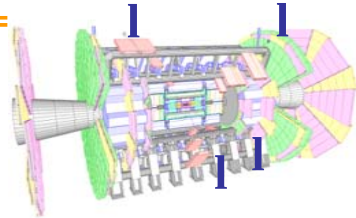
Plans on H->4l (e,μ) analysis with CSC samples



Nectarios Ch. Benekos[1], Rosy Nicolaidou[2], Stathes Paganis[3]
for the collaboration among:
[1] Max-Planck-Institut für Physik, [2] Saclay muon group, [3] Sheffield University

OUTLINE

- Short reminder of what was done in the past
  - Full analyses on DC1 samples
  - Performance studies on Rome samples
- Plans for present /future

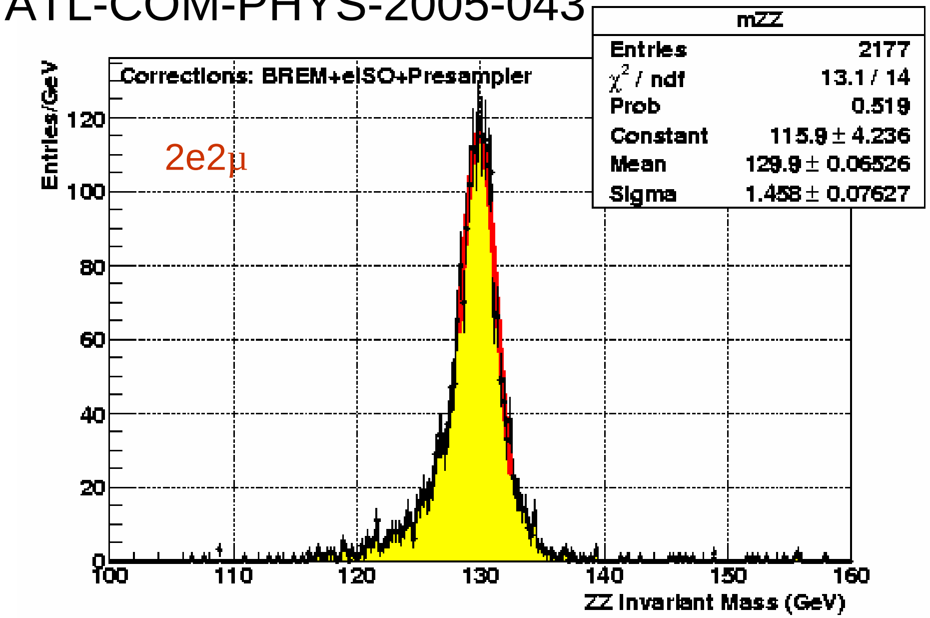
Past Activities I

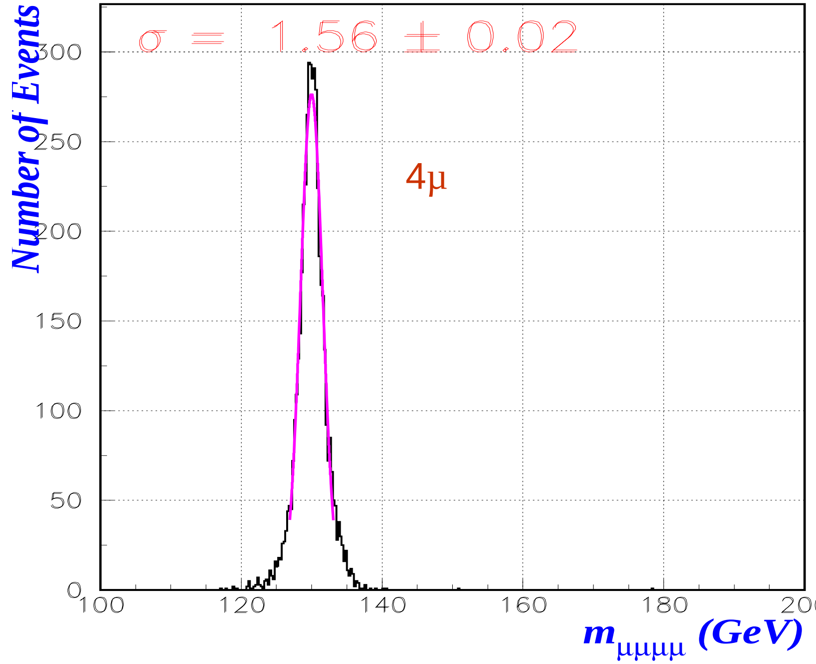
What was done after the TDR (1999) using Data Challenge 1 samples

- Full analysis chain with signal + background in all 3 channels
  - **CBNT based analysis**
  - **TDR-like cuts**
- Main aim of these analyses was to do performance studies on lepton channels

(e.g of talks given on the subject: **Talk on Higgs Working Group** 25/5/2005, **Talk on Physics Week** 5/11/2004)

ATL-COM-PHYS-2005-043

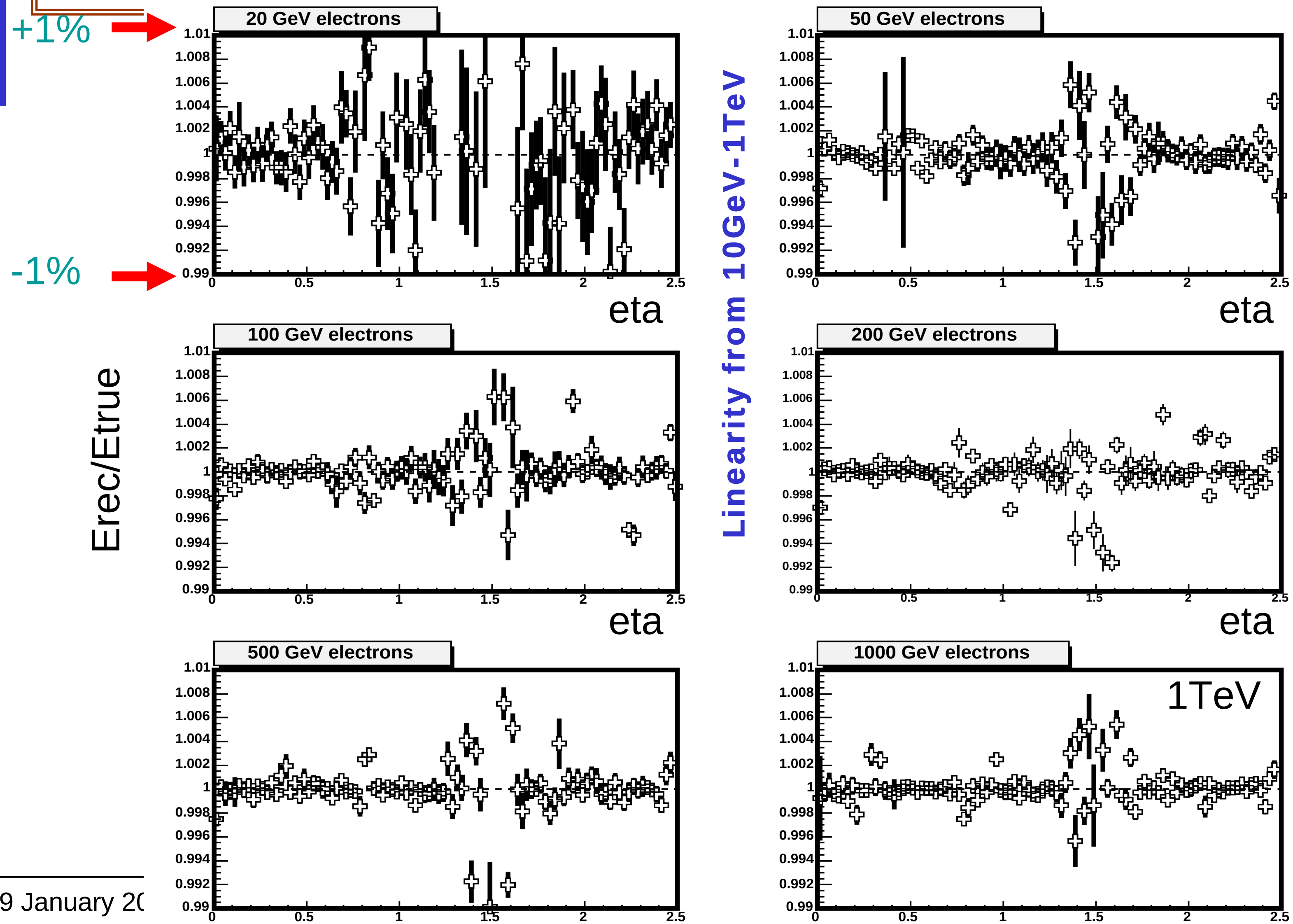




✓*Resolution on m_H:* Worse by ~10% w.r.t TDR
New geometry of μ-spectrometer (cracks) and more realistic simulation of ID (material + field)

Past Activities I

- Erec: new parameterization function introduced based on recent TB Analysis results (T.Carli et al.)
- Extraction of new longitudinal weights
  - Become official after G4 migration
  - at “rome” samples individual weights for 3x5, 3x7, 5x5 clusters were calculated



Past Activities I (Reconstruction efficiency in 4μ state)

- At the TDR eff~84% for 4μ ⇒~16% inefficiency due to the signal acceptance
- Now eff~65% for 4μ ⇒~35% inefficiency out of which we know that

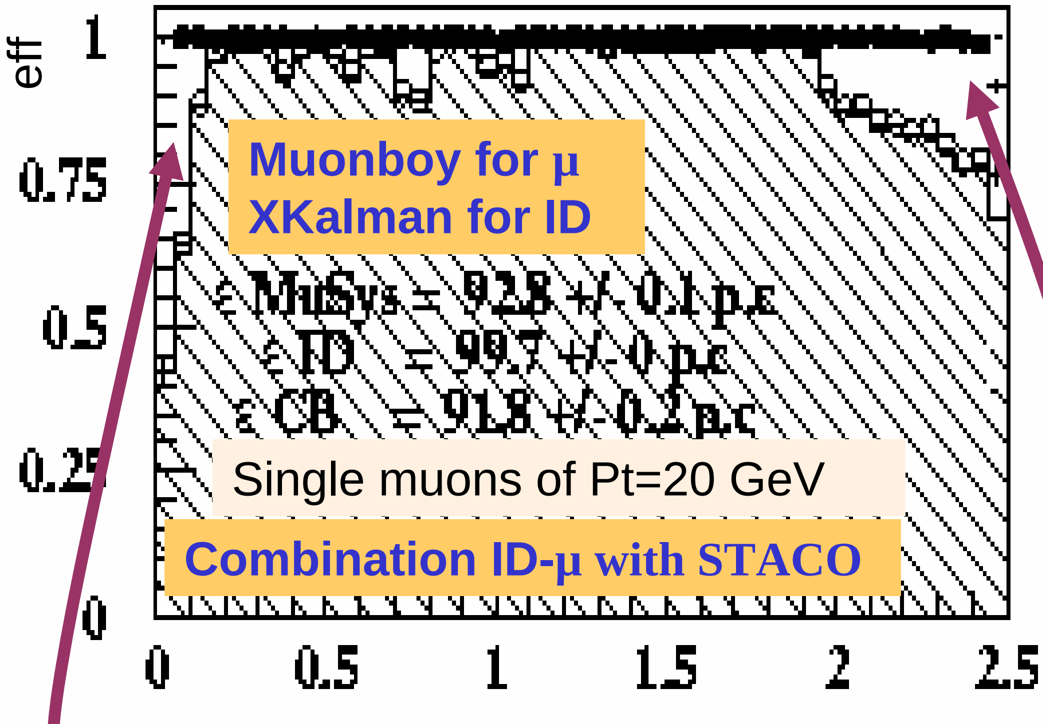
6% signal acceptance

9% due to new layout

4% software problems

6% ($\sqrt[4]{6} \sim 1.5$ %)

Order of magnitude of our incomprehension of the single- μ efficiency



Drop due to new layout (η crack)

Drop due to software problems

Past Activities II – Rome samples

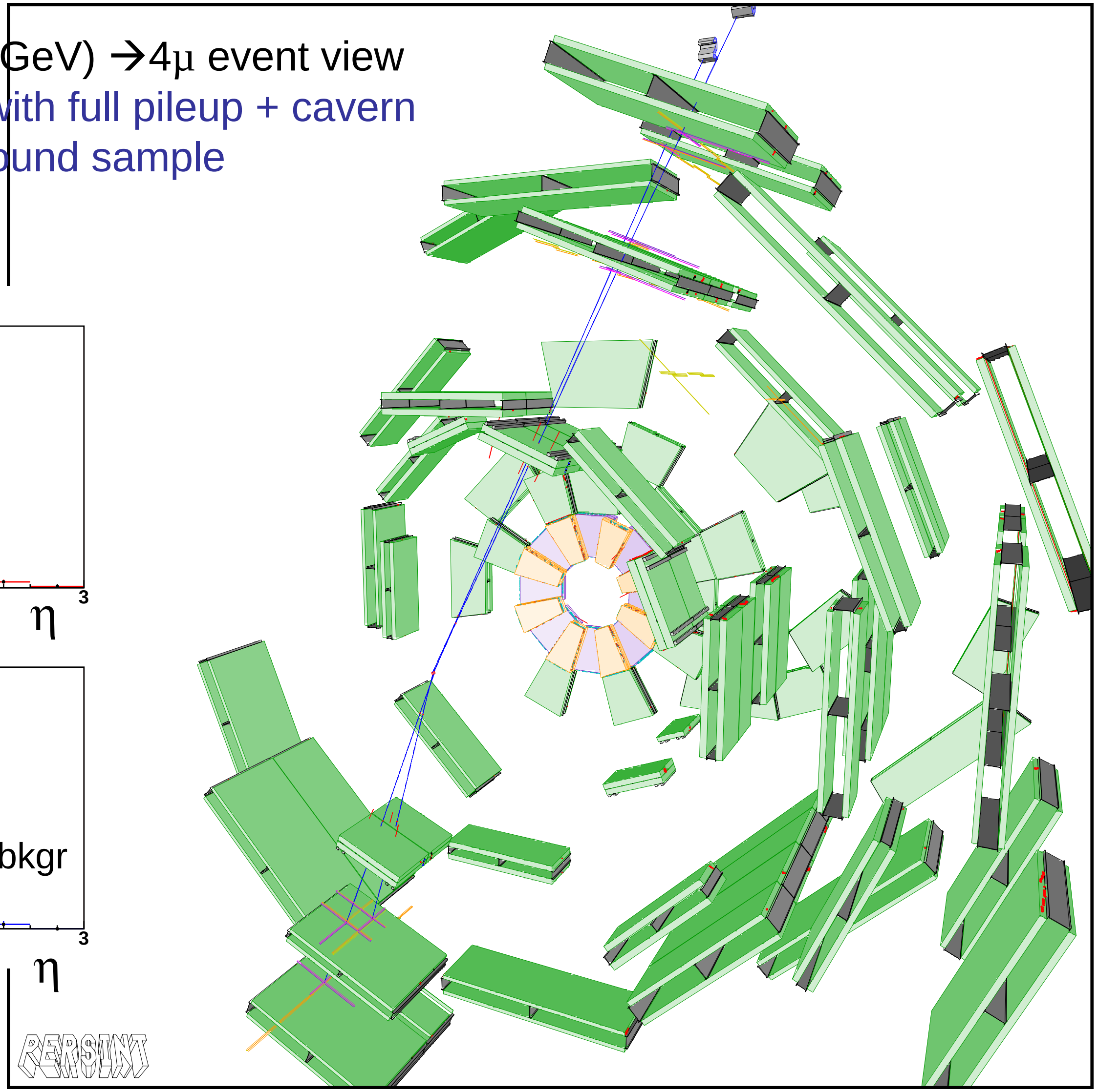
What was done so far with the “rome” samples :

- Migration of analyses in “eventView” framework and first tests
- Stathes talk
- event view wiki page

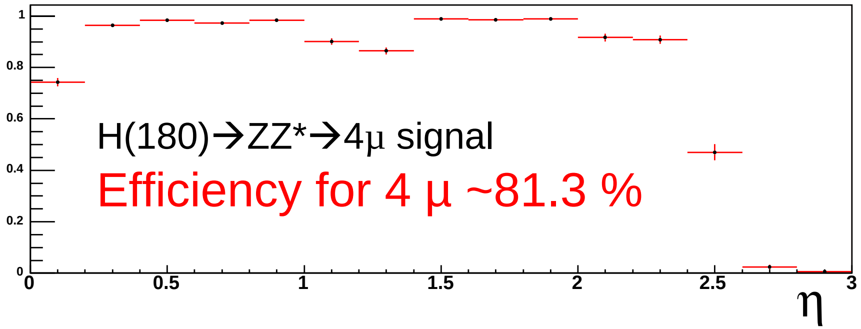
- Performance studies with full pileup + cavern background (4μ channel)
  - Pile-up at low lumi 10^{33}
  - Cavern background with safety factor 1
    - (sf01→1 x nominal ATLAS bkgr)

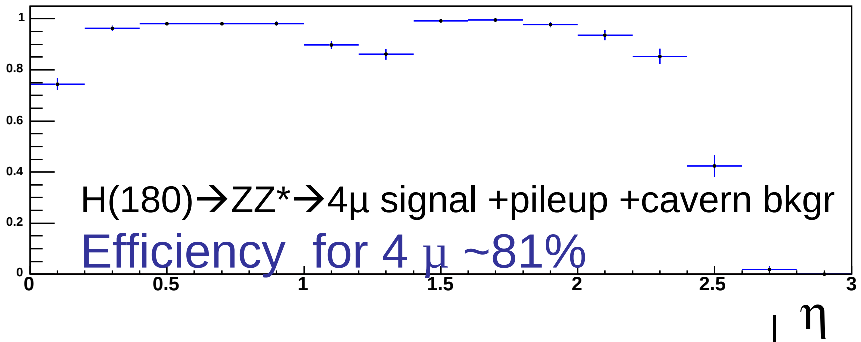
Past Activities II – Rome samples

H (180 GeV) → 4μ event view
signal with full pileup + cavern background sample



Combined ID-μ spectrometer efficiency using STACO package





Plans towards CSC samples

- **Our Aim :**
  - Work at Generator/filter level
  - Performance studies on CSC samples after each release
    - "where we stand" for a quick feedback
  - Full analysis on all 3 channels (4e, 2e2μ,4μ) on a stable release (12.0.X ?)
    - 120 - 200 GeV Hmass region of interest
    - studies on miscalibrated and misalignement effects (detector "as-built")
  - Use of the experience gained by CTB04 analyses (applied to e-id studies)
    - performance study of certain traditional e-id-cuts
    - studies on the systematic effects that each cut may involve
      - Method: Vary realistically the shapes of discriminant observables we are cutting on (e.g. shower width in the strips) and study the effect on the Higgs analysis
        - Comparison of these observables with the existing data to justify their use and performance.
    - identification of correlated e-id cuts so that we can remove those that are more sensitive to systematics than their correlated counterparts

Plans towards CSC samples (cont'd)

- **Generator level:**
  - HiggsMultiLeptonFilter (in collaboration with D. Rebuzzi, S. Rosati, A. Nisati)
    - implementation of a Filter algorithm based on MultiLeptonFilter algorithm
    - cuts on invariant masses could be implemented to generate Zbb and tt backgrounds only in the signal phase space region
    - improve the rejection of background events that won't be selected by the ATLAS Event Reconstruction and Analysis Package, while keeping acceptance 1 for the Higgs signal
    - performance studies as well as studies on possible biases introduced are still needed there

- **DC3 / CSC samples**
  - in order to have a complete analysis with sufficient statistics (signal + bkgr) as it was done in DC1, the production of additional samples may be needed.
    - willing to participate, if needed (plans of the HiggsWG?)
  - The "**complete analysis**" is the key issue since a lot of things changed since DC1
    - software chain
    - Detector geometry

Changes in the ATLAS Software since DC1

Major changes in ATLAS Software chain since DC1 in:

- POOL/SEAL Event Persisency/Dictionary
- Detector Geometry → GeoModel as the unique tool for all subdetectors
- **Geant4 simulation; Athena-based pile-up, digitization and event mixing**
- **Full integration from RecoTaskForce designs/recommendation - new EDM**
- House-cleaning - robustness, performance, dependencies, etc.
- Interactive as well as batch - Python job options files
- GRID production - LCG2, NorduGrid, Grid3
- Testbeam-specific deliverables - DCS data, calibrations, real ByteStream, online monitoring, etc.
- **New Physics Analysis Tools**
- ….

ATLAS Geometry Layouts

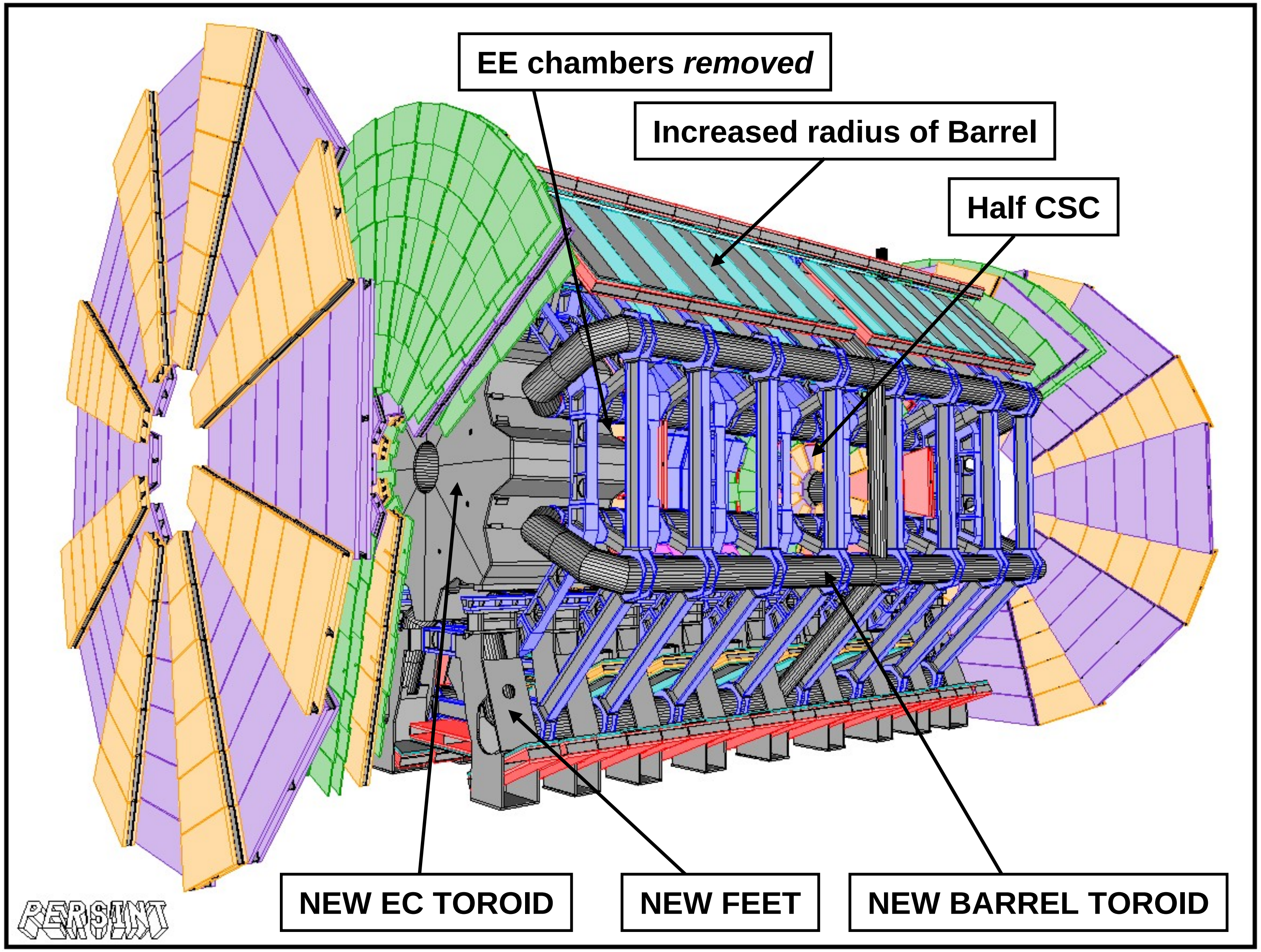
❑ Differences in DC3 and Rome with respect to DC2 Layout

- ❑ Pixel: missing one layer
- ❑ SCT: no difference
- ❑ TRT: missing some end-cap wheels (C)
- ❑ LAr: no difference
- ❑ Tile: missing crack scintillators
- ❑ Muon: initial layout Q instead of P
  - ❑ EEL and EES chambers removed
  - ❑ one layer of CSC removed

❑ Switching between layouts is done by setting only one property in jobOpt.py file:

- ❑**'ATLAS-DC3-02' --> fixes to ATLAS-DC3-01**
- ❑**'ATLAS-DC3-01' --> 3 layers of pixel, no TRT-C wheels,**
- ❑MuonLayout = **R01.initial for the muon spectrometer** which is essentially identical to Q02_initial_pro with the exception of additional, corrected descriptions of the passive material
- ❑**'Rome-Final' --> equivalent to the Rome2005**
- ❑**'Rome-Initial' --> equivalent to the Rome2005**

Geometry layouts (Muon Spectrometer)



Detector Specifications for CSC Simulation

- This includes accuracy of the geometry, plans for alignment studies and effects to include in the digitization. Envelopes and Misalignments
- In order to misalign the geometry in simulation it is necessary to leave enough room around items that will be moved

Summary of DD workshop on 15/11 and SPMB on 21/11

Implementation	Release 11.0.2+	Release 11.0.10+	Release 12.0.0 …
B-field	As in 11.0.1	Barrel toroid with egg shape for toroid and tile (symmetric field over 90º lifted up by 3.5 mm)	Solenoid tilted. End-cap toroids displaced. Asymmetric field map (if memory ok).
Muon chambers	Resolve clashes in layout Q02. Move to layout R as soon as possible.	Move to layout R'. Systematic displacements for barrel (toroid egg-shape). If feasible, also individual displacements.	Individual displacements of all chambers. Deformations and wire sags.
LAr calorimeters	Complete validation of GeoModel and optimise range cuts.	Displacements of solenoid and half-barrels. Displacements of end-caps.	Sagging of lead plates. Barrel/end-cap crack. HV issues. HEC/FCAL refinements.
Inner Detector	Bulk of missing material.	Displacements of barrel TRT, barrel SCT and pixels. Same for end-caps?	Displacements of individual modules. Module deformations. Completion of mat.desc.
Databases and general infrastructure		Tool to migrate small files to Cool. All files migrated to Cool. GeoModel interface for detector pos. in Sol or Glob	Final optimisation of G4 cuts and digitisation parameters. Overall management of CondDB

Analysis Tools

- **Event View** Analysis framework

  - EventView allows us to run in parallel different combinations of the H->4l event and easily study the performance of each of them
    - Example: The S/B for H->4l depends dramatically on the nature of the "electrons" and "muons" used. The best S/B may be coming from combination of egamma electrons and soft-electrons(muons). One may also want to keep particles which are outside the |eta|<2.5 ID region

  - Provides a clean/straightforward particle overlap removal

  - Provides a particle labeling scheme which allows the user to monitor all overlaps

  - Will provide:
    - generic fitting
      - (no more private Z->ee fitters),
    - multivariate and general statistical tools for advanced analysis

  - Allows us to create a miniAOD AthenaAware-ntuple with only the variables we are interested in including our own variables which are automatically written in the ntuple.
    - the ntuple allows back-navigation to the ESDs.
    - It can be read back in our H->4l analysis reducing tremendously the processing time

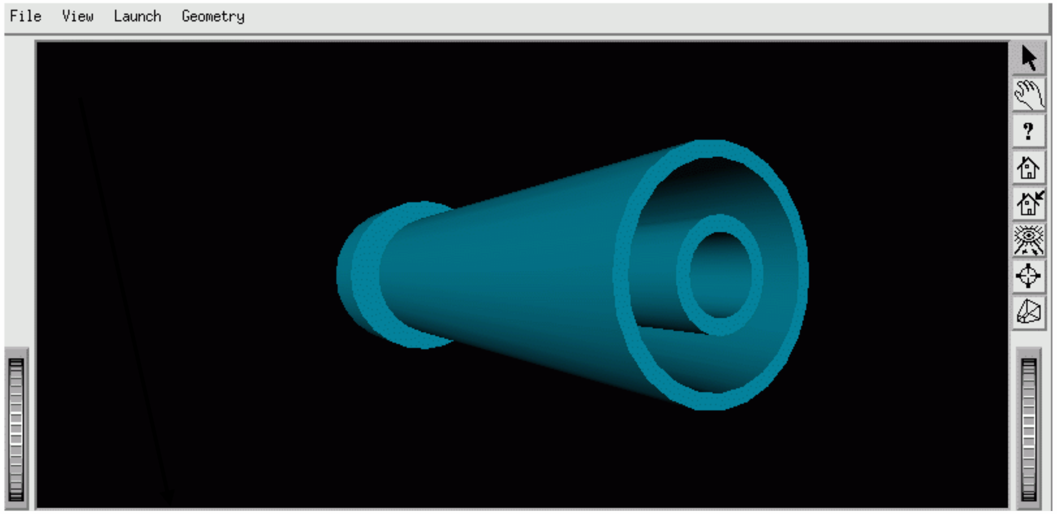
- Repeat the old CBNT based analysis for cross-checks in the beginning at least

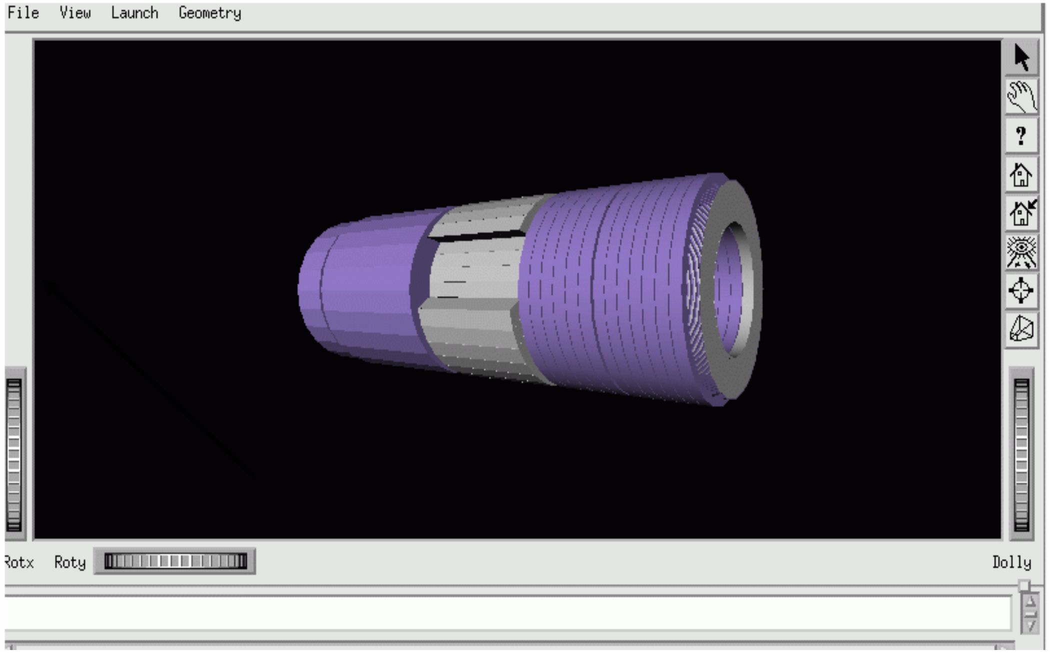
Summary

- Main aim is performance studies with the CSC samples
  - Lepton performance
  - Higgs performance and optimization
- Usage of the new Physics Analysis Tools
  - EventView
- Work on Higgs MultiLepton filter to optimize statistics of background samples

Geometry layouts (Inner Detector)

Detector layouts	Complete	Initial	Complete-300 μm	TDR
Radius of b-layer	5 cm	5 cm	5 cm	4.3 cm
Longitudinal pixel size of b-layer	400 μ	400 μ	300 μ	300 μ
Middle pixel layer	yes	missing	yes	yes
Pixel disk #2 and forward TRT wheels	yes	missing	yes	yes


File
View
Launch
Geometry


File
View
Launch
Geometry
Rotx
Roty
Dolly