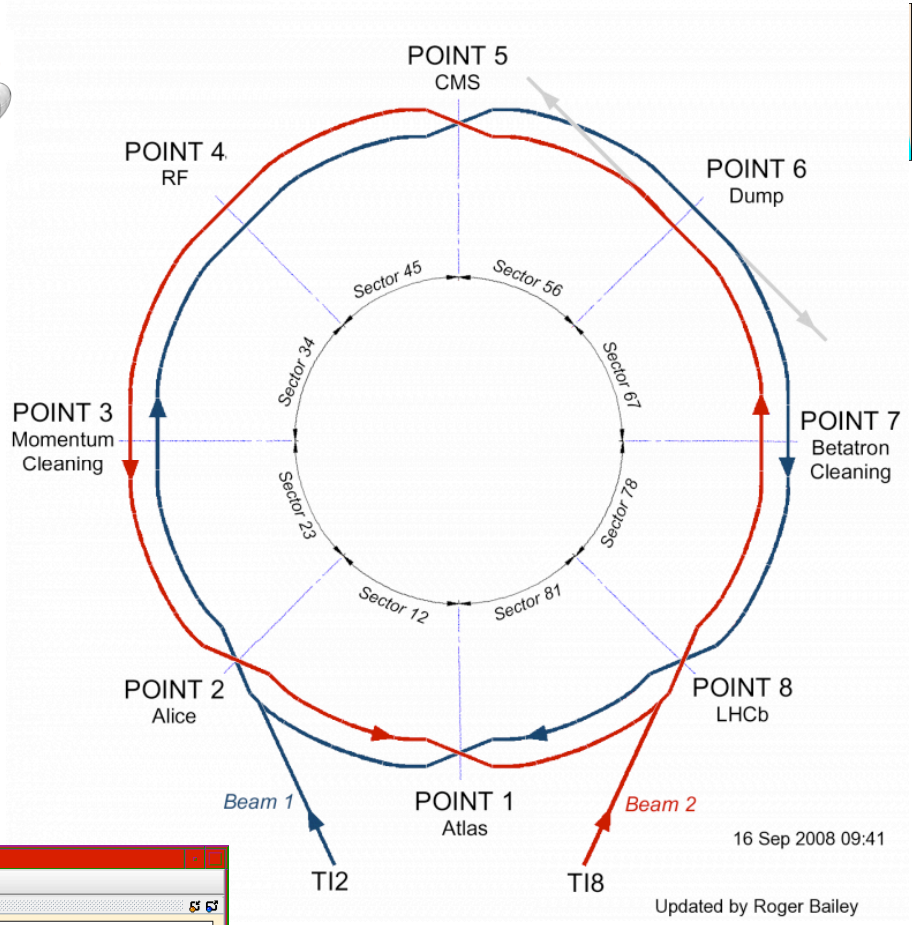
CMS

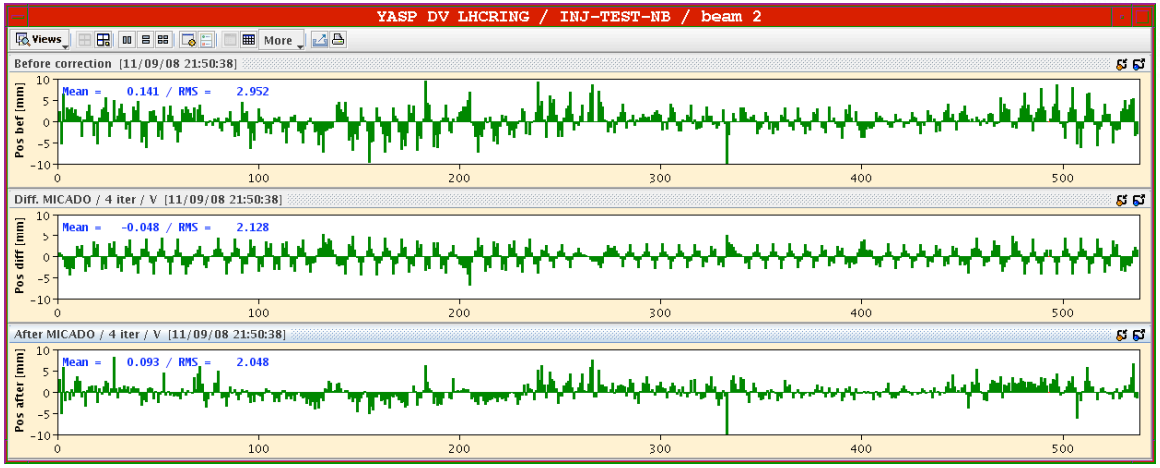
Andreas Meyer

66th PRC, 1 Oct 08
DESY Zeuthen

LHC Startup

- Sept 10:
  - Beam 1 injected and threaded around the machine within 1h, trajectory steering gave 2 or 3 turns
  - Beam 2 injected and threaded around the machine within 1:30h
- Sept 11-12:
  - Commissioning of beam 2
  - Beam circulation (beams up to half an hour)

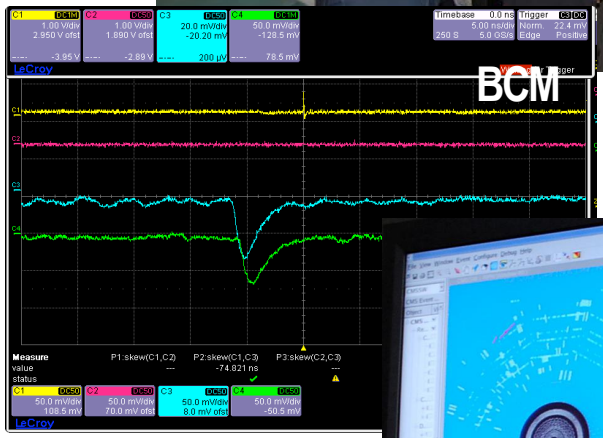


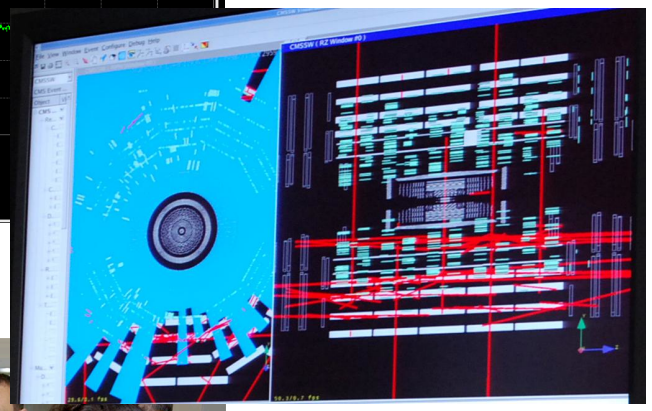


Beam 2 - trajectory steering

LHC Startup

- Synchronization tests Sun 7 - Tue 9 Sept
  - Several shots of single bunches (2.10^9 p) on collimator ~ 150 m upstream of CMS
  - First snapshots of splash events
  - Synchronization of BPTX trigger (good prep for Wed.)
- Wednesday 10 September
  - Splash events observed from both beams
  - 100-1000 TeV measured in ECAL and HCAL
  - Halo muons observed once beam started passing through CMS

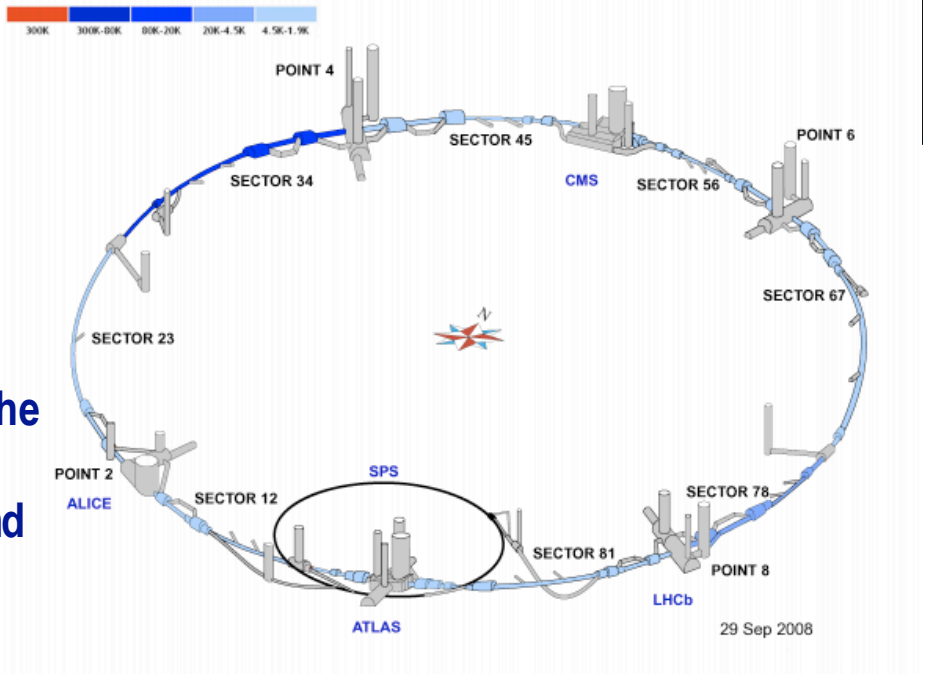




http://cms-project-cmsinfo.web.cern.ch/cms-project-cmsinfo/news.html

LHC Status

- Geneva, 18 September 2008. [...] On Thursday night, 11 September, beam two, the anti-clockwise beam, was captured and circulated for over half an hour [...] The next step is to repeat the process for beam one, and that is set to begin this week. [...] The next stage of the commissioning will be single turn studies using beam one, followed by RF capture and circulating beam in both rings.



- Geneva, 20 September 2008. During commissioning (without beam) of the final LHC sector (sector 3-4) at high current for operation at 5 TeV, an incident occurred at mid-day on Friday 19 September resulting in a large helium leak into the tunnel. Preliminary investigations indicate that the most likely cause of the problem was a faulty electrical connection between two magnets [...]

- Geneva, 23 September 2008. [...] the most likely cause of the incident was a faulty electrical connection between two of the accelerator's magnets. [...] The time necessary for the investigation and repairs precludes a restart before CERN's obligatory winter maintenance period, bringing the date for restart of the accelerator complex to early spring 2009.

CMS Status and Plans

- Near future: CMS remains closed
- Establish solenoid magnet operation at 3.8 Tesla
  - Remove CASTOR and secure heavy objects (cradle and table)
  - Ramp up to operating field (estimated 8-20 October)

- Cosmics Run at Four Tesla (CRAFT)
  - Record cosmics data (CRAFT) for 2-4 weeks (starting after 20 Oct)
  - Commissioning / stress testing of L1 and HLT triggers

Week 40	Week 41	Week 42	Week 43	Week 44 (local schooi holiday, Hallowee n)	Week 45	Week 46	Week 47	Week 48
LR MWGR	LR MWGR	GR	CRAFT	LR MWGR	CRAFT	CRAFT	LR MWGR	LR MWGR

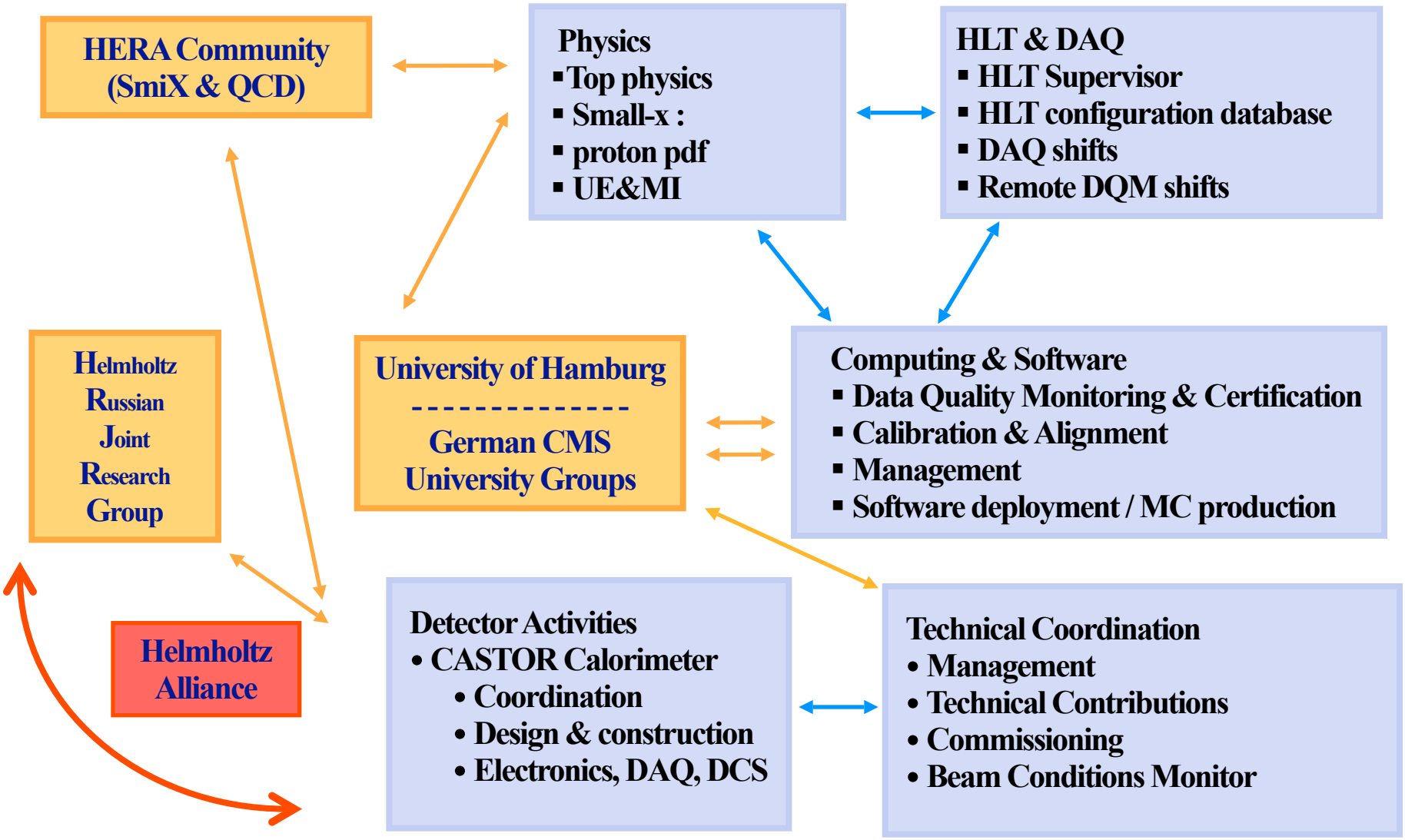
- Make final decision to open CMS towards end of November after information from subsystems and infrastructure etc. on elements to be repaired / installed / maintained has been collected.
- Plan for CMS to be ready for LHC on 1st of March 2009

DESY@CMS

- People
  - Group Leader: Kerstin Borras, Wolfram Zeuner
  - 16 staff physicists, 6 PostDocs, 7 PhD students, 1 Diploma student
    - Young Investigator Group (YIG): (HERA: pdf, LHC: top)
    - Two additional YIG applications submitted recently (SuSy / DQM, Higgs / BCM)
  - Technical help: engineers & technicians & workshops
- Activities
  - Technical Coordination & BCM, CASTOR Calorimeter
  - High Level Trigger & DQM, Calibration & Alignment
  - Computing, Physics
- CMS Coordinators
  - Deputy Technical Coordination (L1): Wolfram Zeuner
  - Computing Coordination (L1): Matthias Kasemann

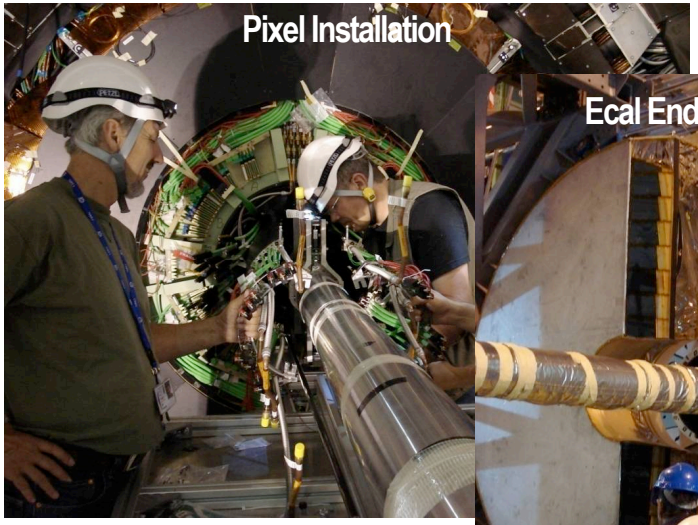
  } CMS-Management-Board
  - DQM Software (L2) / Data Certification Group: Andreas Meyer
  - Alignment & Calibration (L2) / CSA08 / ECom: Rainer Mankel
  - CASTOR Calorimeter: Kerstin Borras
  - GRID-Software Deployment Coordination Christoph Wissing

Activities & Network



Technical Coordination

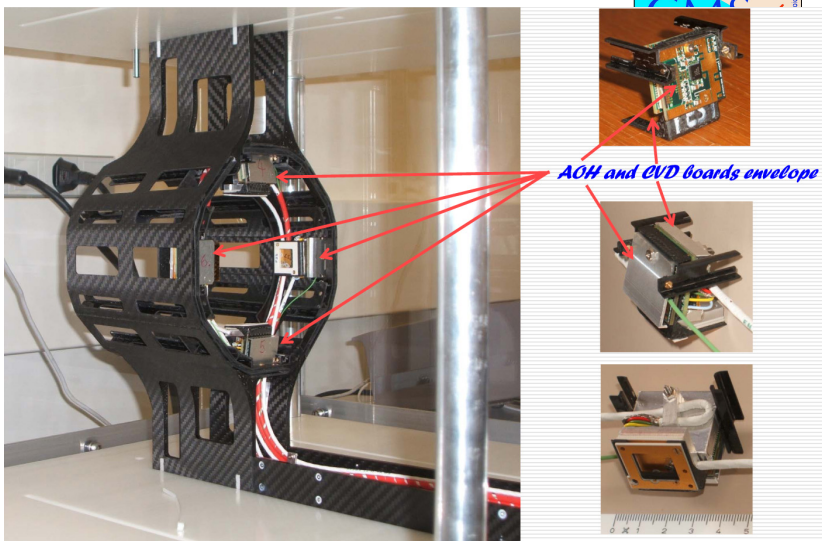
Installed:
- Pixel detector
- ECAL Endcap
- BCM
- CASTOR

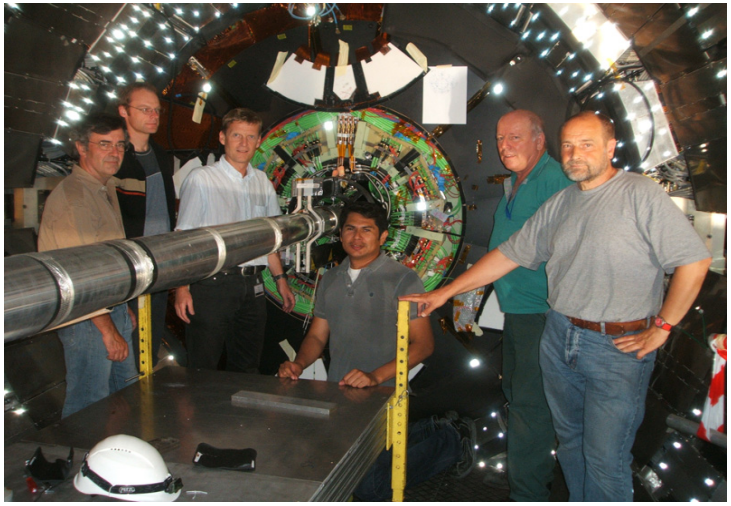


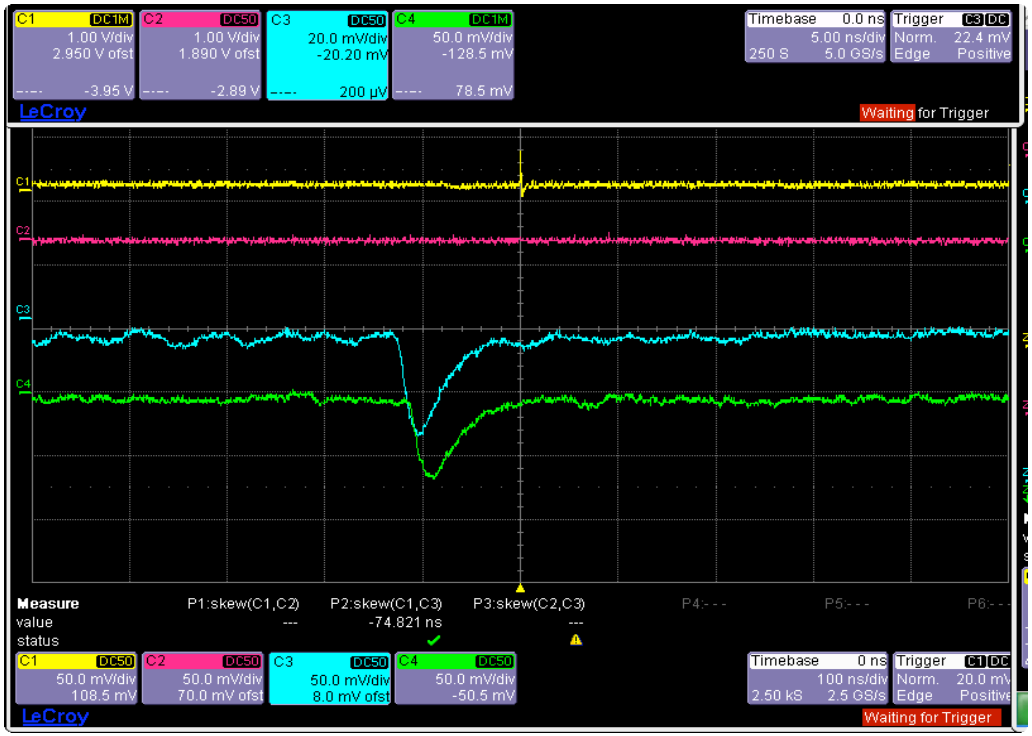
- Long term plan (2010-2014):
  - Contribute to the engineering of the upgrade of LHC with a remote technical office (e.g. finite element calculations)
  - Preparatory phase: install necessary infrastructure for an upgrade of the LHC (approved for European Funding Period 7)

Beam Condition Monitor

- DESY Zeuthen, responsible for BCM1F:
  - Two diamond sensors: 5*5mm^2, sCVD (single crystal chemical vapor deposition), fast r/o
  - Allows bunch-by-bunch monitoring of the beam conditions
- All 8 modules of BCM1F are installed and operational
- Used for first beams on Sept 10



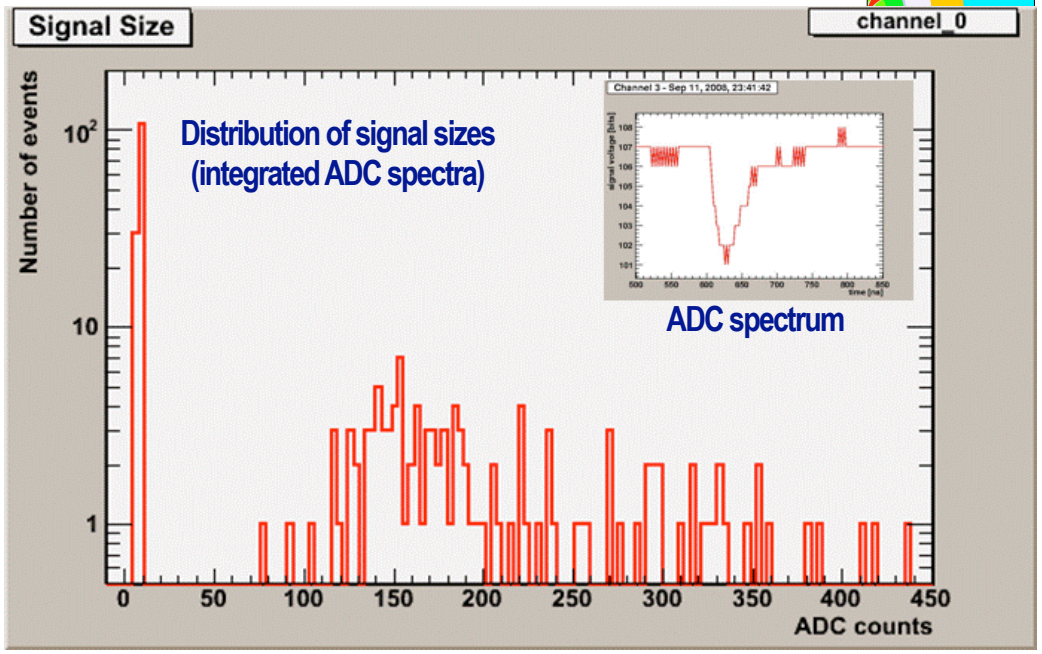




Beam Condition Monitor

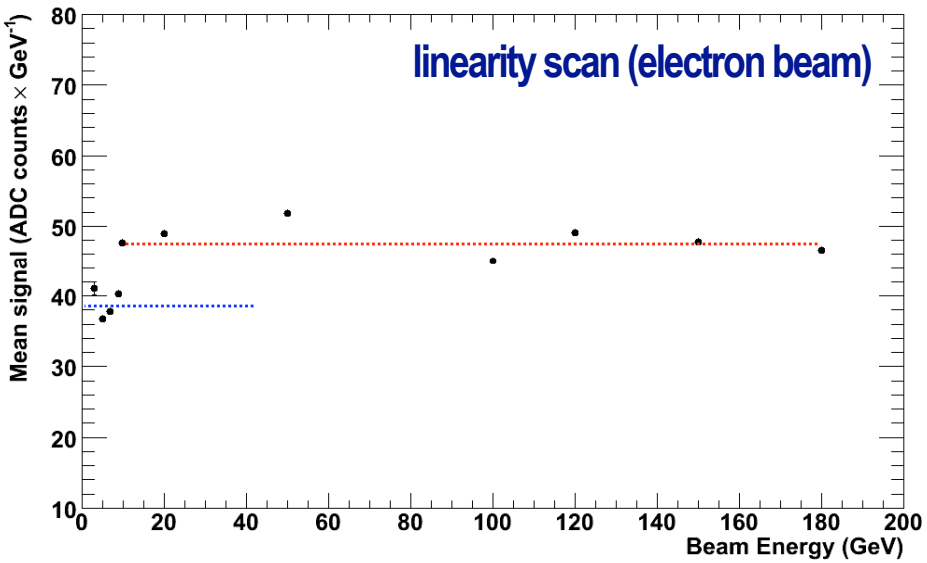
- Current effort:
  - Complete and commission DAQ
  - Publish the data to the control rooms CMS (DQM) and LHC
  - Calibration
  - Data analysis

- Plans (until 2010)
  - Exchange of non-radiation hard components
  - Improve time resolution, advance DAQ
  - Study the upgrade of BCM1F to a diamond pixel sensor telescope



- Preparation for LHC Lumi upgrade (2010-2014)
  - R&D for radiation hard sensors (e.g. CVD diamond, GaAs)
  - Redesign of BCM1F to cope with higher fluxes
  - Development and test of components for BCM1F
- Overlap with the R&D for a future linear e^+e^- collider (FCAL):
  - All R&D topics are embedded in international projects (BMBF-JINR, CARAD)
  - Collaboration with Uni Karlsruhe, YIG application

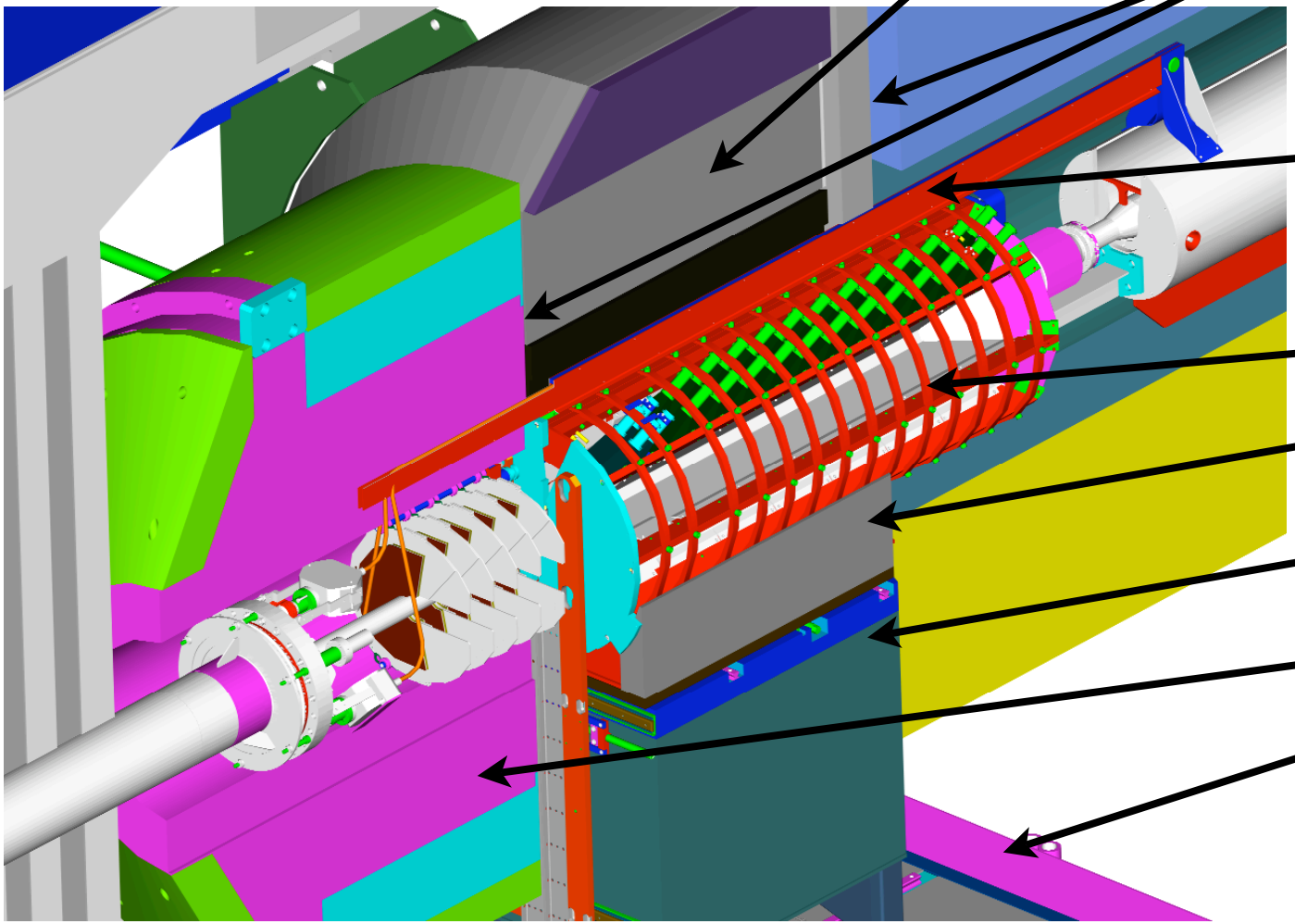
CASTOR Calorimeter



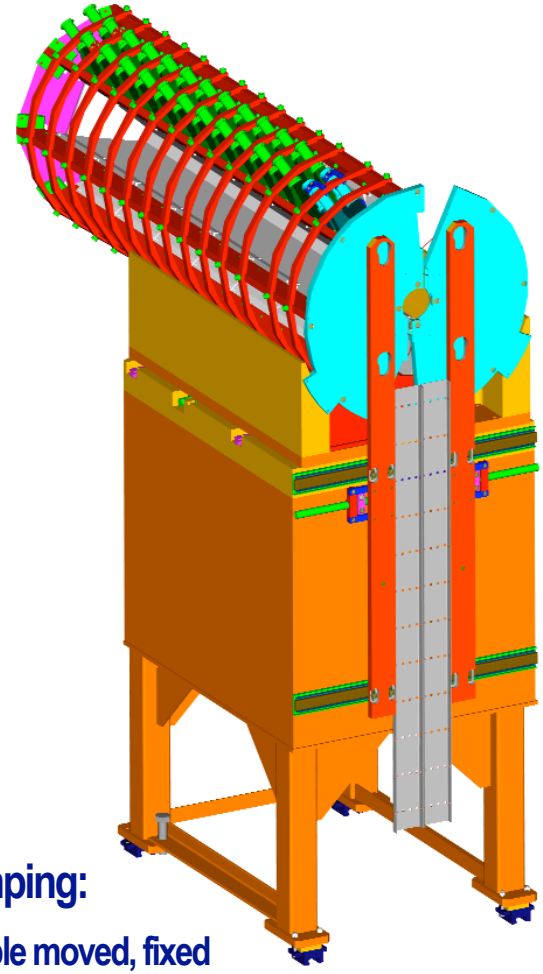
- Installation Milestones passed:
  - Test beam analysis 07: CMS-note / publication in EPJ in preparation
  - CASTOR octant produced
  - 3 weeks of data taking in test beams
    - Linearity scans down to very low energy (3 GeV): already within 20%
    - full calibration and analysis 08 underway
  - Mechanic half shell produced & filled with one octant installed in CMS

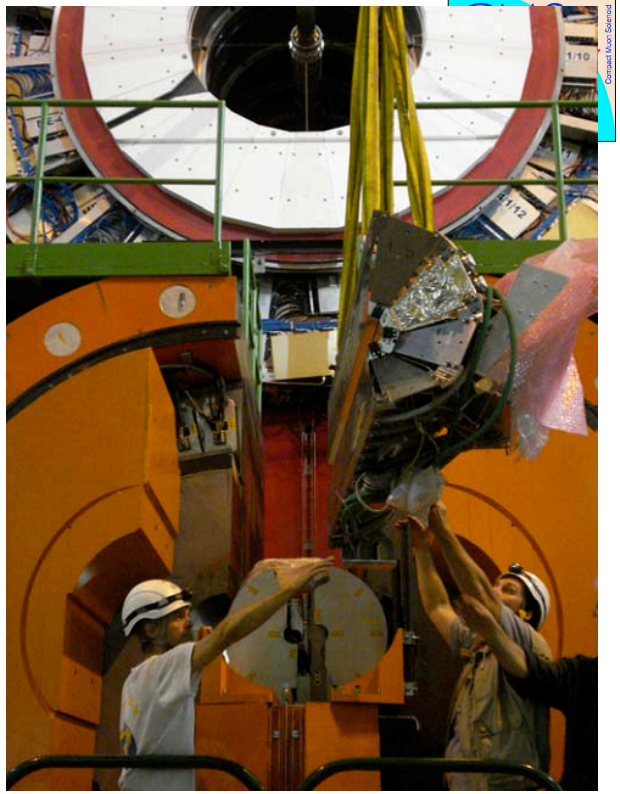
- However, unexpected problems with magnetic stray field ...

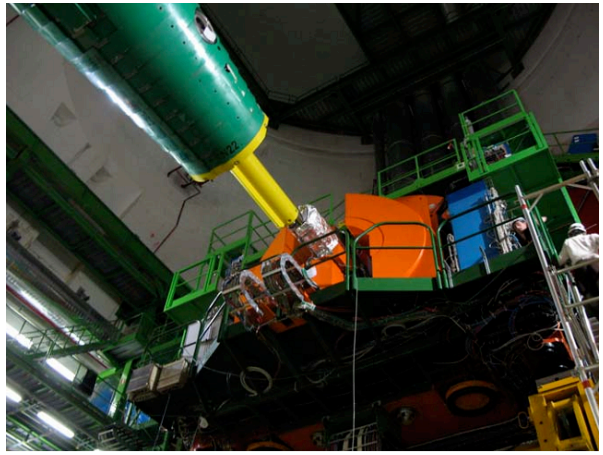
CASTOR Calorimeter



CASTOR Calorimeter







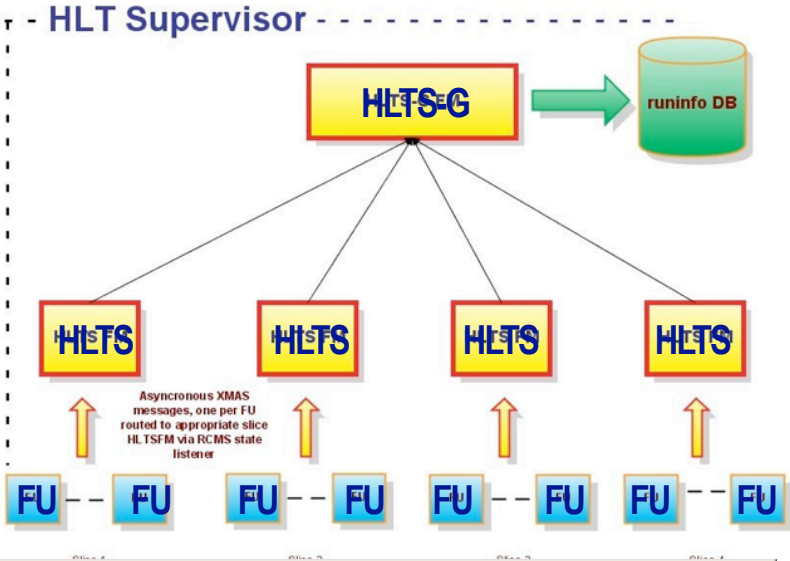
Magnet ramping:

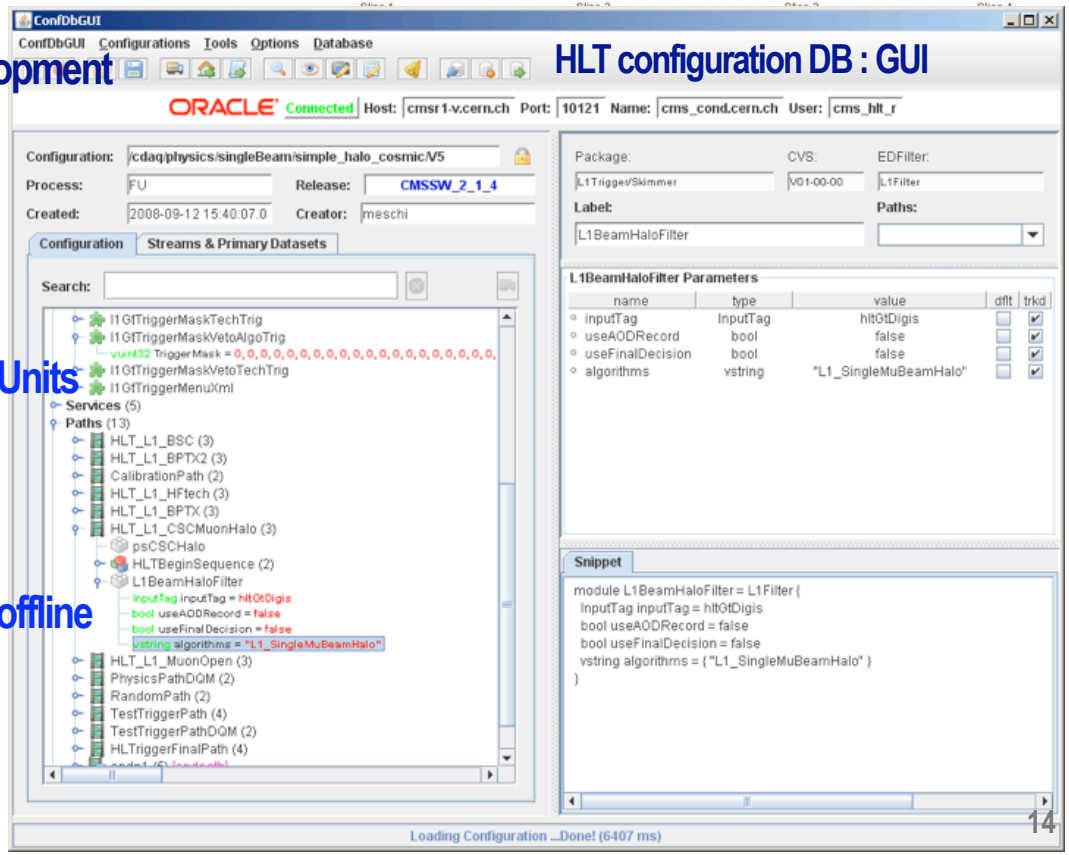
- Collar table moved, fixed
- Collar cradle moved, fixed
- CASTOR moved & possibly whole assembly
- Near future: test ramping with CASTOR removed

High Level Trigger

HLT Supervisor: Run Control and Monitoring of FilterUnits

- Configuration upload, prescale setting, rate monitor
  - Development and operation since 2006
  - Refactored version (spring 2008) successfully deployed
- Configuration database and browser
  Bookkeeping (online) of HLT configurations
  - In use for global runs and HLT filter development
  - Planned/needed for wide-range of
    offline production applications
- Plans (2010-2014)
  - System upgrade from presently 275 FilterUnits
    to complete system (initially 5k FU)
  - Maintain / tune / refine supervisor
    and monitoring tools
  - Extend configuration database for use in offline
  - Develop / deploy / maintain interface
    between online and offline





Data Quality Monitoring and Certification

Online DQM

Online DQM
Histogram
Creation and Filling
(HLT and StorageManager)

Offline DQM

Prompt & Alca Reco
Sim- & Relval
Histogram
Creation and Filling

Offline DQM
Quality Testing

Data Certification

Combine DQM with DCS
and DAQ

Event Processing

Live Histograms

Histogram Files

P5

Tier-0

Histograms in EDM Files

Full statistics histograms

Histogram Root Files

offline DQM

DQM, DCS, DAQ

certification

certification

Orcon

OMDS

Orcoff

DBS

Database

Histo Archive

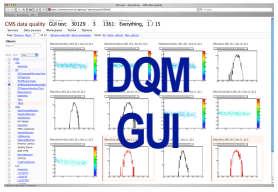
WBM

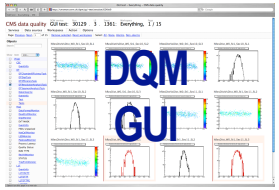
Castor

File Archive

File Store

DQM for / at CAF in preparation





Visualization

Production

Production
just started

Development

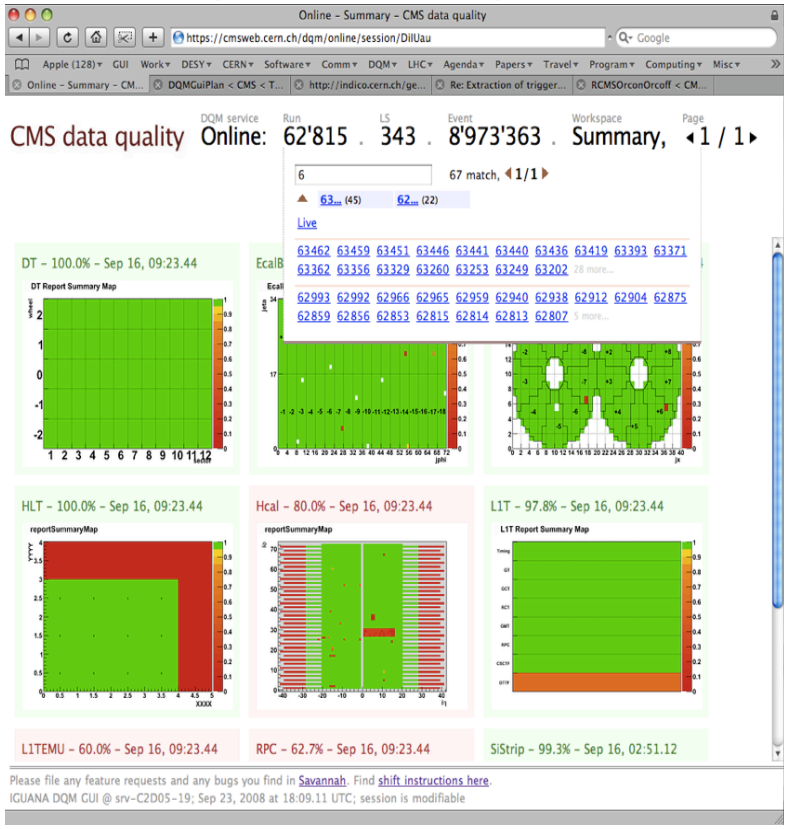
DQM

- Framework software, standardization, subsystem integration, operation
  - online DQM (real time, P5)
  - Tier-0 (prompt reco, alignment/calib, release and simul.-validation)
  - CAF (imminent): DQM for automated analysis workflows
  - Tier-1/2 (planned): DQM for all CMS production workflows
- CMS-wide certification of physics- analysis data (DBS)
  - POG, PAG monitoring (in development)

- DESY contributions:
  - Convenor of CMS-wide data certification group
  - L2-Coordination of DQM software development and operation
  - Regular remote DQM shifts from DESY
    1 shift every day established during GR and CRUZET
  - Maintenance and operation of online DQM
  - Develop / maintain automatic quality test and error handling system

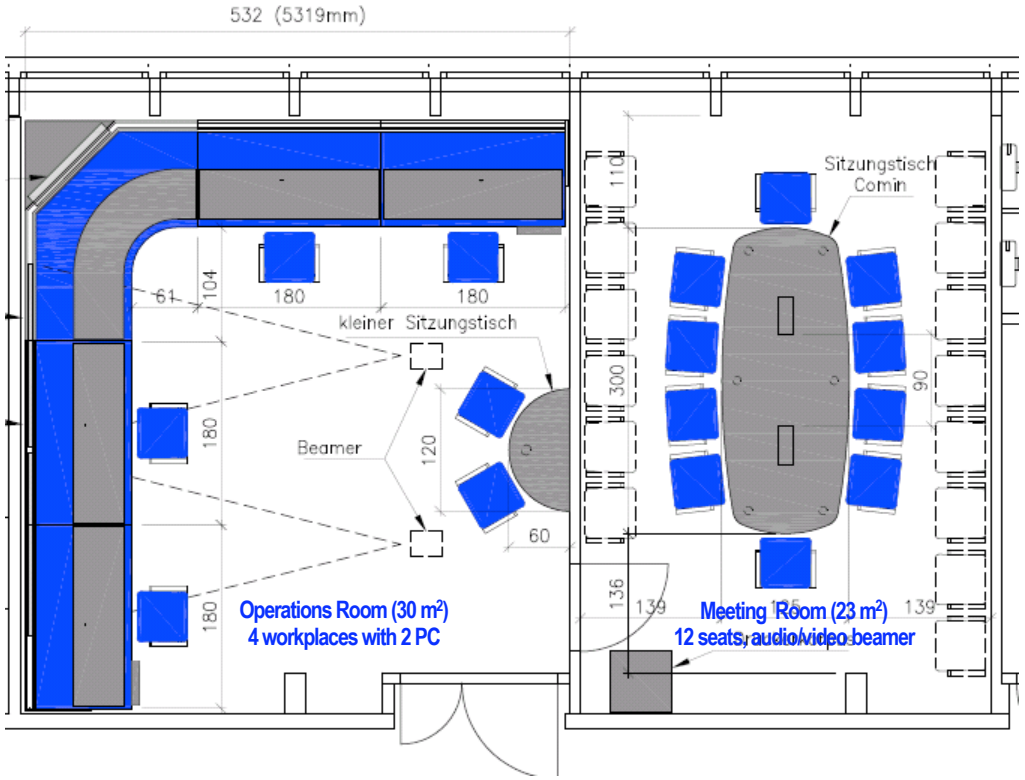
- Plans (2010-2014)
  - Operation / refinement of DQM system and tools
  - Deploy / operate DQM servers at Tier-1 and Tier-2
  - Remote monitoring: Online, Alignment, Tracker, Physics (YIG)

https://cmsweb.cern.ch/dqm/online



DQM GUI: web-based service of histograms:
same tools / look & feel for all CMS systems and workflows

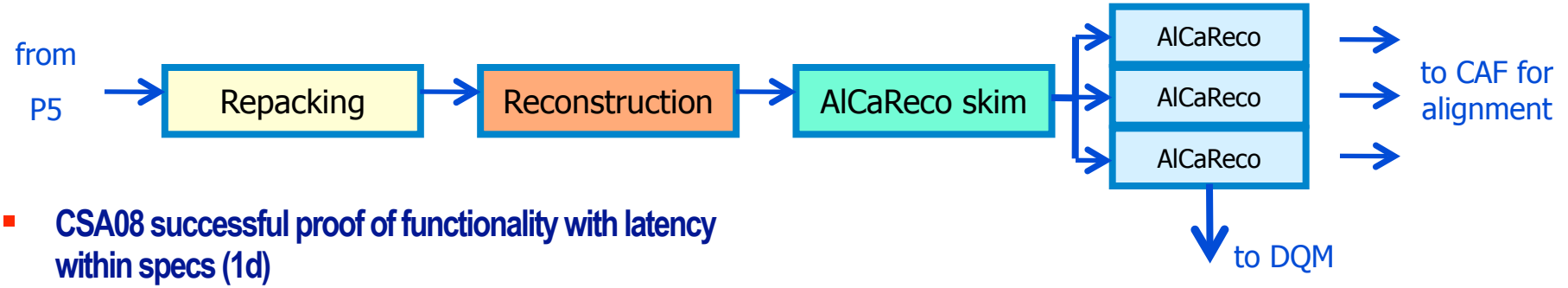
CMS Center @ DESY



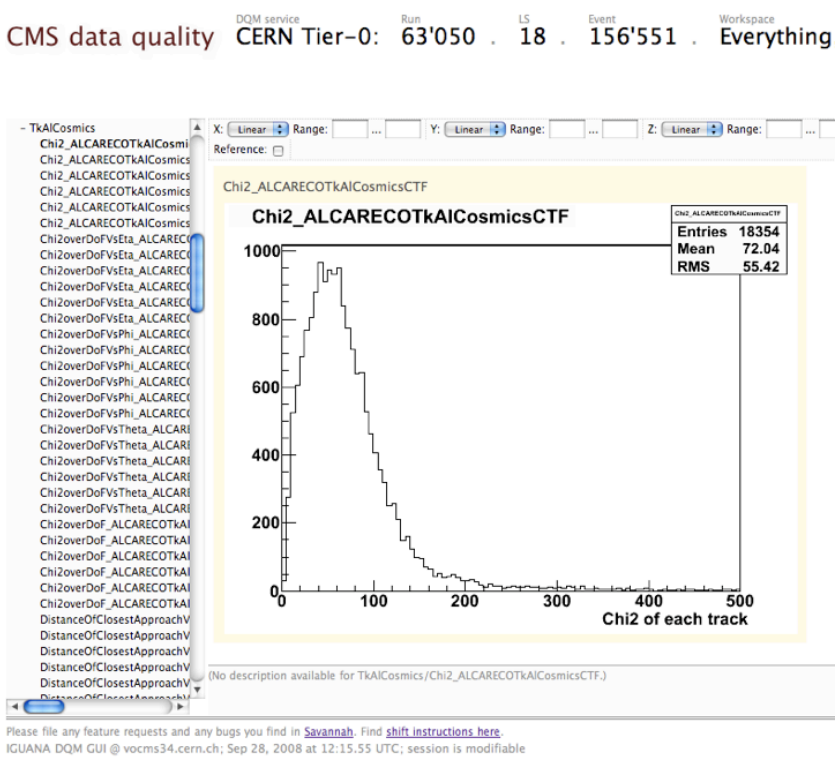
- Goals:
  - Support of CMS data taking from DESY
    - Online data taking:
      Central DQM (P5), shifts
      HLT operation, BCM, Tracker DQM
      (Hamburg Univ.),
    - Offline workflows:
      Physics data certification,
      calibration& alignment,
      GRID / NAF operations
  - Input to CMS operation (shifts and local experts): retrieve and feed back info about CMS status
  - Central meeting point, enhance contacts within the group and with other CMS groups
  - Outreach: presentation of CMS experiment and results to the public

- Status:
  - Room with test installation in use since Jan 2008
  - Regular participation in global runs since July 2008 (DESY (FNAL) covering 1(2) remote shift / day)
  - New room is now available and will be ready for shift operation October 15, in time for CRAFT

Alignment/Calibration

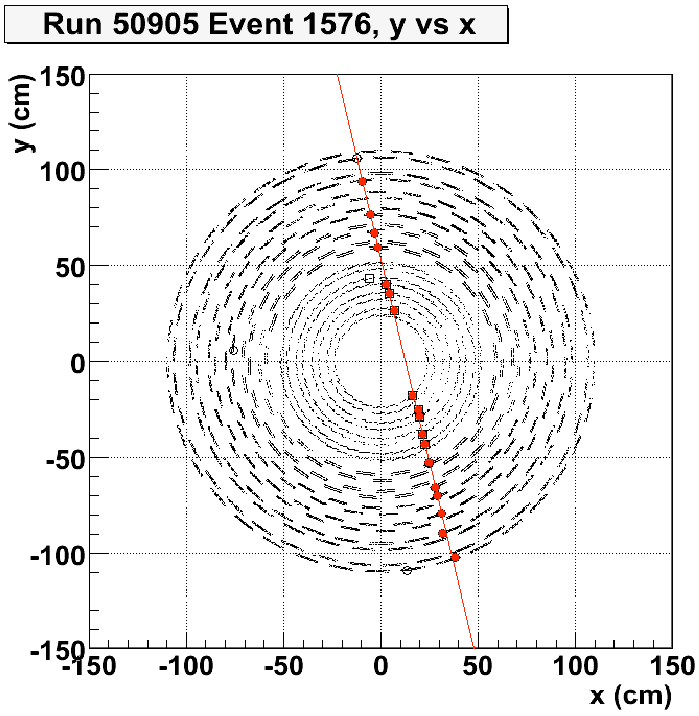


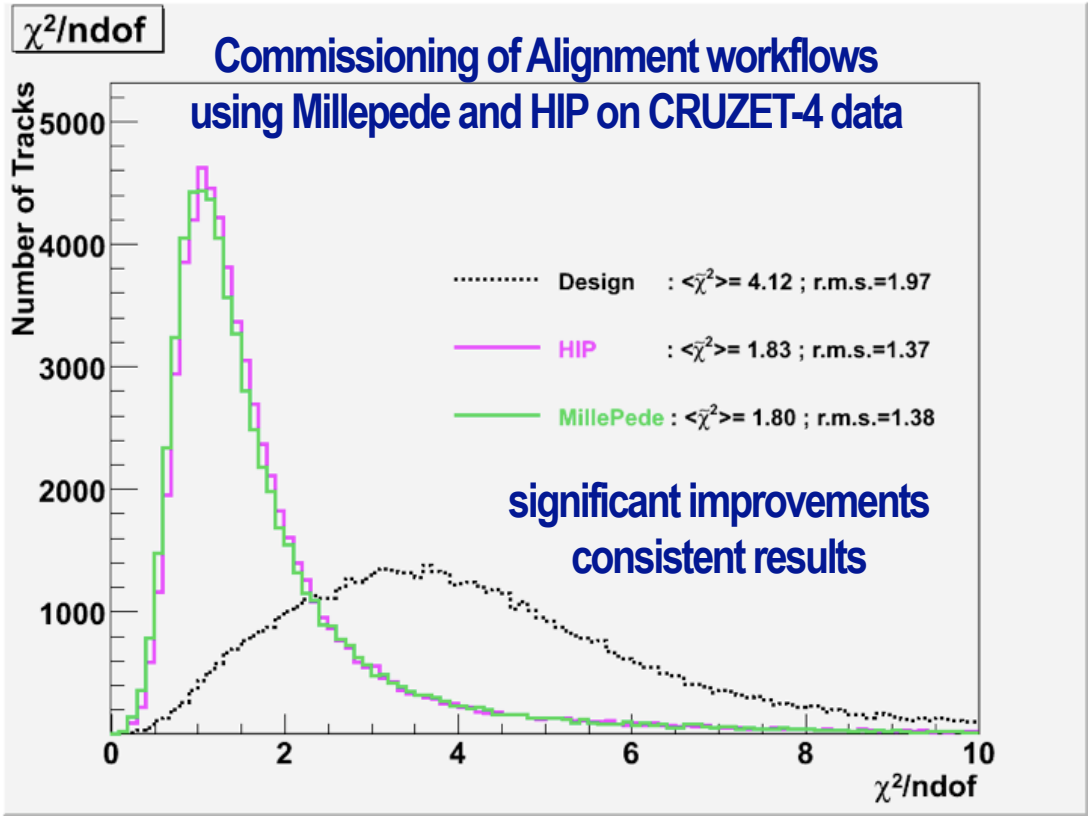
- CSA08 successful proof of functionality with latency within specs (1d)
- AlcaReco production with real data (cosmics, beamhalo):
  - Central production of AlcaReco streams
    - established (presently five streams)
    - in use for tracker and muon system alignment
  - Improving latencies, calibration results becoming available < 1 day
- AlcaReco DQM: detailed monitoring and validation of monitoring output, 1st version integrated (Tier-0)
- DESY contributions:
  - Coordination of Calibration & Alignment group
  - Co-coordination of CSA08 challenge
  - Tracker Alignment using Millepede



Tracker Alignment with Millepede

- The DESY group provides in-depth tracking and millepede expertise from HERA experiments
- Close cooperation with Hamburg University and with author of package (V. Blobel)
  - Development/deployment of mass production toolkit for MillePede-II alignment
  - Participation in tracker alignment campaigns (CSA08, and real data from Global Runs)



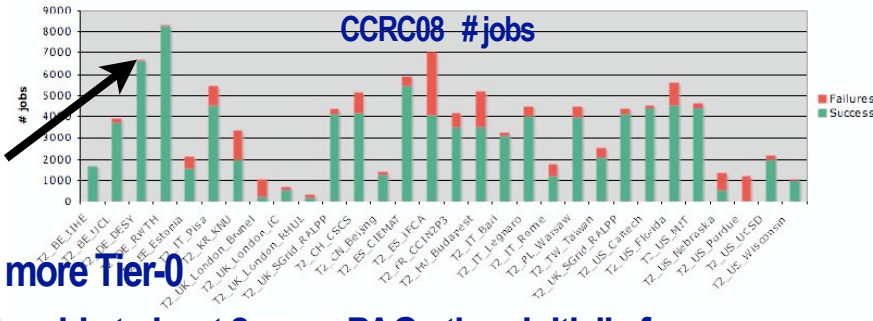


Computing

- CMS-wide Coordination tasks
  - L1-Coordination
  - GRID-Software Deployment Coordination
  - Coordination of EcoM Group "Evolution of CMS Computing Model"

- Participation in CCRC08
- Tier-2 physics group affiliation:
  - associate physics analysis groups (PAG) with Tier-2 centers. Each group "owns" 30TB at one or more Tier-0
  - Additional 60 TB storage pledged by DESY in order to be able to host 2 more PAGs than initially foreseen

DESY



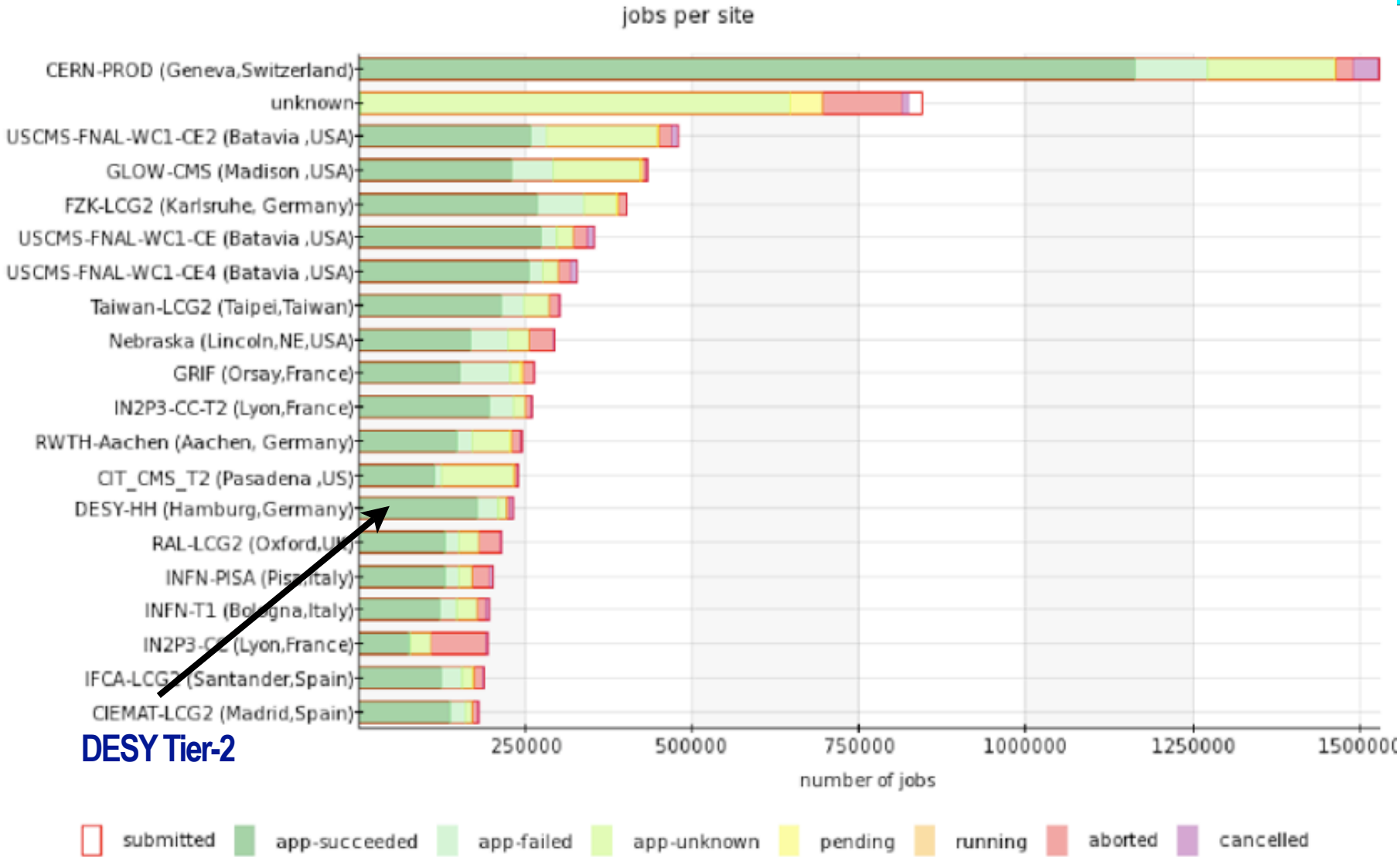
- Plan 2010-2014:
  - DESY will take responsibility in areas of coordination and organization of distributed data analysis.
  - This CMS-wide responsibility extends the role of operating the Tier-2 centre and the National Analysis Facility for the Germany based LHC data analysis
  - Use NAF for CMS centralized analysis data operations, e.g. developments for alignment (to be organized with Hamburg Univ., Karlsruhe and Aachen)

Tier-2 Group Affiliation

	T2_AT	T2_BE	T2_BR	T2_DE	T2_CH	T2_CN	T2_EE	T2_ES	T2_FI	T2_FR	T2_IT	T2_KR	T2_PT	T2_RU	T2_UK	T2_US
FWD phys				1												1
QCD				1						1						2
Higgs								1		1	1					1
EWK								1		1	1				1	1
SUSY	1			1							1				1	1
Top		1		1				1		1						1
Exotica										1				1	1	1
B Physics					1	1			1							1
Heavy Ions														1		0
egamma										1	1				1	2
Jets/MissET				1					1			1		1		1
Muons								1			1			1		2
B-Tagging	1		1							1						1
Tracker				1						1	1					1
Tau / Pflow							1			1	1					1
Trigger DPG								1							1	1
Reserve																2
Unallocated		?											1			1
Current Resources	0	1	1	3	0	0	1	5	2	8	5	1	0	1	4	15
Fall Resources (*)	2	1	1	6	1	1	1	5	2	9	7	1	1	4	5	21

T2_DE (federated Aachen / DESY) host: SuSy, Tracker, FWD Phys, QCD, Top, JetMET

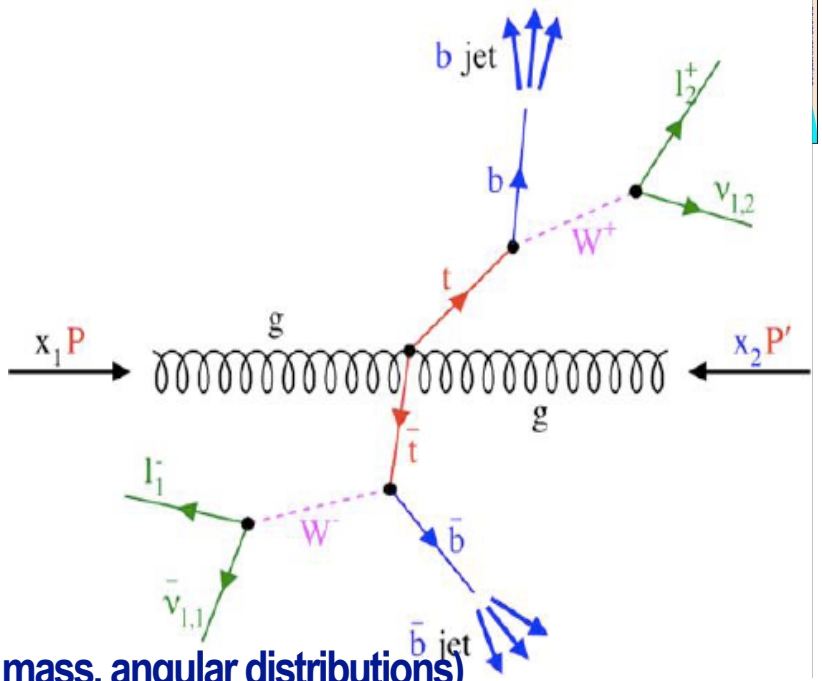
Recent Computing Performance



DESY Tier-2

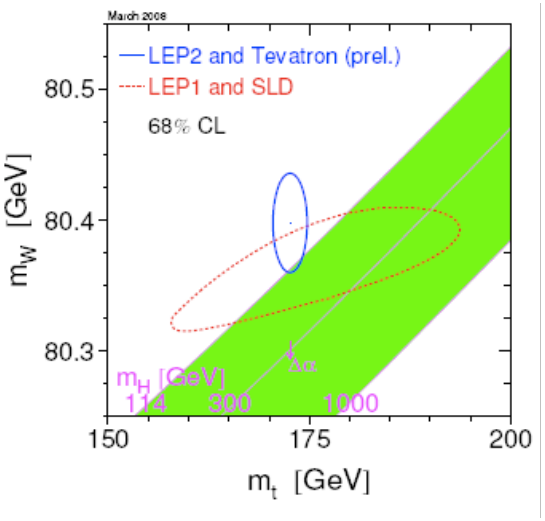
Physics

- Terascale Physics Program
- Experience from HERA / input to ILC
- Close cooperation with
  - German institutes (Hamburg, Aachen, Karlsruhe)
  - Theory Group at DESY



- CMS-group main physics topics:
  - Top Quark Physics (cross section measurements, top mass, angular distributions)
    - 4 PhD students, 3 Diploma students, 2 PostDoc, 2 staff (part time)
  - QCD (understand, predict, describe background to new physics)
    - 1 PhD student, 2 PostDoc, 2 staff (part time)

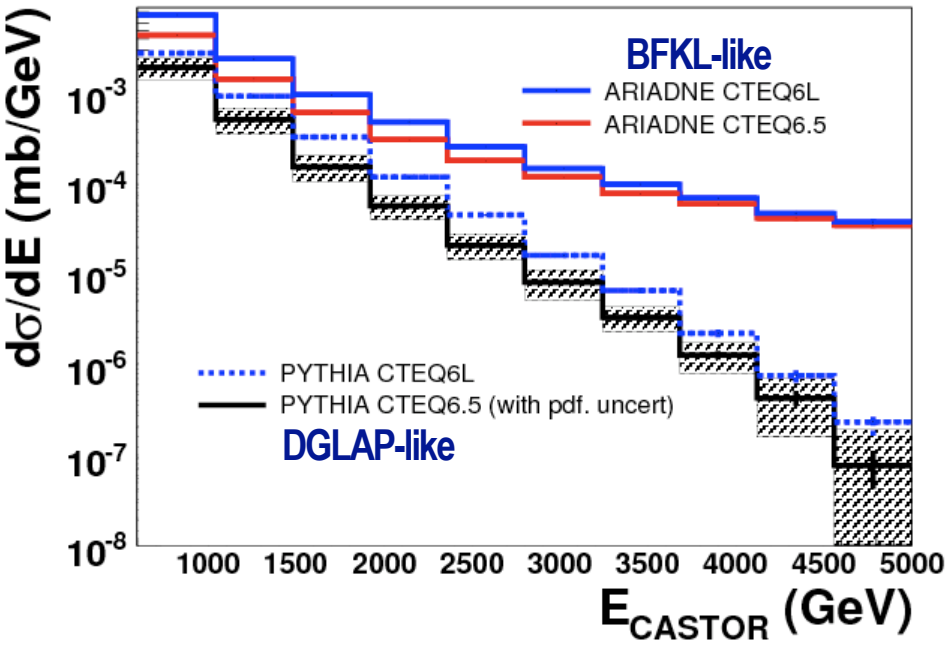
- Plan for 2010-2014: Extend physics program (in coord. with Univs.) covering the full kinematic range
  - Two applications for Young Investigator Groups have been submitted
    - SuSy
    - Higgs

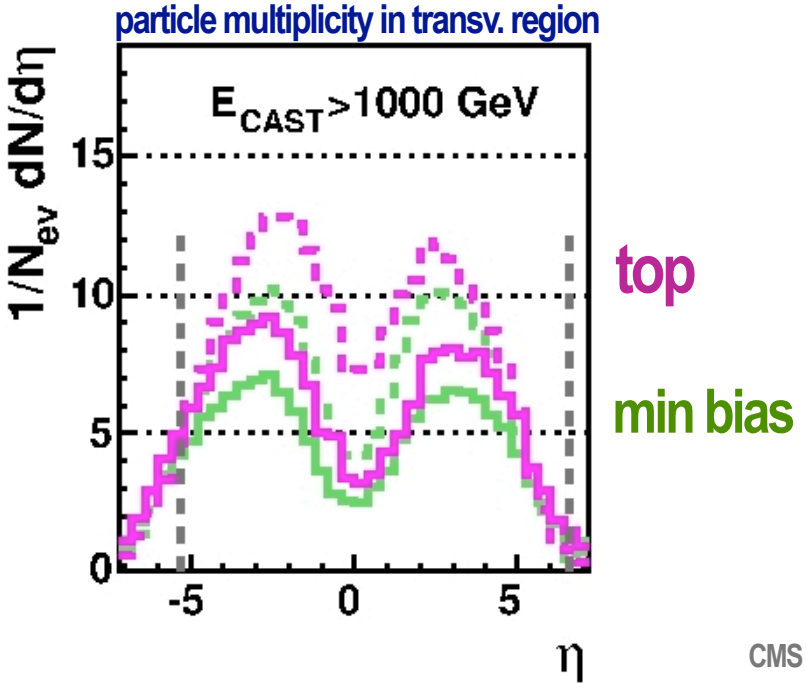


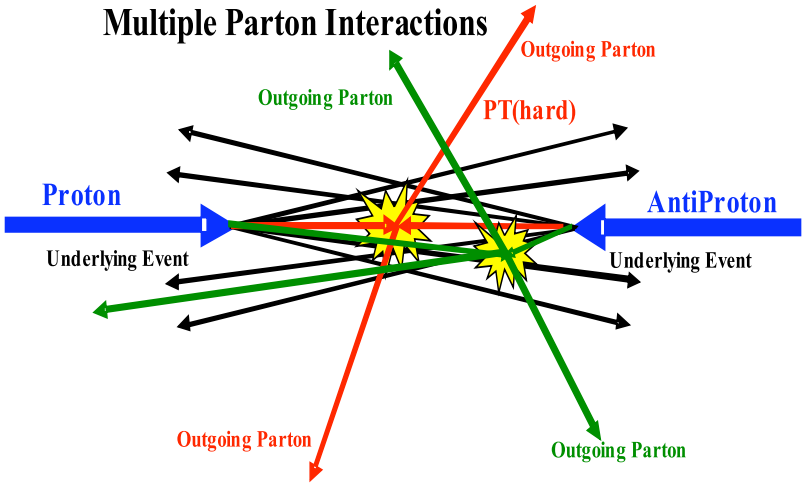
Physics

QCD

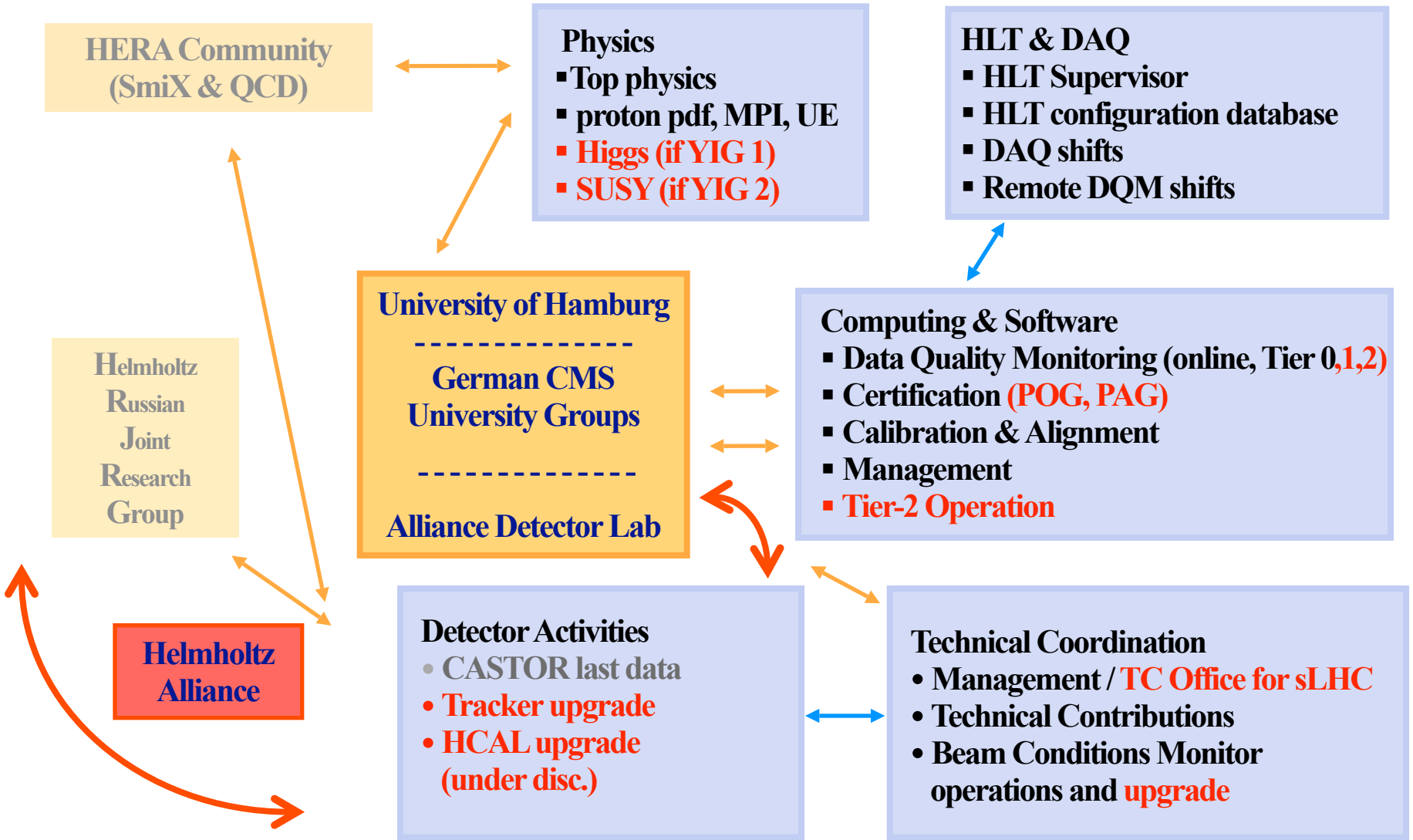
- Parton Distributions: proton structure
  DGLAP / BFKL / CCFM dynamics
- small-x dynamics:
  - parton saturation
  - multi-parton scattering
  - underlying event



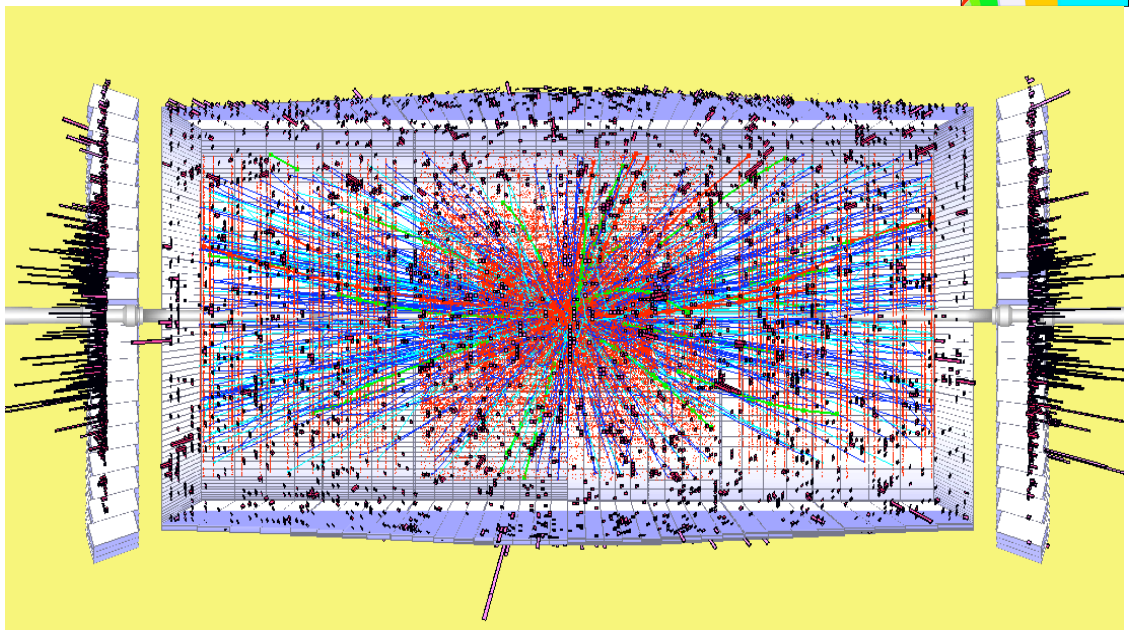




Activities & Network (2010-2014)



Tracker Upgrade

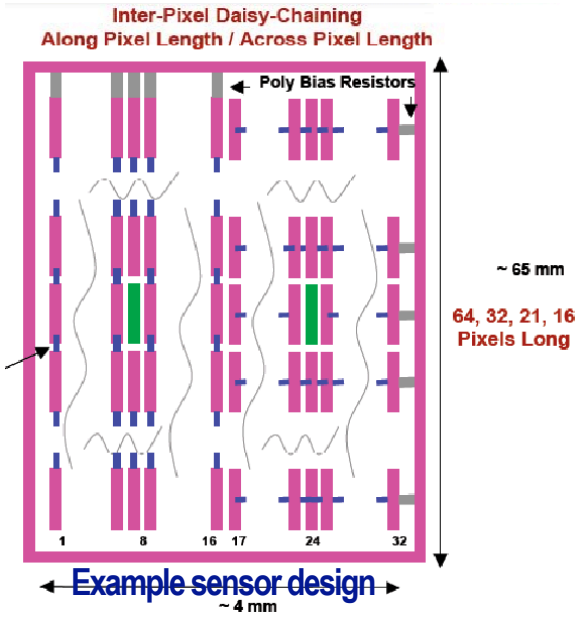


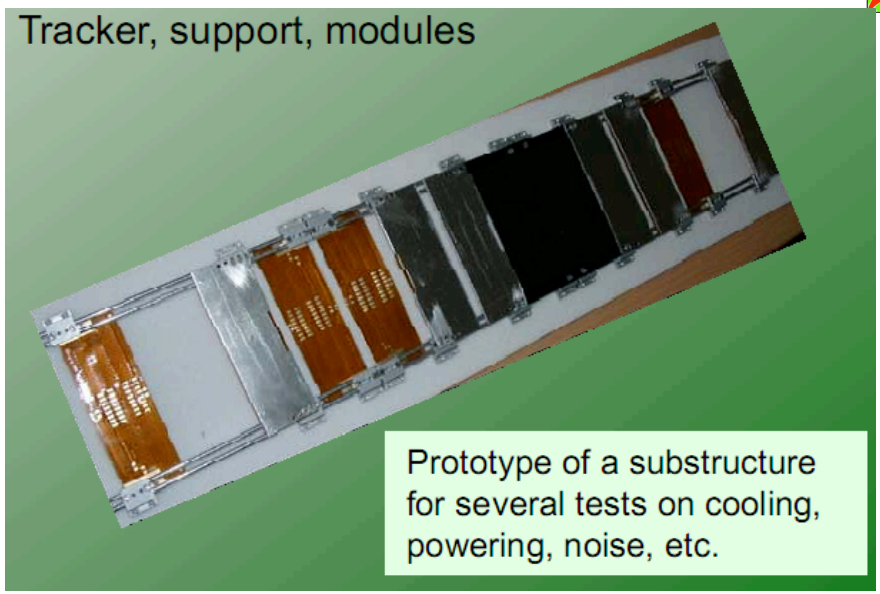
- Luminosity Upgrade sLHC
  - Challenge in radiation and occupancy
  - Reduction of material desirable

- R&D at German universities in context of international CMS tracker consortium started or ongoing e.g. for
  - Sensor material: special silicon crystals to be extremely rad-hard
  - Sensor layout: readout ASIC on top of sensor, variable lengths of sensor strips to cope with increased track density at smaller radii
  - New schemes for cooling (CO_2) and powering: minimize current for readout and minimize material budget for support

Aim for a demonstrator: investigate performance and rad-hardness

Tracker Upgrade





- Possible contributions and provision of special technical support
  - Studies for stability with finite element methods
  - Simulations
  - Precision mounting and bonding
  - Quality control
  - Testbeams using EUDET telescope

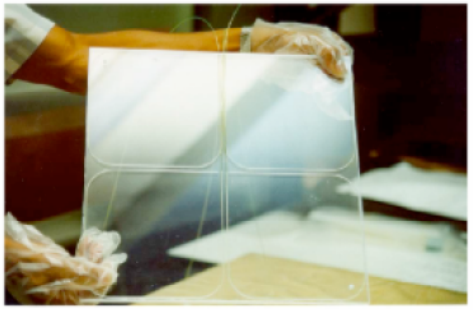
Support of the German groups / detector-lab within infrastructure of the Terascale Alliance

HCAL Upgrade

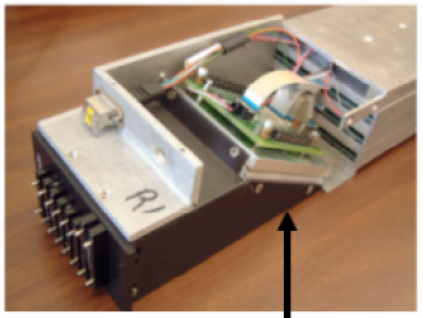
Under discussion

- Radiation damage in innermost layers
- Reduce occupancy of innermost layer
- Timing needed for non-collision background suppression
- HPD discharges
- Use novel technology of SiPM as new read-out device
- Higher granularity → improved resolutio through weighting methods

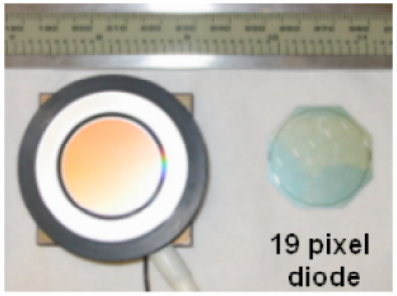
Single layer behind the magnet
4 fibers per tile

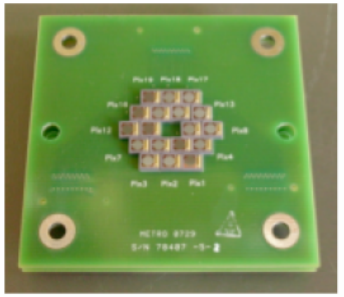


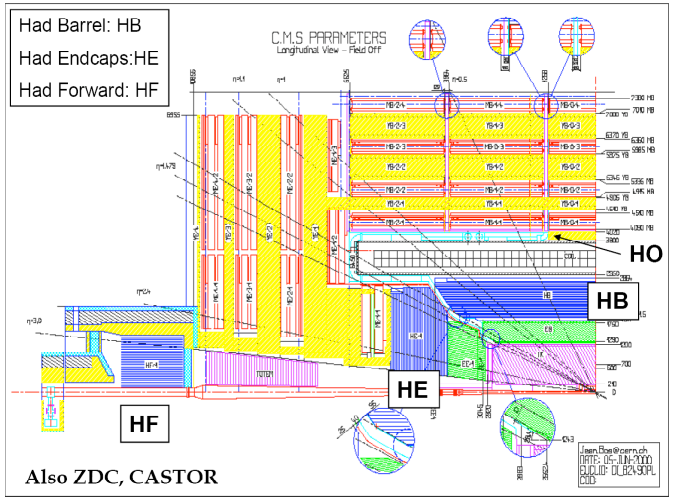
HCAL readout module
4 fibers per tile



Simple replacement of HPD with SiPMs



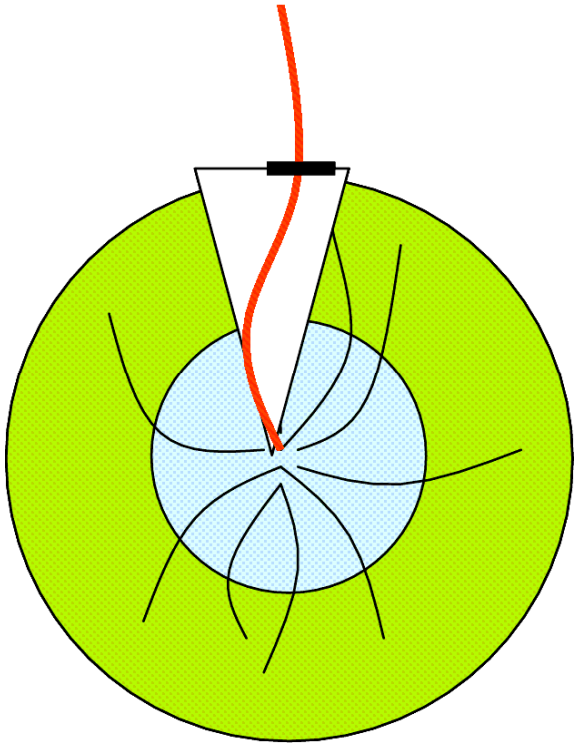




HCAL Upgrade

Possible DESY contributions under discussion

- **Simulation and reconstruction for finer granularity**
  Collaboration with Hcal calibration group (Hamburg University)
- **Adaptation of weighting algorithms for improved resolution**
  Transfer of H1 knowledge
- **Cooperation in handling of SiPM, e.g. characterization, radiation hardness, quality control, calibration, interplay with r/o electronics etc.**
  Synergy with ILC-Hcal group's vast experience from ILC R&D, large scale application for technology
- **Participation in the upgrade for the HO layer -- potential common project between the Hcal and the muon detector groups: muon fast track tag**
  Close collaboration with two groups of RWTH Aachen, studying the option of scintillator tiles with SiPM for medium muon layer



Participation in Hcal upgrade: complements the activities of the German groups in Tracker and Muon, provide competence in calorimetry for later data analysis.

Conclusions

- Activities / deliverables in commissioning and operating the experiment, taking advantage of special DESY expertise staff/seniors
  Tech. Coord., BCM, CASTOR, HLT, DQM, Alignment/Calibration, Remote DQM shifts
- Several DESY staff members have coordination responsibilities at CMS level
- Close cooperation with German universities established (Hamburg, Karlsruhe and Aachen)

- Future: long term contributions providing specific expertise (technical and physics)
  - Detector operation, optimization, software development and maintenance, analysis preparation:
    - Central CMS-wide services
      Trigger - DAQ / DQM / Calibration & Alignment
  - Physics analysis and Computing:
    - Physics analyses with focus on Top-Quark and QCD (SuSy and Higgs planned)
    - Host, prepare, support and perform physics-analyses using NAF coordinated with Hamburg Univ., Karlsruhe and Aachen
  - Contributions to Tracker, Hcal and BCM detector upgrades for sLHC