TEC+ integration - Status and requirements

Tracker Integration Meeting, April 27th, 2005

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Outline

- Status of TEC+ structure integration
- Status of petal reception, infrastructure, readout hardware for TEC+
- Plans for TEC+ testing at CERN
- Answers to Ariellas questions
- Summary
**General structure integration status**

**TEC+:**
- Disk stack pre-assembled, service channels glued to the fixations, stack disassembled
- Service channels filled with fibers by and in Karlsruhe
- Final assembly of disk stack done → **TEC+ mechanically ready**
- Currently service channels are being mounted

**TEC-:**
- Disk stack pre-assembled, service channels glued to the fixations, stack disassembled
- All service channels shipped to Karlsruhe
- Currently disks are being prepared for final assembly

**A huge amount of work implied → next transparencies**
Preparation of the bulkhead for TEC+:

- Cleaning
- Exchange of magnetic screws
- Removal of hook and loop fasteners for enclosure
- Machining of cut-outs for the cables

→ Bulkhead for TEC+ ready, bulkhead for TEC- to be done
TEC+ structure integration: grounding

All petals, CF skins, cable shields etc. are connected to the TEC common ground via a “grid” of copper strips

- Copper strips glued on outer radii of disks
- Braids for ICB connection soldered to strips
- Shielding foils glued to inner shells & back disk

To be done: copper strips on service channels, plus complete TEC- grounding
TEC+ structure integration: alignment

- All three alignment rings glued to their inserts on back disk
- Precision measured on CMM
- TEC+ ring at CERN for calibration
- Pockets for tiltmeters prepared
- Preparation of disk 6 with beam splitter adjusters and fiber tubes

Done for TEC+, ongoing for TEC- (and for the magnet test mockup).
• In the rotation cradle, the TECs are supported by a thick, rigid CF disk
• This “rotation disk” is screwed to the service channels
→ assembly done for TEC+, rotation disk for TEC- in production at ADCO
TEC+ structure integration: precision

Disks:
Offset in x and y and rotation in $\phi$ with respect to average disk c.s., precision of measurement = 50µm:
TEC+ after final assembly: $\sigma(\delta x) = 60$ µm, $\sigma(\delta y) = 60$ µm, $\sigma(\delta \phi) = 70$ µrad
TEC- after pre-assembly : $\sigma(\delta x) = 70$ µm, $\sigma(\delta y) = 60$ µm, $\sigma(\delta \phi) = 80$ µrad

Inserts on petals:
$\sigma(\delta x) = \sigma(\delta y) = 5$ µm, $\sigma(\delta z) < 20$ µm

Module positions on disks:
petal mounted on disk, position of module inserts measured w.r.t. disk c.s.:
$\sigma(\delta x) = 60$ µm, $\sigma(\delta y) = 50$ µm

TEC+ alignment ring:
• Mounting reproducibility: position: 10µm, orientation: 10 µrad
• Tiltmeters on alignment ring and back disk have been calibrated
Aluminum SCs are unscrewed one by one and replaced with CF service channels
Fiber mechanics are screwed to the disks (done)
Continuity of fibers still to be tested with laser pointer (next week)
To be assembled to the fiber mechanics: CF protection plates, fixation C brackets

One accident happened: 2 ribbons squeezed → one SC back to Karlsruhe for repair
• Alignment fibers for TEC+ had to be added to SC channel afterwards and pulled through tube in disk 6 to reach the beam splitters.
• During this exercise, several plastic fiber holders went off → now fixed to SC with glue spot
• Alignment fibers for TEC- integrated together with readout fibers
• Beam splitters will be added later!
5/8 service channels mounted, receive repaired channel this Friday.
TEC+ structure integration: services

Visit of Nick last week:
• Assembly of one set of services
• Study of cable routing/fixation at the bulkhead, sealing molds, precision of pipes, ...

• These are not the final services.
  They did not pass x-ray tests, Lyon is in contact with several companies
• Current planning: services will stay in Aachen for petal insertion tests.
• To be used for integration of first sector (to be exchanged later), if final services are late for TEC+ integration
Issues to be solved:

- Sealing molds on disk 9 collide with petal manifold
- Stability of sealing molds not satisfactory → complete re-design
- Cut-outs for cables at bulkhead rip to be enlarged

- Precision of pipes/connectors with respect to petal manifold not sufficient
  → too much stress on the manifold
- Need to change specs and welding jig
  (One action: Fraunhofer IPT (Aachen) will look at it this week (in contact already for pipe welding))
Rotation cradles

- TECs will be mounted in a cradle during integration
- Can be transformed from transport to rotation cradle in about one day
- Cradles basically ready for both TECs
TEC+:
- end of April: service channels integrated
- end of May: photogrammetry (date fixed)
- 5.7.: TEC+ ready for petal integration

TEC-:
- 1.6.: service channels and services ready
- from 9.6. onwards: integration of service channels
- 19.7.: photogrammetry
- 23.9.: ready for petal insertion
- 26.9.-21.10.: TEC insertion test at CERN
TEC+ integration: petal reception test

Basicallly: take pedestal runs in peak & deconvolution mode, check for bad strips, measure leakage current, compare with data base, add and test DOHM and humidity sensor

Clean room is ready:
- readout hardware in hands & working except TPO (broken?)
- 2 petal grills for parallel work
- microscope
- readout of T and H sensors
- storage space for 10 petals

But: work on run control & analysis needed for automation of test
Waiting for the integration DAQ release...
First petals for TEC+ expected in June
TEC+ integration: plans for testing

The natural unit of a TEC is a “sector”:

- 1 “sector”

- 1 tower = 9 BP OR 9 FP
- 1 tower = 2 cooling loops
- 1 FP + 1 BP = 1 control loop

- Integrate and test petals sector by sector
- For the first sector: perform cold test and grounding/shielding studies
- Take cosmic data and perform alignment studies with tracks
- Test laser alignment
TEC+ integration: DAQ & cooling

In hands today: VME FEC (4 mFECs), 4 PSMs, 2 multi-ribbon cables, 8 power cables (D-sub)

3 PCs (FED, FEC, event builder) currently being set up

chiller, 3.7kW at -20C

pipework etc. to be done

Will pick up 3 watercooled LEP racks on Friday.
Missing DAQ equipment communicated to electronics coordinators.
Clean room will be ready in June 05.
Tests of TEC+ at CERN

- TEC+ will arrive at CERN completely integrated and tested around May 06
- After arrival, a functional readout test has to be performed
- This will be combined with a cold test of the complete TEC+, to be performed in the Lyon cold room (or in a clean room sector by sector using our own chiller)
- Time foreseen for this readout/cold test: 40 days
Arrival and discharge of TEC+

- **Status on arrival:**
  - TEC+ arrives at CERN in the transportation cradle
  - **Dimensions** (rotation configuration):
    - width x length x height = 2.82m x 2.82m x 2.956m
  - Outer CF enclosure will be mounted around the TEC+
  - In addition, an aluminum envelope around the transportation cradle will protect the TEC+ from dust and define a gas volume, to be filled with dry air

- **Discharge:**
  - drive with truck backwards through large main door in 186
  - unload via movable platform
  - cradle has wheels → easy transport as long as there are no steps...

- **Sealing:** upon arrival and during testing, the TEC+ will not be sealed
  (front disk not yet present and sealing molds not sealed yet)
Space requirements

- **Space for work around detector:**
  2m in each direction around transportation cradle, 3m on one side in case petals have to be exchanged
  → 7m x 8m (fits with dimensions of cold room/clean room)
  Detailed planning for space needed for TEC+ and TEC- integration in 186 worked out by Nick and Didier, with possibility to have TEC+ in cold room and TEC- in clean room and vice versa.

- **Space for equipment** (estimates):
  we will bring with us:
  - 4 racks: 3m x 1m
  - chiller: 1.5 m x 1.5m
  - space for DAQ (table, 3 PCs, monitor, switch, operators chair): 2m x 2m
  - all our cables, fibers, pipework (not clear, see below)
  - petal insertion tool with movable table:
    1.5m x 1.5m
  - platform: 2m x 2m

  control room?

  } must fit into clean room, but need possibility to stored outside of clean room
Space requirements

- **Storage space for cables:** for the readout test, 48 LICs of roughly 50m length plus 9 control cables are needed → need to store in false floor or on very stable shelves
- **Storage space for optical multi-ribbon cables:**
  need 13 multi-ribbon cables of final lengths → need to store in false floor or on very stable shelves
- **Storage space for pipes:** use flexible tubes to connect to chiller → not a big space issue
- **Office space:** at least 2 people permanently at CERN, need office in building 28
Activities after arrival

- Transportation of TEC+ into cold room
- Removal of aluminum cover
- Cabling (power cables and optical ribbons) to be done sector by sector
- Pipework to be done sector by sector (we bring all pipes with us)
- Readout and cold test (40 days foreseen)
- Finally: transition from cradle to Antti chariot, mounting and sealing of front disk, crane needed

All “clean work”.

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TEC+ status report
Needs for tools and services

• **Need for tools:**
  - Forklift
  - Crane needed to move TEC+ out of transportation cradle
  - No other specific tools needed, will bring our own tooling with us

• **Need for N2 or dry air:**
  - storage: 1 volume exchange / day (V≈20m³)
  - (cold) testing: e.g. 1 volume exchange / hour

• **Water cooling:**
  - Need water cooling for the three racks:
    1 FED rack with 1kW plus 2 PS racks with 2 Easy crates each = 5kW per rack
    (pressure = 3-6 bar, inlet temperature 15-18°C, flow=0.25l/sec for 5kW)
  - Need water cooling for the chiller (2500l/h, T< 25°C)

• **Cleaning facility for pipes:** not needed

• Total electrical power: ≈30kW
Summary

• TEC+ mechanical structure ready
• Excellent precision of mechanical structure
• 5/8 TEC+ service channels mounted
• Services on the critical path
• Next steps: petal insertion tests and test of rotation mechanism
• Work ongoing to prepare TEC+ integration and testing
• First petals expected in June

• TEC+ shall arrive at CERN in May 06
• At CERN: readout test and cold test