartExecutingRunFunctions();

    COIProcessWaitForShutdown();

    return 0;
}

// Prototype of run function that can be retrieved on the source side.
// Copies misc data to return pointer.
COINATIVELIBEXPORT
void func(uint32_t          in_BufferCount,
          void             **in_ppBufferPointers,
          uint64_t         *in_pBufferLengths,
          void             *in_pMiscData,
          uint16_t         in_MiscDataLength,
          void             *in_pReturnValue,
          uint16_t         in_ReturnValueLength)
{
    assert(in_MiscDataLength >= in_ReturnValueLength);
    if (in_pMiscData != NULL && in_pReturnValue != NULL)
    {
        memcpy(in_pReturnValue, in_pMiscData, in_ReturnValueLength);
    }
}
```