Mechanical Structure of ECAL-P

status report & update

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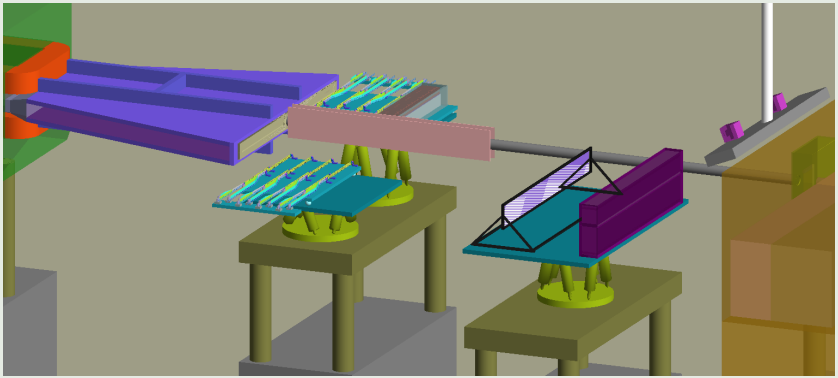
LUXE ECAL weekly meeting, 16-MAY-2023

Outline

Update since LUXE meeting in Tel-Aviv (6-MAR-2023)

- Decisions/agreements made in Tel-Aviv:
  - separate “base-plate” for ECAL-P and Tracker
    (better tension distribution, easier transportation and positioning, more design freedom for each team, etc...)
  - closer distance between ECAL-P and Tracker ($\sim$ 6 cm), non-central location on 6DOF table
  - **ECAL-P can use only 50% of space above the beam-pipe**
  - independent support for tungsten shielding around the beam-pipe (1mm gap to ECAL-P)
  - no rotary table in LUXE experimental hall (some simpler solution for test beam setup, not today...)
- New development:
  - Modified support (upper combs) for PCBs+sensors
  - Modified fixture for lowering/lifting of PCBs+sensors (in progress...)
  - **Aluminum T-frame for holding PCBs** (feedback from Kraków, $\rightarrow$ zoom tomorrow)
  - new “funnels” to guide sensors inside ECAL-P gaps (in progress, not today...)
  - location and mounting of bases/nests for geodesy markers
    (ball mounted retroreflectors)
  - first proposal of “spider” for transportaion/crane
  - new mechanism for manipulating/positioning and fixing ECAL-P
    on the 6DOF “DESY standard” table (in progress...)
  - support for cabling (feedback from Kraków, not today...)

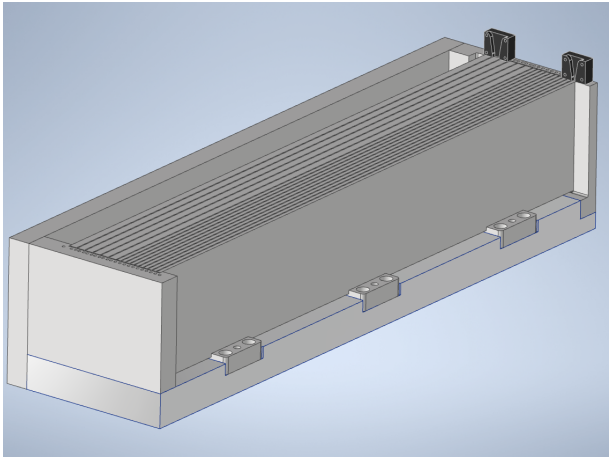
ECAL-P location, CAD view of interaction area (not much up to date...)



- on the “positron-arm” closer to the wall of the experimental hall ($\sim$ 80 cm) space left to the wall...
- ECAL-P and Tracker on a separate tables (base-plates) (separate pillars ?)
- behind shielding tungsten plates ($\sim$ 1000 mm length)

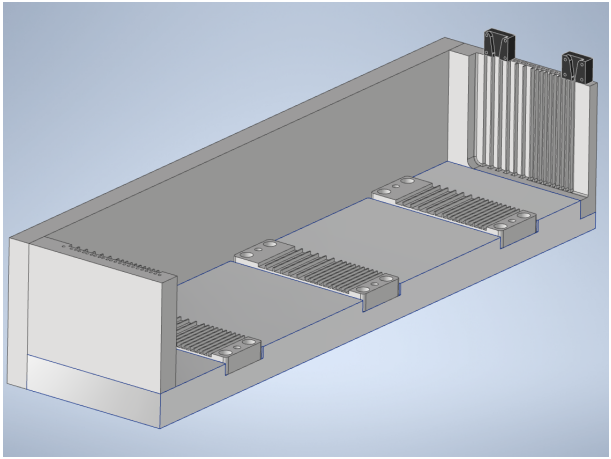
ECAL-P: mechanical parameters

ECAL-P main frame



- main aluminum body of ECAL-P with 3.5 or 7 mm tungsten plates (1 mm gaps)
- current version: 15 layers ($10 \times 1X_0 + 5 \times 2X_0$), keeping **flexible "open architecture"**
- transverse size of single plane: 90×540 mm^2 6 CALICE (320 μm) silicon sensors per plane

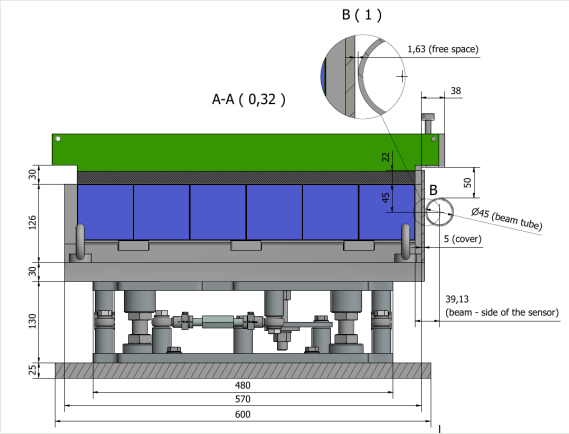
ECAL-P main frame



- interior with **combs and ribs for positioning the plates** (in the bottom and side-walls)
- **10 mm distance between Si sensors and the shielding** (asymmetric beam-pipe side)
- “funnels” to facilitate the insertion of tungsten plates and to protect the combs

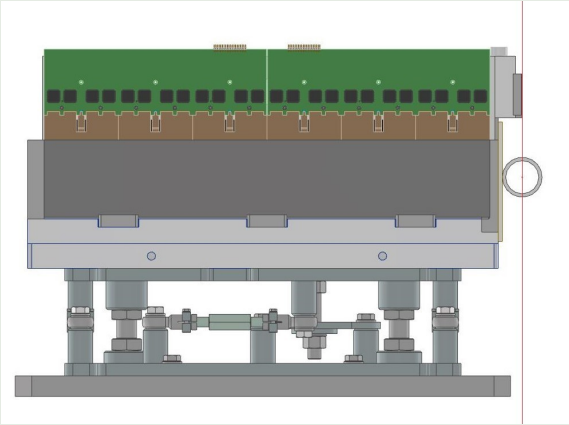
PCBs support: area above the beam-pipe

ECAL-P OLD PCB support: dimensions



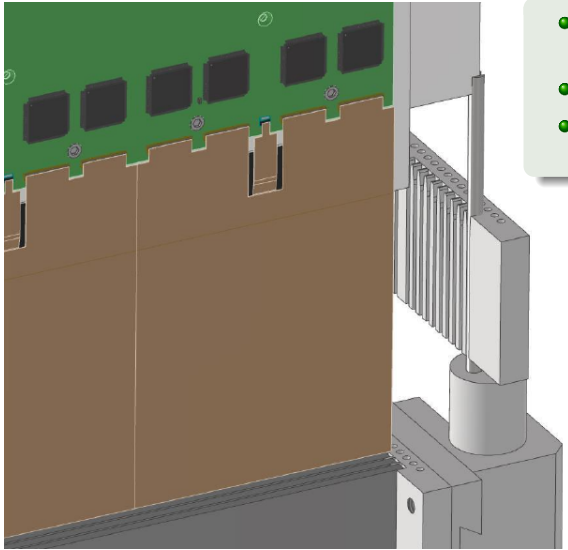
- **OLD:** outer X-dimension: outside beam-pipe axis on ECAL-E territory
- **possible conflict with electron side (e-tracker, ECAL-E ?)**

ECAL-P NEW PCB support: distance to beam-pipe axis



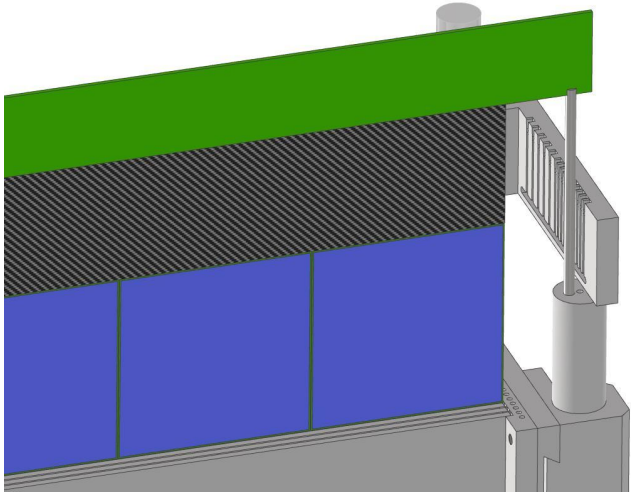
- **NEW:** PCB support occupying only **50% space above the beam-pipe**
- **major redesign necessary (work in progress...)**, new PCB support, new lowering mechanism

ECAL-P NEW PCB support, OLD lowering mechanism



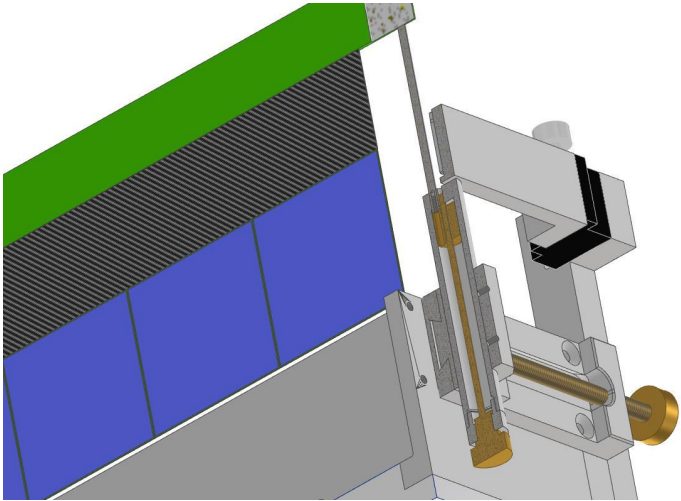
- OLD lowering mechanism:
  clash with NEW narrower PCB support
- redesign in progress...
- (lowering mechanism used only during assembly or repair, not in “working position”)

OLD fixture for lowering the sensors and OLD PCB support



- Structure of PCBs (thickness: $1 \div 1.5$ mm + chips/connectors), kapton foil and Silicon sensors

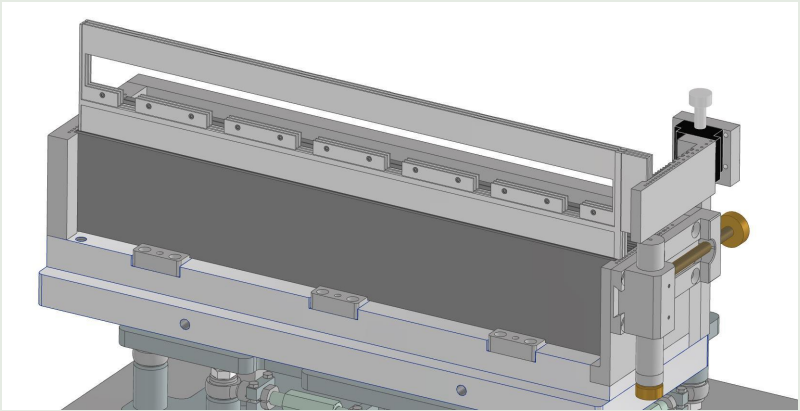
OLD fixture for lowering the sensors and OLD PCB support



- OLD: 2 degrees of freedom: up-down (Y) and forward-backward (Z), gentle lowering, “slow motion”
- NEW: **simpler mechanism under development** (only up-down (Y) motion)

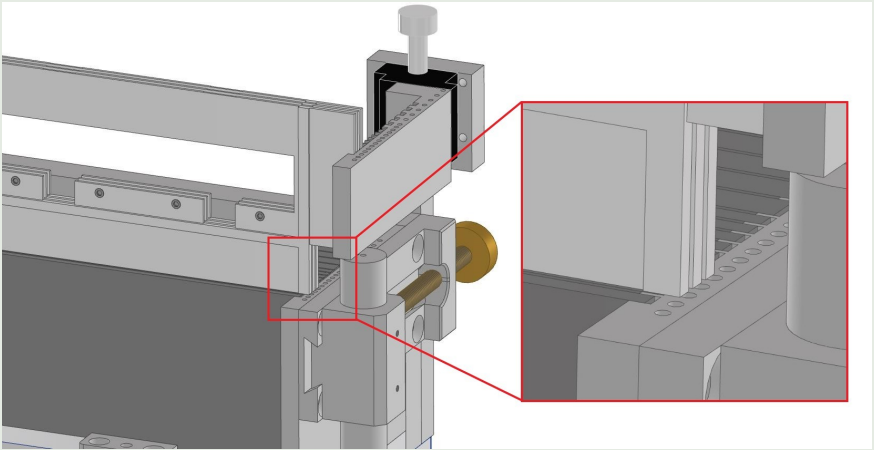
T-frames for PCBs

NEW T-frame for holding PCBs



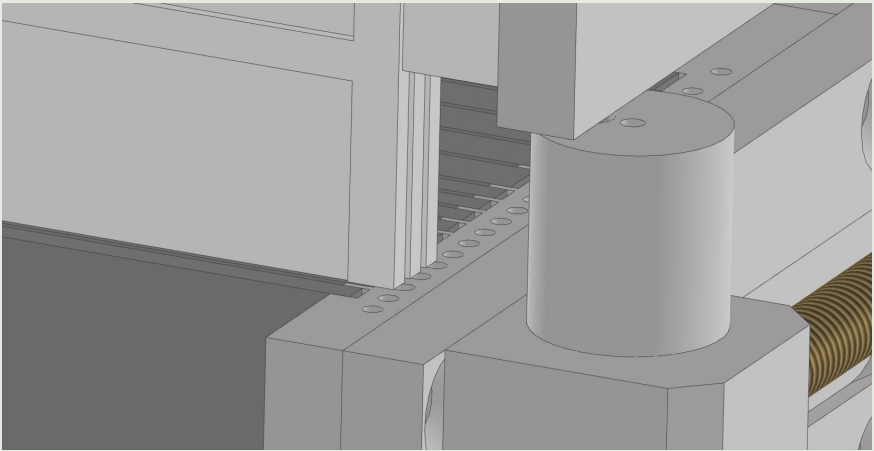
- PCBs will be **not monolithic**, composed of 2 or 3 pieces → **not self-supporting**
- **requires extra mechanical structure** : T-frame made of 3 mm Alu plates ($\sim$ 550 mm) long (!) (plus extra machining for fine substructure), for each ECAL-P frame (**new non trivial element !**)

NEW T-frame for holding PCBs



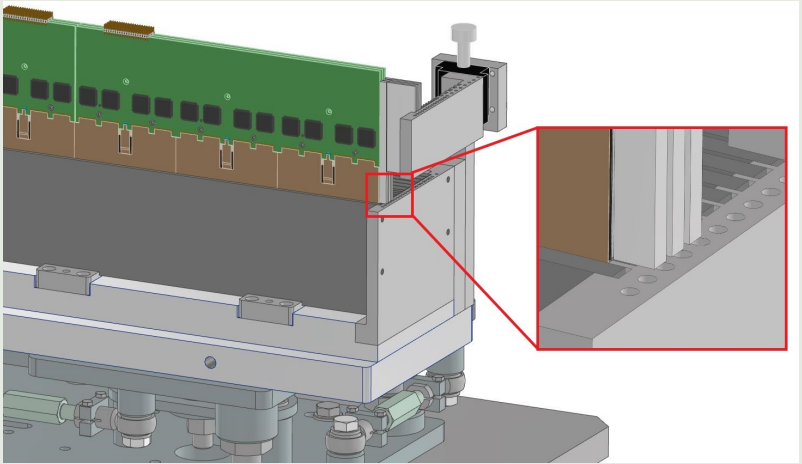
- **substructure of holding/fixing PCBs inside the T-frame** (work in progress... double sided PCBs ?)
- leveling on main body of ECAL-P or on the combs of upper PCB support ?

NEW T-frame for holding PCBs (zoom)



- leveling on main body of ECAL-P or on the combs of upper PCB support ?
- (not on tungsten absorber palates $\rightarrow$ unknown precision of machining)

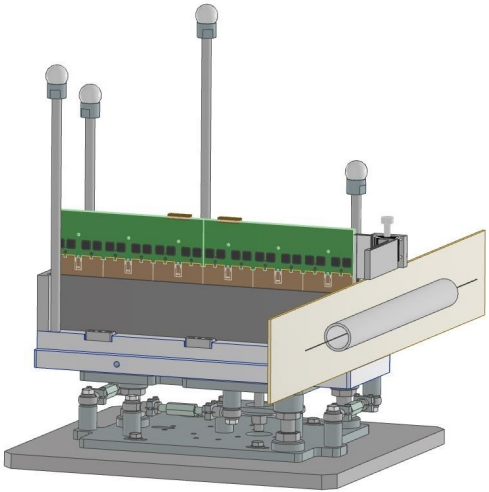
NEW T-frame for holding PCBs



- view with PCB inside (temporary prototype)

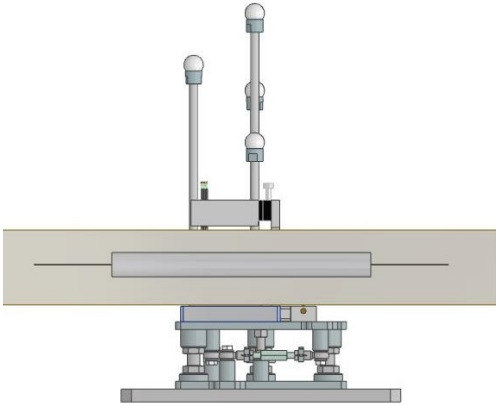
Markers for geodesy survey

ECAL-P: location of markers for geodesy survey



- **4 markers on metal bars**, not on common plane (better constrains of DOF), **exact heights TBD**
- (marker closest to the beam-pipe has the lowest possible position above beam-pipe $\sim$ 20 cm)
- attached directly to the ECAL-P main frame
- not in conflict with other components (easy to remove)
- **looking "upwards" better reproducibility of position**
- waiting for feedback from Louise and Karsten $\rightarrow$ **field of view of laser tracker ?**

ECAL-P: location of markers for geodesy survey



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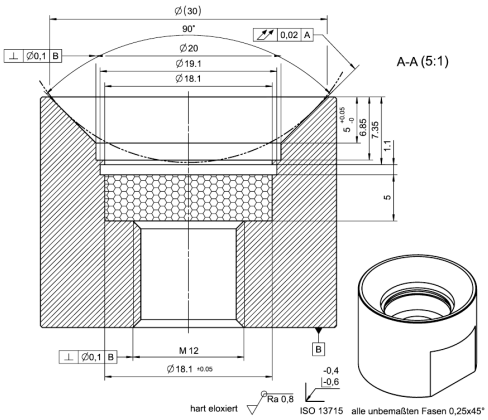
ECAL-P: marker nest for geodesy survey

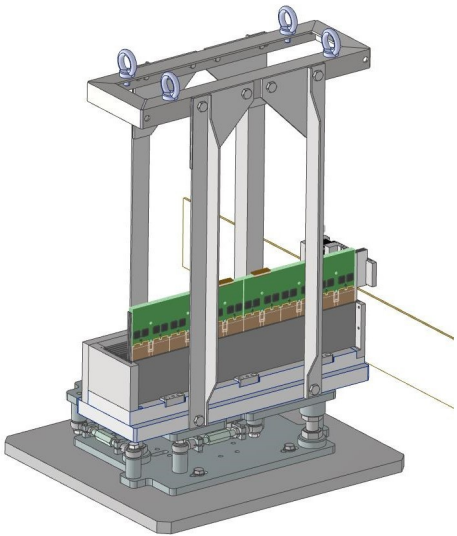


Nest parameters

- standard “Messmarkenbasis_12.2.1_Boden”
- nest: 30 mm diameter
- M12 thread & screw
- neodymium magnet $\oslash$ 18 $\times$ 5 mm

The Spider

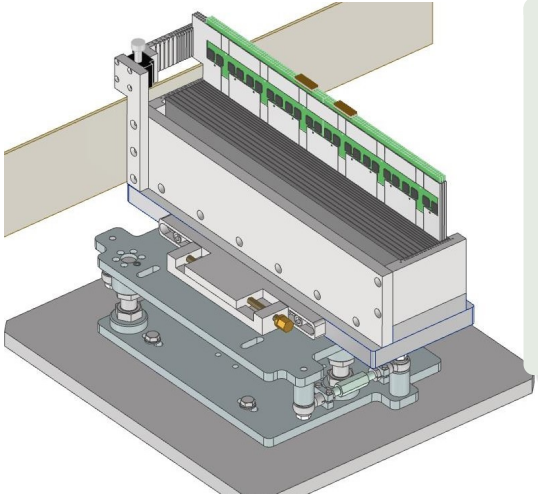
ECAL-P: “Spider” for transportation/crane



- **rigid self-supporting structure**
- attached to the ECAL-P base-plate wit 4 screws
- hooks not on the level of base-plate
- upper part will be still modified (double-“T” shaped angle bars) $\rightarrow$ no welding !
- possible cover/housing (wooden or plastic side walls) for protection during long distance transport

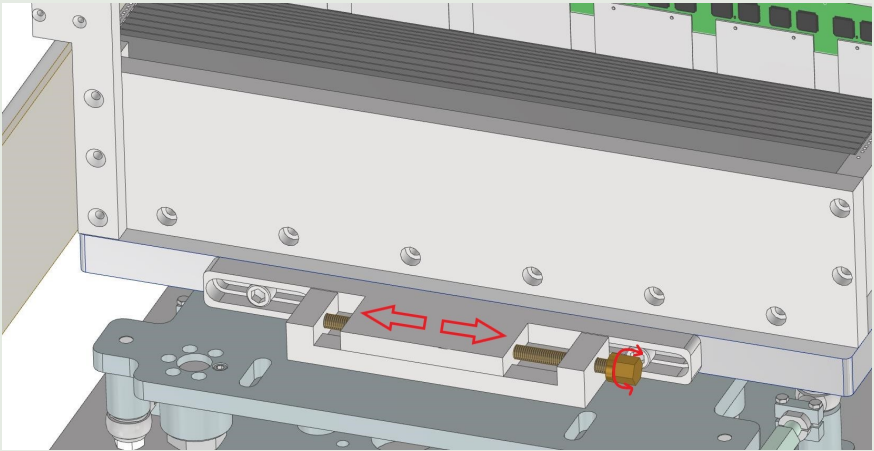
positioning on the 6DOF table

ECAL-P: positioning on the 6DOF table



- **6DOF table has only ± 0.5 cm range**
- degrees of freedom are not independent (tedious iterative procedure...)
- 6DOF table **adequate for leveling** with beam-pipe and tracker
- but not for moving between working and parking position (few cm in X direction)
- crane not precise enough to define the final position with 1 mm distance to the shielding
- ECAL-P will be to heavy ($\sim$ 80 kg) to adjust it manually...

ECAL-P: positioning on the 6DOF table



- new mechanism under design (using M12 holes for spider)... **moving and docking in final position** (to 1 mm gap to the shielding)

LUXE experimental area: 10 t crane in the cavern