ALICE: Progress and Plans

Progress on

- Selected Detector Systems
- Infrastructure in Point 2
- CERN Hostlab responsibilities

Emphasis on the multifaceted collaboration with many CERN Technical Groups

ALICE : AIM of RESEARCH

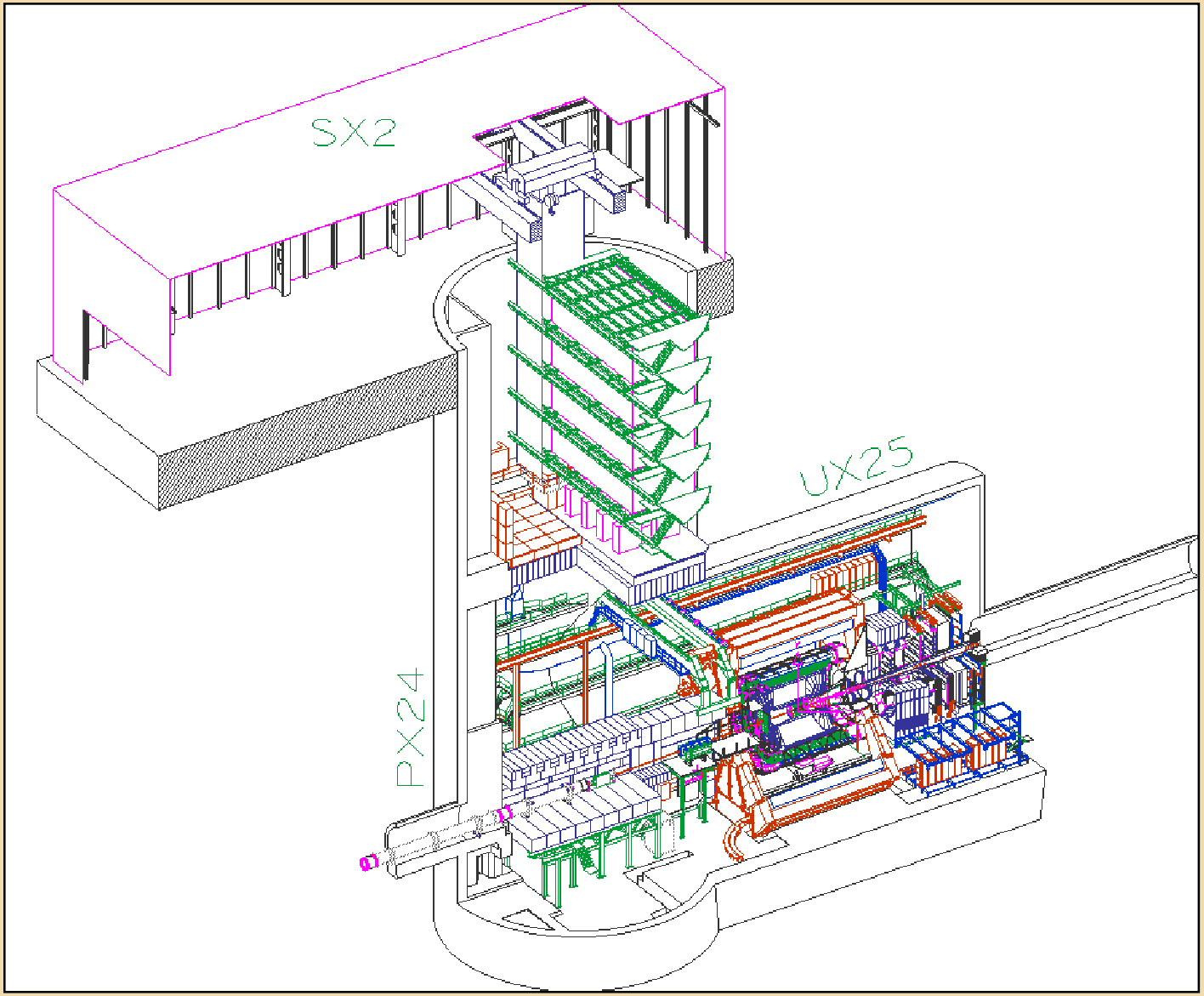
ALICE : A Large Ion Collider Experiment at LHC
Aim : through collisions very energetic nuclear matter (Lead nuclei with Lead nuclei)

→ compression and heating of nuclear matter

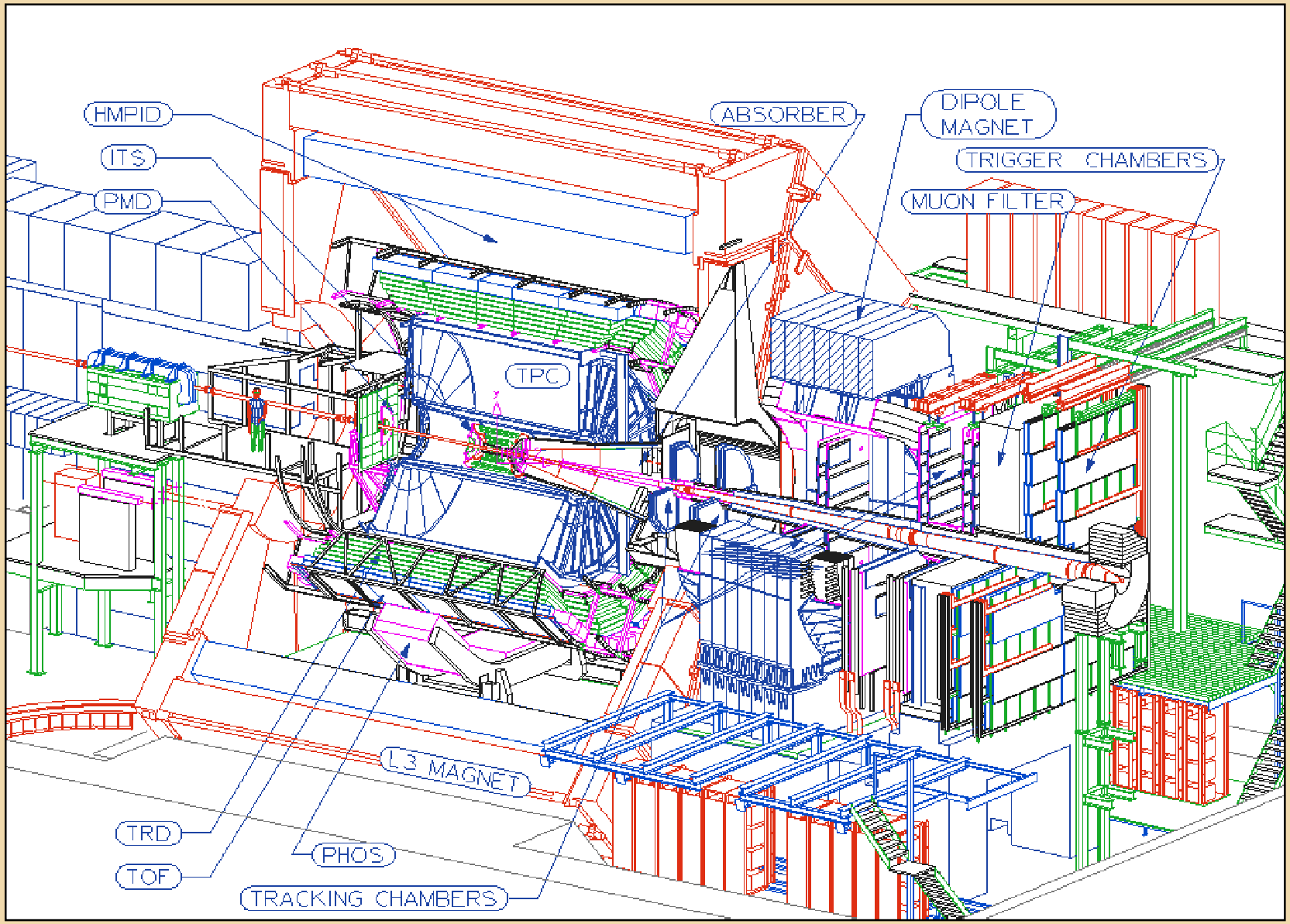
→ induce 'Phase Transition' to 'Quark-Gluon Plasma'

→ create and study the properties of this new form of matter;
thought to have filled all of our Universe 10^{-5} after Big Bang

Implantation of ALICE in Point 2



LAYOUT : 3D VIEW of ALICE



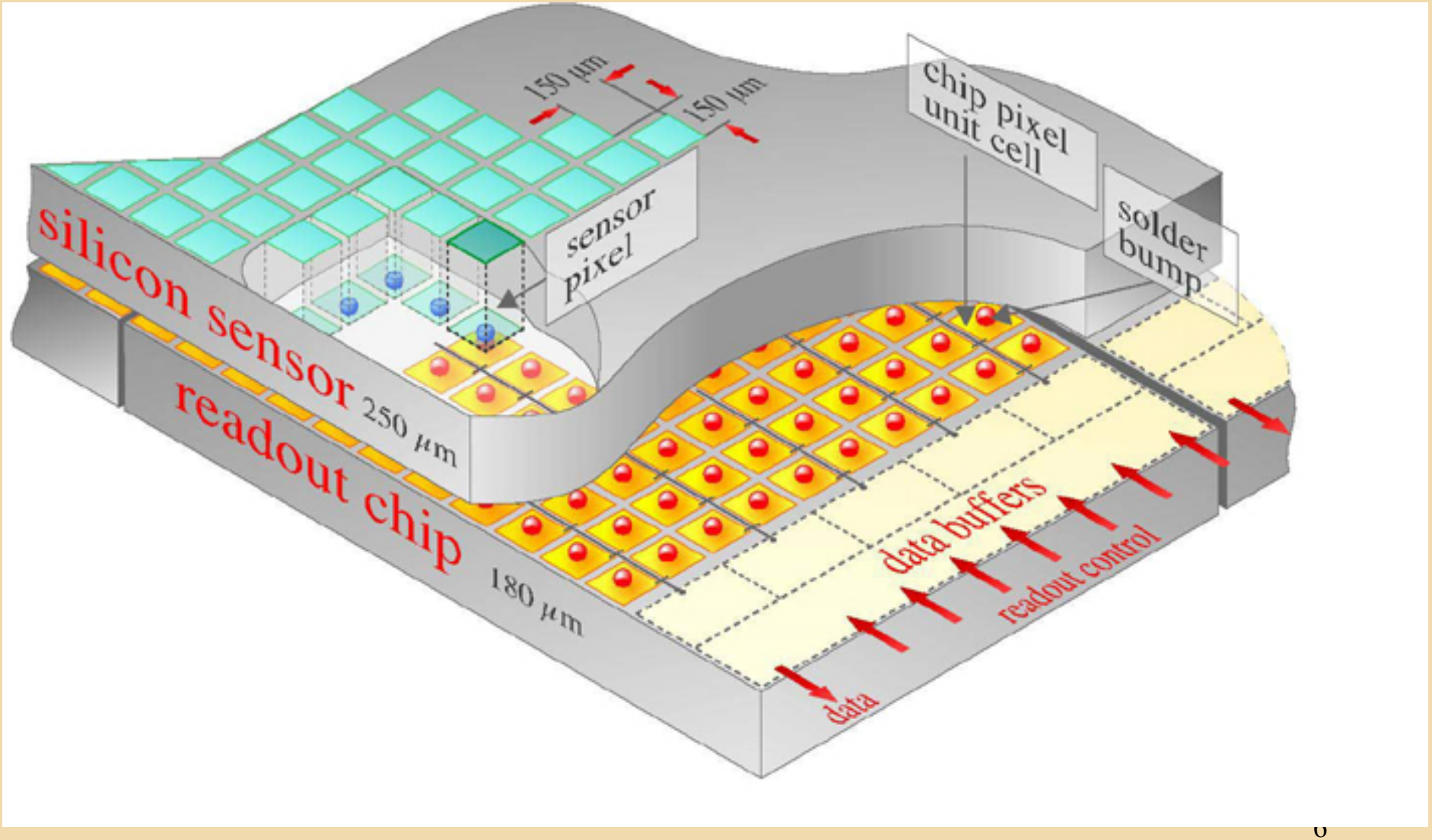
ALICE Detectors : CERN ALICE Team Responsibilities

Pixels : are very small (typically 0.05*0.2 mm^2) silicon detection cells, used for very precise particle tracking

Alice has 10 Million such pixels in its 'Pixel Detctor'

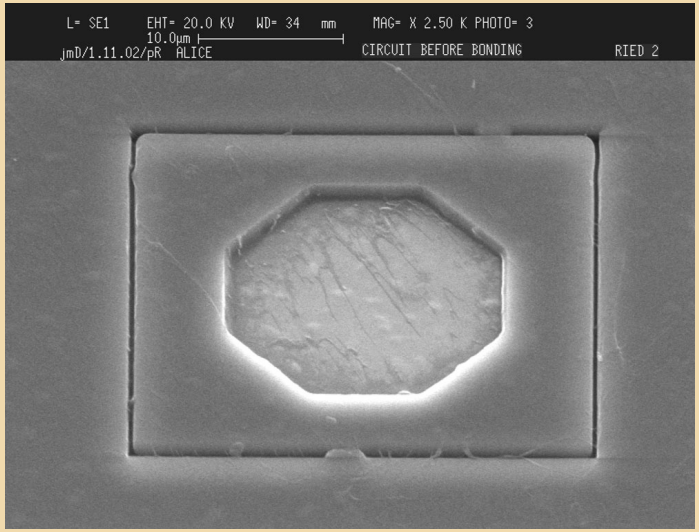
- Electronics Development with EP/ED
- Novel Connectivity with EST/DEM
- Consulting on metallurgical questions with EST/SM
- Cooling issues with ST/CV

SCHEMATIC VIEW: PIXEL SENSORS coupled to READOUT-CHIP with 'SOLDER BUMPS'

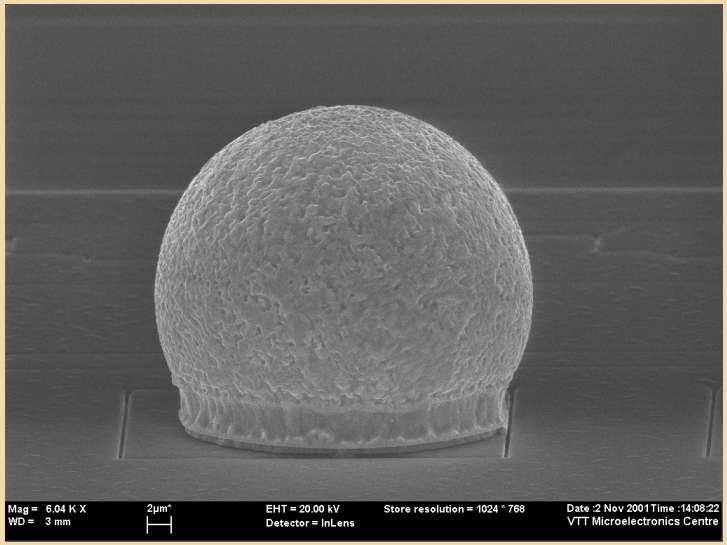


SEM Pictures (CERN, VTT)

Bonding Pad on ALICE Pixel Chip

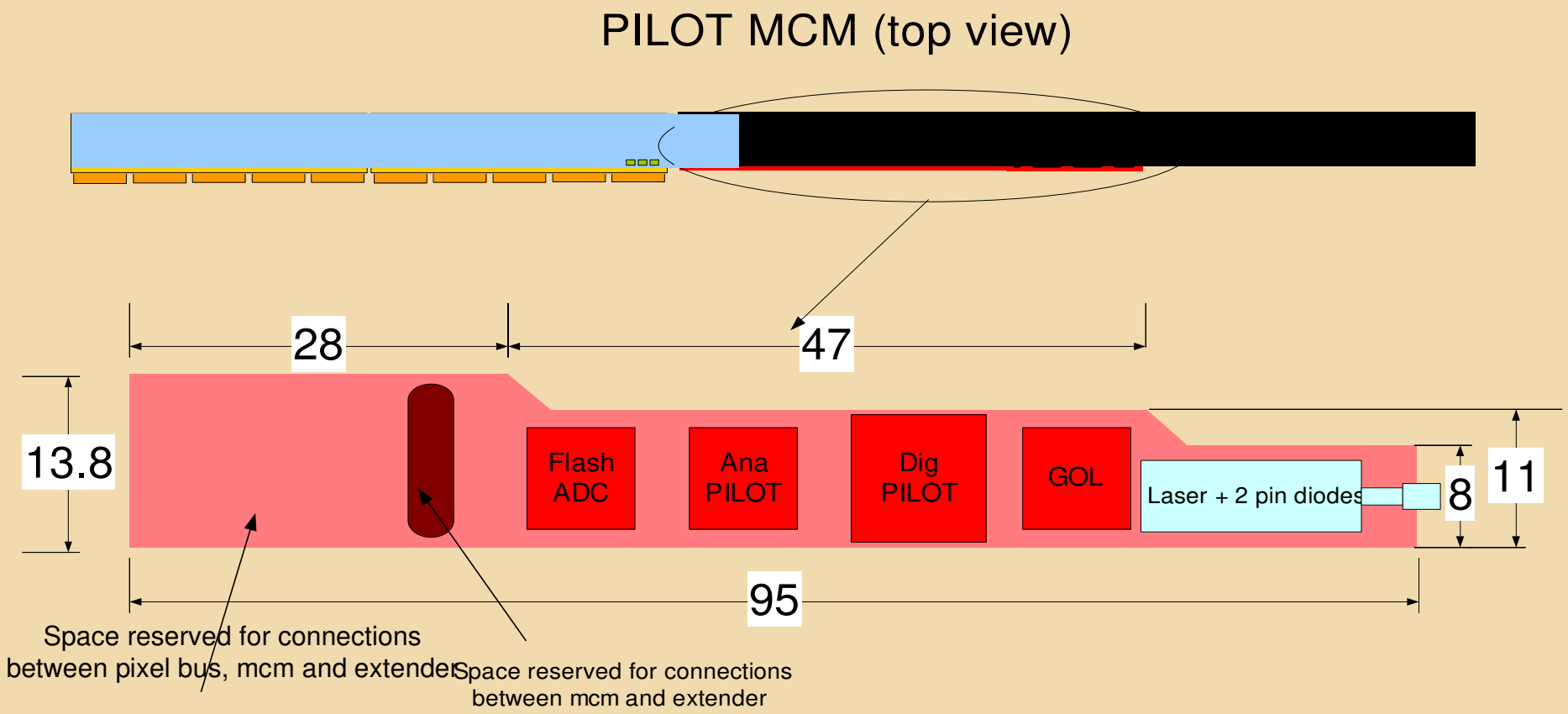


Pb-Sn Bump Bond

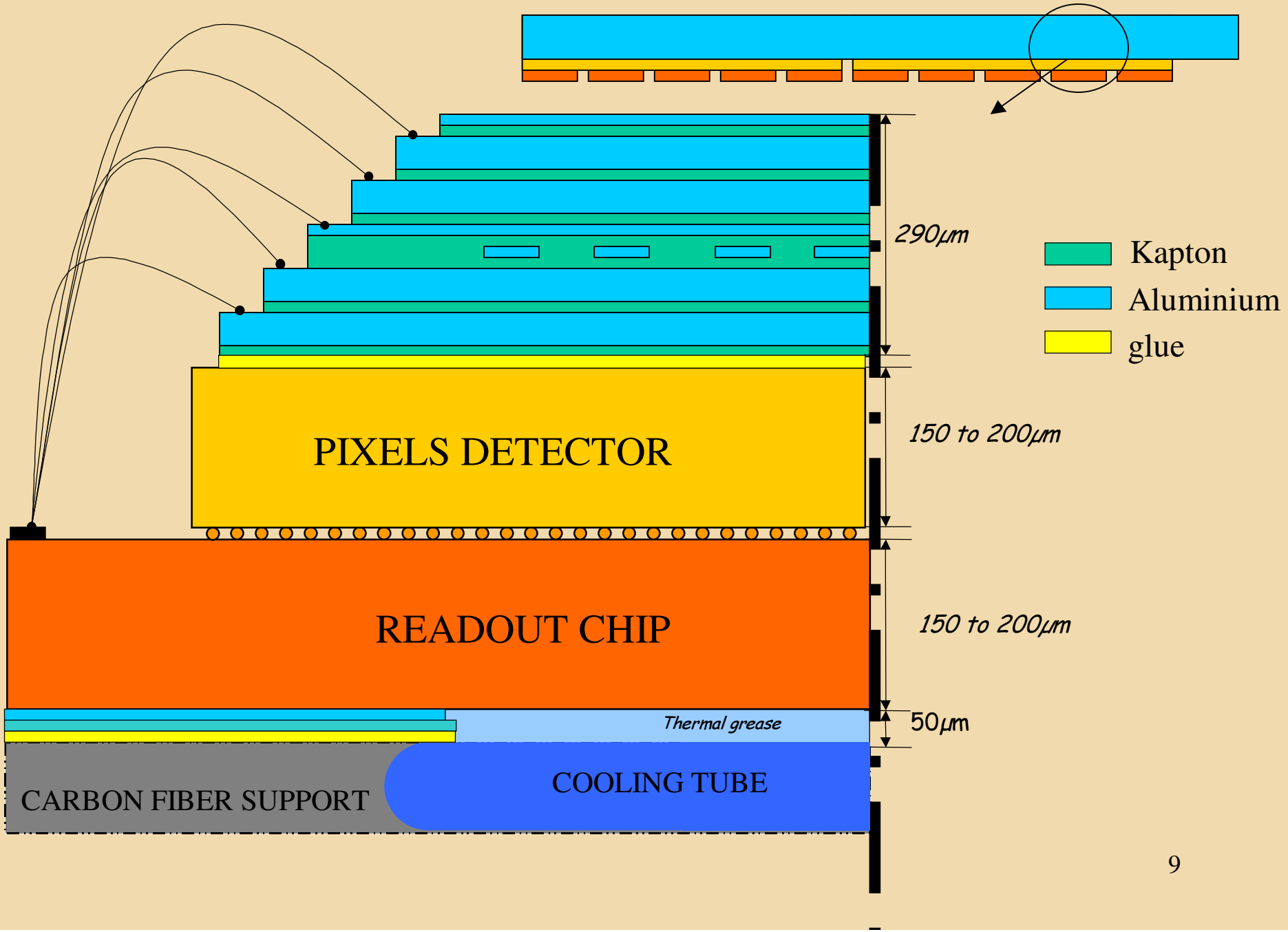


Work done in collaboration with EST/SM

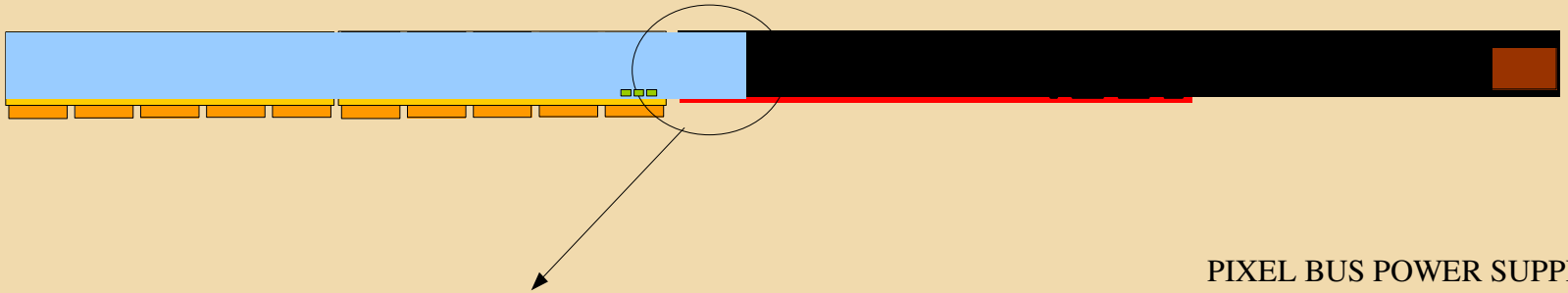
Novel connectivity developed by EST/DEM



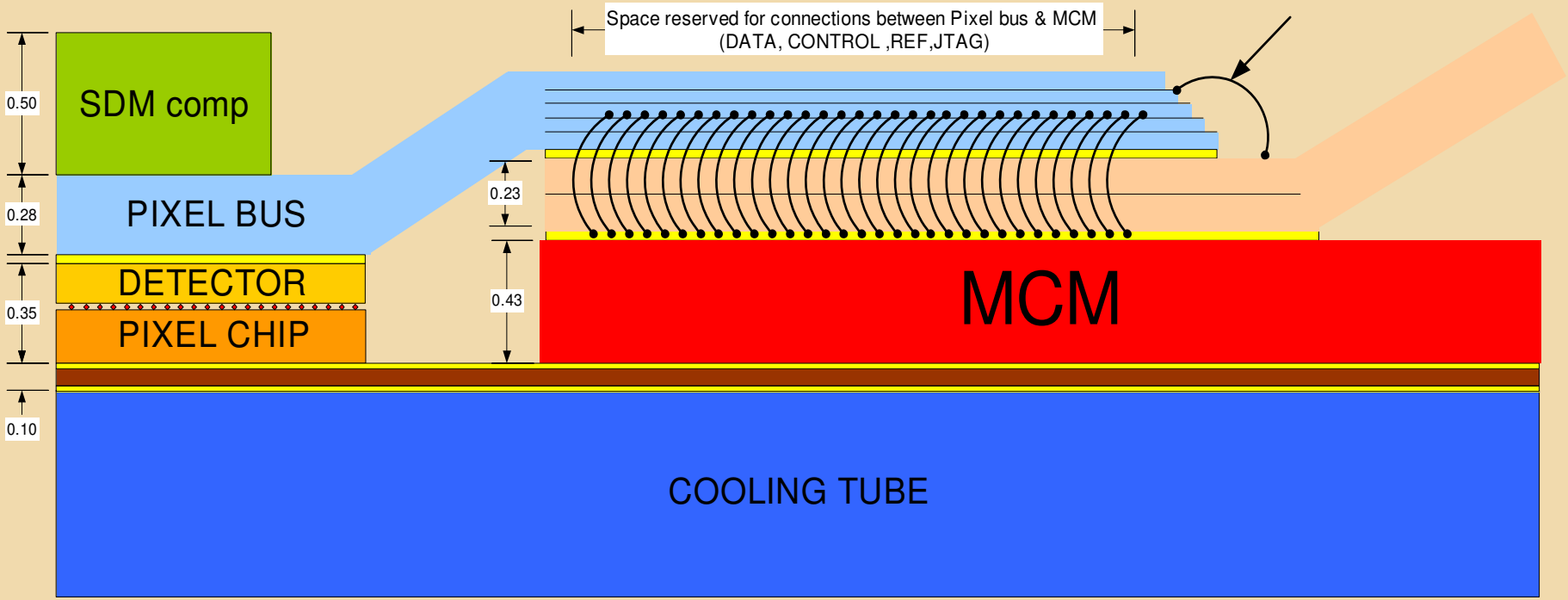
Pixel bus connections



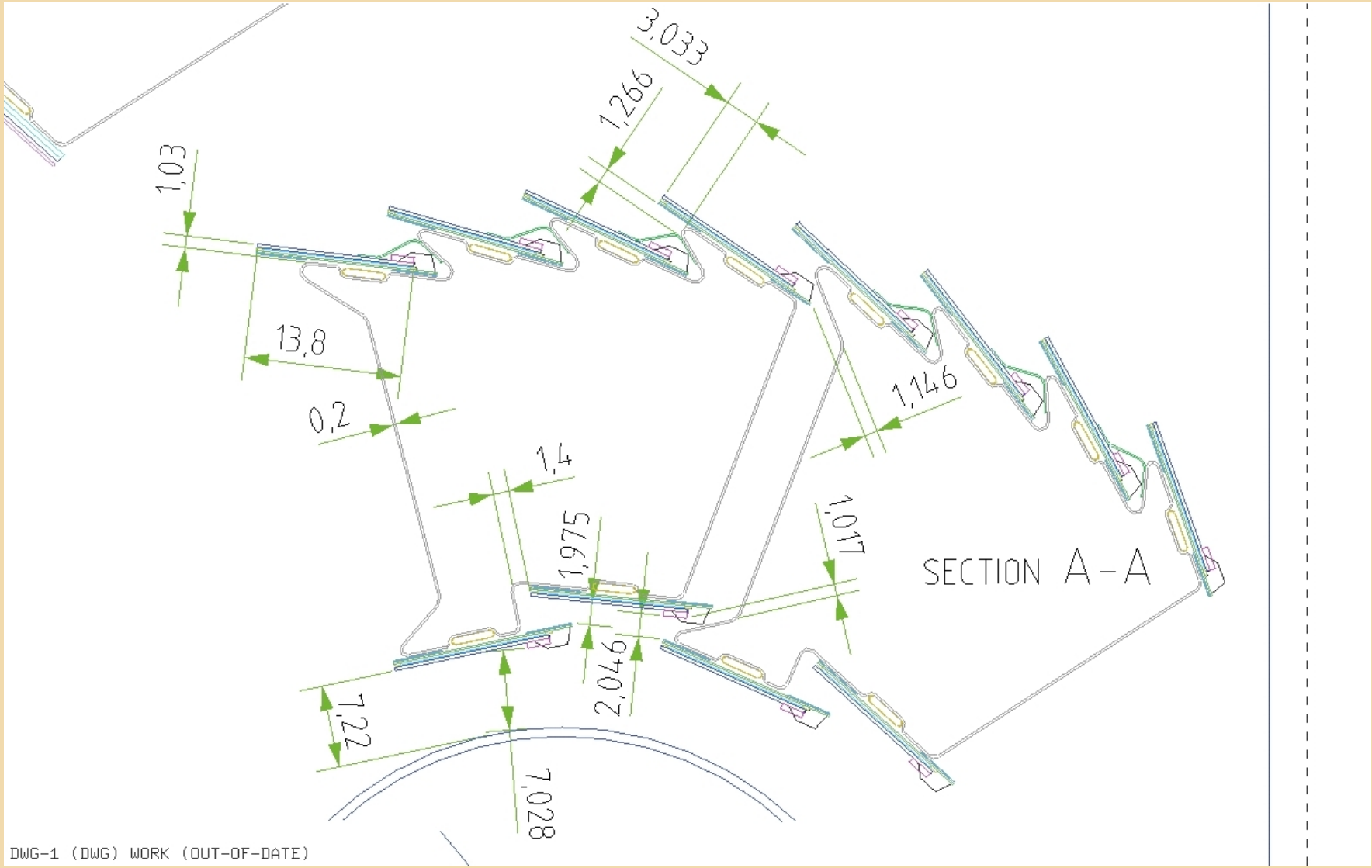
PIXEL BUS AND PILOT MCM CONNECTIONS (1)



PIXEL BUS POWER SUPPLY
100 BONDING WIRES



MODERN MATERIAL SUPPORT STRUCTURES NEAR VACUUM CHAMBER



ALICE DETECTORS : CERN ALICE TEAM RESPONSIBILITIES

TPC (Time Projection Chamber) : distance of tracks are 'projected' on (drift) 'Time-Axis'

ALICE is building the world's largest (100 m^3) TPC

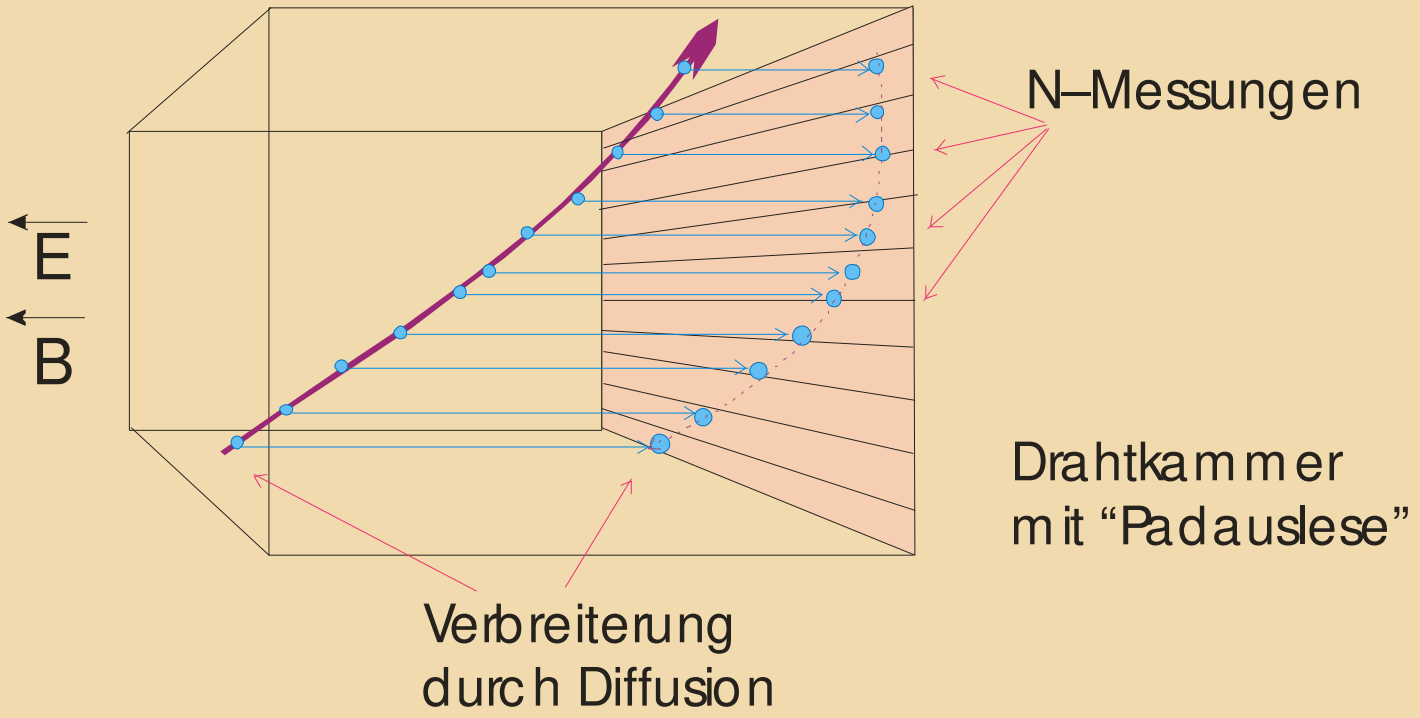
'Field Cage' : Detector and Track Drift volume with 100 kV electrode in collaboration with EP/TA2 ('Technical Assistance)

Readout electronics : > 700,000 channels

complex signal processing detector developed in collaboration with EP/ED

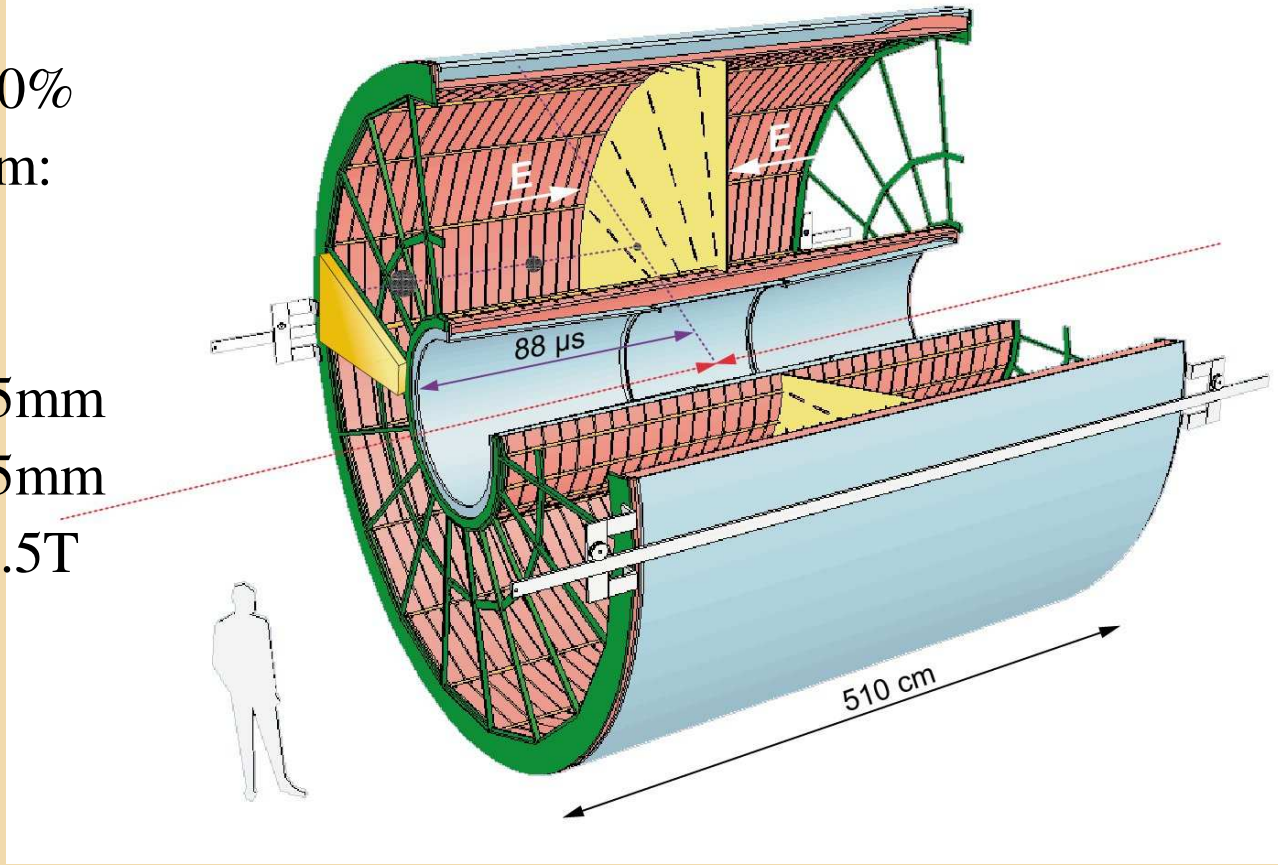
CONCEP OF THE TPC

Ionization produced by charged particles is 'projected' under the influence of a strong electrical field on Readout planes



ALICE TPC: Detectorspecifications

- **Gas** Ne/ CO_2 90/10%
- **Driftfield** 400V/cm:
- **Space resolution:**
  σ= 0.2mm
- **Pads(inner):** 4x7.5mm
- **Pads (outer):** 6x15mm
- **Magnetfeld** : bis 0.5T



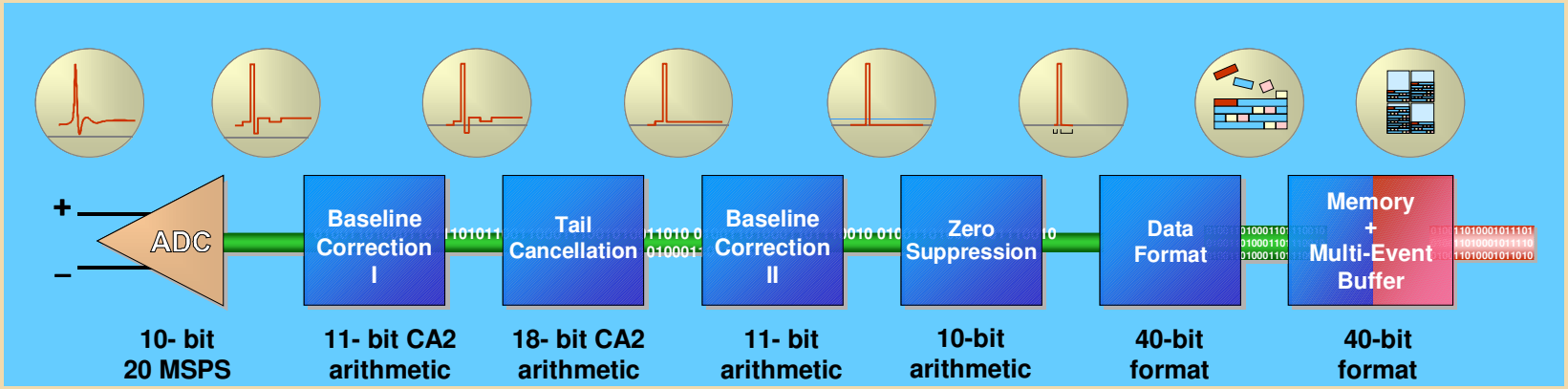
ALICE TPC:during construction

Construction accurracy in z =250µm

Endplates : 250µm

Drahtkammer: 40µm

ALICE TPC READOUT CHIP (ALTRO) in EP/ED

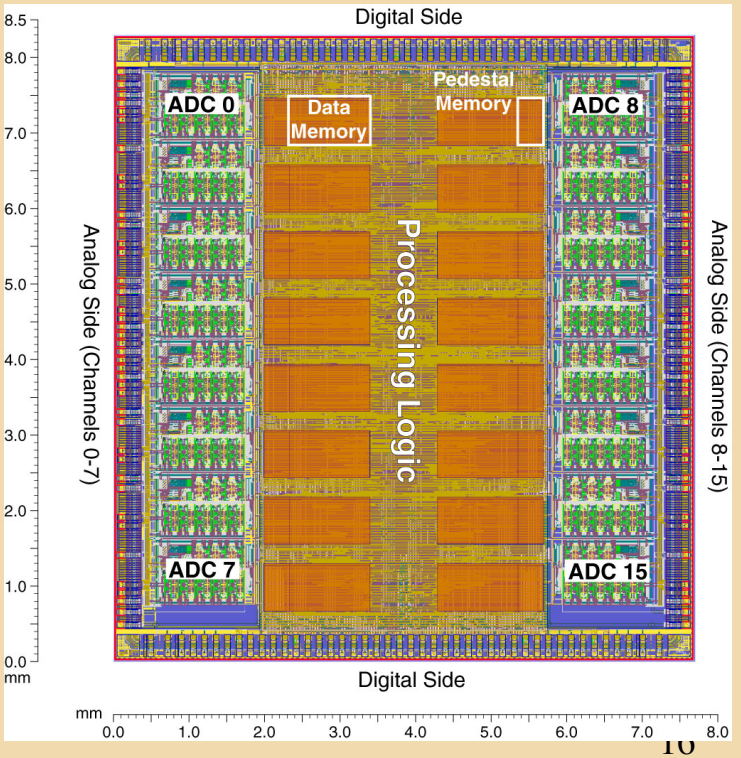


MAX SAMPLING CLOCK 40 MHz

MAX READOUT CLOCK 60 MHz

16-CH Signal Digitizer and Processor

- HCMOS7 0.25 mm (ST)
- area: 64 mm^2
- power: 16 mW / ch
- prototype delivery: Feb '02
- 300 samples (4800 Ch) tested
- delivery of 4x10^4 chips: Dec '02



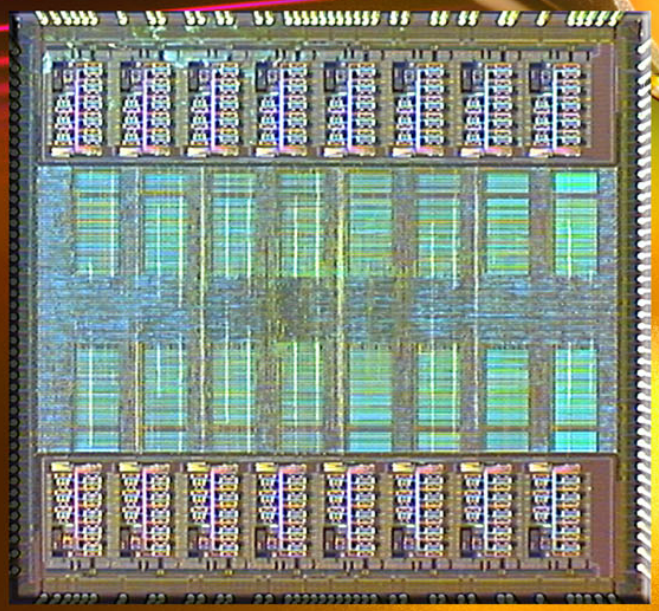
ad ALTRO

STM PRESS RELEASE

"STMicroelectronics Developes World's Most Advanced Data Acquisition System-on-Chip Jointly with the ALICE Experiment at CERN"

"Success in major scientific research project will benefit many aerospace, Medical and industrial applications"

November 25, 2002



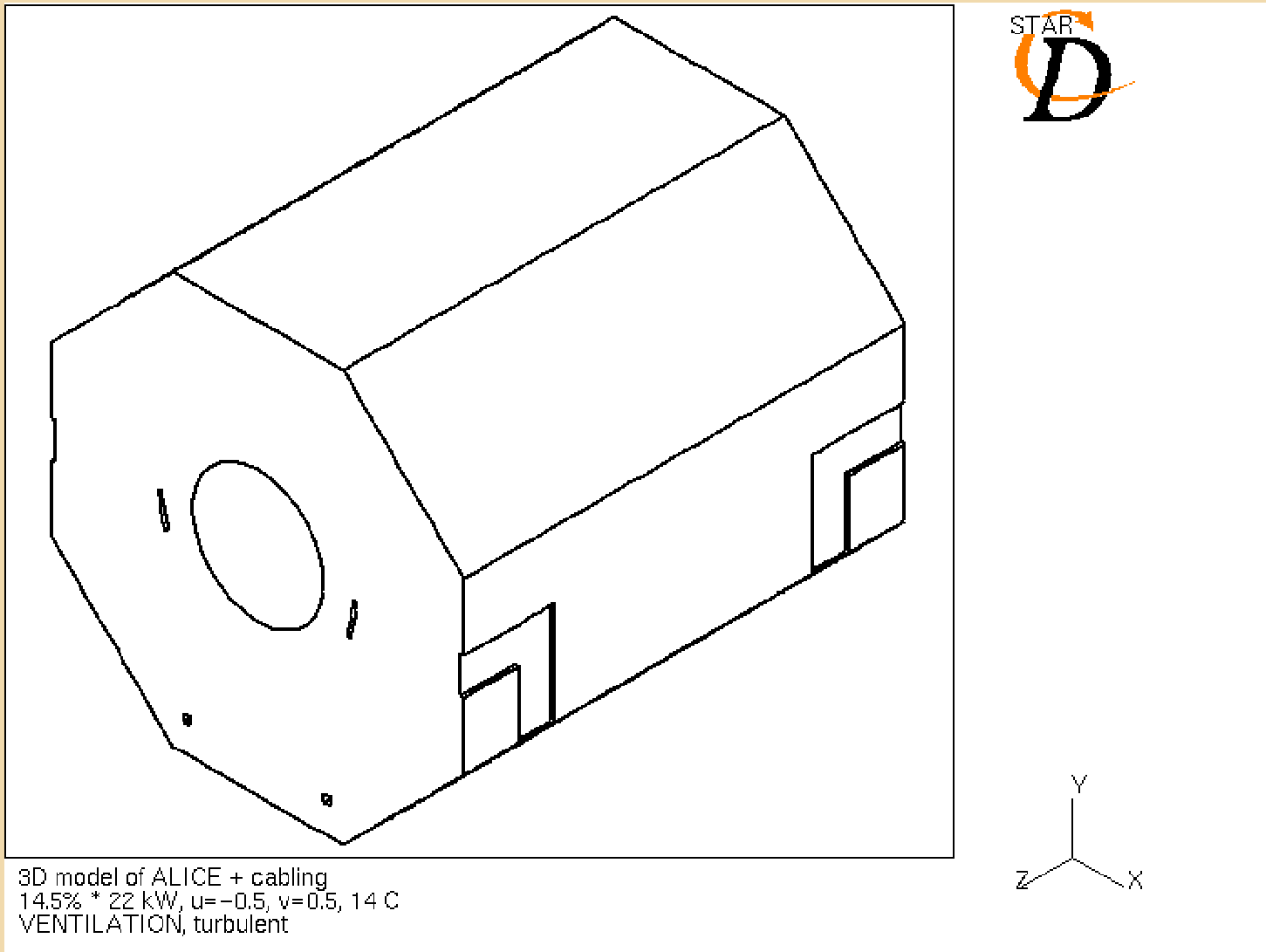
TPC PERFORMANCE : UNDERSTANDING THE THERMAL ENVIRONMENT

- Operation of the TPC requires temperature stability at the 0.1 K level
- Collaboration with ST/CV
- Using the (probably) most advanced, public thermal simulation program to study thermal environment
  - Inside L3 Volume

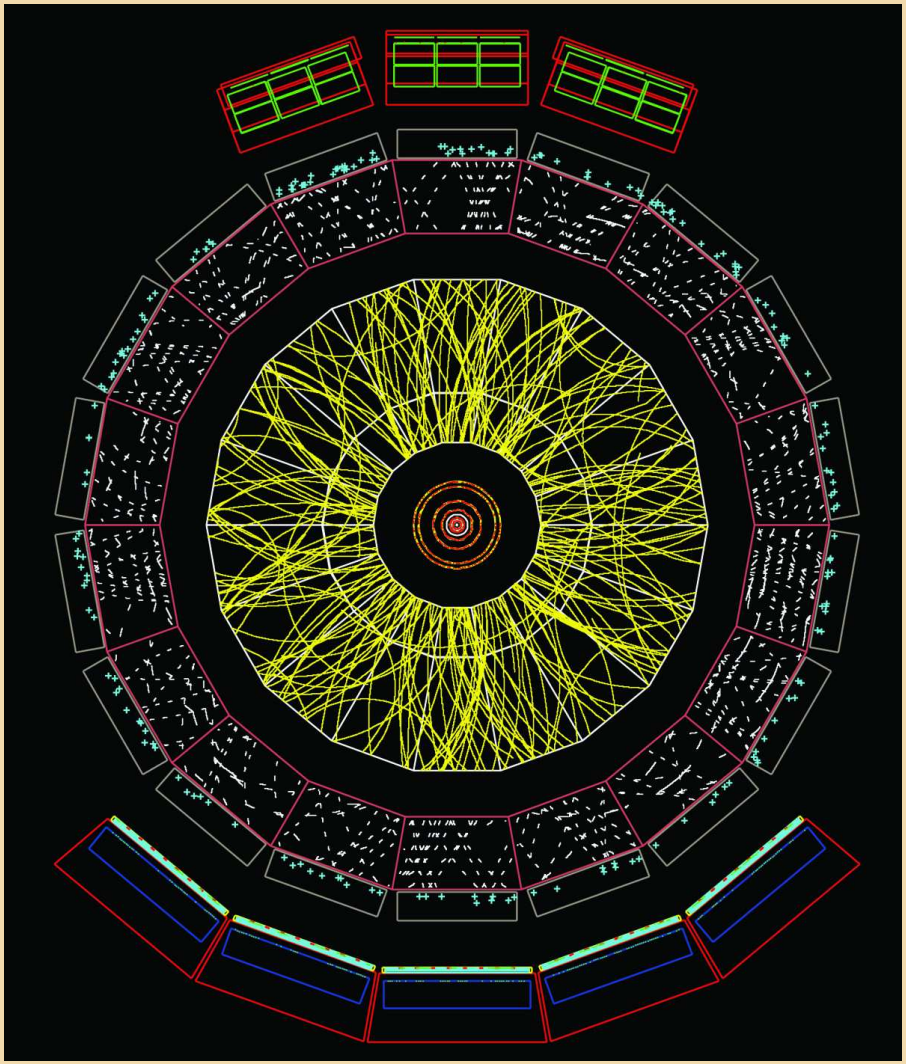
    (led e.g. to water cooled bus bars inside L3;

    to definition of air flux through L3)
- NEXT
  - inside ITS (to be finished)
  - inside Muon Spectrometer (also with Orsay participation)

Temperature map of the L3 Interior



ALICE : Simulation of particle tracks



- Simulation of particle tracks
- Collision of Pb-Pb Ions
- Total number of particles:
- approx. 10 000/coll.
- Shown is ‘time slice’ of 1 %

ALICE DETECTORS : CERN ALICE TEAM RESPONSIBILITIES

HMPID (High Momentum Particle Identification)

Velocity measurement of Cherenkov light

Cherenkov light emitted by medium, if velocity of particle is faster the velocity of light in medium

cos θ (Cherenkov light) = c/(v (particle) n (refractive index))

(similar to shock wave of supersonic airplane)

And momentum measurement

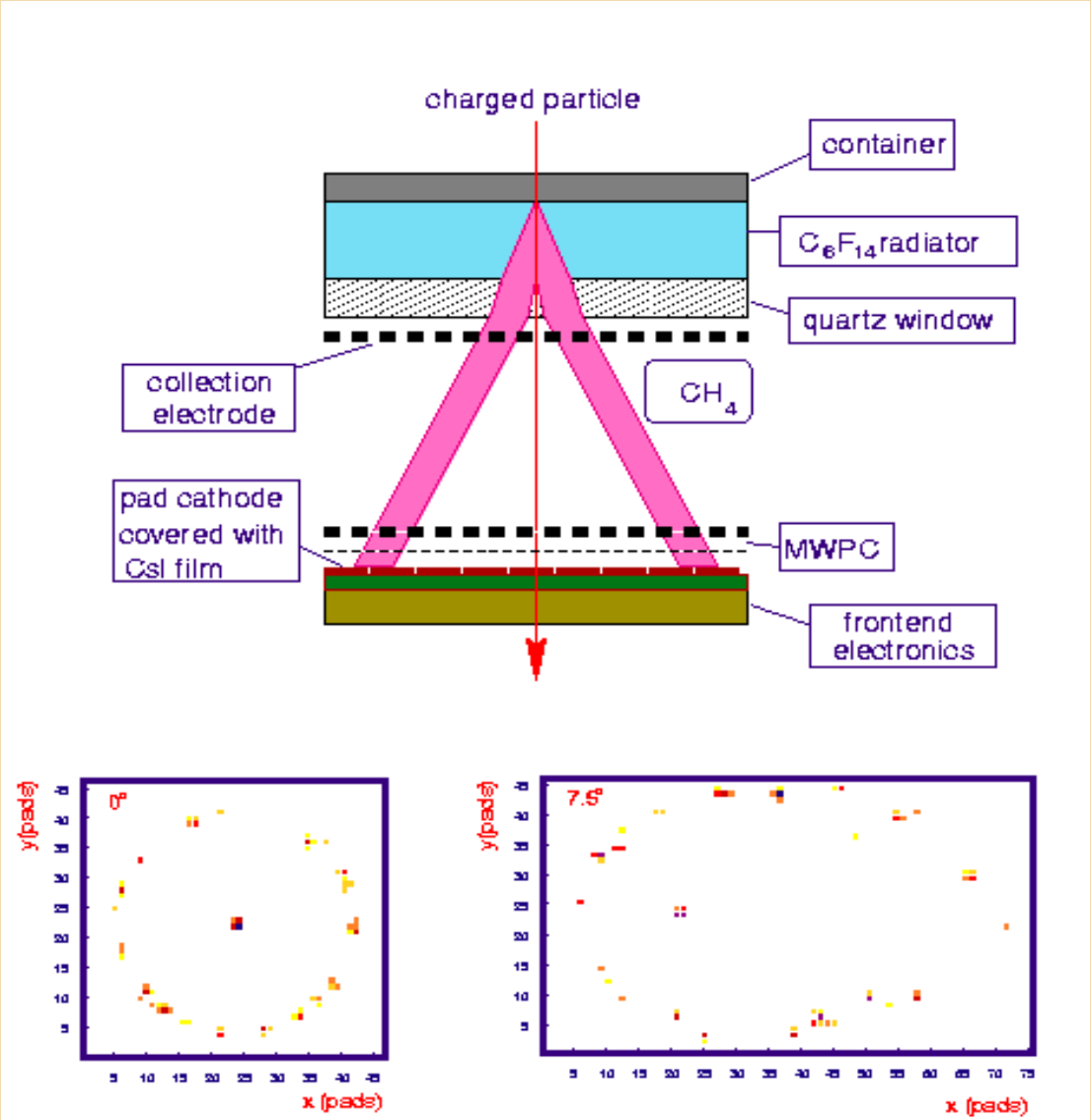
$$p = m\,\beta\gamma c^2$$

Allows mass (m) determination, which characterizes (‘identifies’) particle

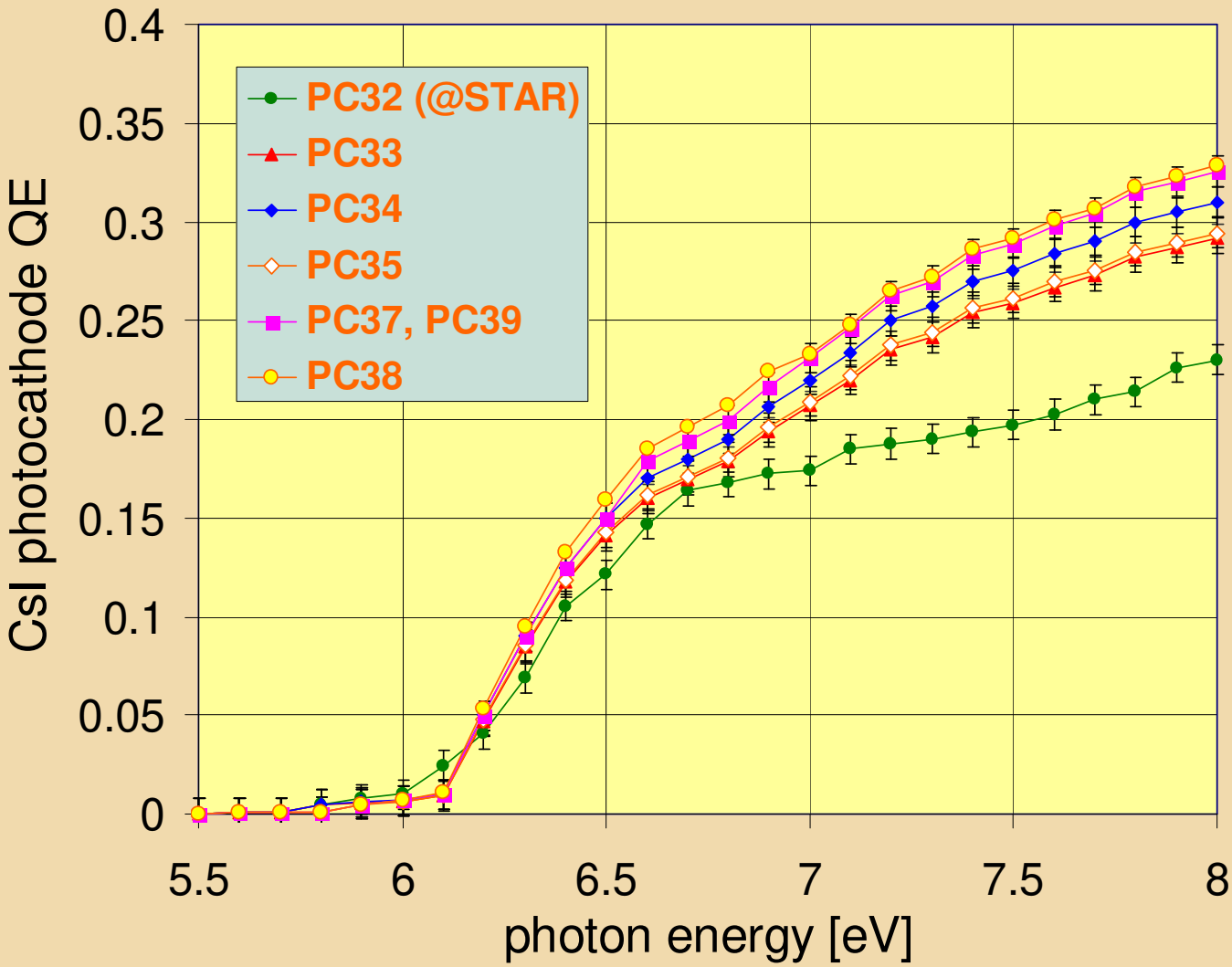
Novel ‘ Imaging’ Technique developed in collaboration with EP/TA 1

EP/TA 2

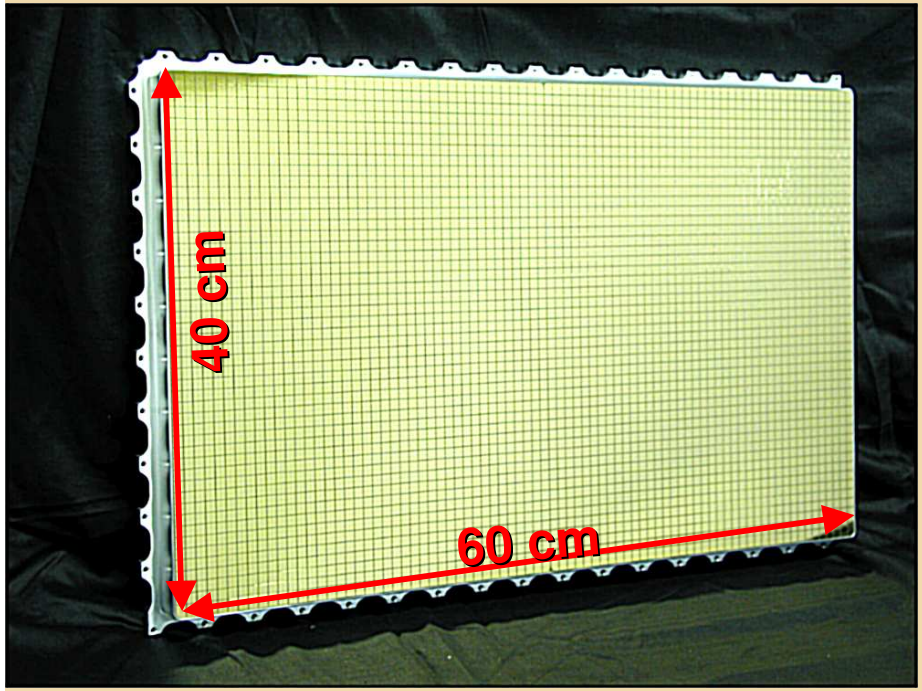
PRINCIPLE of the ALICE RICH (HMPID)
Light detection with CsI-Photocathodes on Pad-Plane

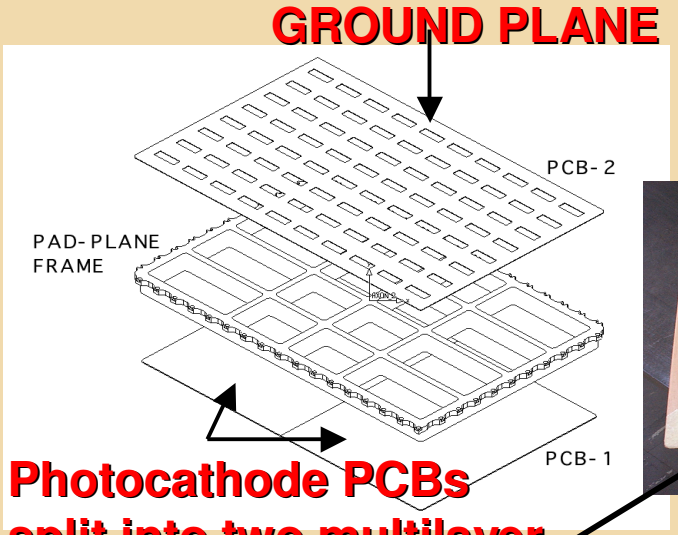


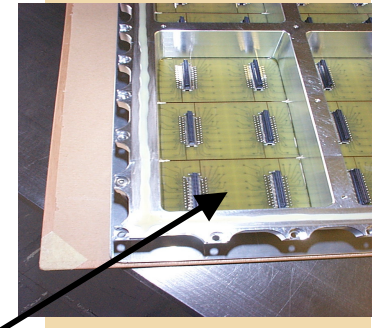
CsI photocathode quantum efficiency



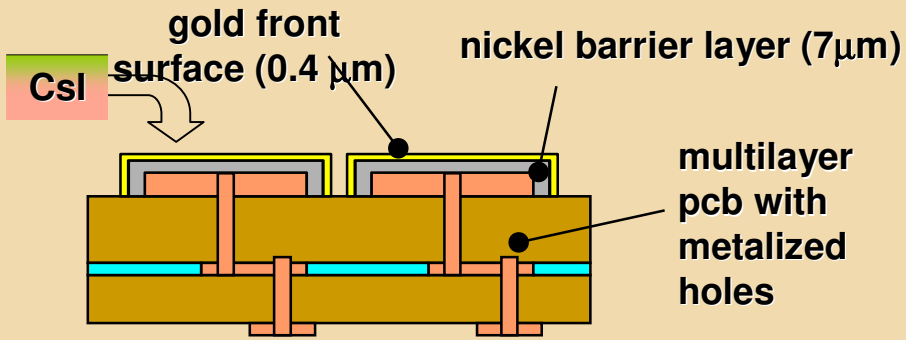
The Devil is in the Details

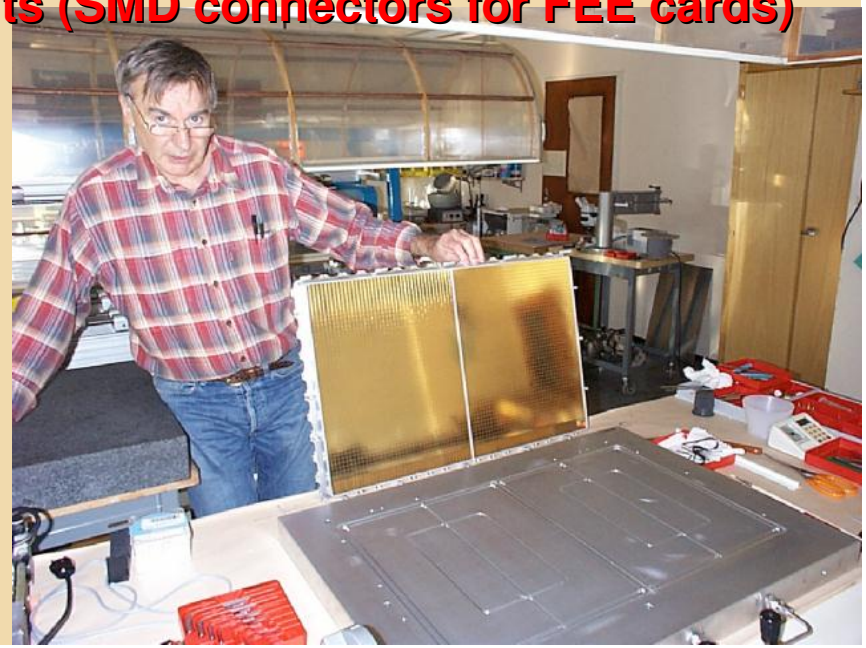






Photocathode PCBs split into two multilayer circuits (SMD connectors for FEE cards)

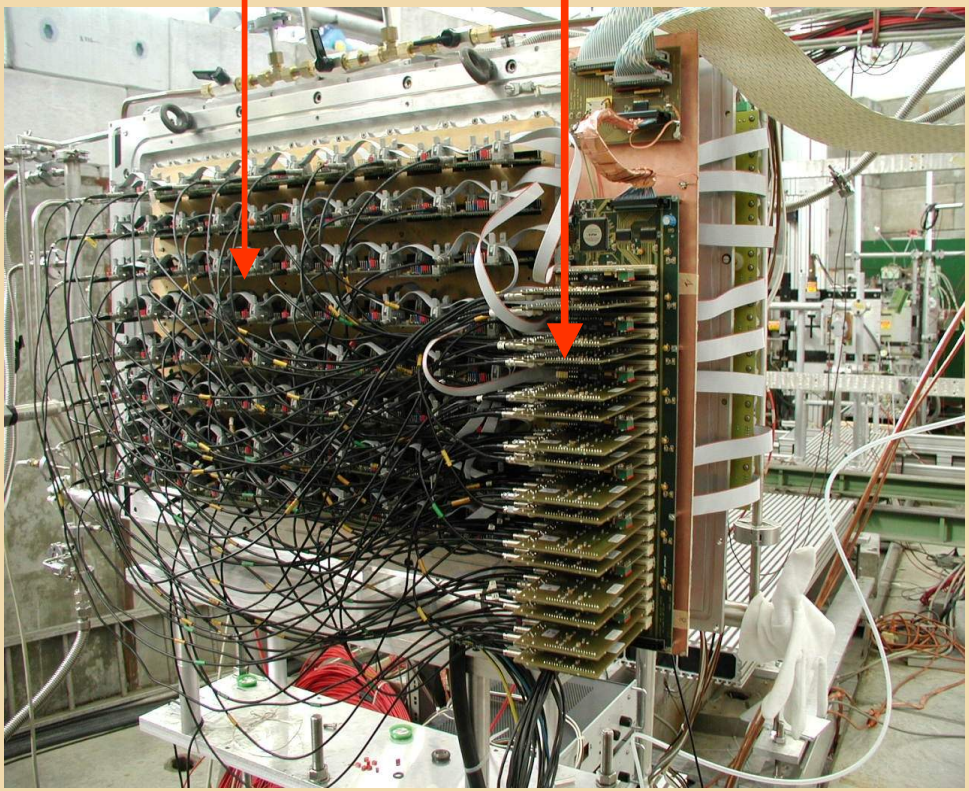


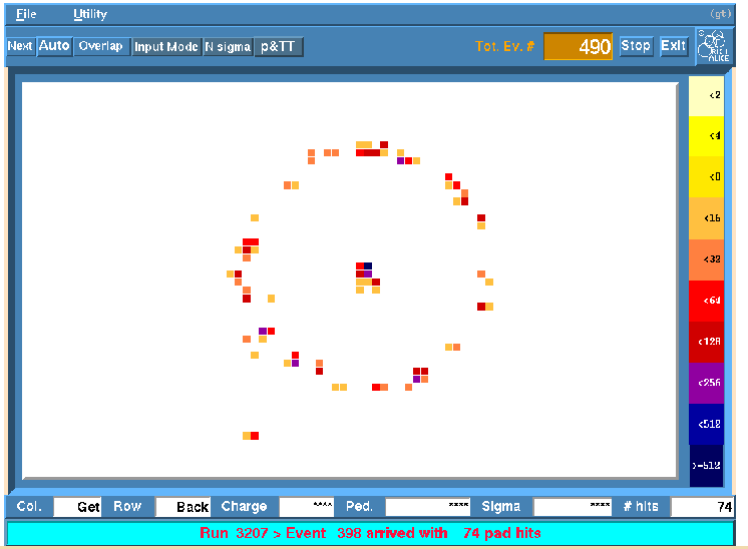


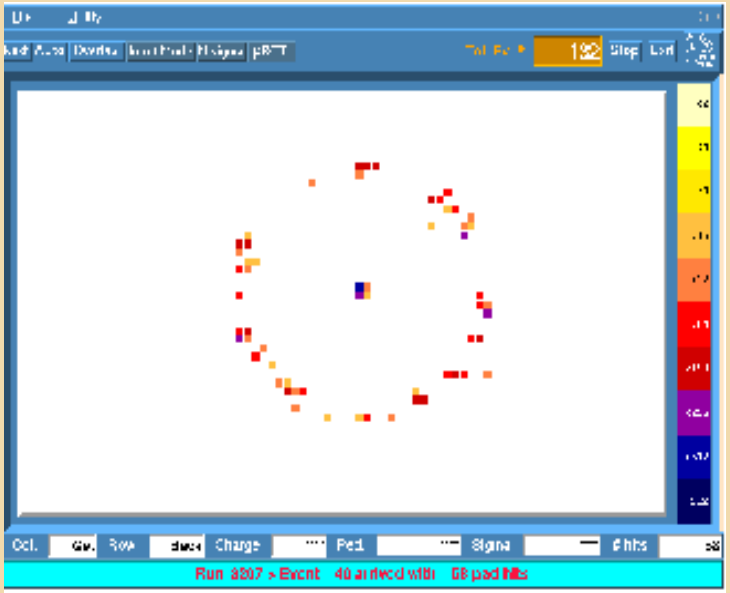
The HMPID proto-3 (one sub-module of final detector) fully equipped with the full FEE/RO chain (3840 channels)

FEE (GASSIPLEX) cards

MCM (DILOGIC) card







ALICE: INFRASTRUCTURE / HOSTLAB RESPONSIBILITIES

Hostlab responsibilities :

formal responsibilities, such as providing

correct working environment;

safe, useable Experimental Hall…

'informal' responsibilities : contribute to the success of visiting groups using CERN as their research facility;

- aim to cover activities, frequently not possible at outside institutes and for which CERN has the appropriate facilities and expertise

- Major engineering tasks
- Special technology groups with their expertise
- Special workshops as incubator for new technologies

Success of CERN depends to a large degree on the perception of our outside colleagues on how well CERN manages their informal, collaborative responsibilities.

ALICE:PROGRESS ON INFRASTRUCTURE/ HOSTLAB RESPONSIBILITIES

Cooling : in collaboration with ST/CV

needs understood, workpackages ('EP definition') established

construction to start

Gas : in collaboration with EP/TA1 and ST /CV

gas pipe routing essentially finished

Electricity : needs understood, workpackages established

rack power distribution in collaboration with ST/EL

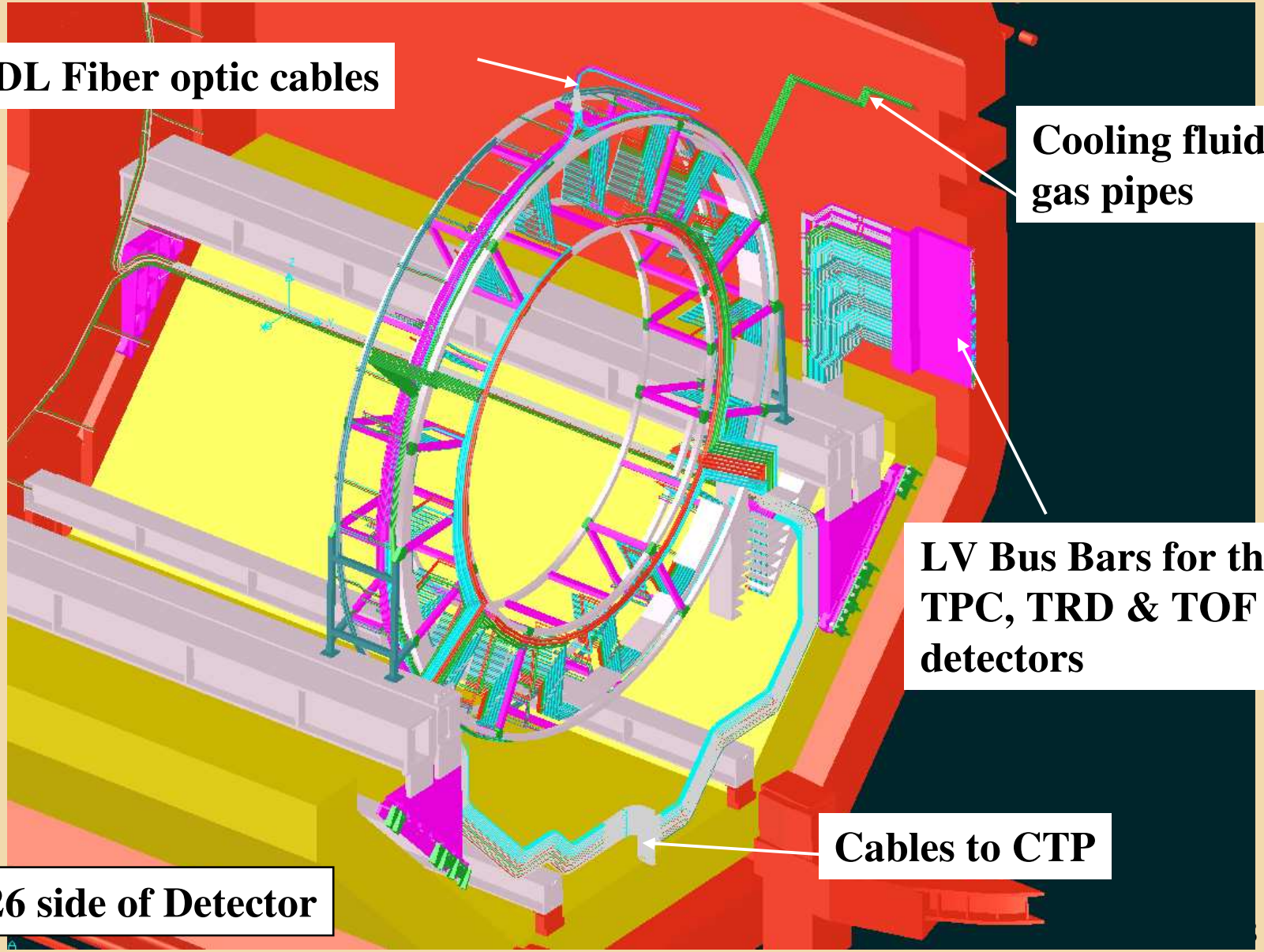
Cabling : major effort, for which we need to be included in the ST/EL cabling contract

Detector Control: In collaboration with AT, IT,ST

Safety Detectors : in collaboration with ST/MA

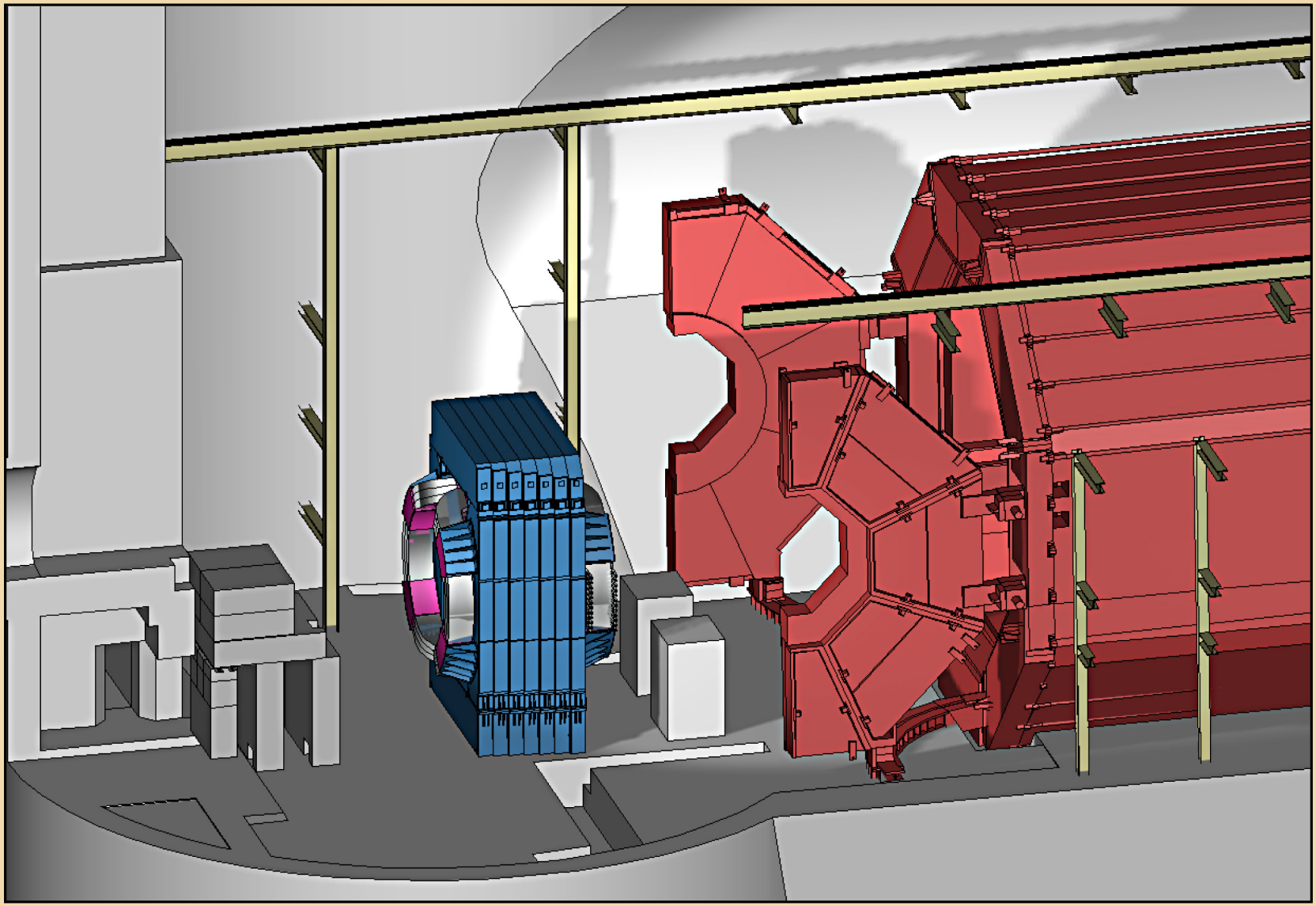
Civil engineering: done by ST/CE

EXAMPLE: SERVICES THROUGH RB26 SIDE

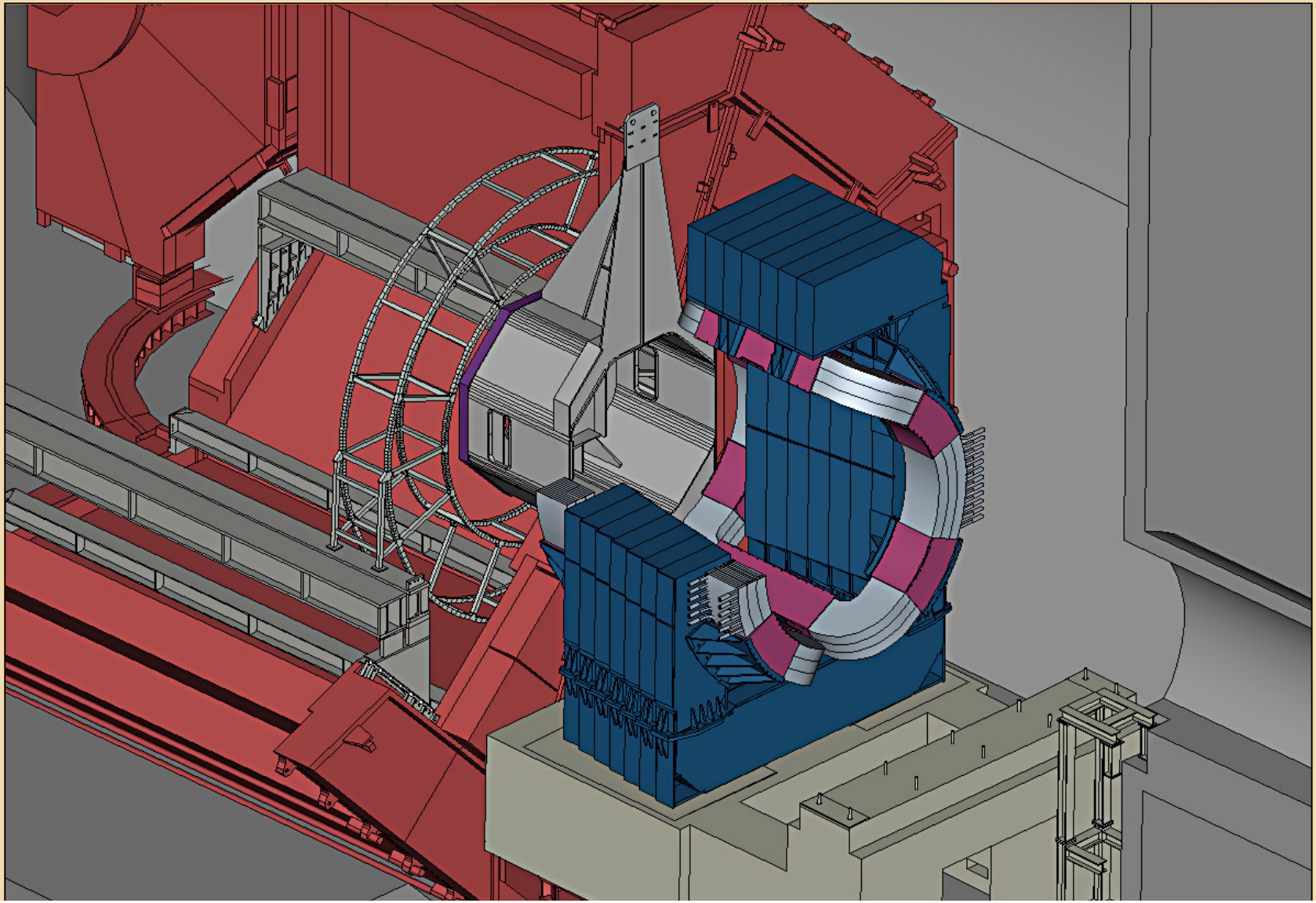


S. Maridor EST/IC & D. Gabriele EST/LEA

Pre-assembly of dipole magnet



Muon magnet on special ST/CE base



ALICE : Infrastructure / Hostlab responsibilities

- **Transport and Cranes** : collaboration with ST/HM

  Transport : requirements for ALICE lees demanding

  compared to ATLAS /CMS; but need availability of a 40- ton trailer for efficient

  operation at Point 2

Crane operators : we have a highly professional Team at Point 2; Knowledge of experiment, environment and collaborators is essential for continued quality therefore

contracts must guarantee continuity over several years

INTEGRATION : KEY MILESTONES FOR TECHNICAL COORDINATION IN 2003

April : Tendering of LV Bus Bars;
Tendering of Muon Absorber Components

April: Muon Magnet Yoke arrives at CERN

May/June: Space frame and auxiliary Service frames assembled at CERN

July: Start of Bus Bard Installation on RB26 side

August: Muon Magnet Coils arrive at CERN

October: Power Tests of Muon Magnet

4th Q: install big support rails
Close L3 RB 26 doors
Construct Muon Spectrometer foundation

ALICE :Conclusions

- ALICE, as the other LHC experiments, has progressed through the efficient, fruitful collaboration with ST and other CERN Technical groups
- ALICE, as the other LHC experiments, can only become reality through continued, successful collaboration with a large spectrum of CERN groups
- CERN will be judged by the quality of fulfilling its responsibility towards and expectations as Hostlab for the ~1200 ALICE collaborators
- CERN-ALICE Team is looking forward to a continued fruitful collaboration with ST Division during 2003, which will be a very critical year for ALICE