



The ATLAS ID.



■ Outline :

◆ Brief ID Overview [FIG]:

- The Transition Radiation Tracker (TRT)
- The Semi Conductor Tracker (SCT)
- General ID items

◆ Then moving into the main topic of this review :

- The PIXEL system as a part of the ATLAS ID.
- The ID installation schedule with emphasis on the PIXEL system

◆ Final comments



ATLAS ID overview, TRT



- The barrel modules are built in the US and the wheels in Russia (A+B) and CERN (C).
- Developments :
 - ◆ Straw production completed
 - ◆ Straw-reinforcements operational in two places (PNPI and Dubna)
 - ◆ The ASIC situation is promising with good results from DMILL (but a cost-problem)
 - ◆ Lab and H8 (testbeam area) measurements with DMILL electronics promising
 - ◆ 8 plane wheel completed and measured
 - ◆ Barrel module production started in the US
- Still too early to be specific about module production rates which in the end will be the critical parameter.
- The final assembly, integration will take place at CERN.
- Critical items :
 - ◆ TRT module production start-up.
 - Main worry is the start-up of the end-cap production in Russia.
 - ◆ Further electronics systems tests - barrel - also urgent as the module production has started.



ATLAS ID overview, SCT



- Fundamental unit a module consisting of 4 silicon detectors, hybrids and heat-spreader plate, supported by barrels or disks.
- Developments :
 - ◆ Detector order in, pre-production completed, PRR completed for 80% of the sensors, production being released
 - ◆ ASIC pre-production (DMILL) in progress, first batch received, performance promising but both performance/yield (low in this batch) will need to be verified/understood better.
- Module FDRs including all surrounding items to take place in the Spring 2001
- Module production in 9 clusters around the world until 2003.
- Integration of barrels and one endcap at CERN, one endcap at NIKHEF.
- Critical items :
 - ◆ SCT electrical system verification.
 - As pre-production series of detectors and ASICs are becoming available, system-tests with several irradiated modules are urgent.
 - Tests have been done for year in the systemtest lab (B186) and H8 but not yet with the module Os.
 - ◆ Production schedule for the optical harnesses another worry
 - ◆ Cooling circuit layouts
 - ◆ Module production start-up, logistics.



ATLAS ID overview, integration



- Some of the subsystem assembly plus the entire ID integration and commissioning will take place at CERN in 2002-2005.
- The main tasks (summary) :
 - ◆ Sub-system assembly (in parallel)
 - ◆ Integration of sub-systems into ID barrel, end-cap A and end-cap C.
 - ◆ Tests of the ID parts (barrel and endcaps).
 - ◆ Survey and alignment (optical and X-ray) and full verification of the ID systems before installation.
- This requires large semi-clean areas (800m²) at the surface, a large amount of infrastructure and a substantial amount of human resources.
- Other major ID integration activities are (not covered in this talk) :
 - ◆ Services layout for the ID and services modelling of critical regions
 - ◆ The evaporative cooling system
 - ◆ Survey and Alignment of the ID components
 - ◆ ID Software



PIXELs in the ATLAS ID



- The PIXEL detector is the innermost part of the ATLAS ID and plays a key role in :
 - ◆ The ID tracking
 - ◆ b-physics and b-tagging

- Initial physics goals of ATLAS :
 - ◆ SUSY and Higgs (leptons, jets, b-tag, E_T -miss)
 - ◆ The ID is therefore crucial: Full rapidity coverage, at least two PIXEL layers, out of which one is the B-layer

- Three layers needed quickly for b-tagging performance :
 - ◆ There is a 30% degradation of the jet rejection going from 3 to 2 layers at a b-jet efficiency of 50%, due to increased fake track rates and increased number of tracks with non-unique PIXEL hit allocations.
 - ◆ This has a significant impact on the SUSY, Higgs and SM physics performance in ATLAS.

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ATLAS ID, PIXEL-layout



- The general status of the PIXEL system : see later talks.
- Due to the ASIC delays, the PIXEL schedule is not anymore compatible with the TDR layout (which requires around 1900 modules ready early 2004) for integration with the barrel SCT.
 - ◆ Reminders and comments :
 - The current schedule was based on having ASIC pre-production starting in September 2000.
 - The current PIXEL schedule was determined by the barrel ID installation date (5/2004), the PIXEL detector had to be ready for integration and testing at the surface in the beginning of 2004.
 - The close linking of the SCT barrel and PIXEL subsystems (in terms of schedule, thermal environment, shielding, testing) is only possible if the subsystems are in phase. With the radiation hard electronics problems this is not the case anymore.
- The obvious question is : can the PIXEL system be installed later as an independent unit, when the entire ID is in place :
 - ◆ Attractive because :
 - To upgrade and change any part of the TDR version of PIXEL system (except the B-layers) the entire ID (TRT,SCT,PIXEL) had to be taken to the surface (both Endcaps and Barrel, opened, modified and re-installed).
 - To miss the first installation date, even with a part of the system, is therefore a major problem.
 - Upgrades and repairs are very difficult.
 - Furthermore, there is still a significant uncertainty about how quickly one can reach a production version of the FE chip.



ATLAS ID installation schedule



- ID barrel :
 - ◆ Required in today's schedule : 3.5.04
 - ◆ Actually ready : 3.5.04
 - ◆ There are no major delays in the barrel SCT or barrel TRT subsystems.
- This mean that the in the TDR layout of the PIXEL system 1900 modules (the fixed part) would need to ready early 2004.

- ID EC-C
 - ◆ Required in today's schedule : 26.7.04
 - ◆ Actually ready : 11.6.04
- ID EC-A
 - ◆ Required in today's schedule : 18.10.04
 - ◆ Actually ready : 15.2.05
 - ◆ The main delay here is in the TRT wheels
- A replaceable PIXEL system can be installed up until April 2005 for LHC startup 1.7.2005.



ATLAS ID, PIXEL-layout



- ID Steering Group September/October this year : pursue fully replaceable PIXEL system.
 - ◆ Launch detailed simulations of performance (electron energy tails and b-tagging performance, material plots and TRT rate).
 - ◆ Engineering studies of the SCT/PIXEL interface, to present a fully replaceable 3-hit PIXEL system (6 months), within defined envelopes for the PIXEL (230mm) and SCT (260mm) to minimise engineering impact and delays for both subsystems.

- The three main constraints :
 - ◆ The routing of the PIXEL services (material)
 - Studies made so far indicate that this is possible if services are routed at radius above 20cm in the EC region.
 - ◆ The dimension of the SCT endcap bore (coverage and alignment grid)
 - SCT envelope is being changed to 260mm without very significant loss of performance, but with several layout consequences.
 - ◆ Use the detailed engineering made over the last 3-4 years in the PIXEL system to avoid a complete redesign of all aspects of the system
 - The design shown in the next two days is very optimised, and also flexible in case of having to go to two layers followed by an upgrade.



Final comments



- The PIXEL subsystem is a (the) key part of the ATLAS ID as it is crucial for both tracking and tagging of long lived particles. It is definitely a part of the baseline ATLAS ID system.
- The PIXEL layout and installation scheme (which will be shown over the next two days) have the maximum flexibility we are able build into the ID system integration in terms of schedule and upgrade possibilities for the innermost layers of the ID.
- From my point of view the baselining of the US PIXEL project is necessary now, in order to have a coherent ATLAS ID (or even ATLAS wide) baseline scope plan in the near future.