PRS and ECAL-egamma

Current situation of PRS in CMS

DAQ TDR work of PRS

Towards Physics TDR

ECAL-egamma tasks and ongoing work

C. Seez, UK CMS Physics Meeting

14th February 2003

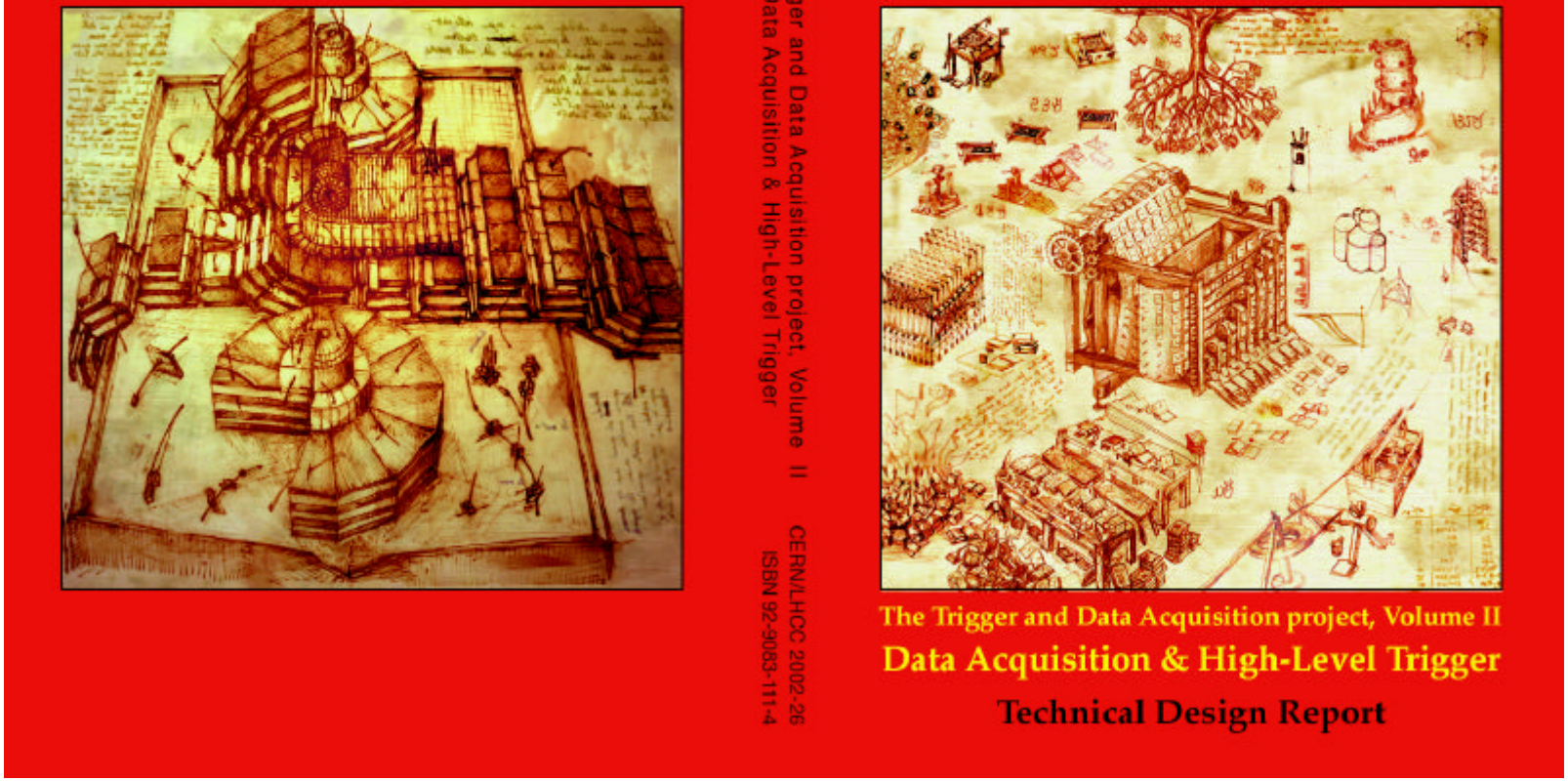
PRS Organization for DAQ TDR (2002)

- Physics Reconstruction & Selection (PRS) groups
  - CPT started in January 2001
  - PRS: the P in CPT (Computing, Phys Reco & Sel, TriDAS)
    - Groups were put in place in 4/99, formalized within each detector group with the start of CPT.
  - Today, since Jan 2001, four groups:
    - ECAL-Electron/Photon
    - Muons
    - HCAL-Jet/Missing E_T
    - TRACKER-b/τ (vertex)
  - Charge: create CMS detector, reconstruction and simulation software; evaluate full chain (from Lvl-1 to offline) of physics selection for CMS. First priority the HLT:
    - study, design & implement algorithms and code to provide the online rejection/efficiency needed for CMS physics plan

ECAL-egamma tasks

- ***Simulation and Geometry (GEANT) — Sasha Nikitenko***
  - **CMSIM®OSCAR; geometry model; geometry interface for reconstruction; verification with test beam data; fast simulation**
- ***Detector response simulation, and digit 'reconstruction' — Vladimir Litvin***
  - **ORCA 'Calorimetry' domain: Sampling ADC simulation and reconstruction; selective readout scheme; simulation of trigger primitives; verification with test beam data**
- ***Electron and Photon physics objects and HLT — Emilio Meschi***
  - **ORCA 'ElectronPhoton' domain; reconstruction and selection of electrons and photons**
- ***ECAL calibration***
- ***ECAL test beam and pre-calibration***
- ***ECAL data handling***

DAQ TDR HLT section was first major milestone for PRS project

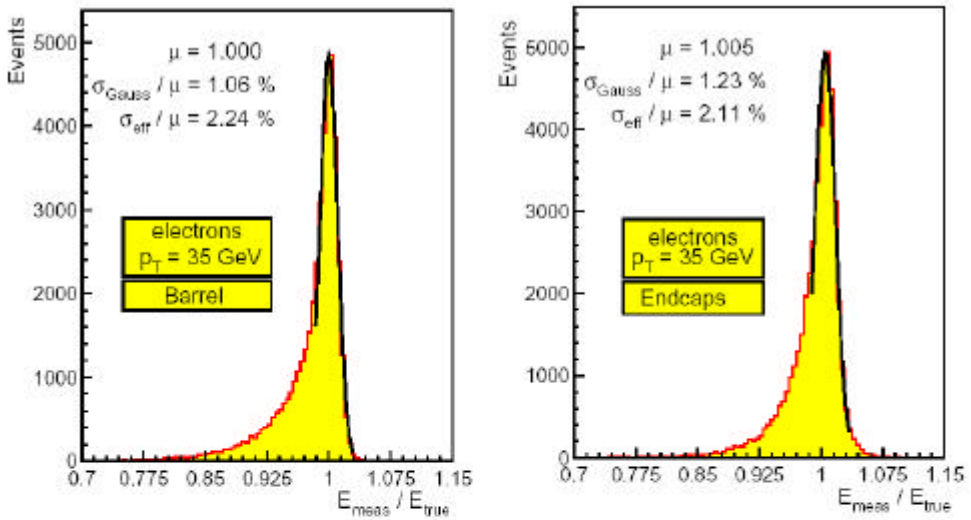


CMS Physics Reconstruction and Selection

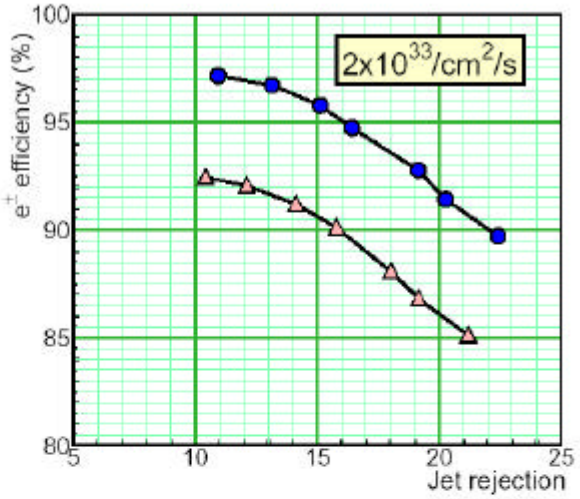
- ***DAQ TDR submitted in December 2002***
  - **Available at** `http://cmsdoc.cern.ch/cms/TDR/DAQ/daq.html`
- ***HLT section (chapters 14-16): A substantial achievement of PRS project***
  - **Complete reconstruction and selection to permanent storage, at both low and high luminosity, with details of rates, and details of efficiencies for benchmark physics channels**
  - **Selection is done within unified CMS OO software framework — no 'two worlds' problem between online and offline**
  - **CPU-time used by the code is compatible with projected performance of HLT farm**

Examples of results

Energy resolution



ε vs rejection for pixel matching



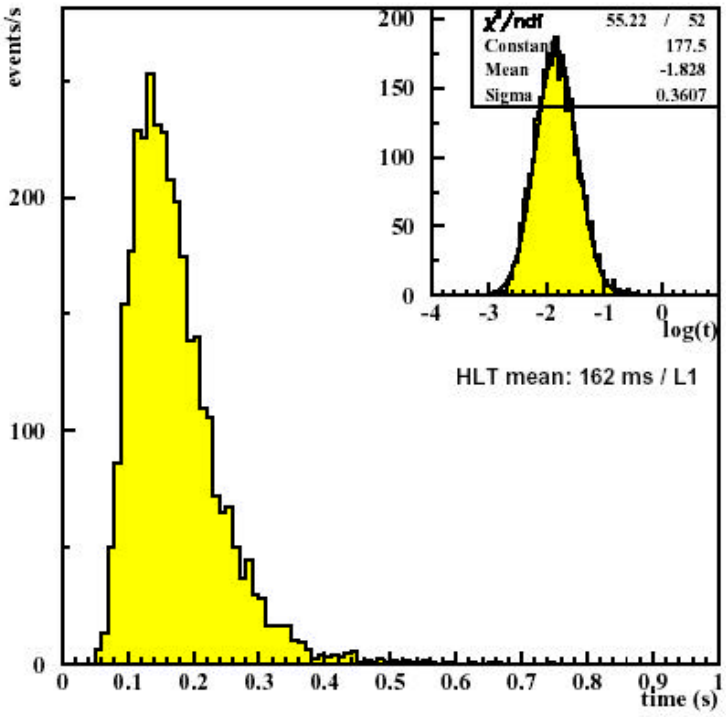
Electron and photon rates output by the HLT at low and high luminosity

	$2x10^{33}cm^{-2}s^{-1}$			$10^{34}cm^{-2}s^{-1}$		
	Signal	**Background**	**Total**	**Signal**	**Background**	**Total**
Single electron	$W\rightarrow e\nu$: 10Hz	$\pi^{\pm}/\pi^0$ overlap: 5Hz π^0 conversns: 10Hz $b/c\rightarrow e$: 8Hz	33Hz	$W\rightarrow e\nu$: 35Hz	$\pi^{\pm}/\pi^0$ overlap: 15Hz π^0 conversns: 19Hz $b/c\rightarrow e$: 6Hz	75Hz
Double electron	$Z\rightarrow ee$: 1Hz	~0	1Hz	$Z\rightarrow ee$: 4Hz	~0	4Hz
Single photon	2Hz	2Hz	4Hz	4Hz	3Hz	7Hz
Double photon	~0	5Hz	5Hz	~0	8Hz	8Hz
TOTAL:			43Hz			94Hz

HLT Reconstruction and Selection: CPU time

HLT level	Mean CPU time (ms)
Level-2.0	154 /Level-1 event
Level-2.5	32 /Level-2 event
Level-3	100 /Level-2.5 event
Total	**162 ms/Level-1 event**

- **Timing on 1GHz PIII**
- **HLT $2x10^{33}$ $cm^{-2}s^{-1}$**
- **1/1000 events selected**
- **Within requirements for online farm in 2007**



Other issues covered

- ***Data format and size***
  - **Selective Readout — selective readout scheme simulated, with results for data volume reduction**
- ***ECAL Calibration***
  - **Statement of what calibration samples are required — but detailed results from full simulation of *in situ* calibration is still an outstanding issue**
    - ➔ **W ®en, Z®ee calibration: Two main issues:**
      - ***Unscrambling the constants — minimization, matrix inversion, or iteration needed***
      - ***The tradeoff between electron efficiency and the presence of bremsstrahlung — variation with h***

        Leads to strategy (for W→eν) of intercalibrating individual crystals within a small region using loose cuts; then intercalibrating regions with much tighter cuts
    - ➔ **j-symmetry method studied in some detail**

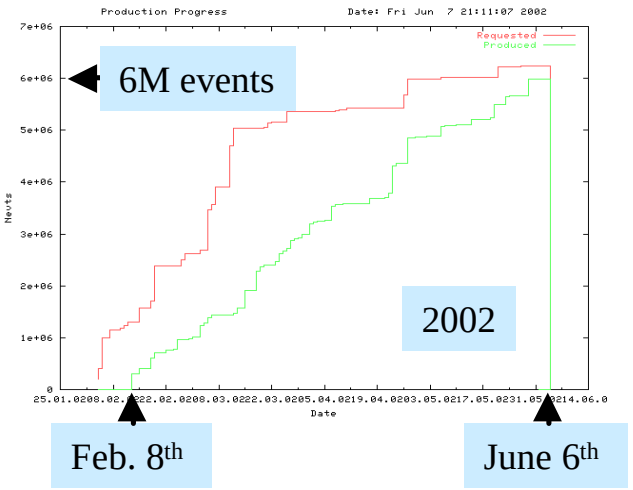
Production of Monte Carlo data

- ***Production team (CCS) produced 5-10M fully simulated events at sites dispersed globally***
  - **Requests for event samples co-ordinated by PRS**

Generators
Pythia…

Fast simulation
FAMOS

Detector simulation
GEANT/CMSIM (OSCAR)



Response simulation
Digitization; pileup
ORCA

Reconstruction and
Selection
ORCA

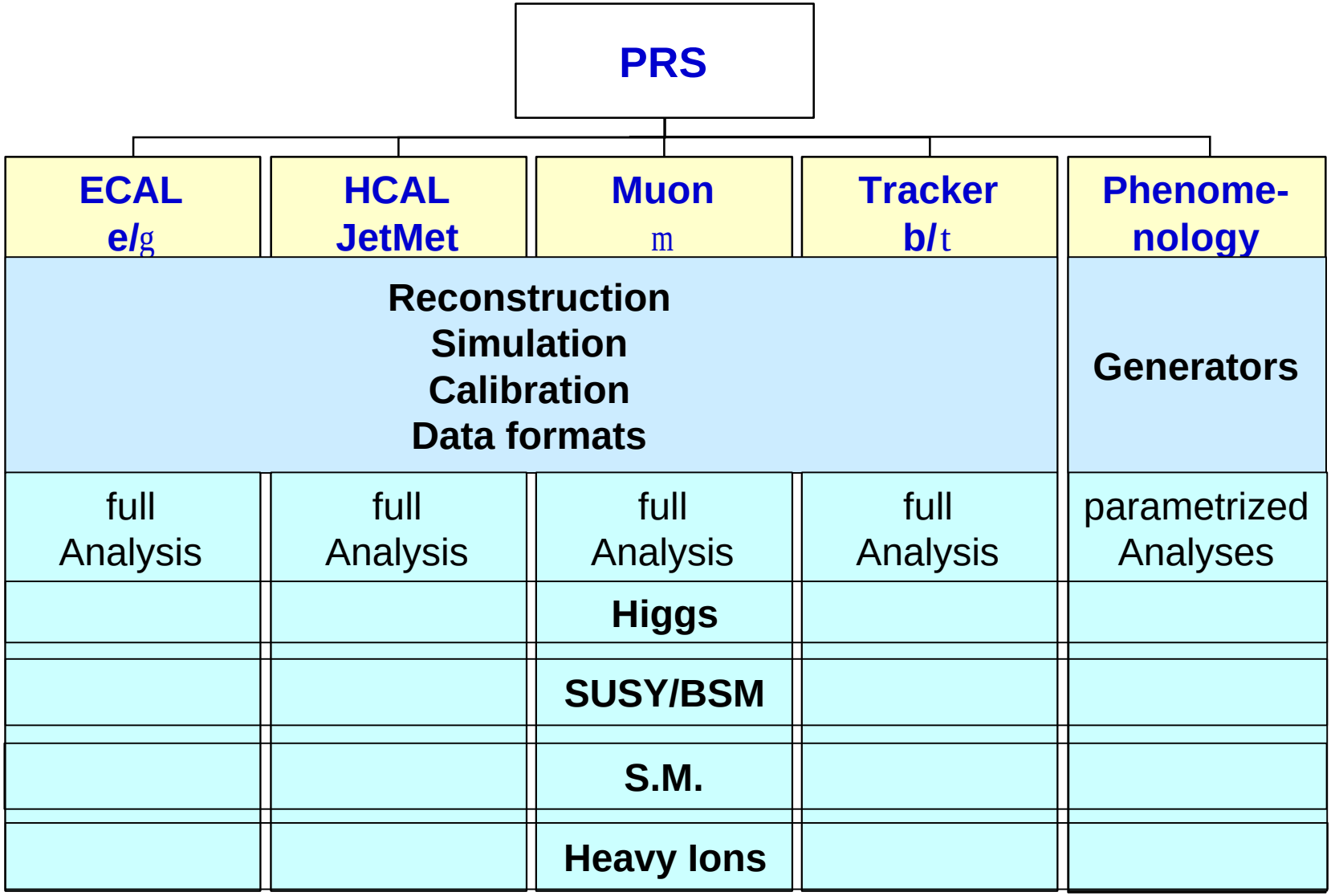
Physics TDR

- ***Next major milestone is Physics TDR***
  - **Startup – 18 months (End of 2005)**

- ***Aim is to develop and demonstrate readiness of people and software tools for analysis of real data***

  - **Volume 1: Detector performance**
  - **Volume 2: Physics analyses**
    - ➔ Part I: Fullest possible detail of ~2 channels/signals/topics for each sub-detector group
    - ➔ Part II: All other physics…

PRS Organization for Physics TDR



Physics TDR – Organization

- ***Detector-PRS groups and Analysis-PRS groups***
  - **Detector-PRS groups have responsibility for full-analysis chapter(s) in Physics-TDR (Volume 2, Part I)**
    - ➔ So, chapter on H→γγ in ECAL—e/γ group
  - **Analysis-PRS groups have responsibility for Volume 2, Part II**
    - ➔ So, chapter on SUSY Higgs in Higgs group
- ***Selection of group leaders for Analysis-PRS groups***
  - **Currently consulting with the collaboration…**
- ***On "detector-PRS" side: need to decide on two analyses that will be pursued in detail***
  - **These are the "full analyses"**
  - **For ECAL-egamma these will probably be:**

    H®gg and H®ZZ*®4e

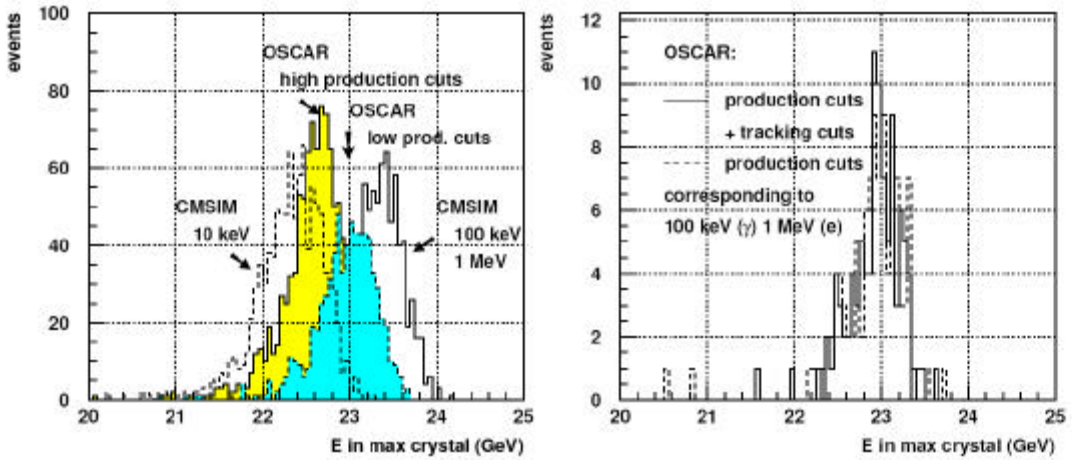
    - they cover a rather full range of reconstruction and selection issues for electrons and photons

Current situation…

- ***2003 is the year of OSCAR***
  - **Changeover from GEANT 3 (CMSIM) [Fortran]**
  - **To GEANT 4 (OSCAR) [C++]**
    - ➔ Use of Data Description Database (DDD – XML based description)
- ***Also, to complicate matters, the change of the persistency mechanism from Objectivity to ROOT streaming***
- ***Verification of OSCAR by June***
  - **Tuning of parameters production cuts, cutoffs etc – vs CPU time**
  - **Generation of significant samples for comparison CMSIM/OSCAR**
  - **Verify geometry model**
  - **Verify physical properties of e.m. showers etc – e.g. width of e.m. showers in ECAL**
  - **Final validation of the simulation model will be with test beam data**

Example of work in progress…

OSCAR 1.4.0 versus CMSIM 127



- The main change is in CMSIM between the 10 keV cuts used by Sasha and 100 keV (γ) 1 MeV (e) cuts.
- The OSCAR results presented in the previous meeting had the default production cuts (10 cm corresponding to 1.16 MeV (γ) 231 MeV (e)) and only the tracking cuts at 100 keV (γ) 1 MeV (e), which was a mistake.
- The tuned production cuts (2mm/0.9mm) give very similar results with Sasha's 0.02 mm sample, and no change with the tracking cuts apart from timing.

K. Lassila-Perini e/γ meeting 15.1.03

- **Need to check effect of "light collection curve"**
- **Express as $S1/S9$ to compare with test beam data**

DC04

- ***"Data Challenge" for Computing Model — must deal with 50M events over 1 month: proof of data handling etc***
  - **Generation of these events will occupy all CMS production capacity during second half of 2003**
  - **However detector PRS groups will specify data samples so as to obtain maximum usefulness…**
  - **Data desert: previous MC data requires ORCA 6/RedHat 6/Objectivity and is likely to become difficult to access before much new MC data becomes available… ("New" = ORCA 7/RedHat 7/ROOT)**

Ongoing or needed work…

- In situ *calibration*
  - Large and urgent task
- *Electron tracking*
  - Appropriate to different selections: HLT, calibration, ZZ* etc
- *Converted photons*
  - Reconstruction; use of tracks to reject p^0; use of tracks to locate vertex
- *Use of pre-shower detector (to reject p^0, use of position measurement)*
- *Full HLT selection coded in ORCA*
- *New EE trigger tower scheme*
  - And basing of EE trigger tower description in DDD
- *Selective readout modified for new EE readout scheme*
  - Readout elements are supercrystals; proposed selective readout scheme based on trigger towers
- *Simulation of readout units — clustering in region of interest*
- *Full ECAL geometry description to be re-written*
  - Not urgent; OSCAR geometry still based in GEANT 3 description…

Summary

- ***Physics TDR: test of, and development of, readiness of people and software***
  - **Physics and phenomenology with simulation and Monte Carlos is useful and interesting, but we shouldn't loose sight of the ultimate goal: real data**
- ***UK people already involved in many aspects and at many levels; we should aim to increase the participation***