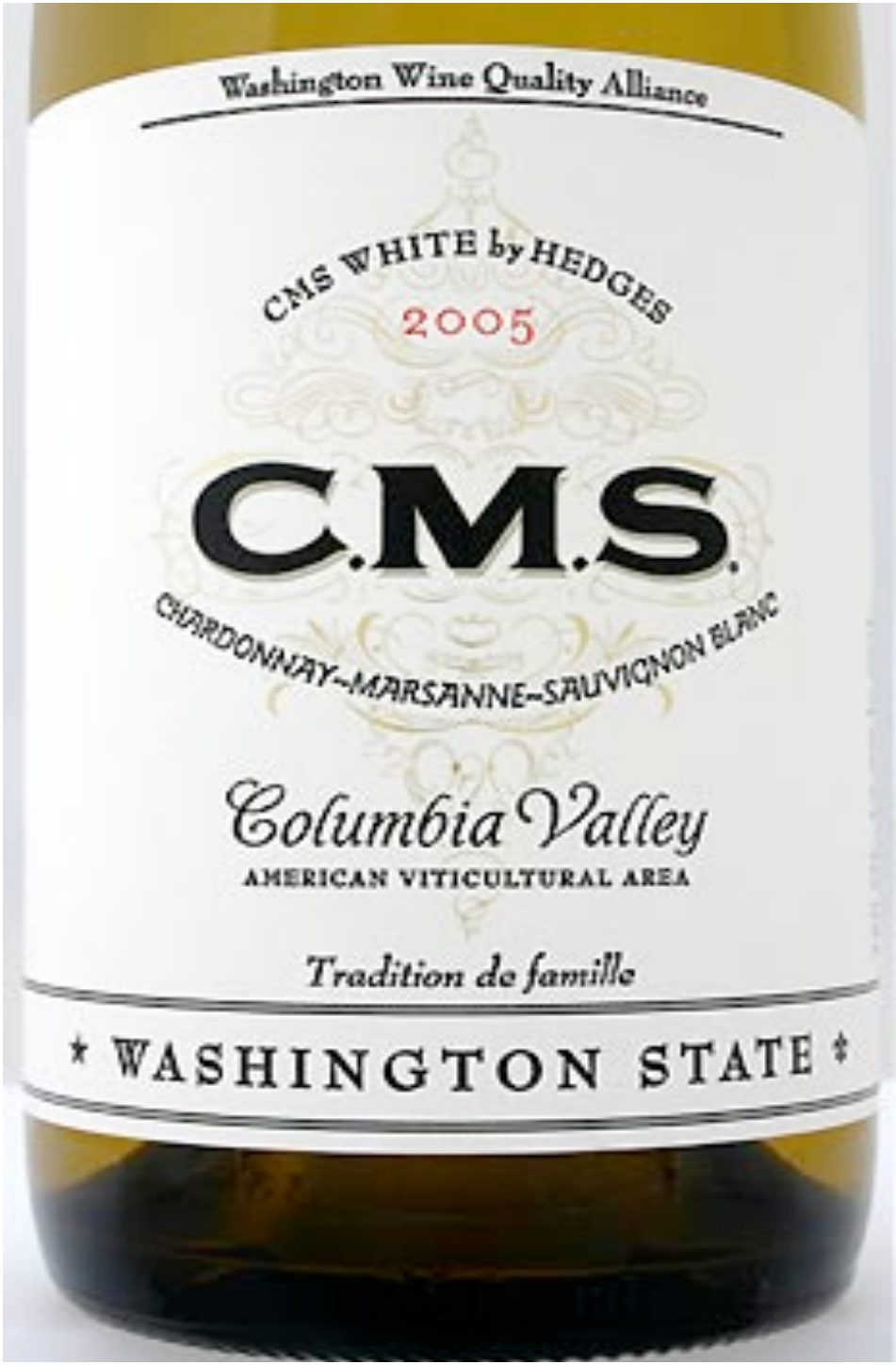
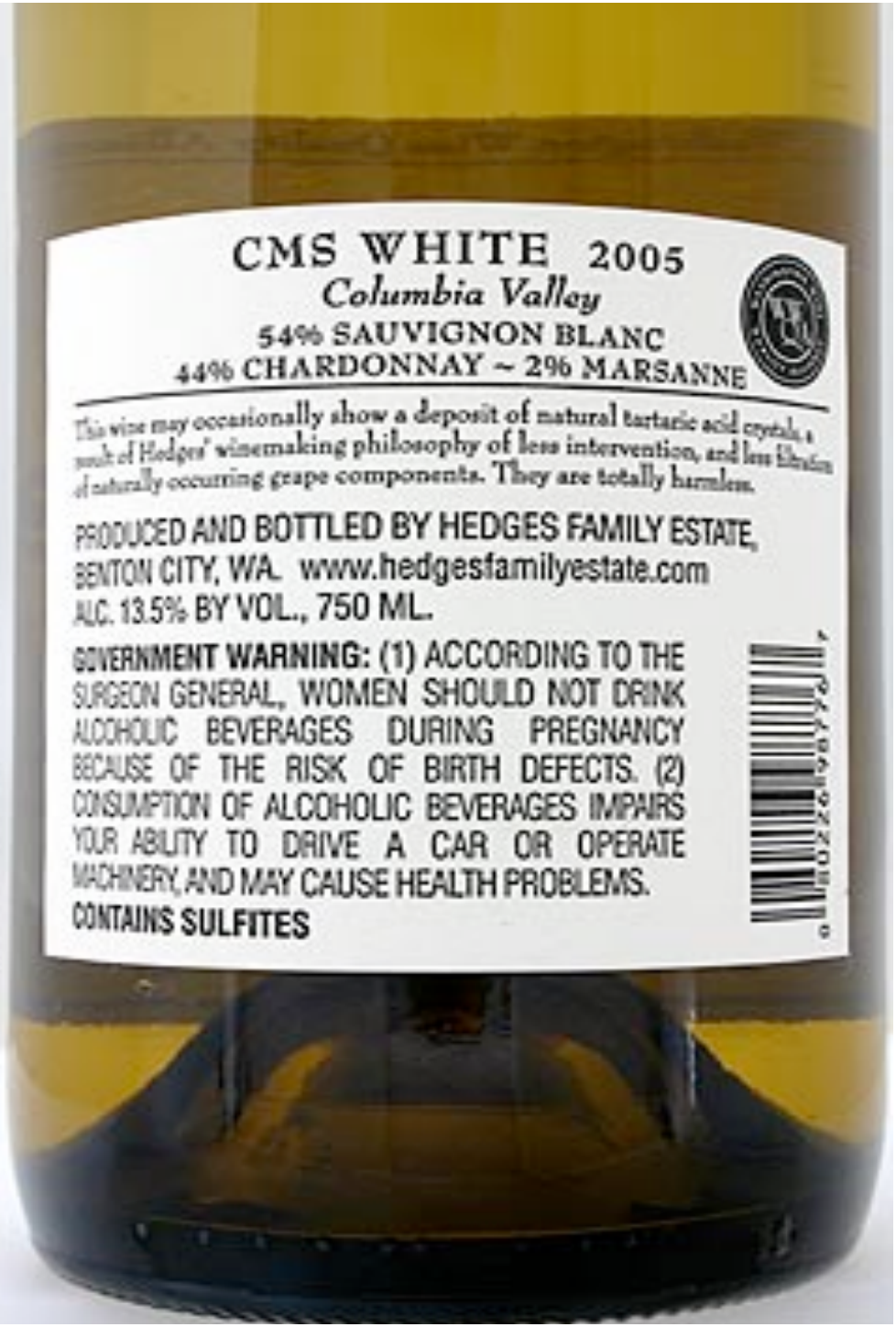

Washington Wine Quality Alliance
CMS WHITE by HEDGES
2005
C.M.S.
CHARDONNAY~MARSANNE~SAUVIGNON BLANC
Columbia Valley
AMERICAN VITICULTURAL AREA
Tradition de famille
★ WASHINGTON STATE ★


CMS WHITE 2005
Columbia Valley
54% SAUVIGNON BLANC
44% CHARDONNAY ~ 2% MARSANNE
This wine may occasionally show a deposit of natural tartaric acid crystals, a result of Hedges' winemaking philosophy of less intervention, and less filtration of naturally occurring grape components. They are totally harmless.
PRODUCED AND BOTTLED BY HEDGES FAMILY ESTATE,
BENTON CITY, WA. www.hedgesfamilyestate.com
ALC. 13.5% BY VOL., 750 ML.
GOVERNMENT WARNING: (1) ACCORDING TO THE SURGEON GENERAL, WOMEN SHOULD NOT DRINK ALCOHOLIC BEVERAGES DURING PREGNANCY BECAUSE OF THE RISK OF BIRTH DEFECTS. (2) CONSUMPTION OF ALCOHOLIC BEVERAGES IMPAIRS YOUR ABILITY TO DRIVE A CAR OR OPERATE MACHINERY, AND MAY CAUSE HEALTH PROBLEMS.
CONTAINS SULFITES

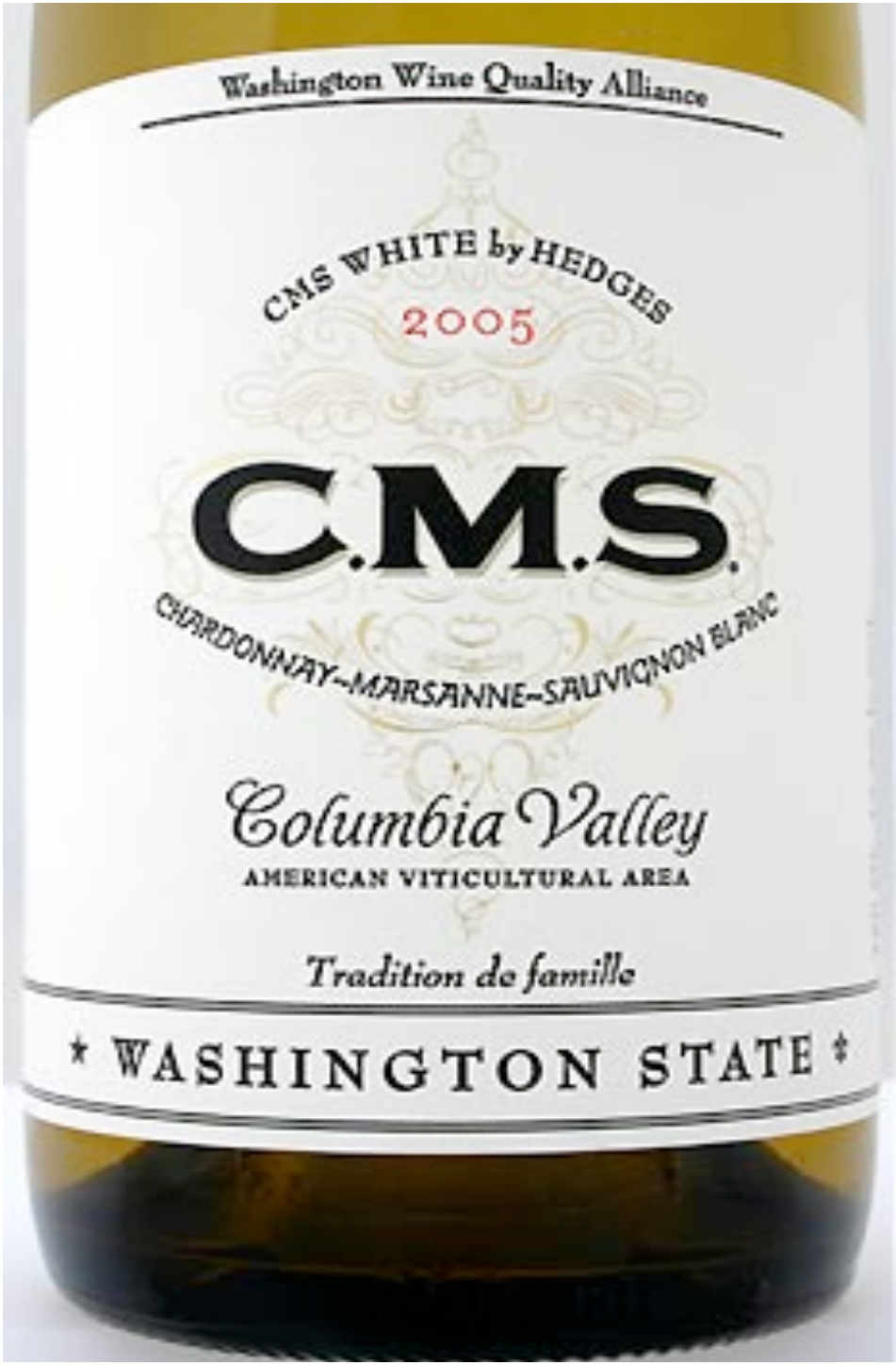
The CMS Pixel detector

Freya Blekman

for the

CMS Collaboration

Cornell University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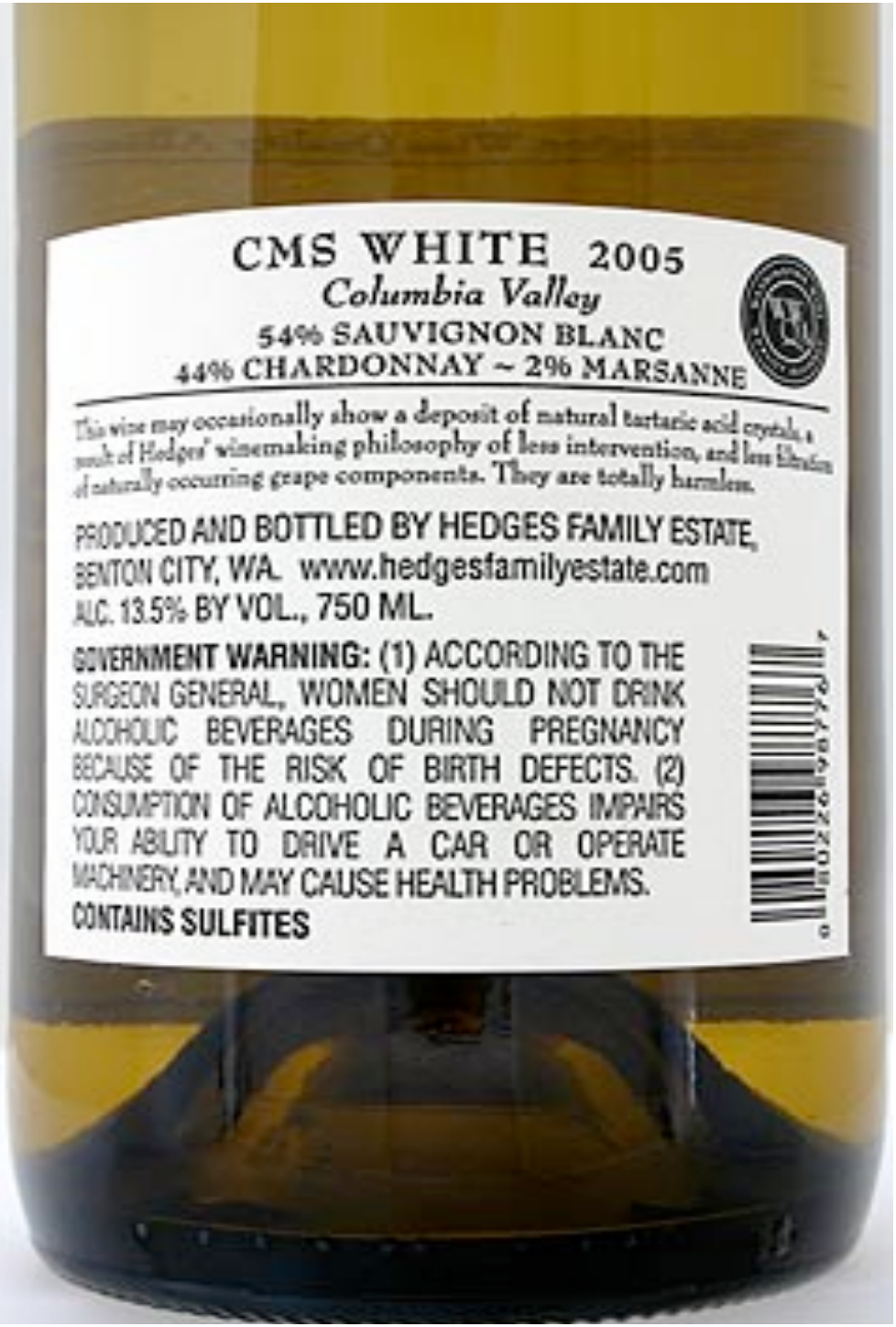
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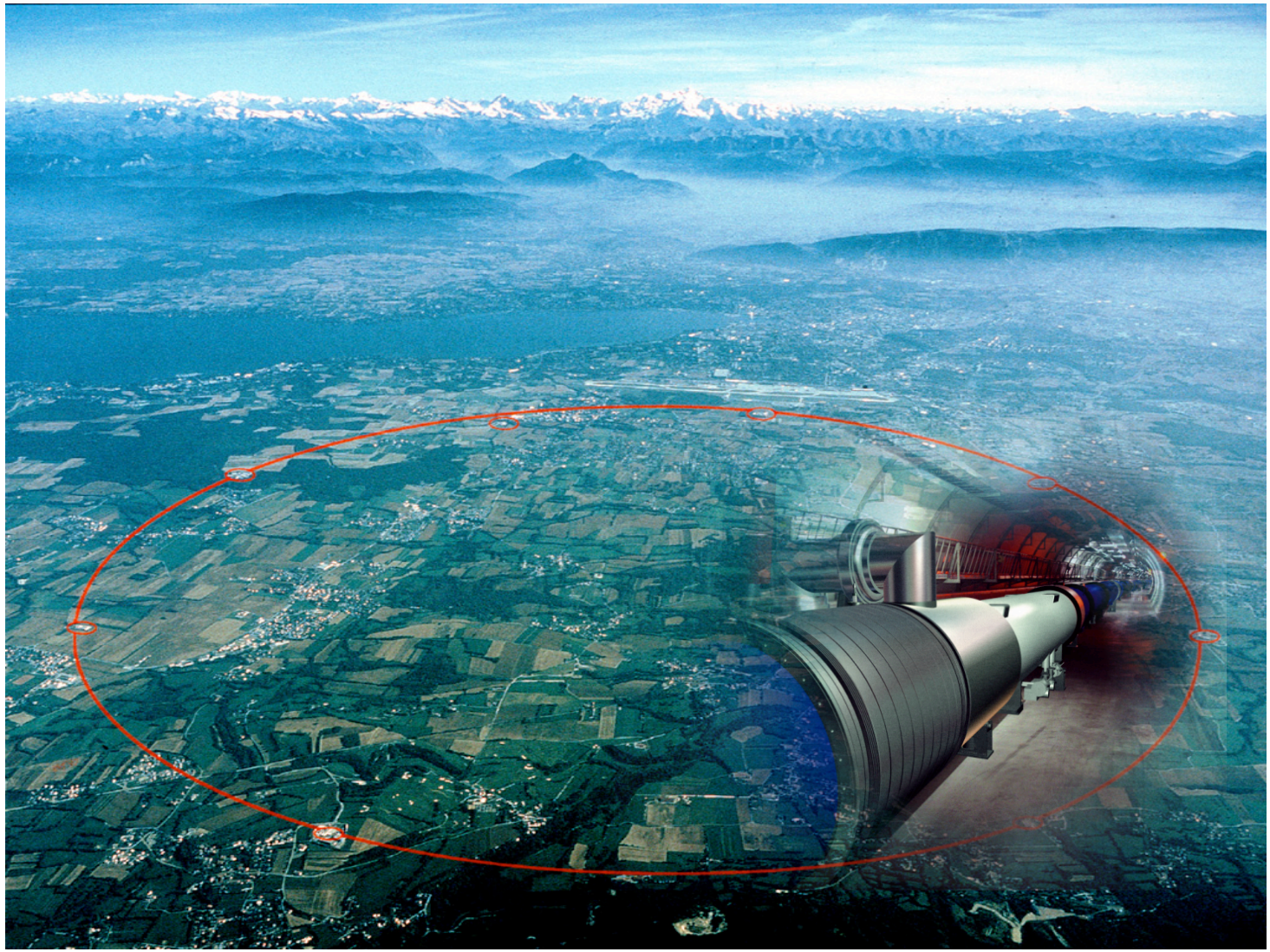
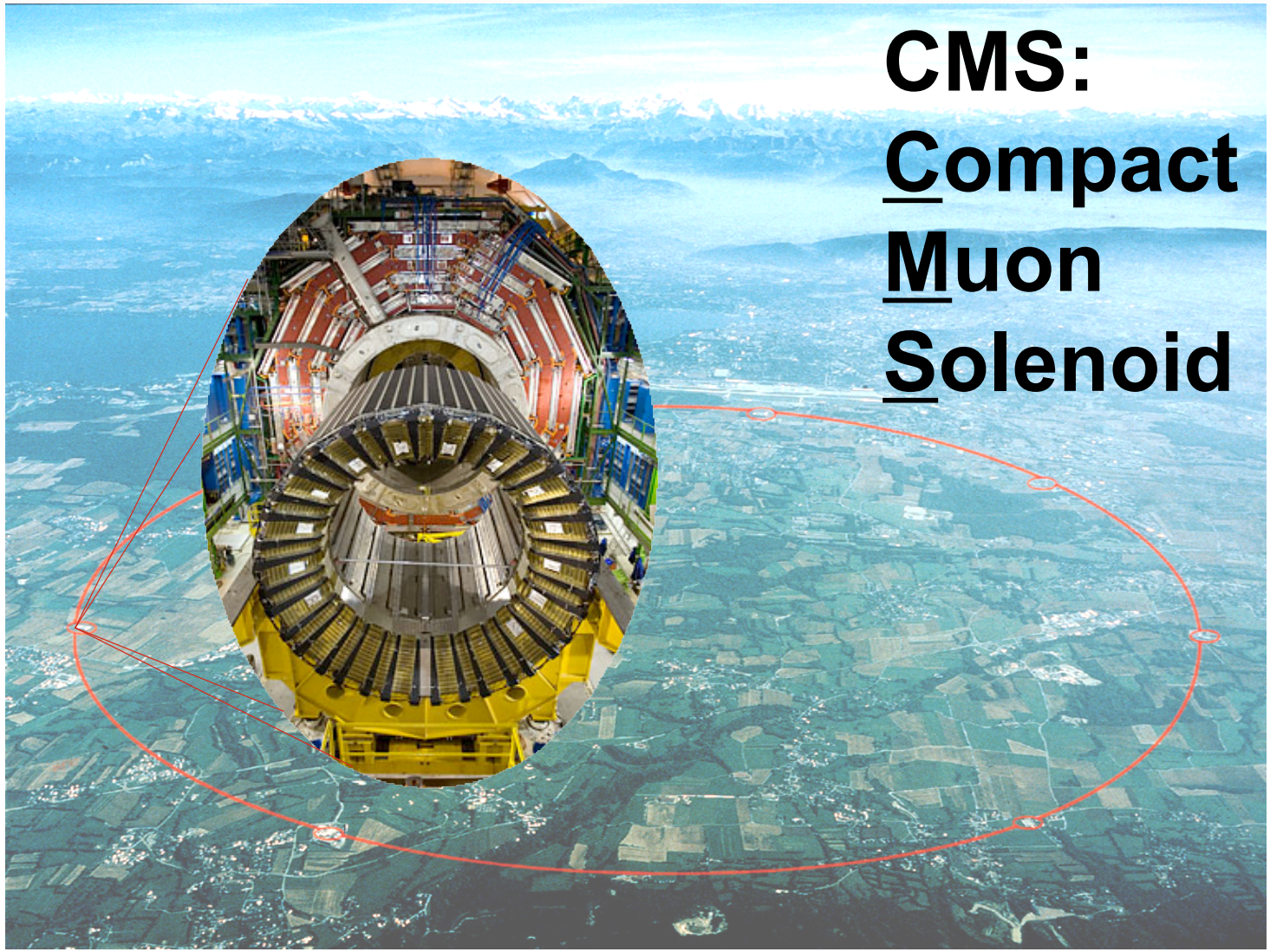
CONTAINS SULFITES

Outline

- What is CMS?
- What is the CMS pixel detector?
- Calibration
- Clustering
- Commissioning results

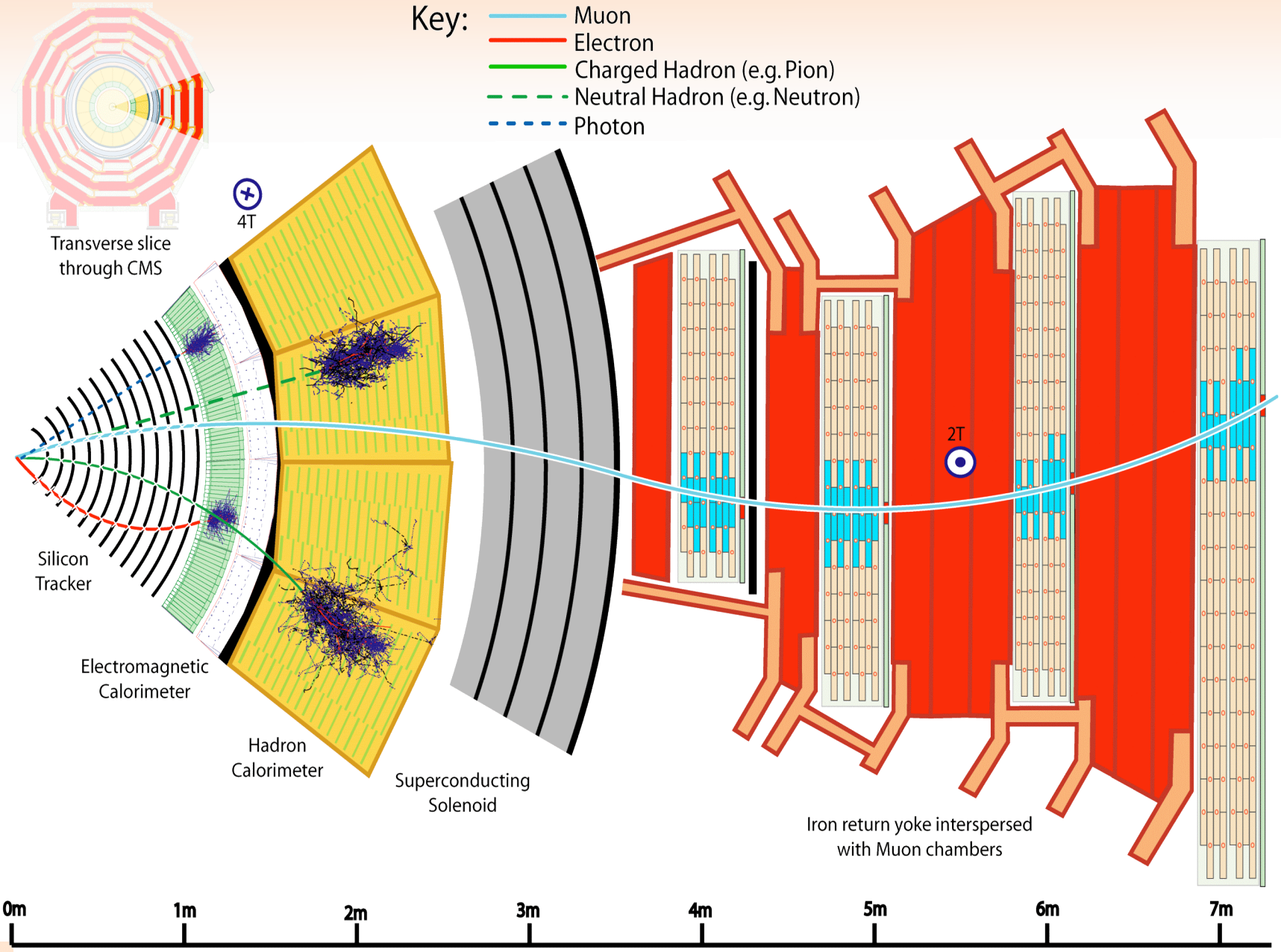


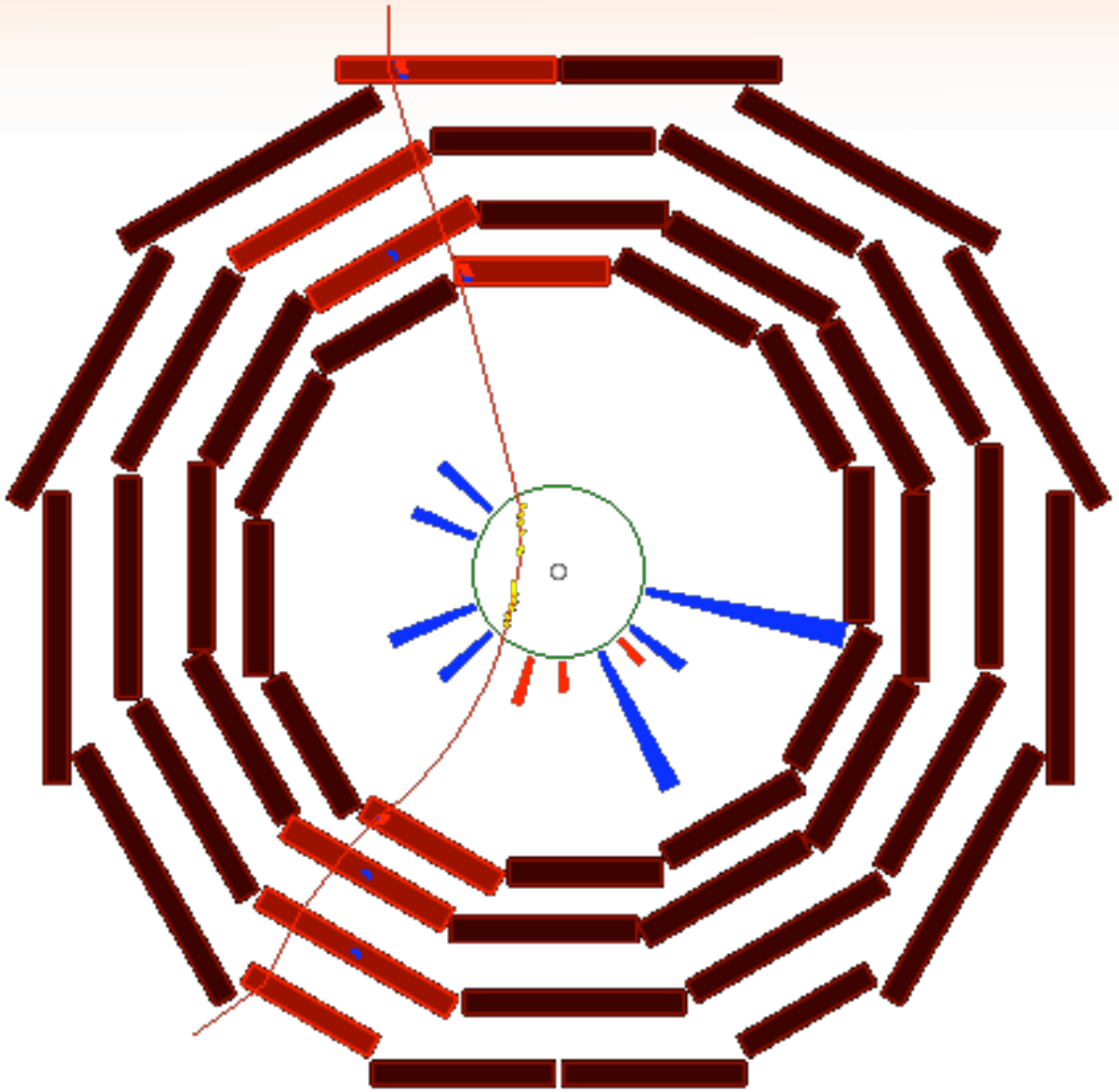

CMS:
Compact
Muon
Solenoid

Main goal: Find Higgs boson

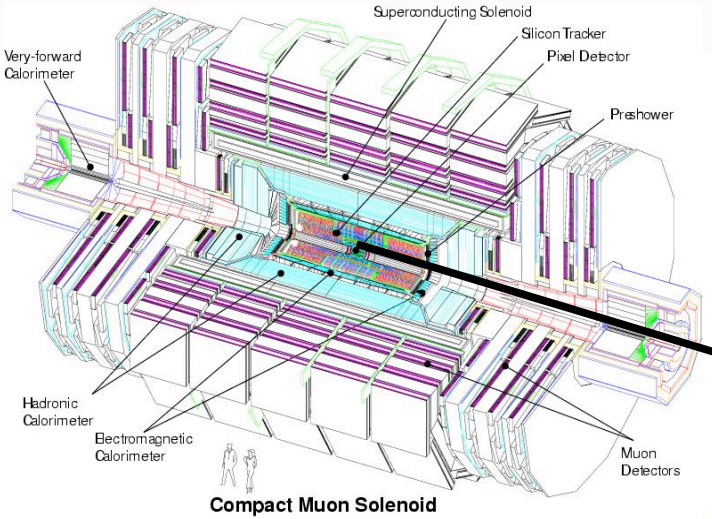
- High accuracy tracking of charged particles
- Excellent muon and electron identification
- Excellent photon resolution in 50-100 GeV range

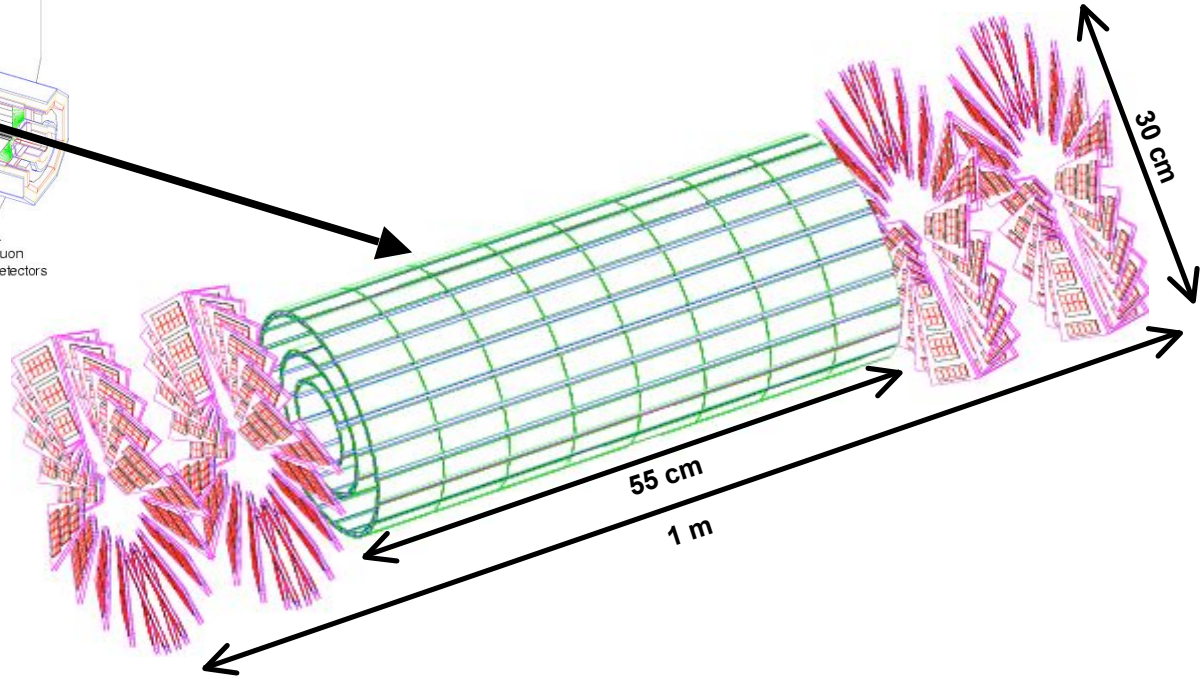
Criteria also good for general searches
CMS is general purpose experiment


Key:
Muon
Electron
Charged Hadron (e.g. Pion)
Neutral Hadron (e.g. Neutron)
Photon
Transverse slice through CMS
4T
2T
Silicon Tracker
Electromagnetic Calorimeter
Hadron Calorimeter
Superconducting Solenoid
Iron return yoke interspersed with Muon chambers
0m
1m
2m
3m
4m
5m
6m
7m



Pixel Detector:
Center of CMS detector
Closest to collision point





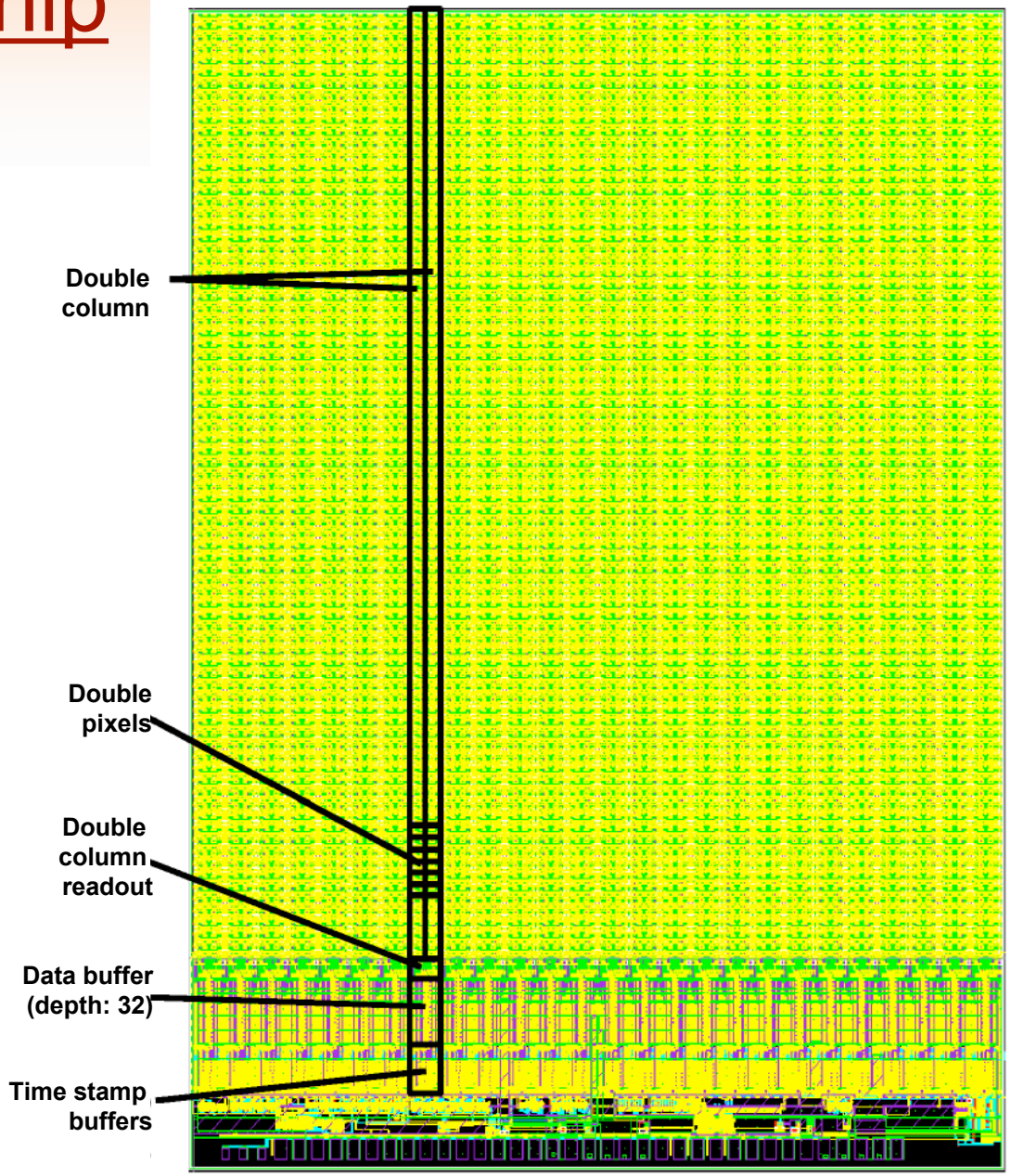
Barrel + Forward pixel:

~ 67 M pixels (100 x 150 μm²), BPIX >48M & FPIX >18M

Constructed in 1440 modules (8k - 66k pixels each)

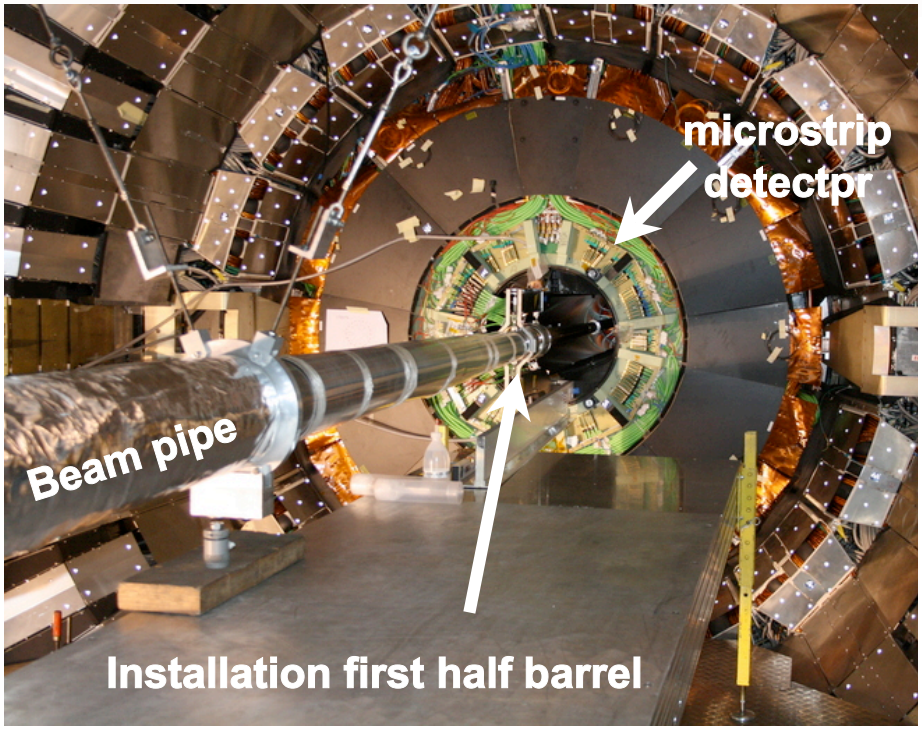
Pixel Readout Chip ('ROC')

- Developed at PSI with IBM
- Size: 52 x 80 = 4160 pixels
- Bump-bond connection to sensor
- Includes amplification & zero-suppression on pixel level
- Readout unit: double column
- Buffers hits until trigger decision
- Each ROC must be tuned for optimal performance: part of initial checkout procedure



Installation

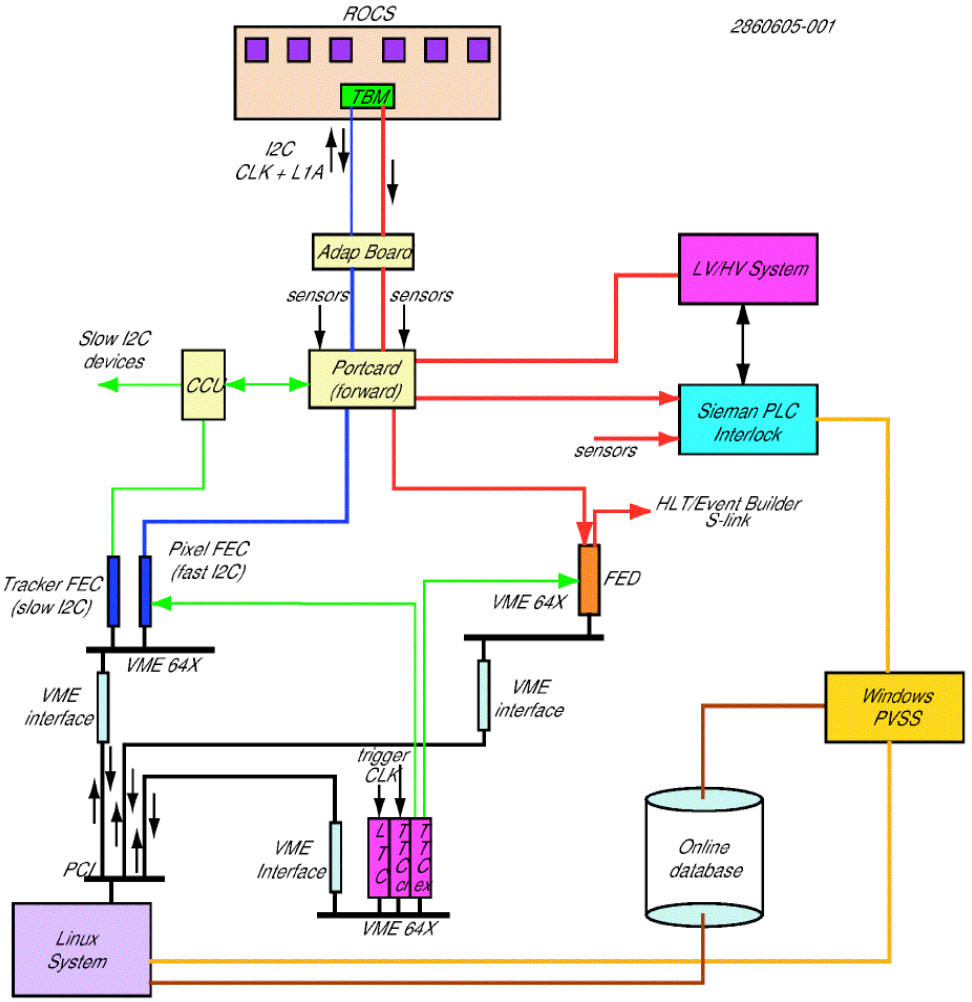
- Assembly at FNAL (forward) and PSI (barrel)
- Installation:
  - Barrel July 23-24
  - Forward July 29-31
- First weeks: check out connectors, cooling, minimal performance.



- Full detector in cosmic data run with rest of CMS: August 22
- Less than one Month from installation to first data taking:
  - Expert commissioning team > 30 people

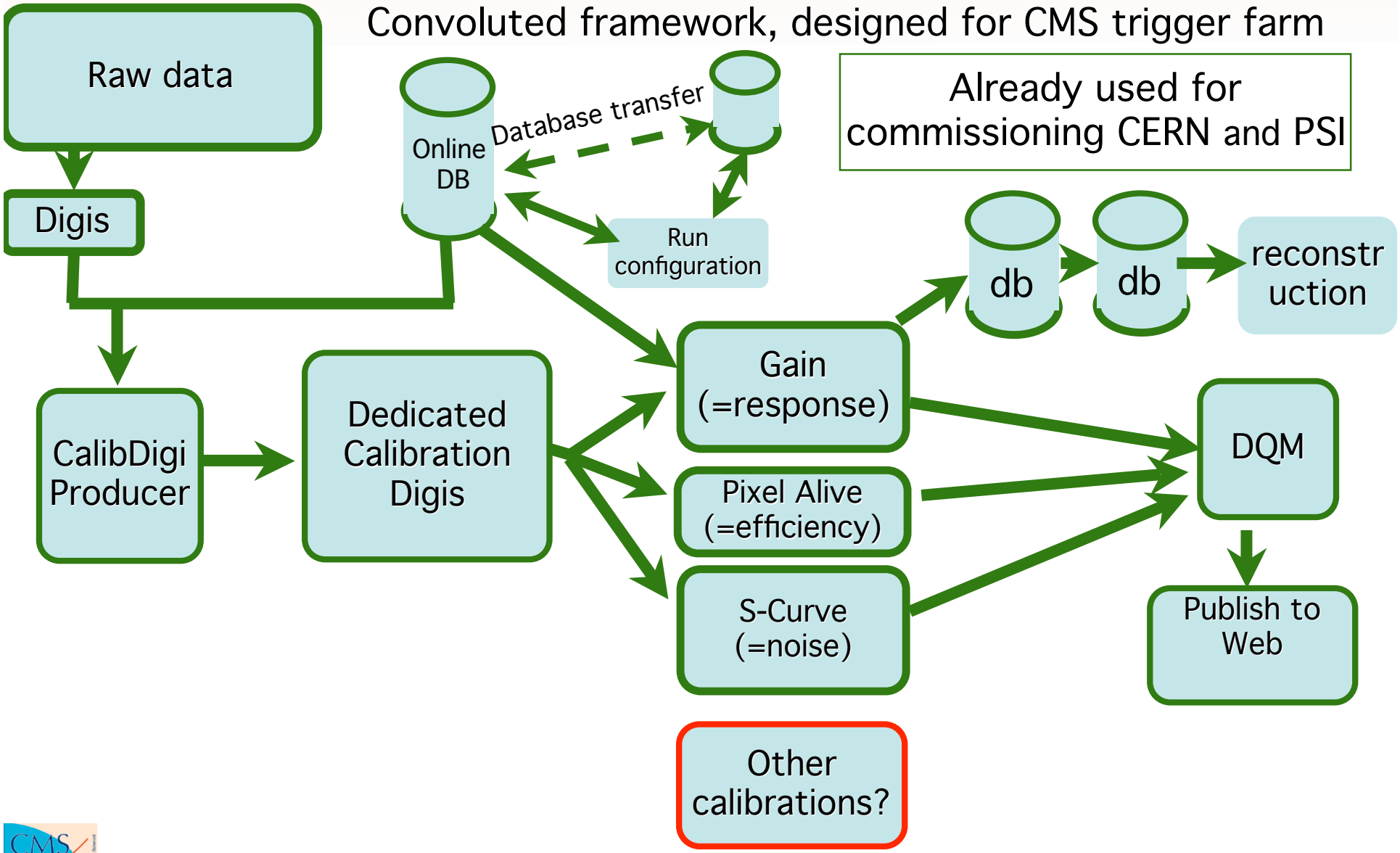
Calibration during check out

- Convoluted online calibration system
  - Goal is to determine the settings for all different components needed to operate the detector
  - Many (~25) calibrations necessary
  - Most elaborate calibrations done in offline analysis due to large data volumes
- Charge injection + readout used to measure response
  - controlled by online software



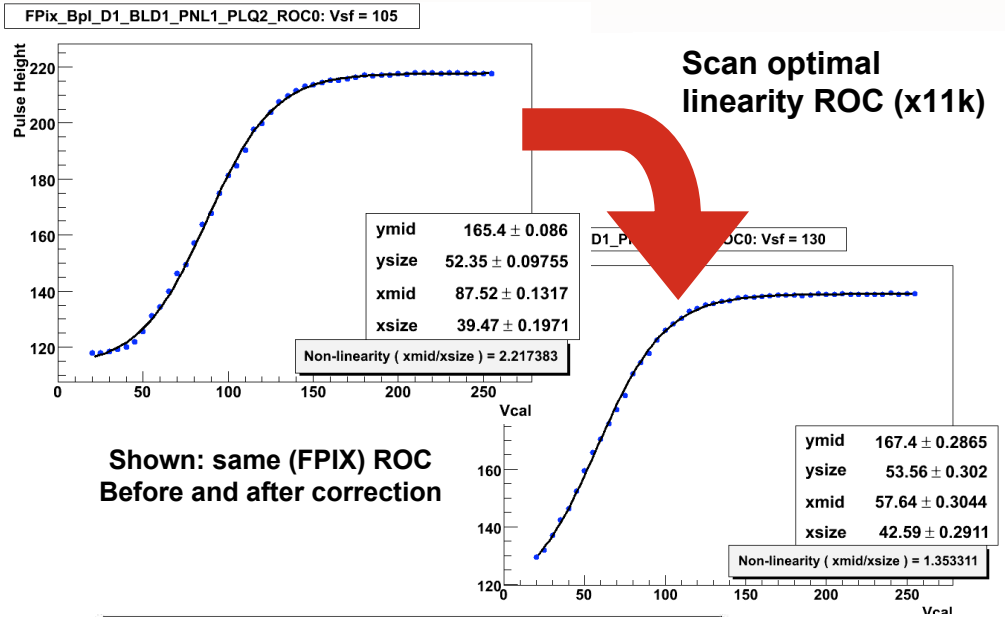
Calibration system

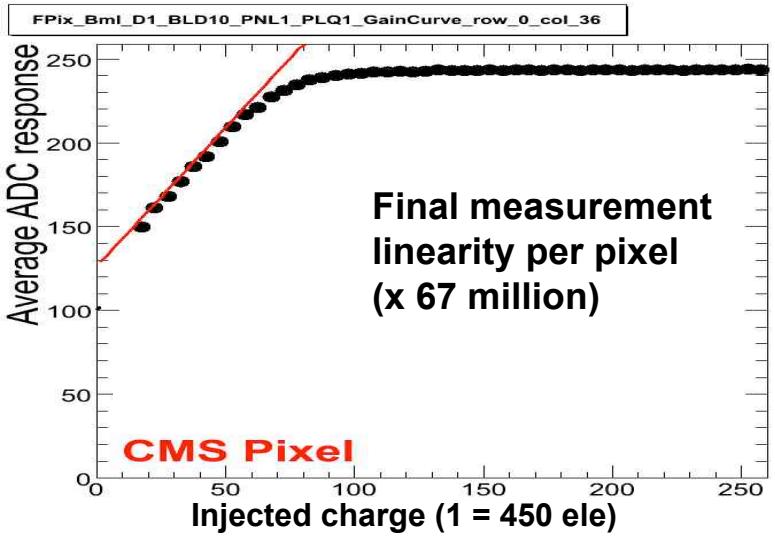
Convoluted framework, designed for CMS trigger farm



Pixel gain calibration

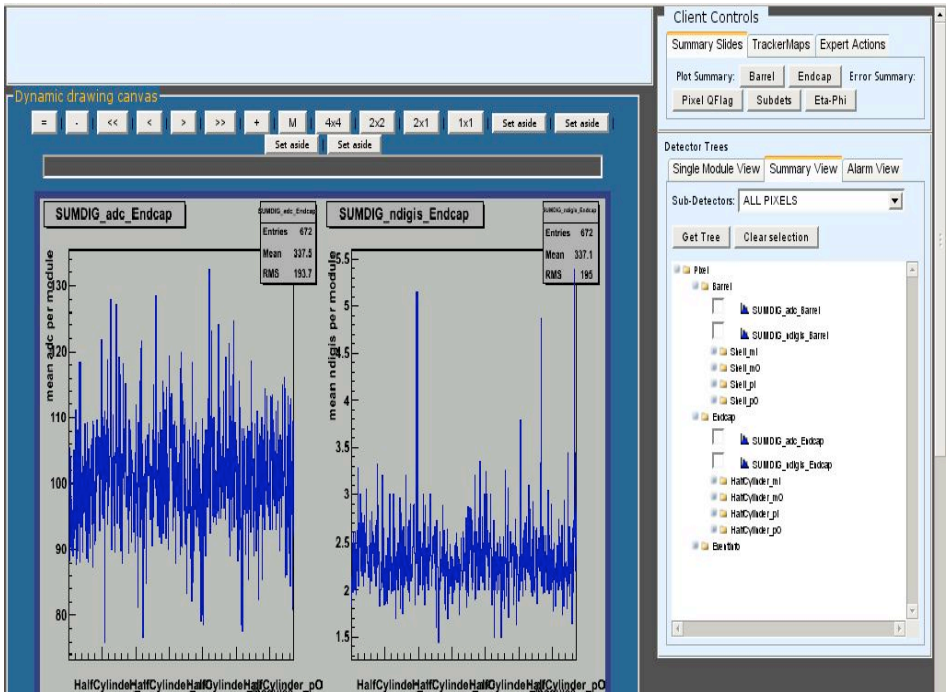
- Measured by charge insertion for every separate pixel
- Design: response linear to 1.5 - 2 minimum interacting particles (1 mip~20,000 ele)
  - Dedicated (online) calibration to achieve linear behavior
  - ROC level
- After tuning linearity:
  - Linear up to 35k electrons ☺
  - Side-product: find unresponsive pixels and mark as dead
  - Measurement input to (offline) cluster reconstruction





Pixel data quality monitoring ('DQM')

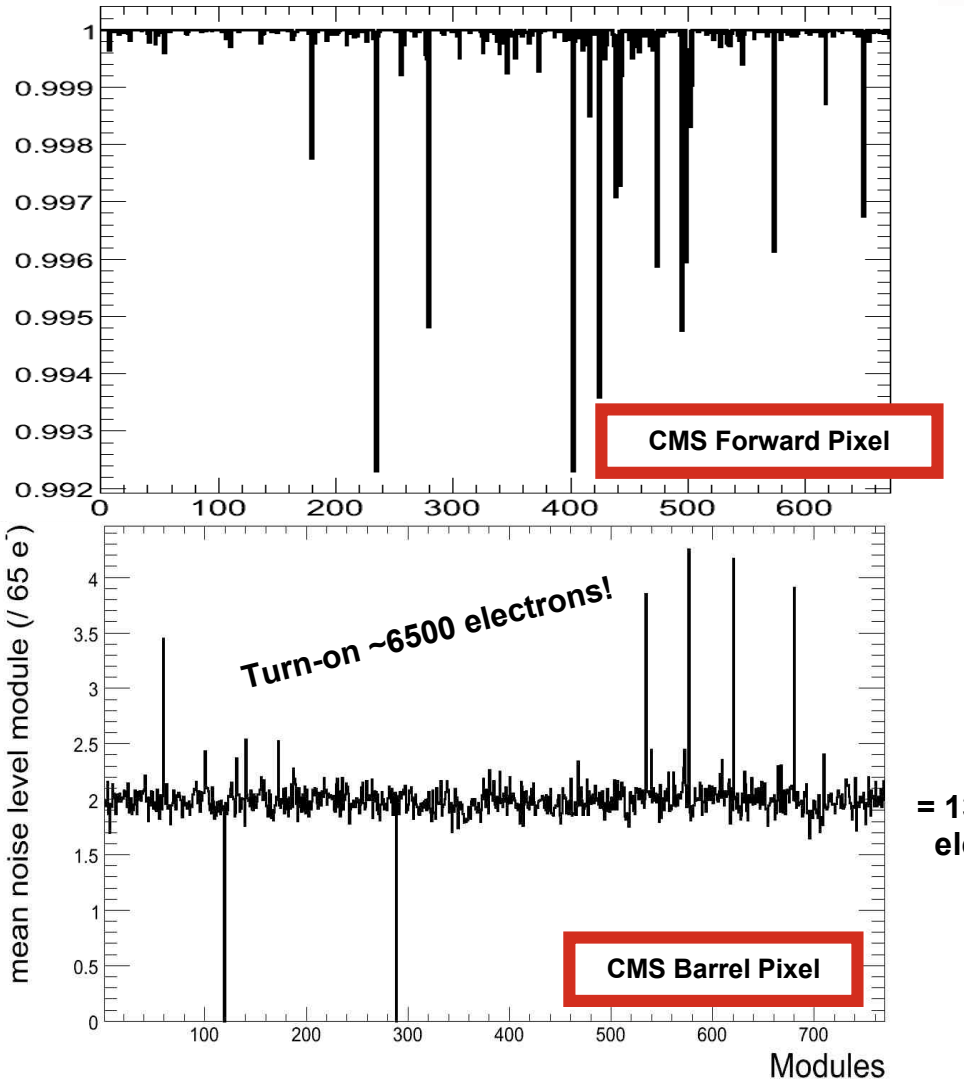
- Offline calibration software part of pixel DQM
- DQM = powerful tool
  - Uses asynchronous system with servers & clients
  - Code can be run both on HLT or in offline runs
  - Versatile: can be examined by gui, web browser or histogram output file
  - Infrastructure for summary histograms, reference histos, detector hieranchy navigation, offline browsing
  - Accessible to DQM shifts at CERN and remote



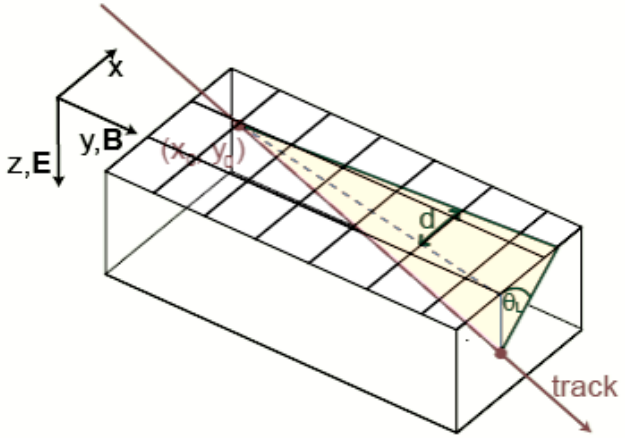
First look at detector quality

- Results from DQM
  - Average detector response: over 99.9 % efficient
  - Inefficiency typically means ROC needs retuning
    - So significant fraction expected to be retrieved

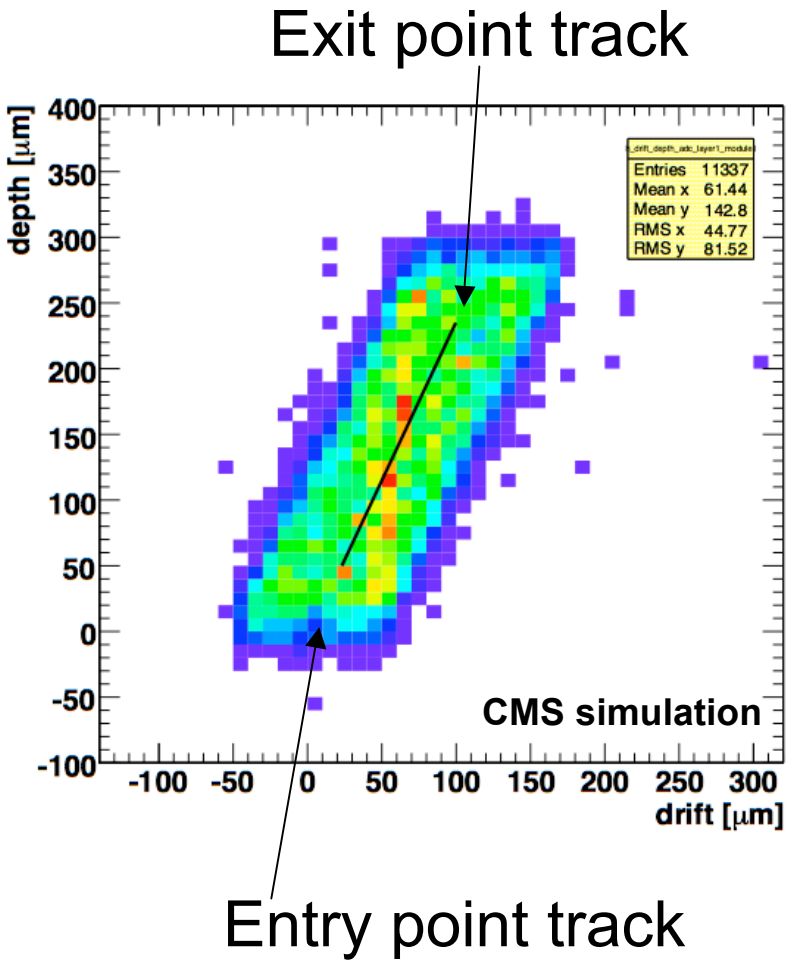
- In total <20 modules currently under-performing
  - Most are retrievable



CMS pixel detector: The greater plan

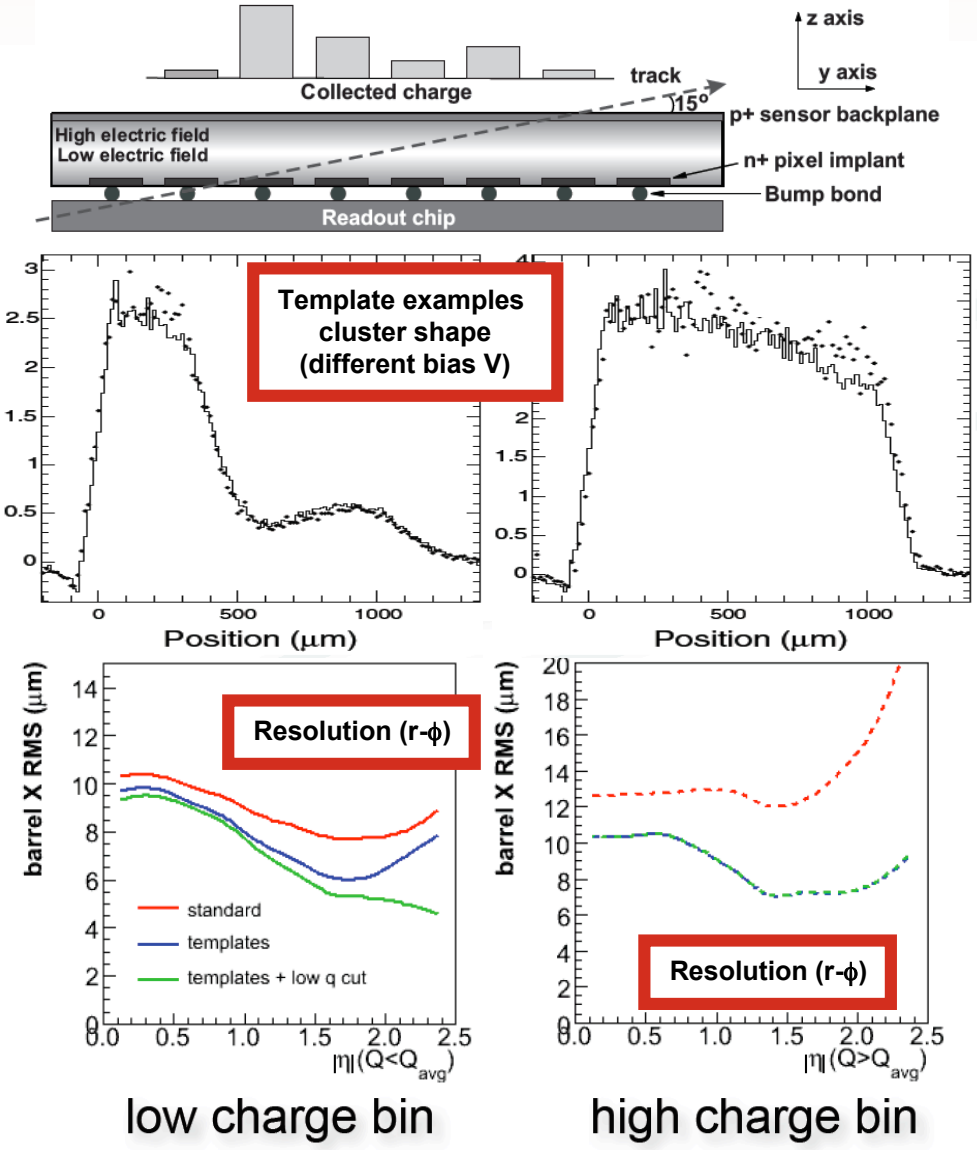


- CMS: 4 Tesla field in tracking volume
- Make use of shallow angle: cluster sharing
  - Need for accurate charge measurement
- Need to understand Lorentz Angle: measure from data



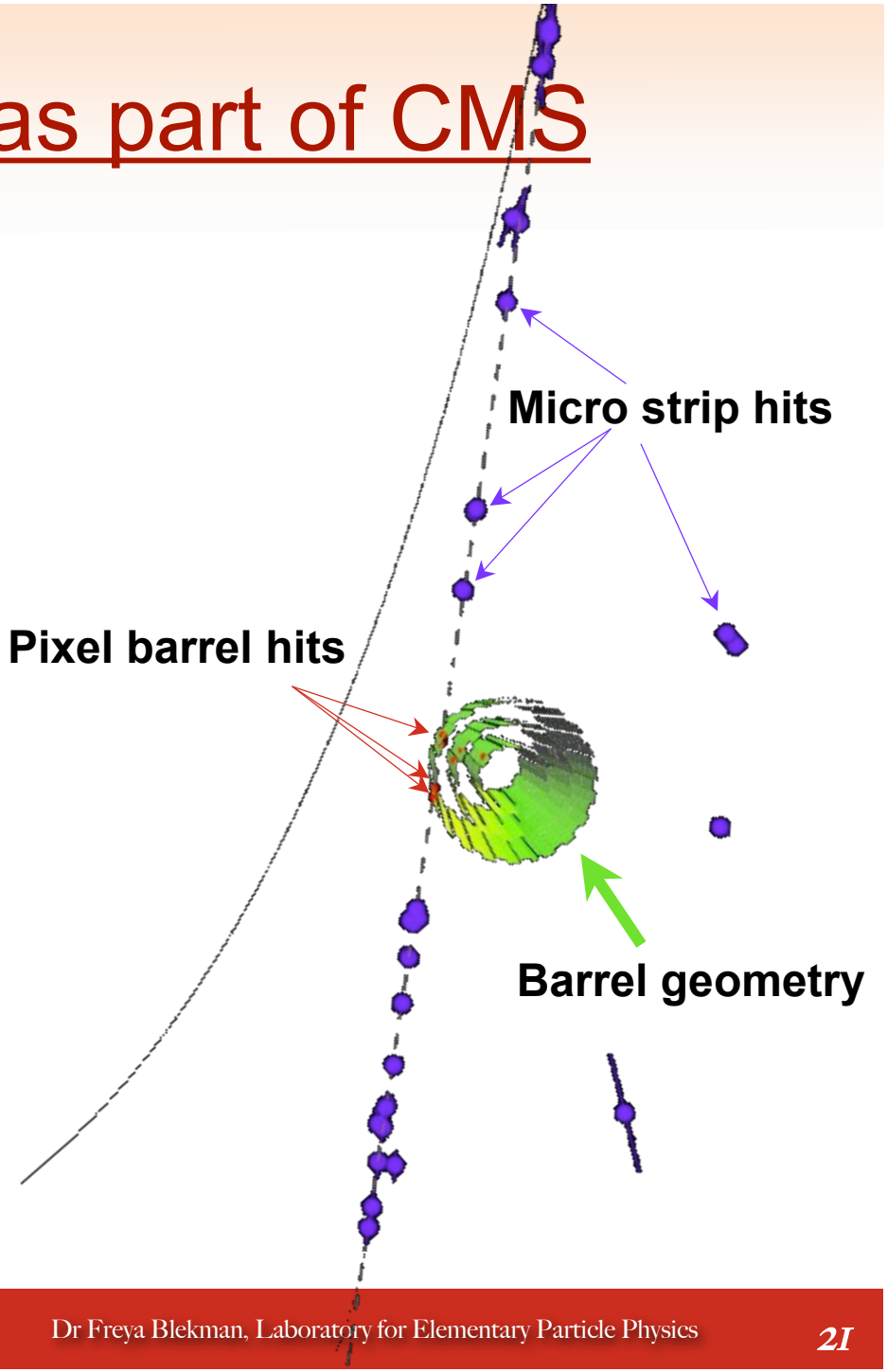
Cluster reconstruction

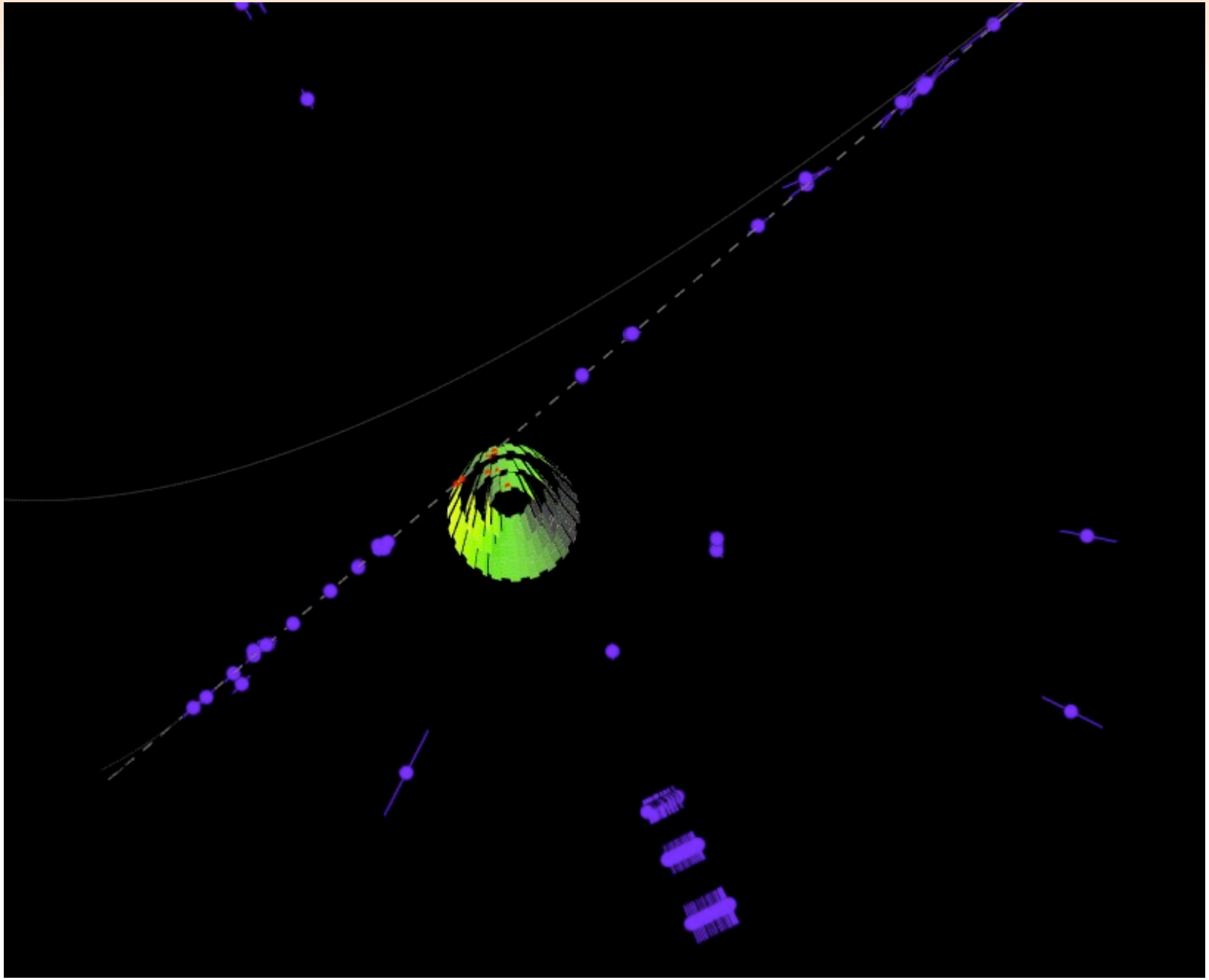
- CMS pixel detector configured to have small angles track - module
- CMS cluster reconstruction is two-step
  1. Find cluster using charge interpolation method
     - Fast but not most accurate
  2. Use fit to “template” clusters for final track fit
     - Templates derived from detailed simulation & will be measured in data
     - Dependent on irradiation, track angle, magnetic field
     - Significant improvement in position resolution

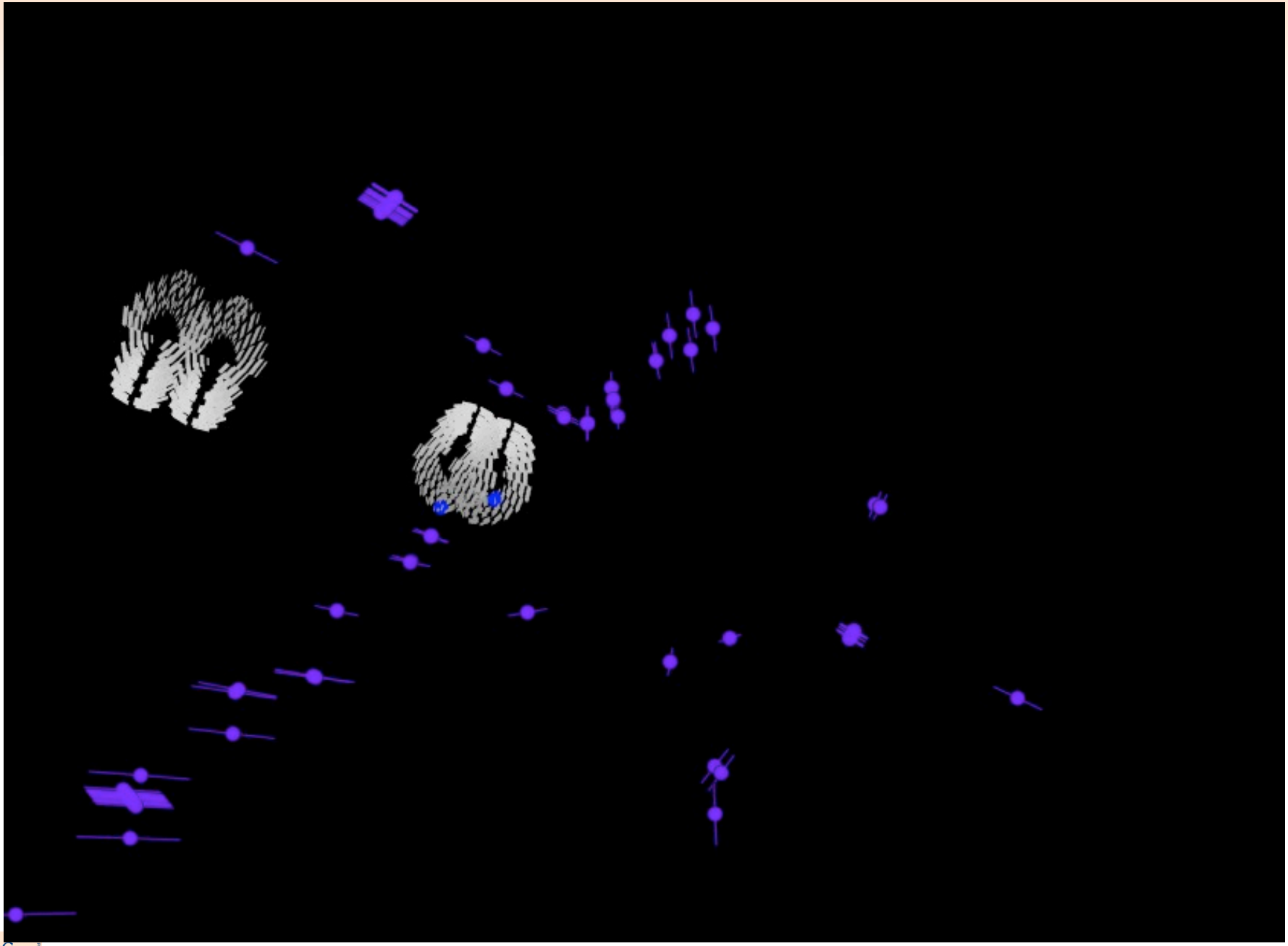


Pixels read out as part of CMS

- CMS currently running with the whole detector
  - Waiting for beam
- Shown: Cosmic ray event without magnetic field (zoom)
- This week: runs with 3.8 T magnetic field
- First beam expected:
  10 September (next week!)







http://cms.cern.ch/

- CMS pixel detector combines charge information with template clustering for excellent hit resolution
- CMS pixel detector has successfully passed first commissioning phase
- We are looking forward to the first collisions!
- Many thanks for your attention
  - more exciting results coming VERY soon