ITS Upgrade Studies- Working Group 5
Cooling, Cabling, Services, Mechanics and Integration

ITS Upgrade Meeting, 29th November 2010

L. Musa

- Tasks
- Structure
- Discussion

WG5 – Tasks

In collaboration with the other WGs, WG5 will develop a conceptual design and perform a feasibility study for the following detector upgrade items

- Detector ladder design (joint study with WG3 and WG4)
- Beam pipe integration
- Detector ladder mechanical support
- Kinematic support
- Insertion mechanism and installation
- Power distribution (WG5 ⇆ WG3 & WG4)
- Cooling System
- Cabling and Service System
- Alignment and spatial mapping
- Manufacturing and assembly procedure
- Cost

WG5 – Structure

Members (13)

Bari: C. Pastore, V. Paticchio, R. Santoro

CERN: D. Perrini, A. Tauro

Padua: C. Bortolin, R. Dima, A. Pepato

St. Petersburg: S. Igolkin

Torino: P. Barberis, B. Giraudo, S. Coli

Trieste: A. Rashevsky

Conveners: D. Perrini, R. Santoro

We warmly invite other members of the collaboration to join the ITS Upgrade WG5 to

- work on one or more tasks or
- simply participate to the meetings and contribute to the discussions

Meetings

- frequency
- audioconference or videoconference
- indico: ALICE ITS upgrade (http://indico.cern.ch/categoryDisplay.py?categId=3211)

Exchange capability

- Building in the capability for rapid exchange of the ITS2 detector is a is a key goal
- Rapid exchange capability will allow yearly fixes
- Replacement capability provides a way to
    - allow repairs of possible failures that could compromise the data quality
    - overcome premature radiation damage
- If detector replacement is not routine, risk free and fast, it will always be ruled out event in the event of a degraded performance from other interest in ALICE and the other LHC experiments
- Building a detector system with rapid exchange capability means more careful upfront attention to installation design, which improves chances for successful installation and deployment

Mechanical design

The mechanical design has to be driven by the following goals

1) minimize multiple coulomb scattering, particularly at the innermost layer
2) locate the inner layer as close to the interaction region as possible
3) allow rapid detector replacement (easy insertion mechanism and installation)
4) provide complete spatial mapping from the beginning

1) and 2) set the limit on pointing accuracy to the vertex

3) is motivated by the recognition of difficulties encountered in our present ITS as well as in the other LHC experiments with unexpected failures.

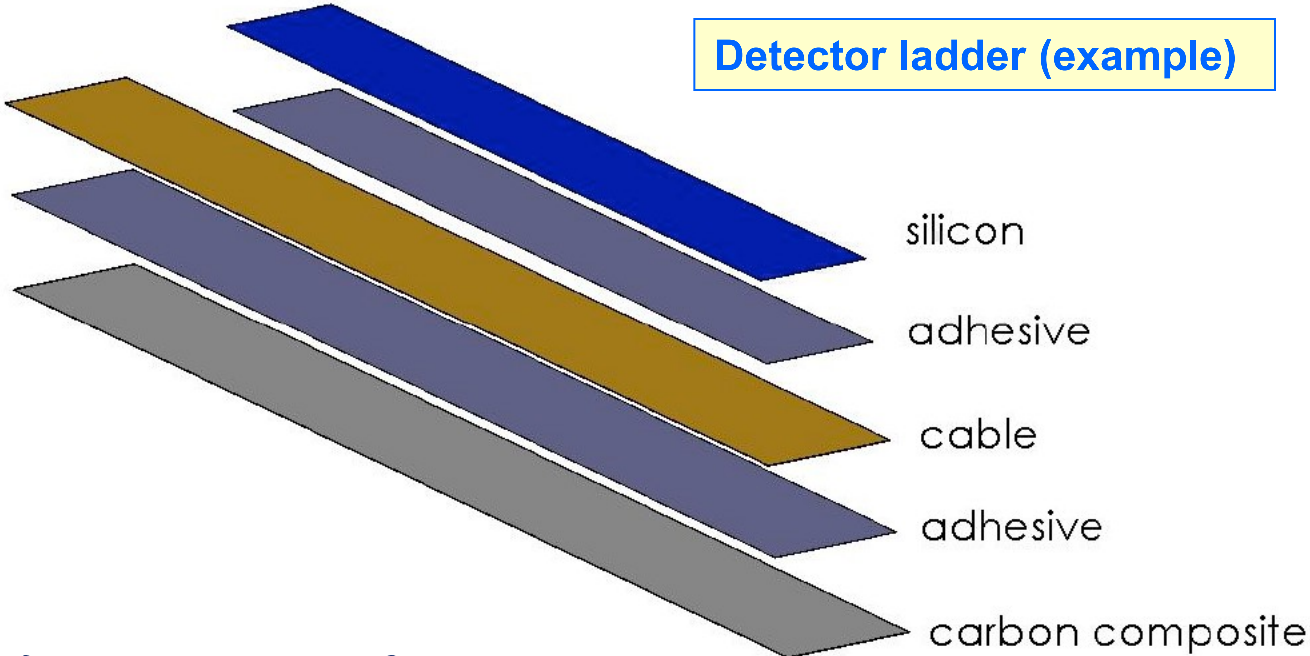
3) is also motivated by the need to replace detectors that may be radiation damaged by operating so close to the beam.

4) is important to achieve physics results in a timely fashion. We should pursue a design that allows to know, at installation, where each pixel is located with respect to each other to within ~20 microns and to maintain the position throughout the lifetime of the detector.

Detector ladder design (classical design for central barel)

The mechanical support for the detector assemblies (chips or hybrid structures) arranged in ladders

Detector ladder (example)

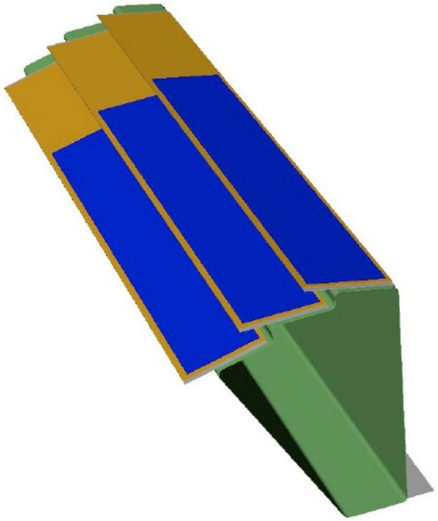


Some inputs from the other WGs

- power, services (LV/HV cables, optical fibbers)
- dimensions and hermeticity
- design of electrical cable (double sided or multilayer)
- bonding scheme of pixel chips to bus

Detector ladder design (classical design for central barel)

The mechanical support for the detector assemblies (chips or hybrid structures) arranged in ladders



Many design options for

- cooling (air, CO_2, ...)
- carbon sheet for handling chips and heat conduction
- beam for stiffness and support of ladders (carbon composite beam a la ITS)
- significant stiffness is required to control deformations for gravity and cooling forces in case of air cooling, differential expansion forces for temperature and humidity
- in case of air cooling (a la STAR) the beam can also provide a duct for cooling and adds cooling surface area

Cabling and support services

The cabling and the support service should be studies since the very beginning

Alignment and spatial mapping

The pixel detector should be designed to have full pixel-to-pixel mapping at installation with a 3D tolerance envelope of ~20micron.

This will eliminate the need for spatial calibration with tracking other than the 6 parameters defining the pixel detector unit location relative to the outer tracking detectors. Tracking, on the other hand, can use the pixel detector to spatially map the outer detectors, if required.

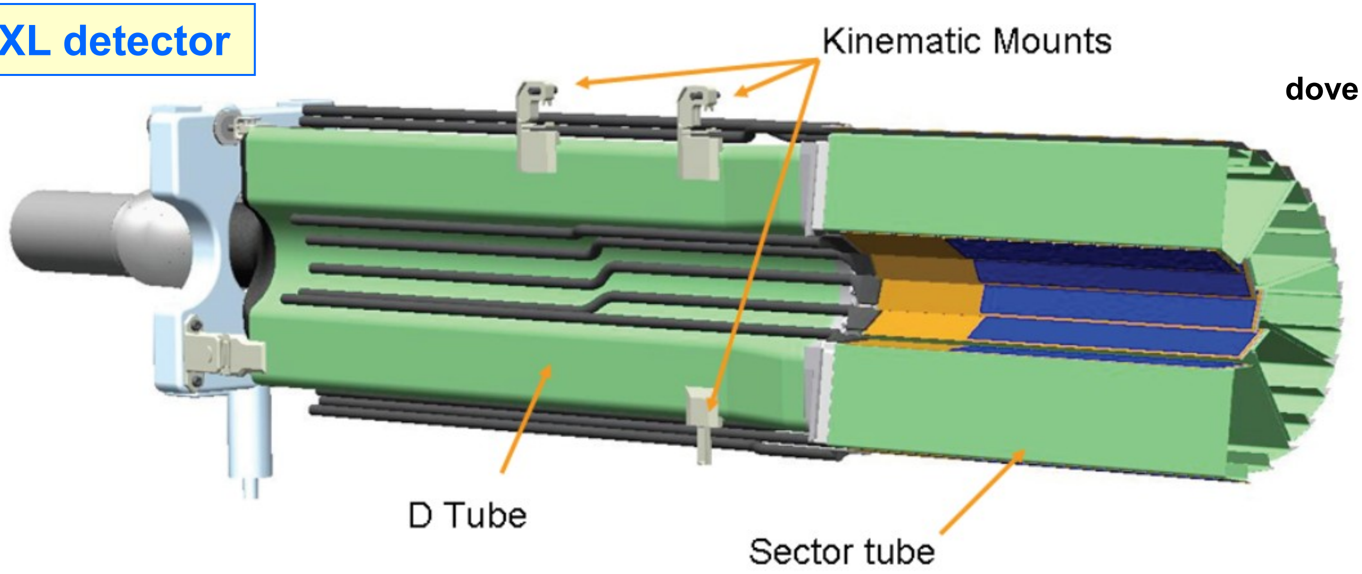
Example: using a vision coordinate machine to determine the detector locations on the fully constructed ladder half modules.

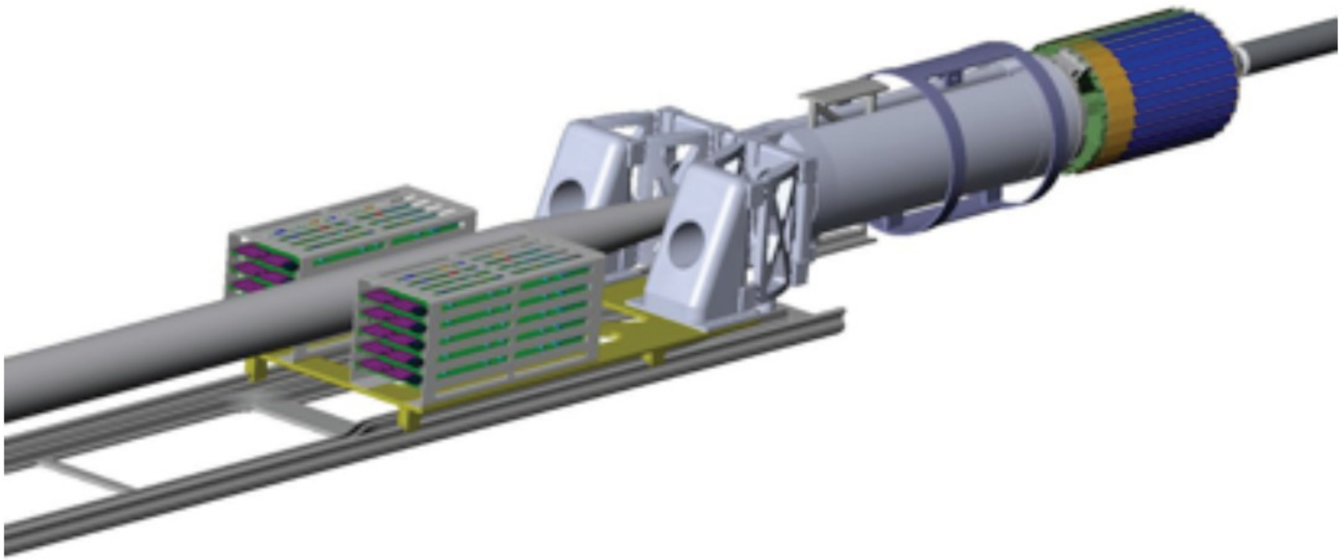
A full 3D map of the ladders is necessary since the manufactured ladder flatness might exceed the 20 micron envelope.

The pixel chip can be manufactured with reference targets in the top metal layer that can be picked up by the vision coordinate machine and the ladders mounted such that there is an unobstructed view

STAR PXL detector

dove tail mounting





Kinematic supports and docking mechanism