



Further developments of the SRS online monitoring system with embedded SRS AMORE real-time analysis

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SCRIBE overview

SCRIBE (Slow Control and Run Initialization byte-wise environment) is a new web Slow Control & Monitoring system featuring SRS ZeroSuppression implementation

- Graphical interface works through dynamic web-app
 - FEC configuration via web
 - Multi-client, x-platform, x-device
 - Easy to learn (self-explained)
 - Immediate feedback with real-time plots
 - Integration with DATE and AMORE

Outline

In view of the imminent GE1/1 mass production, the CMS collaboration made an effort to simplify data-taking and data-analysis for reducing time needed to characterize and qualify new constructed detectors.

New Implementations

- New version of SCRIBE to be rolled out by this week
 - Feature to take several runs unmanned
 - Added rate per run
 - Embedded real-time SRS AMORE analysis
 - AMORE with improved mapping
 - AMORE with increased performance running agents in parallel

New version of SCRIBE expected by this week

Feature to take several runs unmanned



Slow Control & Run Initialization Byte-wise Environment



General | SRS system | ADC Card | APV Application Registers | APV Hybrid Registers | APZ Registers | ZS PEDESTALS | **DAQ** | DQM

["Run 513 finished\n"]

CONFIGURE AND RUN START/STOP

Rawdata folder
Rawdata filename
Number of runs

DATA-ANALYSIS SETTINGS

Events per cycle
Cycles

Run to analyze

DAQ will take N run one after the other.
We use this feature when we want to take 10M events spit into a N of files. In this way as soon as a run is over SRS AMORE process starts the analysis seamless and unmanned.

New version of SCRIBE expected by this week

Feature to embed AMORE seamlessly



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["Run 513 finished\n"]

CONFIGURE AND RUN START/STOP

Rawdata folder

Rawdata filename

Number of runs

DATA-ANALYSIS SETTINGS

Events per cycle

Cycles

Run to analyze

Amore agent settings are available and modifiable online, data-analysis takes place automatically in background on the latest rawdata file

New version of SCRIBE expected by this week

Feature to embed AMORE seamlessly



Slow Control & Run Initialization Byte-wise Environment



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["Run 513 finished\n"]

CONFIGURE AND RUN START/STOP

Rawdata folder
Rawdata filename
Number of runs

DATA-ANALYSIS SETTINGS

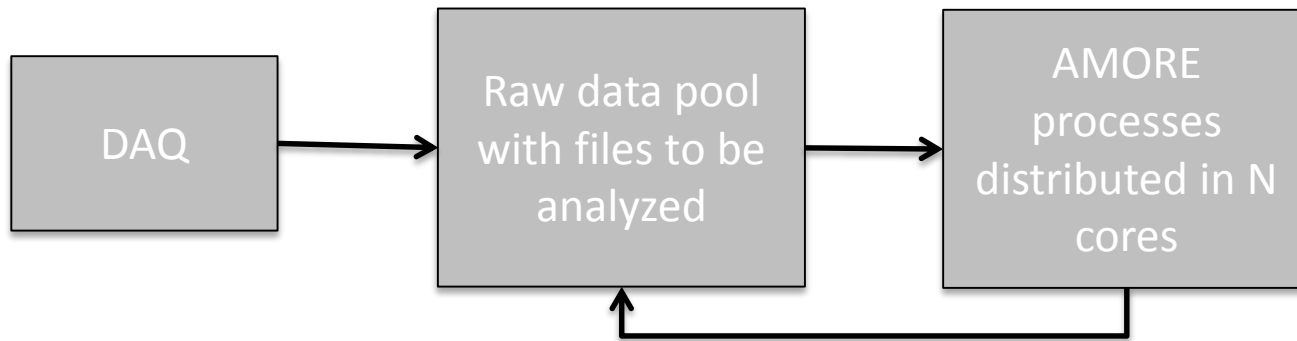
Events per cycle
Cycles

User can decide to re-analyze a run just entering run number here

New version of SCRIBE expected by this week

Feature to embed AMORE seamlessly

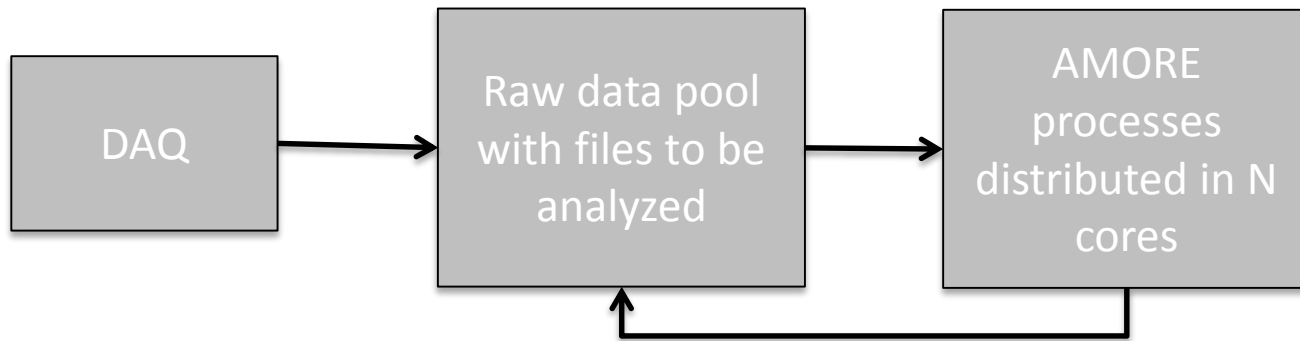
Available for standard PC and cluster of computer



1) Once DAQ has acquired the desired triggers it sends the rawfile to be analyzed in a dedicated pool, DAQ can resume to take-data

New version of SCRIBE expected by this week

Feature to embed AMORE seamlessly



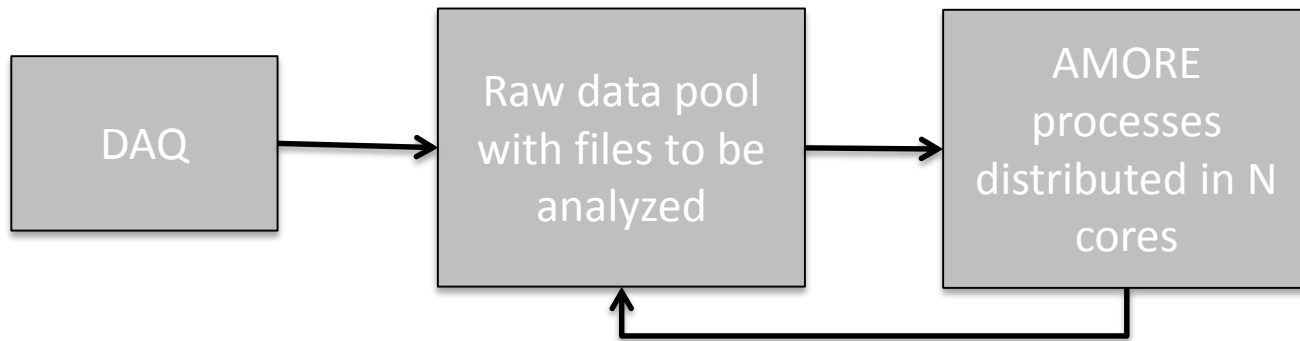
2) The pool gets populated with all runs that should be processed, the pool is organized with a queue, first run that arrives is the first run to get analyzed.

The Analysis works with 4 (or more depending on your CPU) AMORE Agents in parallel so 4 raw data files get analyzed.

The pool can manage any queue length, so if more than 4 rawfiles are in the queue they will wait for a free Agent

New version of SCRIBE expected by this week

Feature to embed AMORE seamlessly



3) Once a rawfile has been analyzed that job is removed by the pool releasing the AMORE agent and the CORE.

The pool and the analysis work seamless in SCRIBE without any need for issuing commands/buttons, the pool/analysis are always ON waiting for jobs to be submitted. CPU consumption of the scheduler that manages the pool is insignificant once pool is idle.

New version of SCRIBE expected by this week

Feature to embed AMORE seamlessly



Slow Control & Run Initialization Byte-wise Environment



General | SRS system | ADC Card | APV Application Registers | APV Hybrid Registers | APZ Registers | ZS PEDESTALS | DAQ | **DQM**

```
["Run 500 finished\n"]
```

```
212 212 cluster 212 hits 224 225 226 227 228 229 230 232 233 234 244 245 246 247 248 249 250 251 253 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273  
274 275 276 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 300 301 303 304 305 306 307 308 309 310 311 312 315 323 324 325 327 328 328 cl 328 hits  
329 330 331 332 333 334 335 336 337 338 339 342 343 344 345 350 351 372 373 374 375 377 379 380 381 382 383 384 385 386 387 388 389 390 391 392 394 396 397 399 400 402 403 404  
405 406 407 408 409 410 423 424 432 433 434 435 437 438 439 440 441 442 443 444 446 458 460 461 462 463 464 472 499-500 499 500 671
```

DATA-Taking -> Data-Analysis -> Data-Quality Monitoring

Now SCRIBE features automatic data-analysis with pool of Agents running in parallel and a DQM to show user-defined sets of plots

New version of SCRIBE expected by this week

added run per rate

Folder where SCRIBE is saving DATA (set by User in DAQ tab)

```
-rwxr--r-- 1 SRSUser users 576160040 Feb 29 19:44 fitgem459.raw
-rw-r--r-- 1 SRSUser users 61879 Feb 29 19:44 fitgem459_ped.root
-rw-r--r-- 1 SRSUser users 3 Feb 29 19:44 fitgem459_rate.info
-rwxr--r-- 1 SRSUser users 39769380 Feb 29 19:49 fitgem460.raw
-rw-r--r-- 1 SRSUser users 61879 Feb 29 19:49 fitgem460_ped.root
-rw-r--r-- 1 SRSUser users 3 Feb 29 19:49 fitgem460_rate.info
-rw-r--r-- 1 SRSUser users 61879 Feb 29 19:58 fitgem461_ped.root
-rw-r--r-- 1 SRSUser users 3 Feb 29 19:58 fitgem461_rate.info
-rwxr--r-- 1 SRSUser users 32036380 Feb 29 19:58 fitgem461.raw
-rw-r--r-- 1 SRSUser users 61879 Feb 29 20:03 fitgem462_ped.root
-rw-r--r-- 1 SRSUser users 3 Feb 29 20:03 fitgem462_rate.info
-rwxr--r-- 1 SRSUser users 2351560 Feb 29 20:03 fitgem462.raw
-rw-r--r-- 1 SRSUser users 61879 Feb 29 20:07 fitgem463_ped.root
-rw-r--r-- 1 SRSUser users 3 Feb 29 20:07 fitgem463_rate.info
-rwxr--r-- 1 SRSUser users 1558240 Feb 29 20:07 fitgem463.raw
-rw-r--r-- 1 SRSUser users 61879 Feb 29 20:12 fitgem464_ped.root
-rw-r--r-- 1 SRSUser users 3 Feb 29 20:12 fitgem464_rate.info
```

In the data-folder SCRIBE writes automatically:

- Rawdata files
- Rootdata of the pedestal
- Rootdata SRS AMORE
- Time of the run in seconds

New AMORE with flexible customizable APV channel -> physics strip mapping

AMORE mapping file

```
#####
# CMSGEM
#####
# ReadoutType DetType DetName Sector SectPos SectSize nbConnect orient
#####
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR1, 139, 401, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR2, 236, 384, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR3, 409, 355, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR4, 571, 326, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR5, 733, 300, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR6, 867, 275, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR7, 1056, 242, 3, 1
DET, CMSGEM, CMSGEM, CMS, CMSSECTOR8, 1169, 223, 3, 1
#####
# FEC Name APV Name FECId ADCchNo apvIndex APV Hdr Sigma Cut
#####
#
#####
#APV fecId adcCh detPlane apvOrient apvIndex apvHdr
#####
#
#
APV, 1, 0, CMSSECTOR8, 0, 0, 1300, 0
APV, 1, 1, CMSSECTOR8, 0, 2, 1300, 0
APV, 1, 2, CMSSECTOR8, 0, 1, 1300, 0
APV, 1, 3, CMSSECTOR7, 0, 1, 1300, 0
APV, 1, 4, CMSSECTOR6, 0, 2, 1300, 0
APV, 1, 5, CMSSECTOR5, 0, 2, 1300, 0
APV, 1, 8, CMSSECTOR6, 0, 0, 1300, 0
APV, 1, 9, CMSSECTOR6, 0, 1, 1300, 0
```

The CMS GE11 readout board has different sector routing for some APV, we implemented this functionality in AMORE so that every APV can have its own mapping.

SCRIBE Embedded real-time SRS AMORE analysis performance

Can a standard PC afford to do online full-event analysis at kHz level?

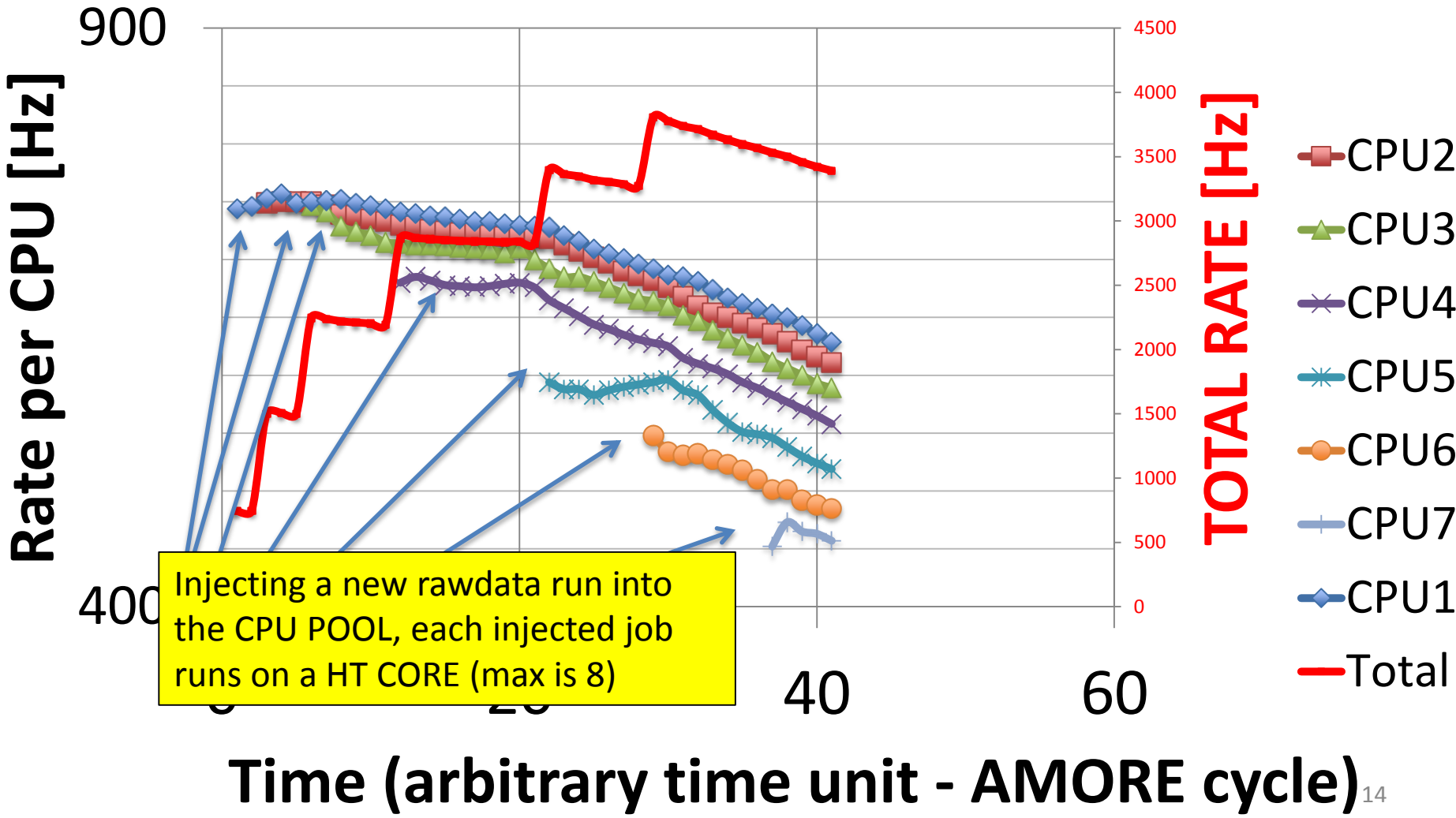
A few things to note:

- In a cluster of computer it's "easy" to parallelize things to do. This is achieved reserving a number of COREs and submitting jobs, a dedicated scheduler/framework balances workloads (the scheduler needs a few cores for itself).
- Standard pc has limited number of COREs (typically 4..), to implement parallel job submission, a scheduler has to be implemented to monitor/check CPU available resources and balance workload at runtime. Scheduler must be cpu-resource light
- What about Intel Hyper-threading (HT) proprietary technology?
 - This is available by default on all recent (<5years) Intel CPU
 - Linux is compatible with HT Intel firmware from kernel 2.4 (SL5 has 2.6 ☺)
 - HT allows to operating system to use 8 CORES (4 are virtual of course but HT firmware manages that transparently allowing us to exploit more efficient workload balance among jobs in the COREs.

SCRIBE Embedded real-time SRS AMORE analysis performance

Using 24 APV

Can a standard pc afford to do online full-event analysis at kHz level?

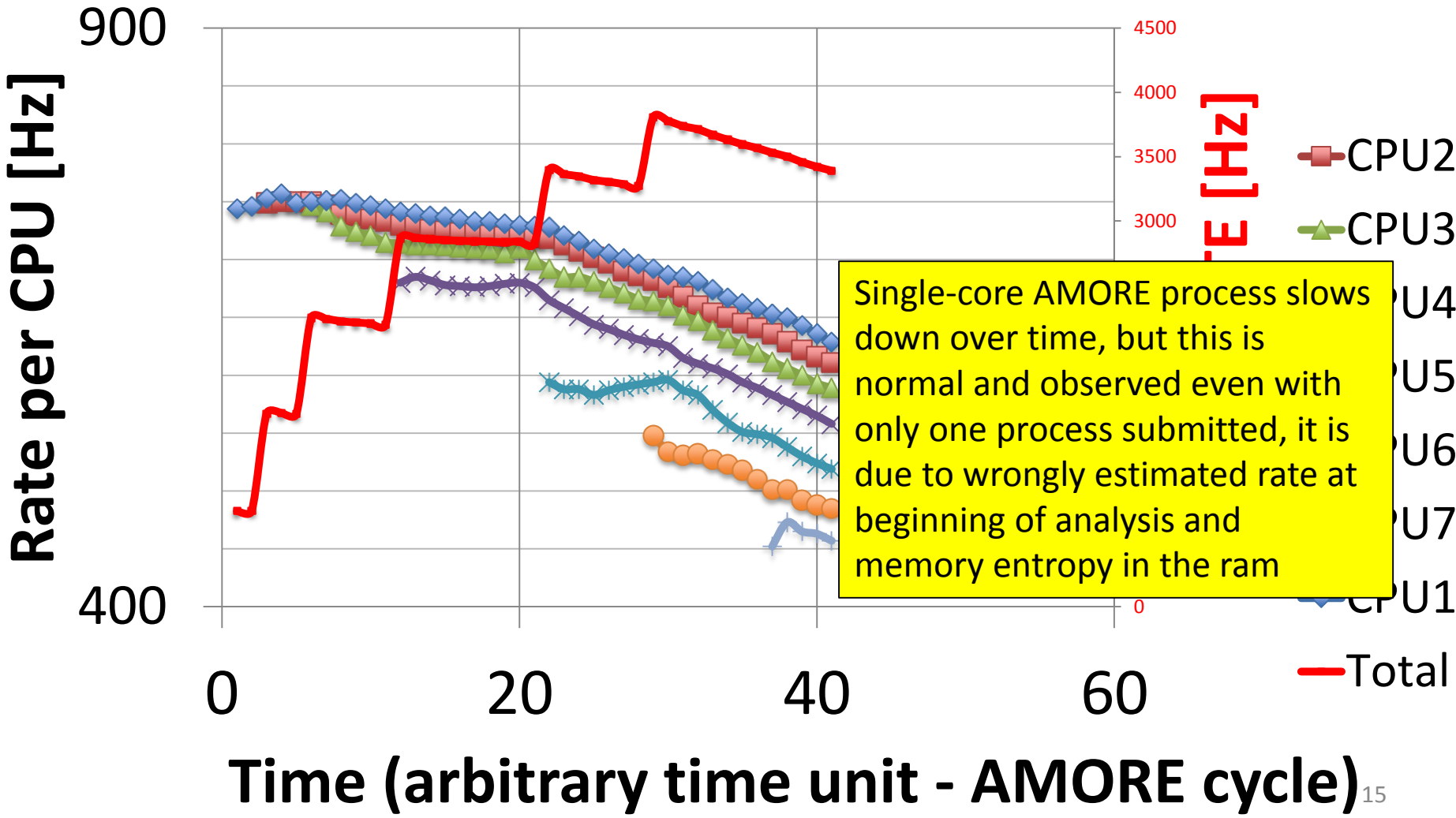


Injecting a new rawdata run into the CPU POOL, each injected job runs on a HT CORE (max is 8)

SCRIBE Embedded real-time SRS AMORE analysis performance

Using 24 APV

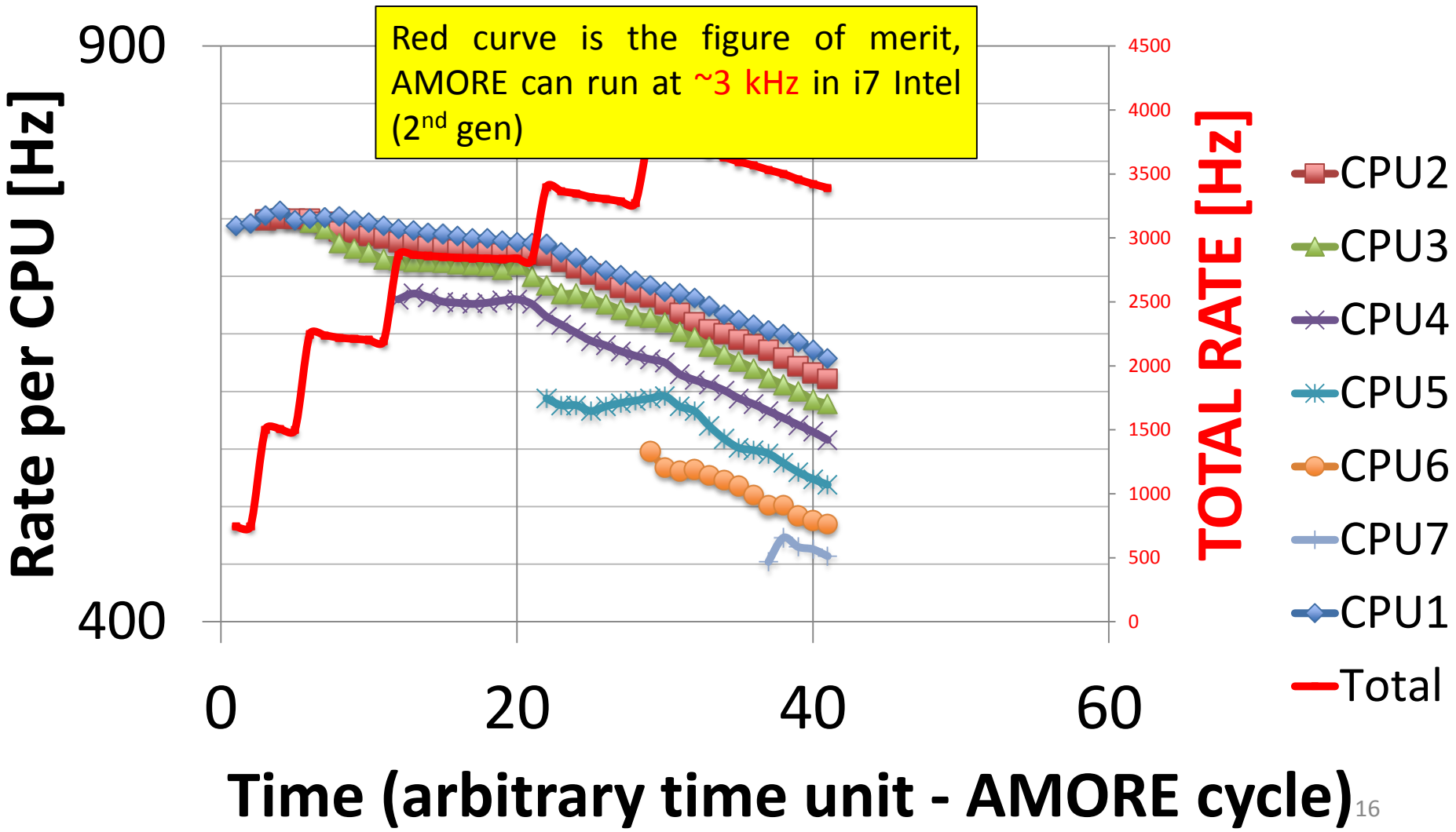
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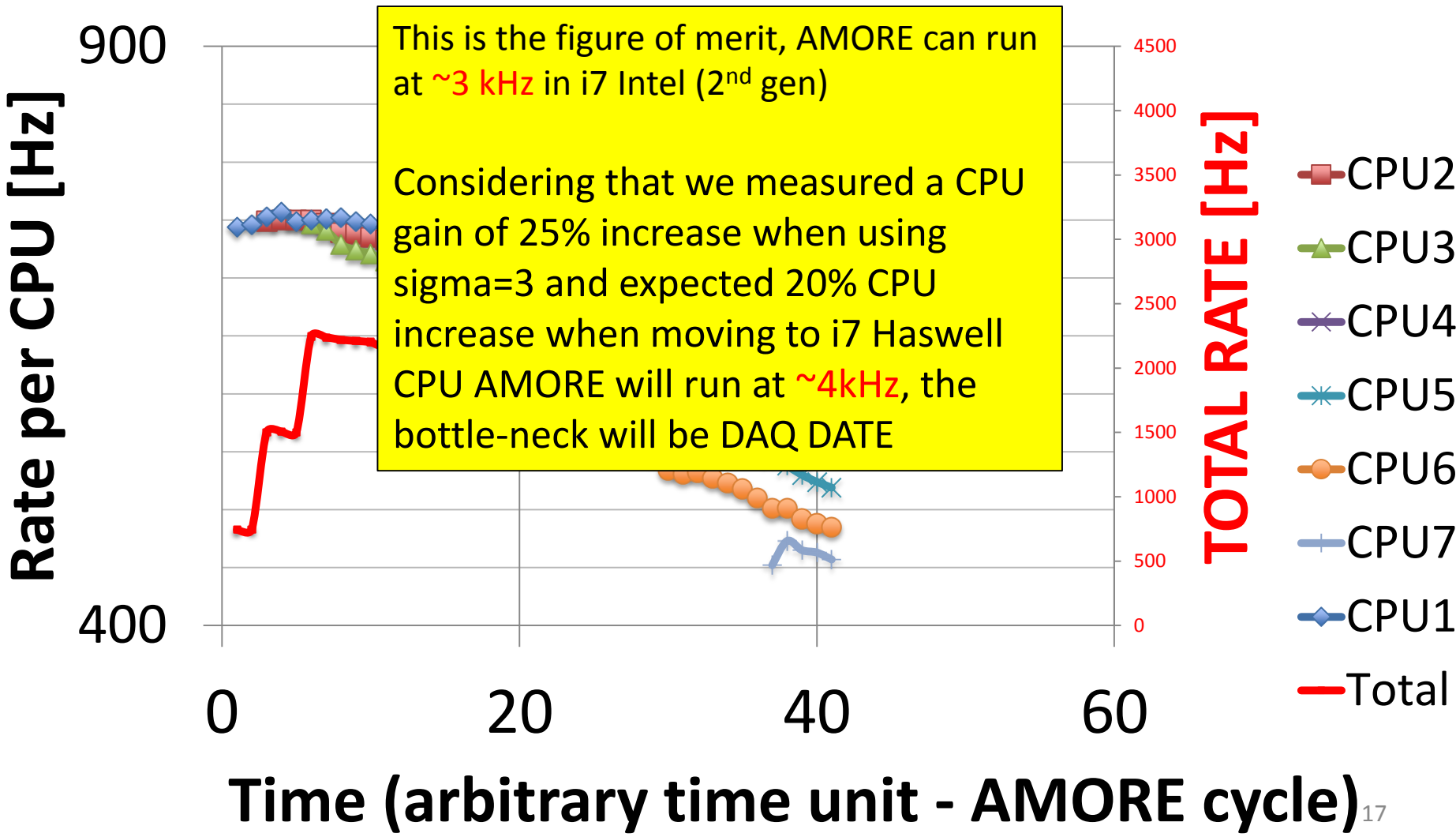
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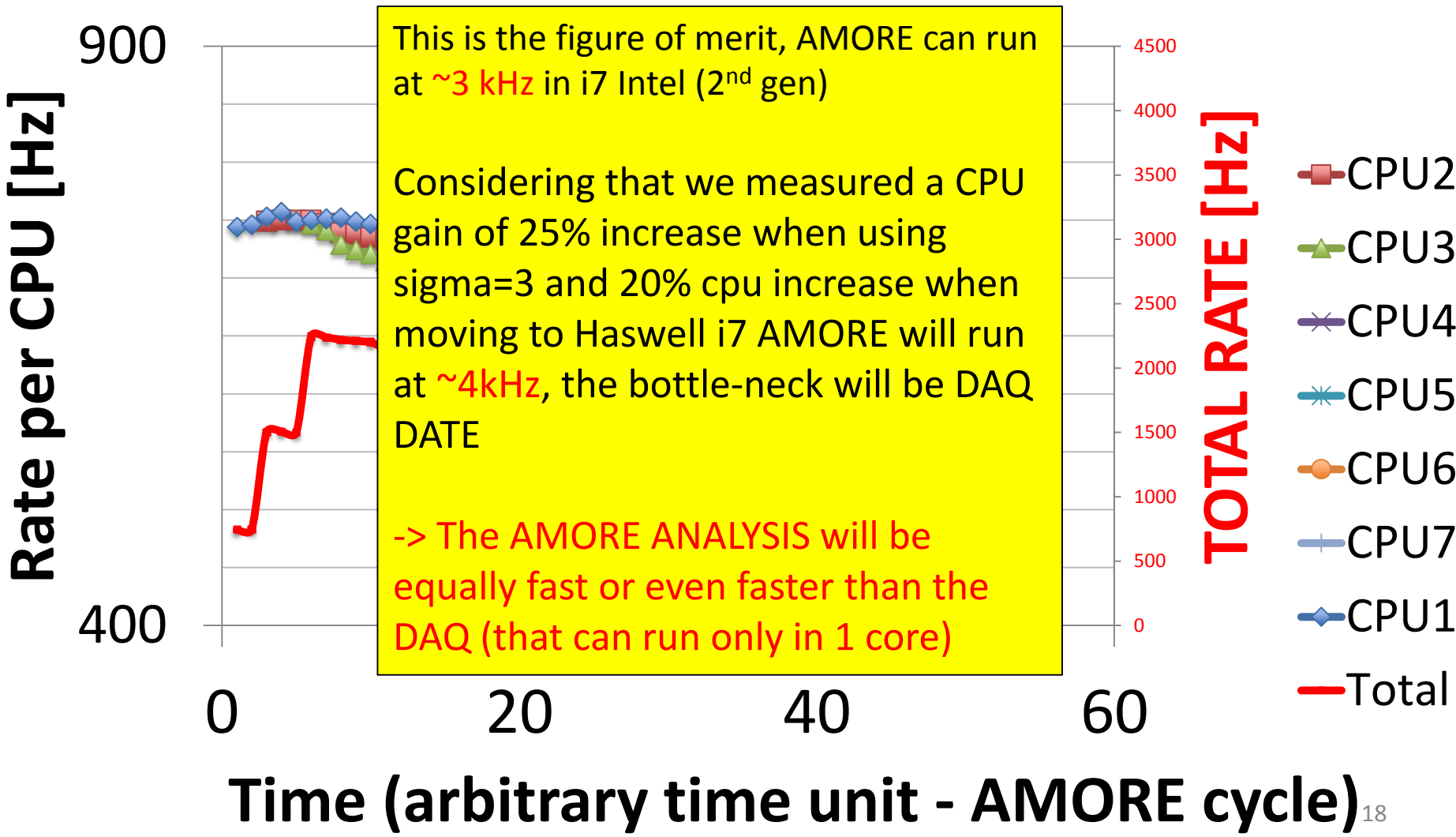
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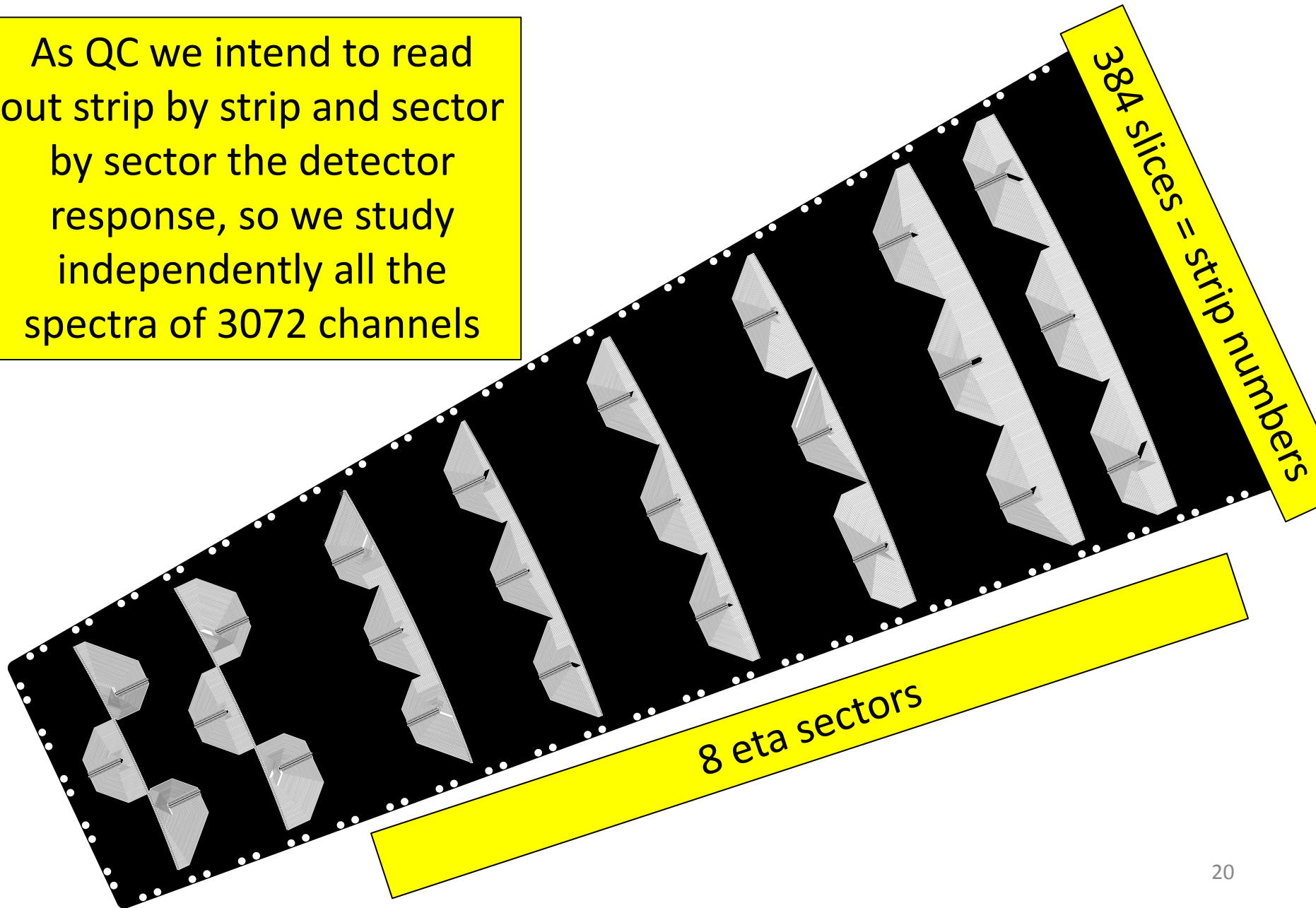


Some highlights from QC plots for detector validation to show benefits of SCRIBE and ZS

Single-strip level (3072) analysis of old CMS prototype version (GE1/1-III) irradiated with X-ray.

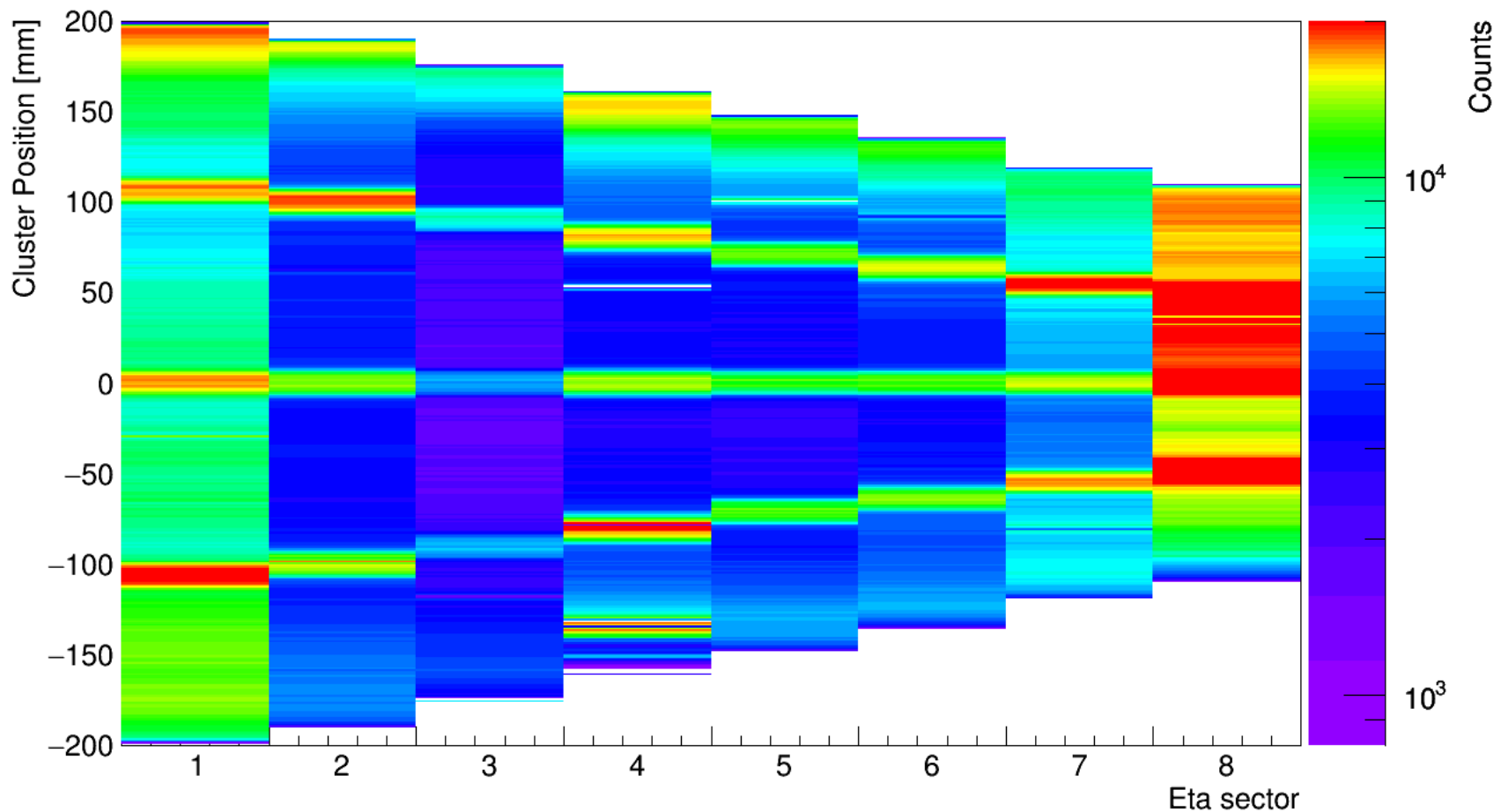
Detector response strip by strip

As QC we intend to read out strip by strip and sector by sector the detector response, so we study independently all the spectra of 3072 channels



Single-strip level (3072) analysis of old CMS prototype version
(GE1/1-III) irradiated with X-ray.

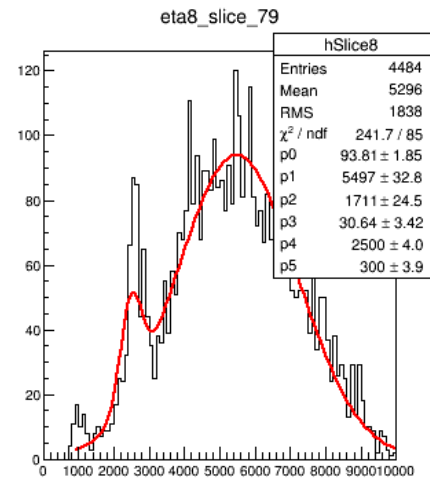
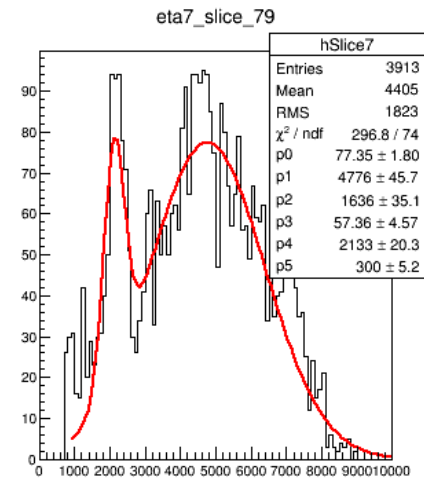
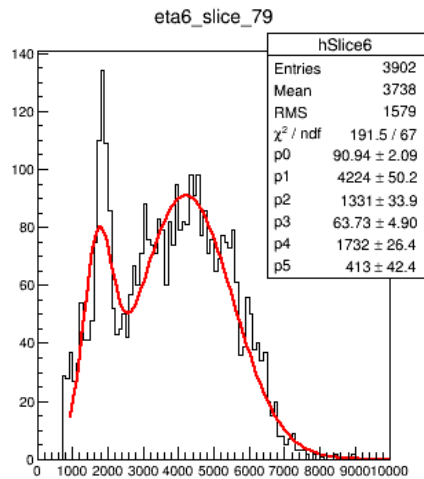
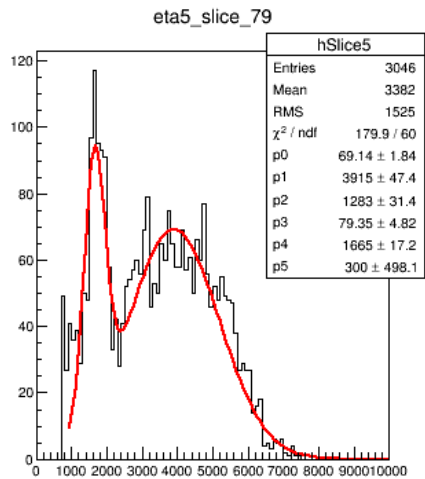
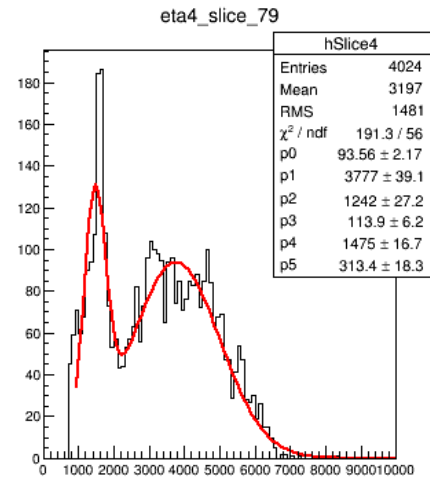
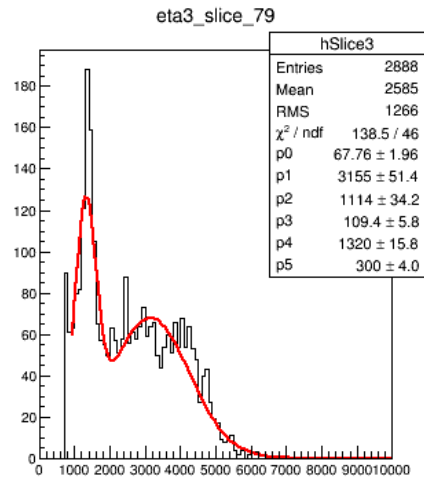
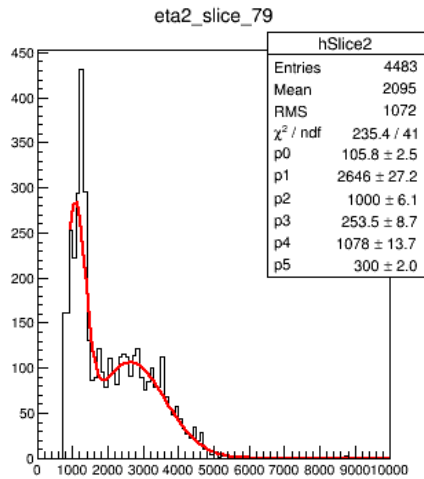
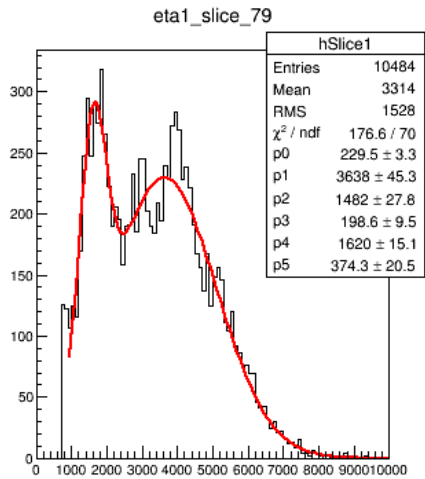
CMS GEM occupancy



Detector inside the x-ray box, fully illuminated



A few representative raw spectra [slice=79 eta1-8]



Mean of pulse height spectrum (in ADC counts) for all 3072 strips

