LBL, May 10 2000
Software week

Physics milestones for Software

F. GIANOTTI (CERN)

+ Some requirements

MC generators → see I. Hinchliffe

September 2000:

- output of major generators (Pythia, Isajet, Herwig) interfaced to HepMC++
- Isajet and Pythia interfaced to framework
- configuration manager available ?

ATLFAST → see P. Clarke

- Today 2 versions available:
  - Fortran: very rich, used for Physics TDR
  - ATLFAST++ (ROOT based): less complete (e.g. jet algorithms and shower parametrisations missing) C++ but no full OO design
- New OO version is being prepared.
- Fall 2000:
  - new OO version
  - one or both (still to be decided) old versions

} interfaced to framework

Fall 2000 : physics groups start use MC generators + new ATLFAST from framework and redo benchmark TDR physics studies to validate new environment / packages

Deadlines for results:

- ATLAS week Feb. 2001
- ATLAS Physics Workshop ~ June 2001
- Full validation : middle 2001

GEANT4 physics validation

→ see K. Amako

- Comparisons with test beam data started → lot of work needed

- Lot of experience in ATLAS with simulation packages
  September '97 : dedicated ATLAS workshop → conclusions in ATL-COM-PHYS-99-5

  - need to simulate physics processes from ~ 10 eV (ionisation potential in gas) up to few TeV
  - validation may impact test beam programme (e.g. do we need $\pi^{\pm}$ E < 5 GeV ?)
  - most difficult :
    - had interactions ID
    - had packages Calorimeter
    - radiation background Muon

→ need coherent effort in ATLAS

First ATLAS wide meeting at CERN
on May 18th (video available)

Deadlines towards validation:

- October 2000: Physics simulation workshop at CERN
- ATLAS Physics workshop ~ June 2001
- "finalise validation" ≡ G4 can replace G3 by end 2001

- There is a lot of experience on simulation packages
  September 1997: devoted ATLAS workshop at CERN
  → conclusions summarised in ATL-COM-PHYS-99-056.

- G4 will be validated against test beam data and G3.
  First studies indicate that a lot of work is needed
  → see D. Barberis talk

Note: -- need to simulate physics processes from ~10 eV (ionisation potential in gas) up to few TeV
-- validation may impact test beam programme, e.g. if one needs low-energy pions (E < 5 GeV)
-- help from GEANT4 team is necessary

- "Physics" requirements:
  -- G3 and G4 must be simultaneously available and interfaced to the SAME geometry to allow direct comparisons
  -- need FLUKA interfaced to ATLAS geometry.
  Work started → FLUGG project
  (FLUka with Geant4 Geometry)
  Note : FLUKA is also essential tool for radiation background in the experiment and for hadronic interactions in the Inner Detector.

Do we need an "intermediate" simulation ?

i.e. shower library or shower parametrisation

With ATLFAST and GEANT we are not far from covering our needs …… BUT

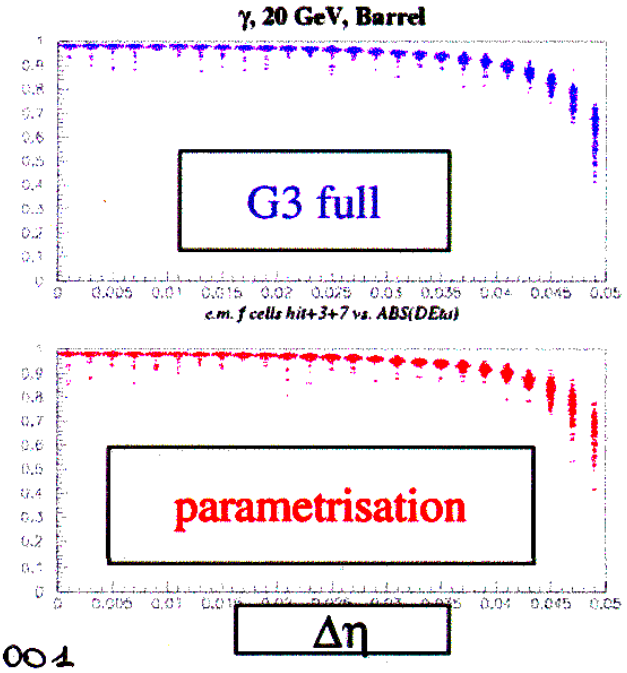
Shower parametrisations:
should make ATLFAST more powerful → trigger
should make GEANT4 faster (e.g. full sim. replaced by parametrisation in well-behaving detector regions).
Examples: A → ττ, W mass measurement

Work started :

-- conceptual study to understand for which processes, which particle, which E / η parametrisations could be used. Look also at past/present experiments

-- first parametrisations made for LVL1 trigger studies

EM fraction in
Δφ x Δη = 3x1 trigger towers vs distance from impact point in η wrt impact cell centre



Time scales:

- Physics simulation workshop October 2000
- ATLAS Physics Workshop 2001

Reconstruction → see Reconstruction session

- New reconstruction in framework by end 2000
- We should also have ATRECON (or parts of it) wrapped into framework for reference ?

NB: TDR data must be available to the framework from Objectivity on same time scale

→ End 2000: Combined Performance Groups can start use new reconstruction within framework
→ repeat benchmark TDR performance studies reading TDR data from Objectivity

Deadlines for results:
- ATLAS Physics Workshop ~ June 2001
- TDAQ TDR (~ middle 2001): e± trigger
- Full validation: end 2001

"What Mock Data Challenge, or other activities which exercise the full spectrum of software from simulation through physics object data, is being planned ? How will the success of these exercises be assessed ?"

A few "milestones"

- October 2000 : Physics simulation workshop
  To discuss GEANT4/ test beam data comparisons (G4 team will be invited)
  First conclusions on shower parametrisations

- Spring 2001: ATLAS Physics workshop
  Results on benchmark performance using new reconstruction running in the framework and reading TDR data from database.
  Results of benchmark physics studies based on MC generators and new ATLFAST running in the framework.
  Second round of results from GEANT4 physics validation and shower parametrisation

- Summer 2001 : TDAQ TDR
  Single electron trigger with new reconstruction in EF

- End 2001 : Mock Data Challenge Zero
  ~ 10^5 Z + 1 jet events with $Z \rightarrow \ell\ell$. Allows performance studies of all sub-detectors
  Read/write database, all simulation levels (G4, ATLFAST, shower parametrisation), trigger, full reconstruction

- 2002 : Mock Data Challenge 1 (see Norman's talk)
  ~ 0.1% of data collected in one year.
  Low L : B-physics dominate trigger rate
  High L : inclusive electron trigger dominates
  Operation of the FULL software chain (including to some extent calibration/alignment) + validation of distributed computing.
  Physics sample: that expected in the absence of New Physics (e.g. correct mixture of all Standard Model processes).

- End 2002 : Computing TDR
  Results of the above steps

- 2003 : Mock Data Challenge 2 (see Norman's talk)
  ≤10 % of data collected in one year at high L.
  Complete use of calibration/alignment.
  Sample split into sub-samples. Each sub-sample contains SM processes + a process from New Physics (not known to the people doing the analysis).

- t_0-1 (t_0= LHC start-up year) : ``Readiness document''

-- work done on MC generators, MC library which will be used, status/strategy of MC production
-- strategy for using different levels of simulation for different processes
-- reconstruction strategy
-- comparisons G4/test-beam → systematics from full sim.
-- main figures of Physics TDR redone with new software