Status of the RPC production

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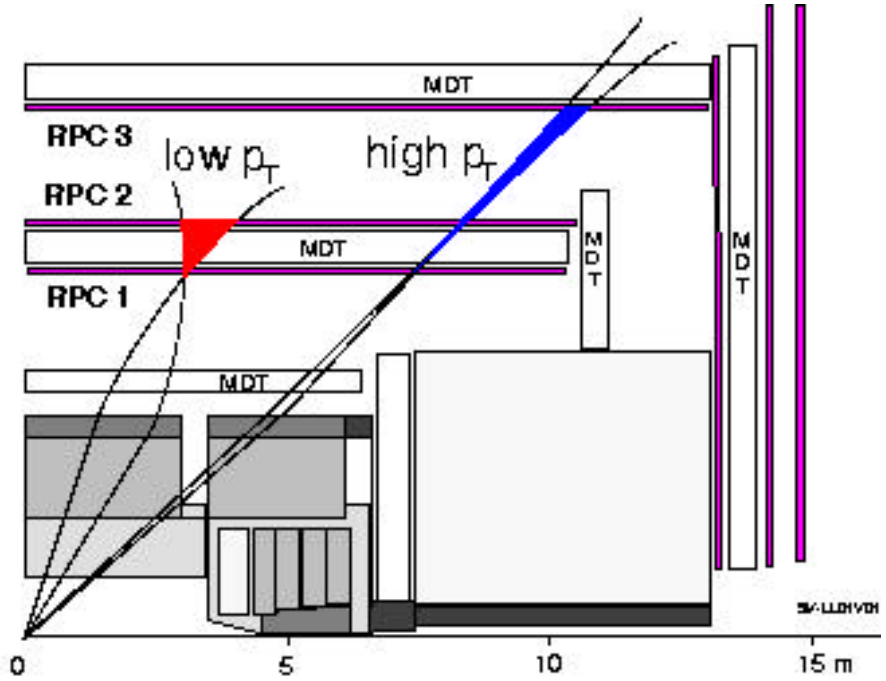
Outline

- **Reminder of the project**
- **Quality assurance of detectors**
- **Integration**
- **Status of production and Q.C. improvements**
- **Conclusions**

Participating institutes

- INFN Lecce (RPC production)
- INFN Naples (RPC production)
- INFN Roma 2 (RPC production)
- IHEP Protvino (RPC production)
- INFN Roma 1 (Trigger electronics)

Barrel muon trigger schematic



-1 Schematic view of the trigger principle.

- Each station has 2 indipendent detector layers: 2 measurements in η and 2 in ϕ
- Low p_T trigger uses RPC1 and RPC2 stations
- High p_T trigger uses low p_T results and RPC3 station
- The two layers in each station have independent LV & HV power supplies

What does an RPC look like?

Basic Unit

To cover 3.500 m^2:

1004 Standard Units

16 different dimensions

97% coverage

132 Special Units

(with holes for alignment bars)

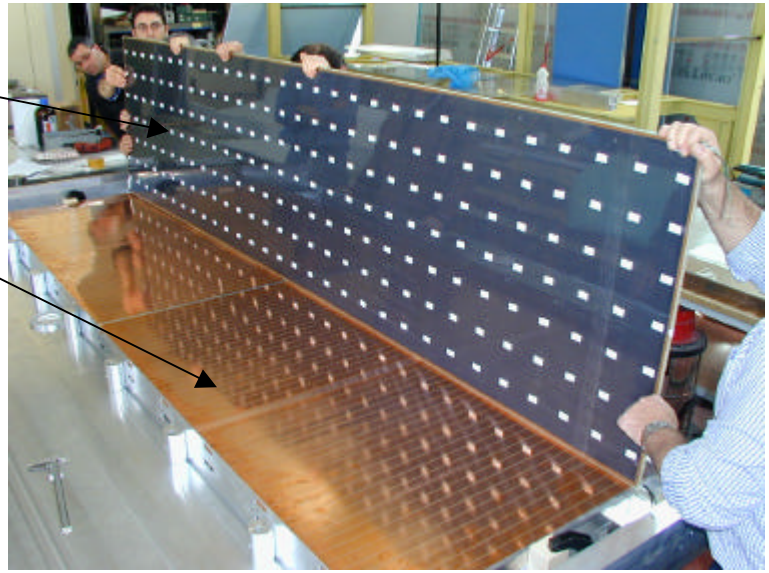
4 different dimensions

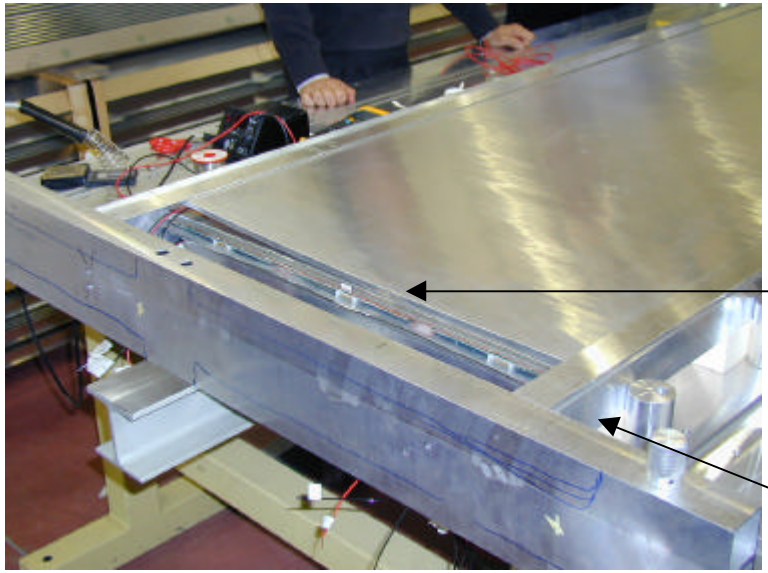
3% coverage

One Unit is a sandwich

Gas volumes

Cu readout electrode panels



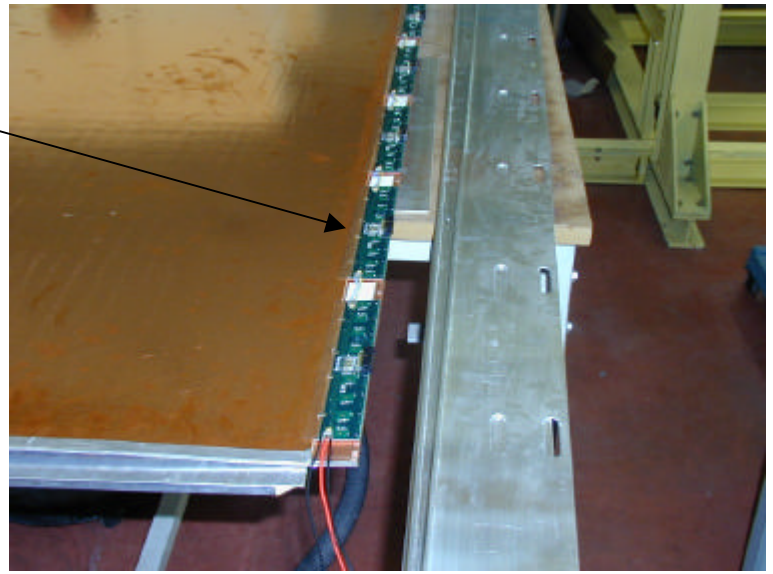


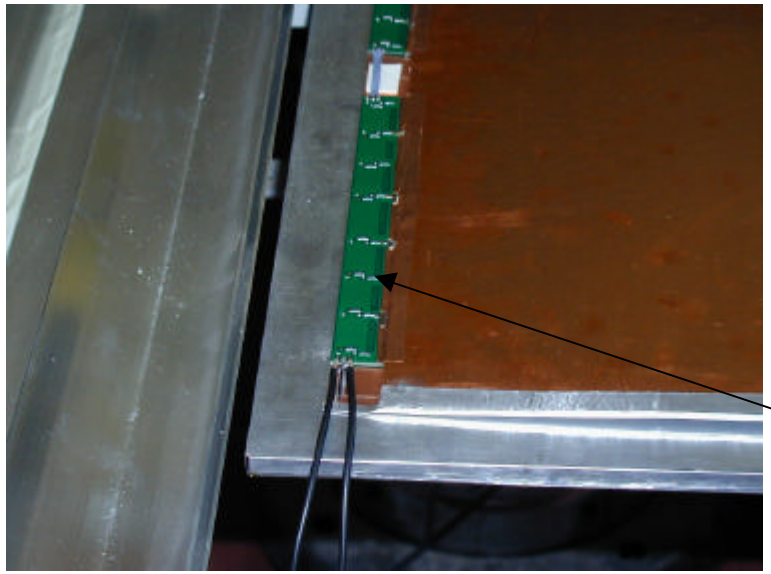
Paper honeycomb and Al support panels (Faraday cage)

Al lateral profiles

Front-End electronic is inside

Front-End boards with 8ch GaAs
3 stage amplifier and discriminator





Back-End boards with terminating resistors and test pulse distribution

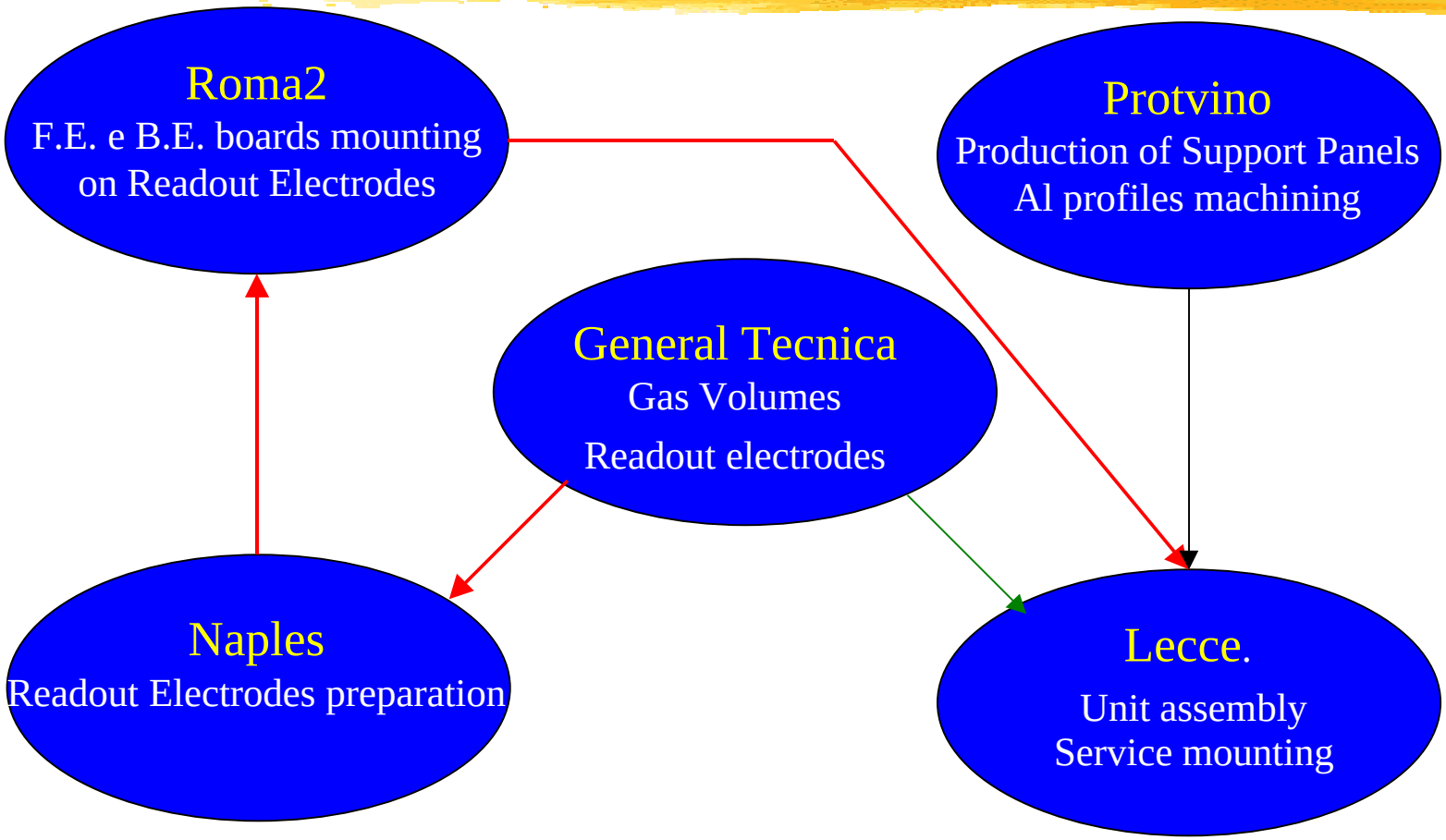
A few numbers

Units:	1.136
Bakelite plates:	7.360
Gas volumes:	3.680
Electrode readout panels:	8.560
F.E. and B.E. Boards:	48.148
• Readout channels:	385.184

Production principles

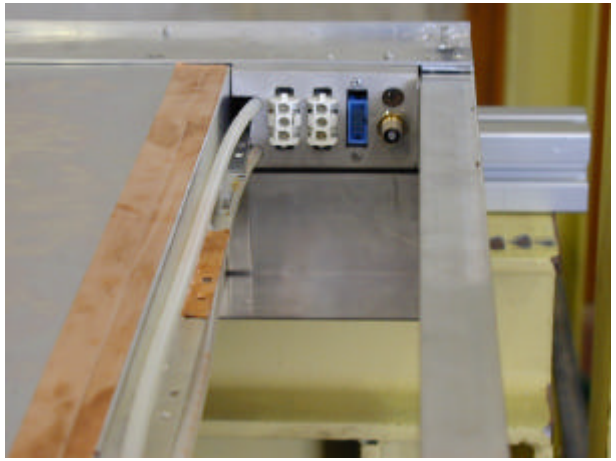
- All parts are produced by industry.
- To avoid duplication of tools and have higher efficiency in production, all additional works on detector parts are done in only one site.

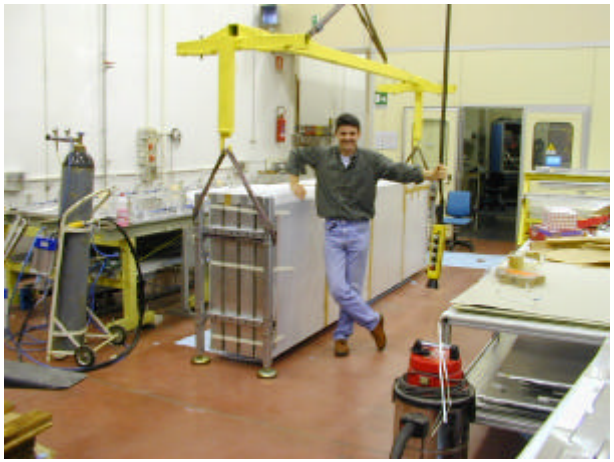
Production flow chart



Quality control (1)

- All services (High Voltage, Low Voltage, Test, Gas connectors and Faraday cage) are mounted in Lecce.



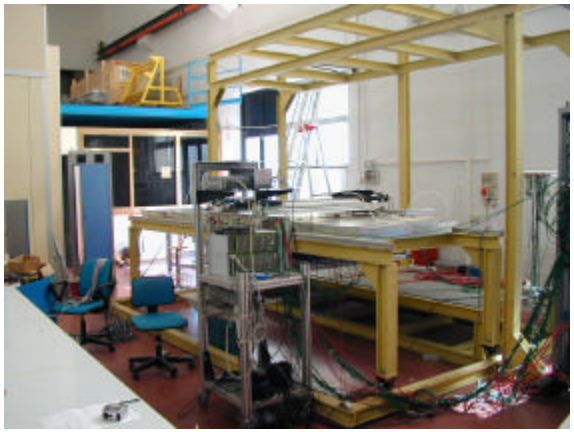


- 2/3 of the Units are transported (group of 4 Units) in Rome 2 and Naples for quality control with cosmic rays. The remaining 1/3 is certified in Lecce.

Quality control (2)

Three test stations are operational

Tracking of CR is done with RPCs or Drift Chambers



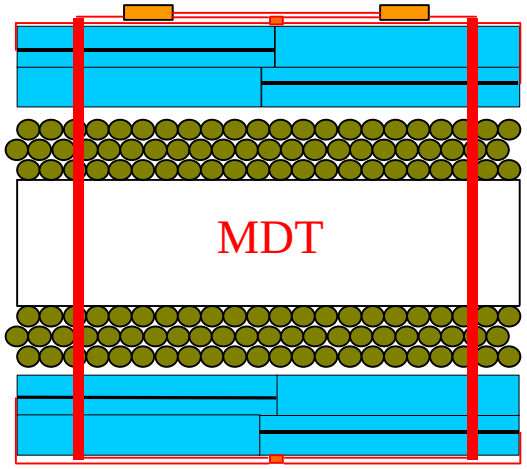
Lecce

Roma2

Naples

Each station allows the simultaneous test of 8 Units

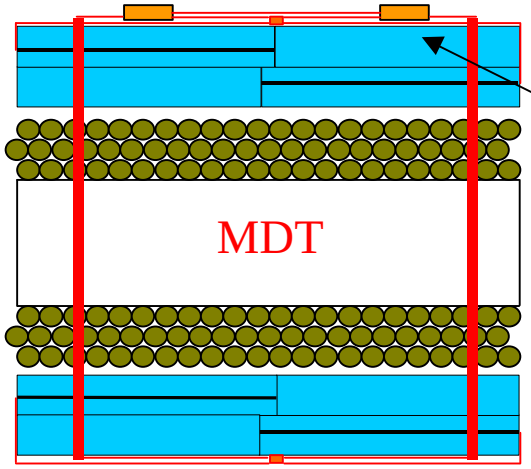
RPC - MDT integration (1)



RPC Units (4 for low p_t stations and 2 for high p_t stations) are mounted and cabled on MDTs before installation in the ATLAS cavern.

A fast functionality test of the full packages is foreseen at this stage

RPC - MDT integration (2)



Trigger and read-out electronic (splitter and pad boxes) is mounted on top of the RPCs.

In some cases also MDT electronics has to be mounted on RPCs.

Warning: Trigger electronic schedule should be matched with muon barrel chambers installation schedule.

RPC - MDT integration (3)

- MDT-RPC common supports are defined for BML and BMS chambers.
- For BOS chambers the project is under way.
- For BOL chambers the project not yet started.
- Space at CERN for system integration is still a problem to solve

Preproduction

- A set of three BMS Units was assembled last year as a first test of assembly.
- Front-End and Back-End boards for these Units were not the final ones.
- Main goals of this preproduction were:
  - define all tools necessary for the assembly phase.
  - finalize services for the Units.

Start of production

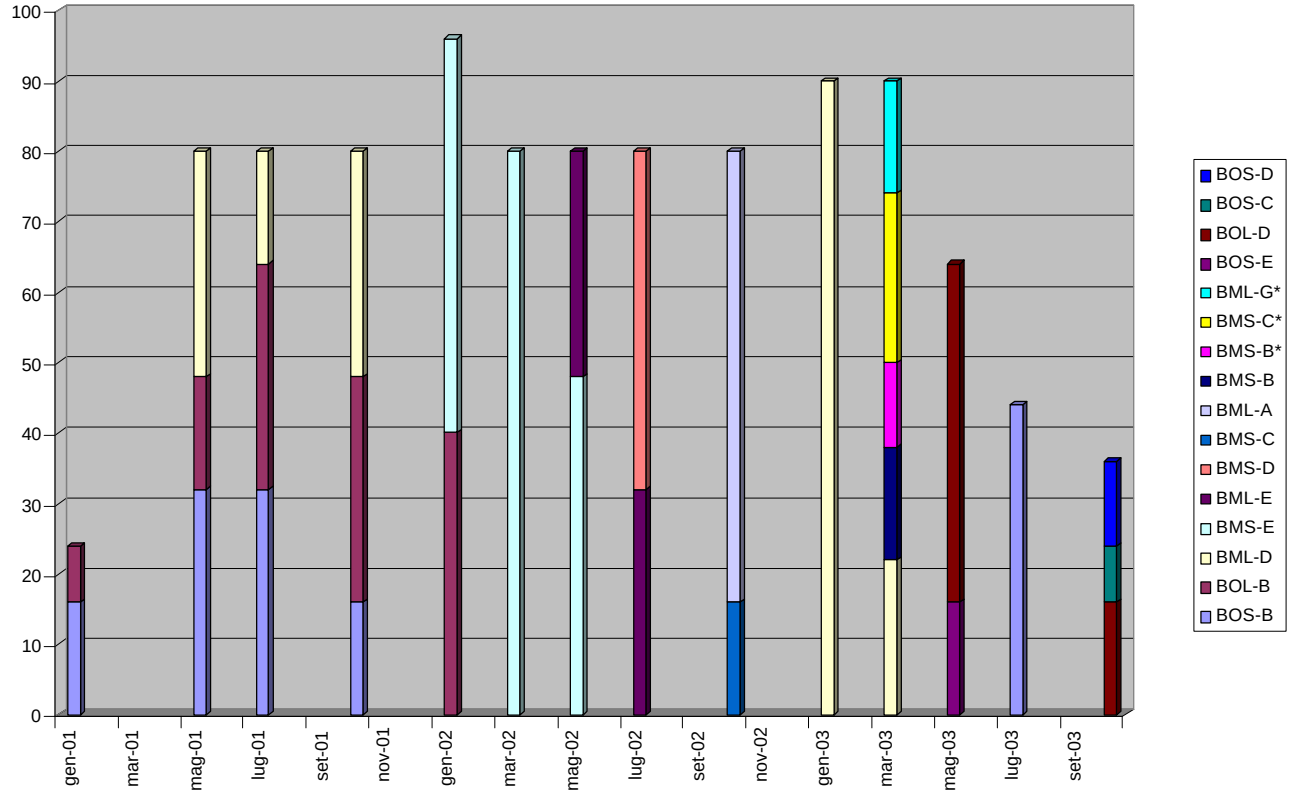
- Due to delay of tender procedures for Front-End boards production (inside the detectors!) the decision was taken to start production with a special order for 1.500 boards.
- The delivery of these boards had 2 months delay.
- These boards have now allowed the production of 24 Units, 16 for BOS and 8 for BOL chambers (largest size). Their assembly is being completed this week. 1 Unit in Lecce, 2 Units in Naples and 2 Units in Rome are under test with cosmic rays.

Start of production

- All assembly tools and procedures for assembly of Units are now done or understood.
- Production database (MS Access) is operational.
- Unit assembly rate: 3 Units/day. Not a bottleneck.
- A new assembly hall (no delay in production) is being prepared in Lecce.

Mass production (1)

- In the schedule approved by EB Units production must be completed by the end of 2003.



Mass production (2)

- Bakelite plates: on schedule
- Electrode readout panels: on schedule
- GaAs Front-End chips: produced (50.000)
- Support panels: on schedule
- Al profiles: produced and machined
- Gas volumes: 2-3 months delay (improved Q.C.)
- Front-End Boards: 4-5 months delay (tender procedures and industry)

- Of course, last point determines the global delay for Units assembly

Improvements in Q.C. (1)

- Many discussions with LHCC referees have been about the coating of inner surfaces of gas volumes with linseed oil.
- For L3 and BaBar chambers (streamer regime) the coating procedure did not allow complete polymerization of the oil on the inner surface.
- Preliminary results of laboratory test of L3 chambers in Naples show negligible decrease of efficiency after 7 years of running. Efficiency loss in BaBar chambers mainly due to temperature increase.

Improvements in Q.C. (2)

- Coating of ATLAS RPCs is done with a new “protocol” which assures complete polymerization of the inner surface. This procedure was already active at the time of the PRR in Feb. 1999.
- Bakelite surface is smoother and oil coating is thinner than that used for BaBar and L3.
- To avoid possible problems with dust deposition on the surface we will improve Q.C. during production.

Improvements in Q.C. (3)

- Improve the oil/air filtering system.
- Visual inspection of samples after coating and periodical chemical analysis of linseed oil.
- Up to now gas inlets and outlets have been drilled, using all possible precautions to avoid dust deposition inside the gas volume.
- We are now producing injection molded pieces with holes to avoid drilling of the holes.

Conclusions

- Production procedures are understood.
- Q.C. during gas volume production is being improved.
- Mass production has started but front-end PC boards have 4-5 months delay which will influence Units assembly.
- Schedule is tight but ... we can work hard to fulfill it.

- “ *No evidence that ATLAS chambers will have problems if operated according to design conditions* ”
  LHCC referee conclusion