

ATLAS Toroid History

Updated: 28 November 2006 (Roger Ruber)

Information from:

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CERN library:

- ATL-TECH-92-003, ATL-TECH-92-004 (EAGLE)
- ATL-TECH-93-008 (ASCOT)
- ROM-NI-999 (ASCOT): S. Petrarca et al. (1992)
- Evian-les-Bains (1992) Proceedings of the General Meeting on LHC Physics & Detectors

1980s: Experiment Proposals for LEP

An experiment with a toroidal magnet is proposed (but rejected) for LEP.

Marc Virchaux (NA4, deep-inelastic muon scattering) is the driving force behind the idea for a muon spectrometer with an air-core toroid.

1992: Experiment Proposals for LHC

EAGLE (Peter Jenni):

Inner tracking detector in a 2 T solenoidal field

- inner detector radius 1.1 m, length 8 m
- thin superconducting solenoid ($\sim 1.0 X_0$, $\Delta r = \sim 0.22$ m)
- common cryostat for solenoid and liquid argon calorimeter

Accordion type liquid argon calorimeter

Hermetic hadron calorimeter (fibres or tiles)

Warm iron toroid muon spectrometer

- 2-4 m thick
- inner radius 4.6 m, length 14.7 m
- outer radius 9.18 m, length 27.120 m

Total weight 26,400 t (estimated)

ASCOT

central tracking detector

1.5 T solenoid

Liquid argon calorimeter

Muon spectrometer with 12 coils toroid (compare to 6 coils toroid for CLAS at CEBAF)

- Superconducting iron core end-cap toroids
 - twin toroid (2 behind each other with detectors in between)
 - radius 1.0 – 4.65 m, length 4.8 m
 - field at iron 2.45 – 3.72 T at 23.8 kA

- Superconducting air core barrel toroid
 - coil cryostats $26 \times 5 \text{ m}^2$
 - pancake shaped cryostat with sliced hole for detectors
 - 10 cold voussoir rings (inner support ring)
 - 10 warm strud rings (outer support ring)
 - overall support from the mid-plane, connected through the cryostat (cold mass) with sliding interface
 - inner free radius 5 m (outer radius 9.9 m)
 - peak field at conductor 3.5 T at 20 kA, 26×10^6 Aturns

Total weight 10,500 t (estimated)

ATLAS

Combination of EAGLE + ASCOT, due to similarities in design.

Interface region at 5 m radius:

- EAGLE inner detector + calorimeters
- ASCOT muon spectrometer with air core toroid

1994-1996: ATLAS pre-design studies

Barrel Toroid (CEA)

- cold voussoirs
- connection voussoirs at ribs

End-Cap Toroid (RAL)

- single cryostat

Solenoid (KEK)

- thin-walled ($0.66 X_0$) by using reinforced aluminium stabilizer

Design is considered too expensive. Costs for ATLAS should be equal to CMS.

Re-design:

- from 12 to 8 coils
- total ampere-turns 10% down
- barrel toroid gets warm support structure
 - warm voussoir
 - interface by titanium tie rods connected in between the cold ribs
 - tie rods can bend following the contraction of the coil during cool down
 - main support does no longer require warm to cold interface
 - main support feet moved from mid-plane to the bottom
- barrel toroid gets circular cryostats
(simpler, cheaper and more space for the detector)

1996 – 1999: Final design adjustments

Toroids:

- construction model coil B0 to study warm support design solutions (with help of LASA)
- same superconducting Rutherford cable for ECT and BT
- ECT and BT connected in series