ALICE upgrade plans

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LHCC Upgrades
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Reminder

- **ALICE has been designed primarily for Heavy Ion Physics. The Detector has therefore been optimized for (PbPb) luminosities of the order of 10^{27}**
- **pp Physics in ALICE is "minimum bias", low-luminosity**
  - **primary** motivation is the collection of comparison data as a tool to understand the Heavy-Ion ones
  - in addition several interesting measurements have been identified, for which the specificities of ALICE (low-p_T cutoff, PID) make it complementary to the other experiments => e.g. see figure
- **The optimal luminosity for ALICE during proton running is from 10^{29} (optimize pileup in TPC) to 10^{31} for low cross-section observables**
- Therefore **ALICE plans for the future are only very indirectly linked to the LHC high luminosity upgrade**

Upgrades (ongoing)

- A **program to upgrade some elements of ALICE is already ongoing**
- In fact ALICE has evolved considerably from its Technical Proposal, largely because of the new data from RHIC, which are also at the base of some of the future upgrade ideas. In particular
  - the TRD has been approved much later than the other central detectors, and it is expected to be complete by 2009/2010
  - a new EMCAL calorimeter (very important for jet-quenching) has been added recently
    - US project, with French and Italian involvement.
    - 4 SM installed this year out of 11
    - to be completed by 2010/2011

Upgrades (future)

Upgrade ideas for > 2010

- Vertex upgrade:
  - 2nd generation vertex detector (closer to beams)
  - → heavy flavour baryons, fully reconstructed B, …
- Forward upgrades:
  - new detectors for forward physics (tracking & calorimetry)
  - → low-x in pA, AA
- Particle id upgrade:
  - extend to p_T range for track-by-track identification to O(20) GeV/c
  - → new physics interest, based on RHIC results
- High rate upgrade:
  - increase rate capability of TPC (faster gas, increased r/o speed)
  - → rare hard probes (Υ, γ-jet, …)
- Calorimetry upgrade:
  - extend EMCAL to opposite ϕ
  - → Improve γ-Jet acceptance, dijets
- DAQ & HLT upgrades:
  - → more sophisticated and selective triggers

Impact on the beampipe

Constraints for ALICE beampipe installation

ALICE Beampipe is difficult to access due to the structure of the experiment

Can an upgraded beampipe and ITS detector be installed in 6 months ?

2 months to open the experiment and remove the Miniframe
2 months to bring back the Miniframe and close the experiment

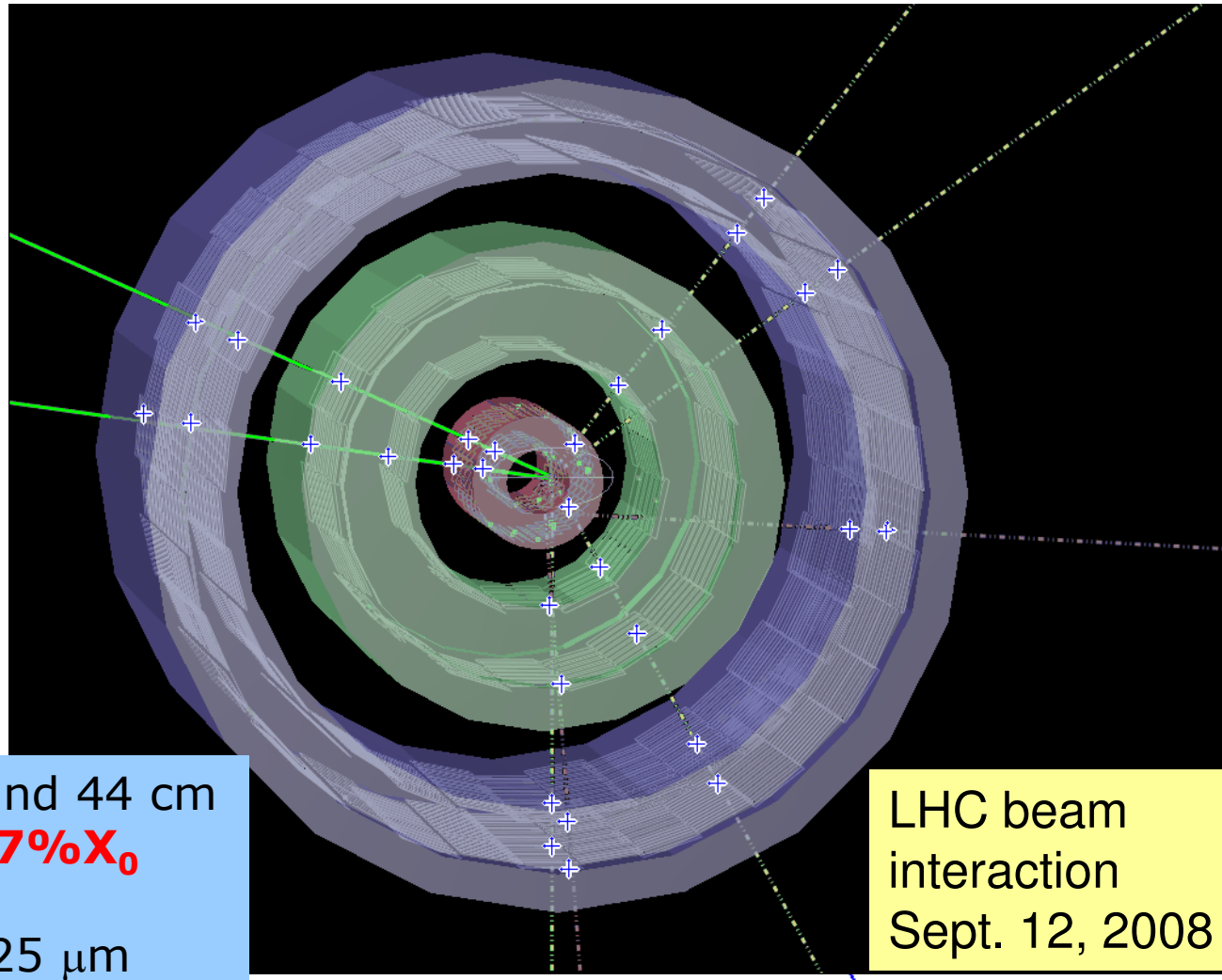
→ 2 moths left for

Installation of ITS table, Delphi Frame and ITS rails
Transfer current beampipe, Service Chariot and ITS on rails
Move TPC to parking position
Disconnect & remove Service Chariot
Remove FMD2
Move ITS Barrel (SSD, SDD) to Parking position
Remove SPD
Remove Beampipe
Reinstall new Beampipe
Bakeout of new Beampipe
Install new SPD detector
……

NO WAY to do this upgrade in a 6 moth shutdown. We need a longer shutdown

Inner Tracking System upgrade

- Present 6 detector layers based on three silicon technologies:
  - SPD (pixels)
  - SDD (Si Drift)
  - SSD (Si strips)
- Unique level-zero trigger (fast OR)



LHC beam interaction Sept. 12, 2008

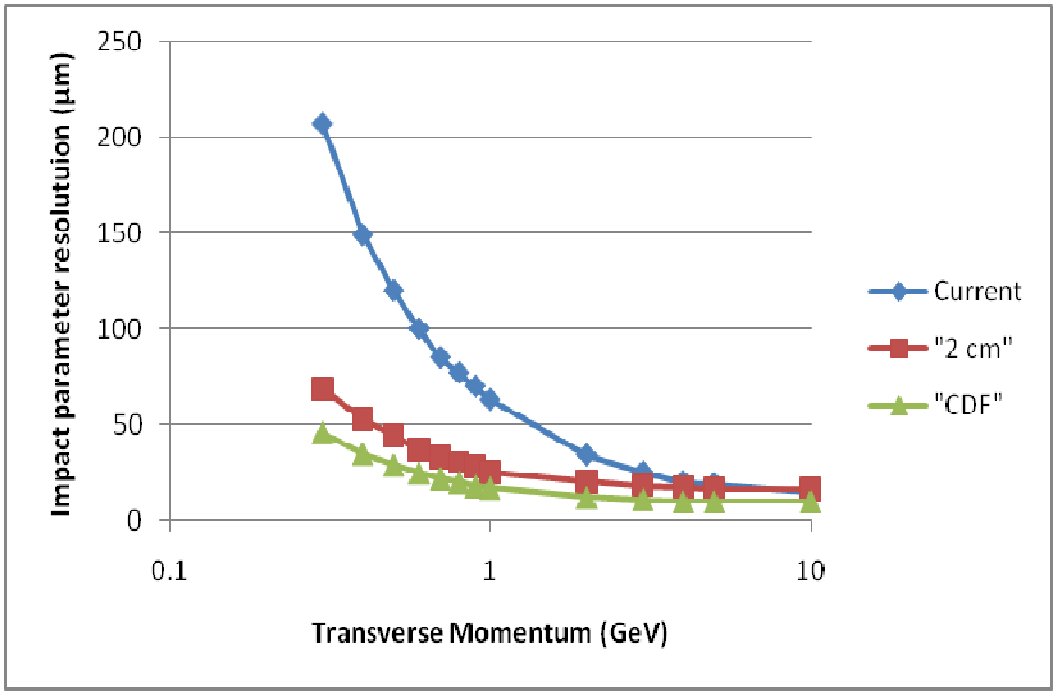
Radii: **4**, 7, 15, 24, 39, and 44 cm
Total material budget of **7%X_0** (normal incidence)
Pixel size 50 μm times 425 μm
Beam pipe radius 2.98 cm

Inner Tracking System upgrade

- Goal: a factor of 2 improvement in impact parameter resolution
- Improving the impact parameter resolution by a factor 2 or better will:
  - Increase sensitivity to charm by factor 100;
  - Give access to charmed baryons (baryon/meson ratio in charm sector – main issue is understanding of recombination);
  - Allow study of exclusive B decays;
  - Allows first measurement of total B production cross section down to zero P_T ;
  - Improve flavor tagging.

Inner Tracking System upgrade

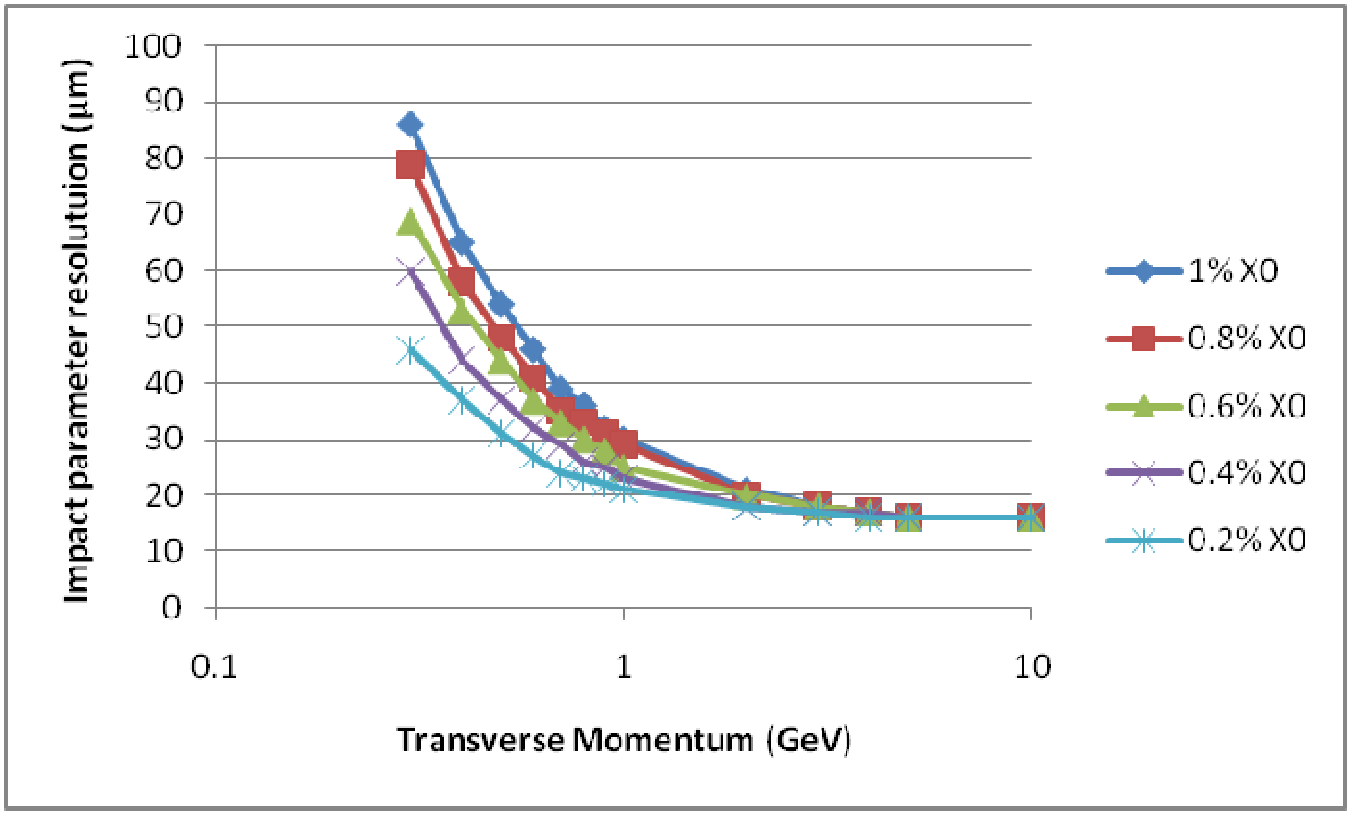
- Thinnest and smallest beam pipe (à la CDF):
  - Present radius of 2.9 cm
  - Wall thickness Be 800 μm to 400 μm?
- ~ 2 cm radius – 800 μm minimum for relevant upgrade
  - Thickness of first layer critical



- Replace (at least) the two innermost (pixel) layers
  - Design:
    - key design parameters:
      - material budget (including power dissipation!)
      - space resolution
    - > investigating concept options for R&D

Effect of first layer thickness

- e.g.: “2 cm beam pipe” configuration
  - default in calculation set to 0.6% X_0
  - effect of variation from 0.2% to 1% X_0:



  - substantial effect => strong motivation for R&D

What has happened since February

- Regular Upgrade Forums each ALICE Week
- Forward Calorimetry upgrade
  - Continuing effort on simulations to define optimum coverage and location
  - R&D on Si-W calorimetry in collaboration with PHENIX
- Vertex (and forward) tracking upgrade:
  - Would rely on very thin pixel detectors
  - => Involvement of ALICE groups and designers in monolithic pixel detector R&D
- VHMPID
  - Fast progress of R&D
  - Propose the installation of a module 0 for testing in ALICE in the near future
- Forward Muon arm upgrade
  - Continuing effort on simulation
  - Would probably require a modified beampipe
- Other developments continue design progress

ALICE

THE ALICE DETECTOR