News from CLICdp and LCD

FCAL workshop October 2018, DESY Hamburg

Konrad Elsener, CERN

News from CLICdp

CLICdp **collaboration workshop** 28-29 August 2108 (73 registrants)

https://indico.cern.ch/event/703821/ (almost all slides are public)

CLICdp Advisory Board (review session on 17-18 April 2018)

on request of the panel:

review report not to be distributed beyond CLICdp members

Panel feedback

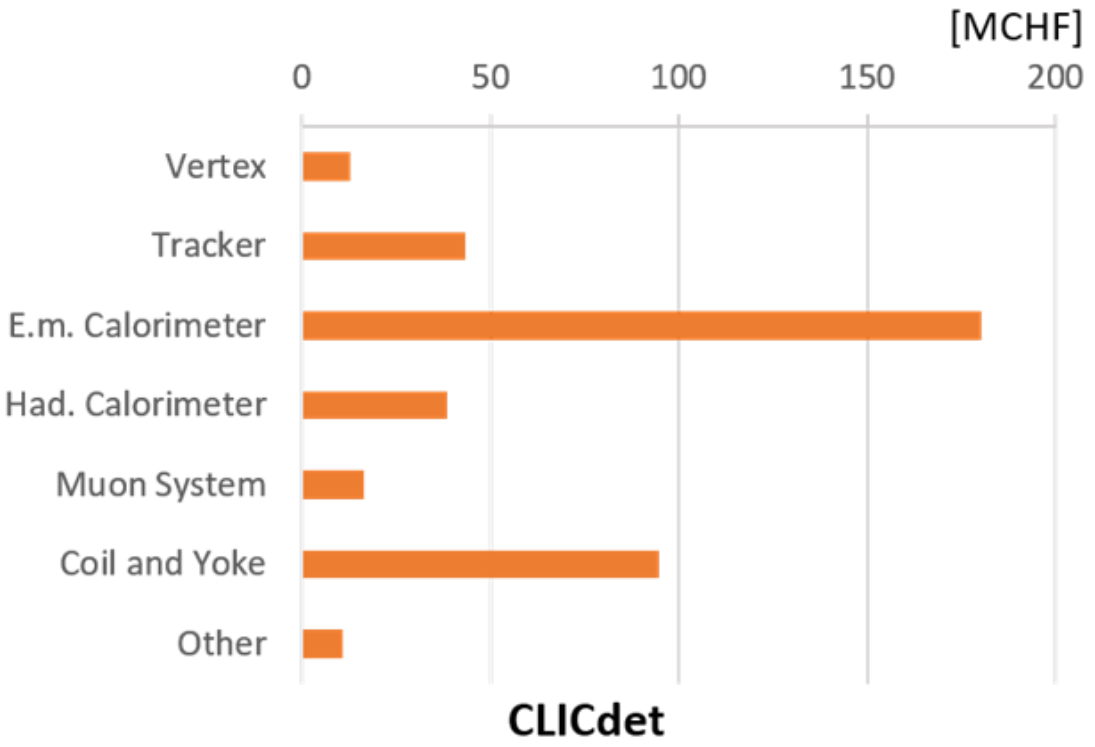
- The panel gave initial oral feedback, and wrote a report that was delivered on Friday.
- After discussion, the panel's feedback is restricted only to the collaboration – thought it could be more useful to us this way
- –> therefore please do not share it more widely
  [discussion at Institute Board today]
- Very positive reaction from the Advisory Board, reflected throughout report:

> In general, the Advisory Board considers that the work going into establishing the physics case for CLIC is excellent, and we suggest ways to help strengthen the presentation of that case. With regard to the specific detector R&D, as discussed below, the board was generally highly impressed by the work in progress, and strongly encourages its continuation.

- Recommendations are gathered here with some initial reactions, for discussion
- In many cases recommendations were already captured by initial oral feedback, but in others the extra context given by the report makes the intention clearer
- 'R' recommendations are short- to medium-term
  'F' recommendations are potentially longer-term ('future')

CLICdet cost estimate

(NB. Aiming at an accuracy of 30%;
discussions under way with AHCAL - any further input is welcome!)



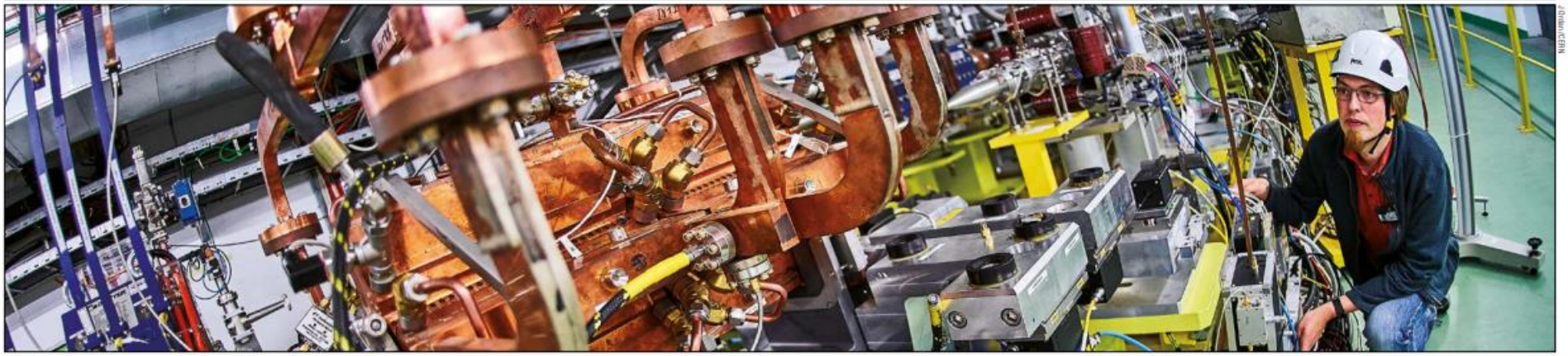
	[MCHF]
Vertex	12.76
Tracker	43.23
E.m. Calorimeter	180.34
Had. Calorimeter	38.54
Muon System	16.28
Coil and Yoke	94.86
Other	10.79
Total	**396.8**

(N.B. “Other” contains cost for FCAL elements, taken from 2012: **6.6 MCHF**)

CLIC Communication Initiative

(example)

Accelerator applications

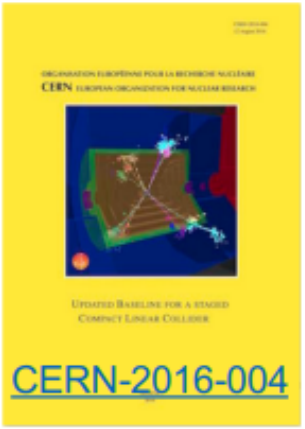


High-gradient X-band technology: from TeV colliders to light sources and more

Technologies developed for the Compact Linear Collider promise smaller accelerators for applications outside high-energy physics.

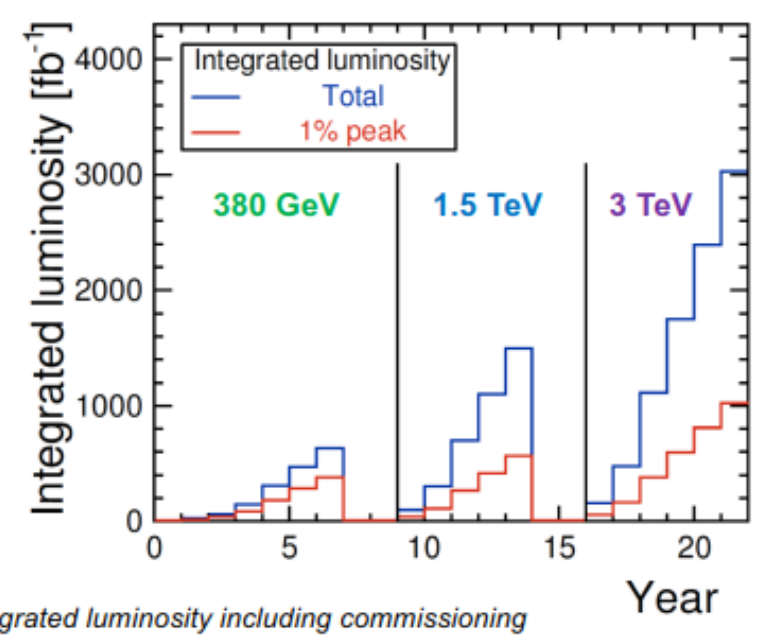
CERN Courier
April 2018

CLIC staging baseline



CERN-2016-004

380(350) GeV: precision Higgs and top physics
1.5 TeV: BSM searches, precision Higgs, ttH, HH, top physics
3 TeV: BSM searches, precision Higgs, HH, top physics

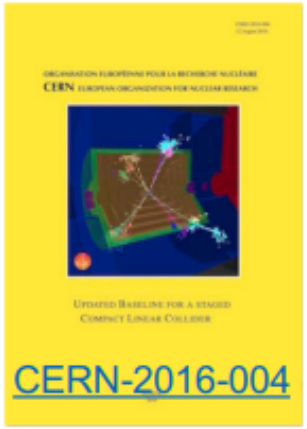


Integrated luminosity including commissioning with beam and stops for energy upgrades

Stage	$\sqrt{s}$ (GeV)	$\mathscr{L}_{\text{int}}$ (fb^{-1})
1	380	500
	350	100
2	1500	1500
3	3000	3000

Dedicated to top mass threshold scan

CLIC staging baseline



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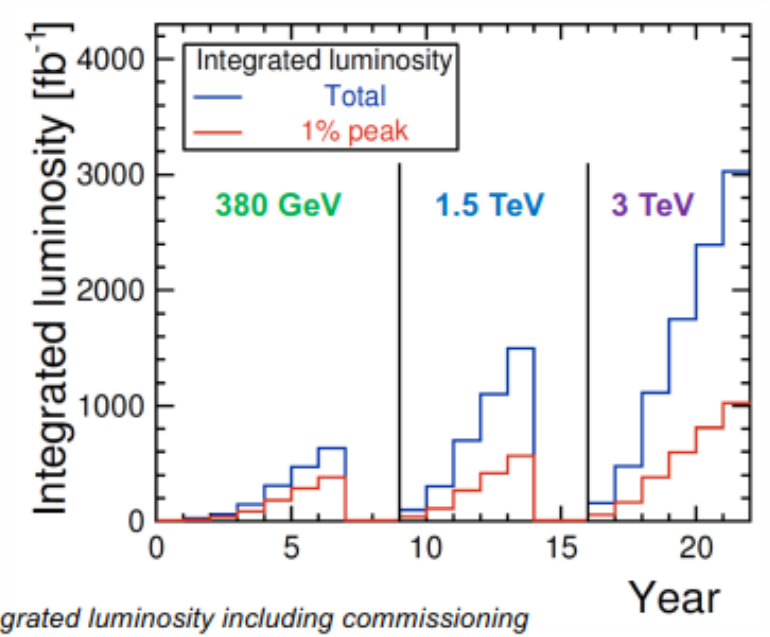

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New in 2018:
STAGING UPDATED

Update on staging

- Strengthening the physics case
- Tuning assumptions used in different future projects
- Updated CLIC baseline plan for energy staging

Motivations for an update

1.) Physics:

• σ(ZH) using recoil method only possible at the first stage
→ limited by relatively short first stage
(only 3 years with nominal luminosity)

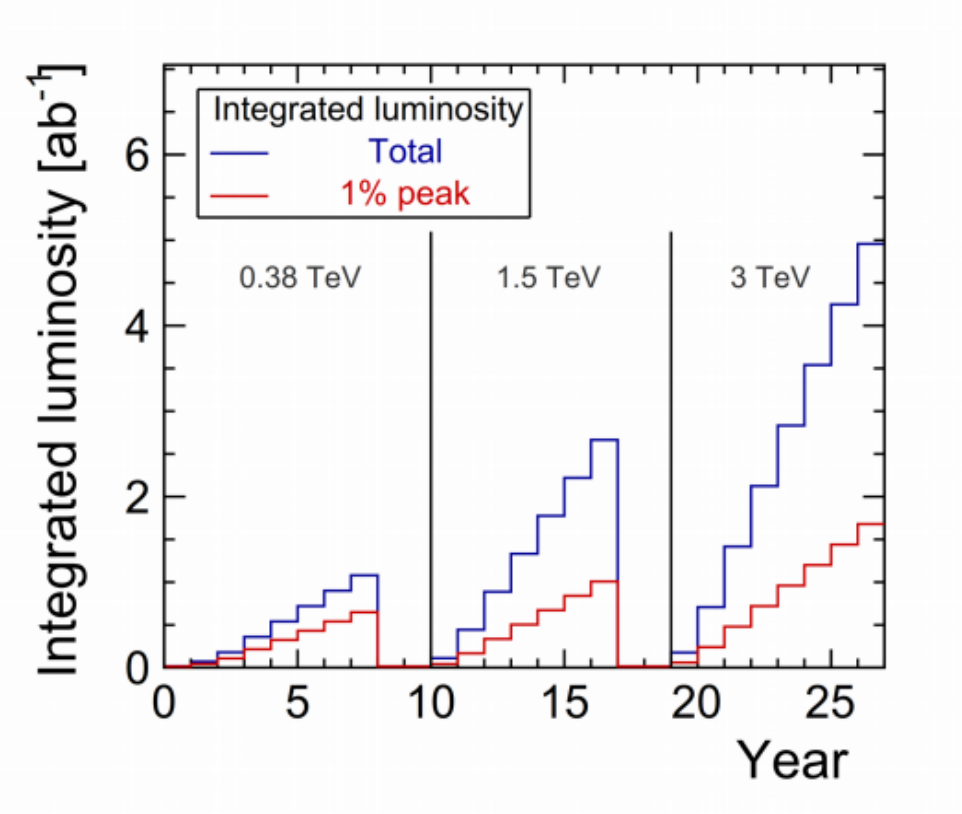
• Several flagship measurements at high energy, e.g. double Higgs, limited by statistics

2.) More consistency with other options:

• Run time per year:
1.08×10^7 s (CLIC), 1.2×10^7 s (FCC-ee), 1.6×10^7 s (ILC)

• Very different ramp-up scenarios (CLIC most conservative)

Adopted updated staging baseline



Based on discussions with Lucie Linssen, Aidan Robson, Frank Simon, Daniel Schulte and Steinar Stapnes.

- The energies of the three stages are unchanged
- Ramp up first stage: 10% / 30% / 60% ramp up 2nd and 3rd stage: 25% / 75% (identical to ILC)
- Following presentation by Frédérick Bordry in the SPC: 1 year = 1.2×10^7 seconds (75% of 185 days)
- Full program of 27 years provides:

$1\ ab^{-1}$ at 380 GeV
(incl. $t\bar{t}$ threshold scan)
+ $2.5\ ab^{-1}$ at 1.5 TeV
+ $5\ ab^{-1}$ at 3 TeV

CLIC(dp) documents for ESU

CLICdp reports serving as ingredients for a CLIC(dp) summary report:

- **Updated Baseline for a Staged Compact Linear Collider** (380 GeV, 1.5 TeV, 3 TeV) ✓
  - arXiv:1608.07537, CERN-2016-004
- **Higgs Physics at the CLIC Electron-Positron Linear Collider** ✓
  - arXiv:1608.07538, Eur. Phys. J. C77 (2017) no.7, 475
- **The optimised CLIC detector model CLICdet** ✓ ✓
  - CLICdp-Note-2017-001 and Draft *CLICdet detector validation note*
- **Overview of CLIC top physics** ✓
  - *Top-Quark Physics at the CLIC Electron-Positron Linear Collider*
- **Extended BSM studies**
  - *"The CLIC Physics Potential"* ⇐ to be completed in 2018
- **CLICdp detector R&D report** with main CLIC technology demonstrators
  - *"Detector technologies for CLIC"* ⇐ to be completed in 2018
- **Common summary report CLIC/CLICdp**
  - Will also include schedules, cost, power, future plans ⇐ to be completed in 2018

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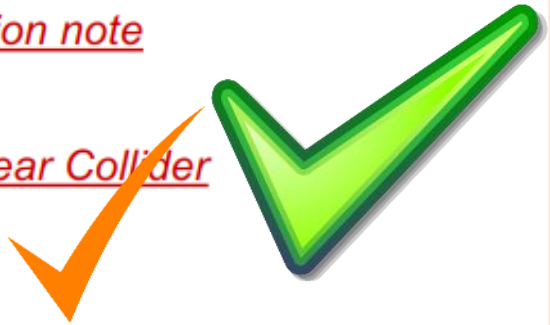

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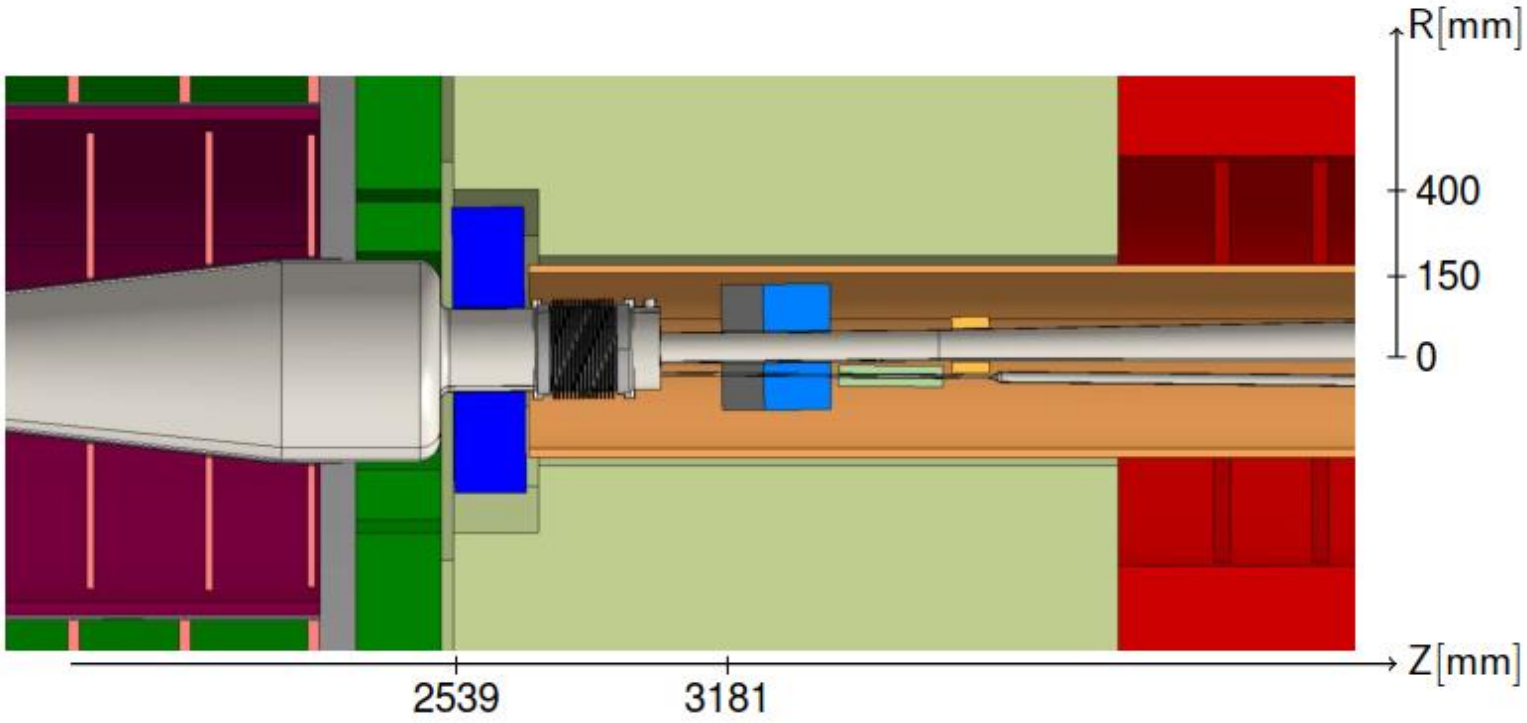
Very Forward Region

- Crossing angle of 20 mrad between beam axes
- Minimal acceptance of a cone of 10 mrad half-opening due to coherent pairs at 3 TeV
- Forward e.m. calorimeters: **LumiCal** and **BeamCal**, **ECal** and **HCal** endcaps
- The BeamCal is located in the centre of the HCal endcap



Occupancies in LumiCal and BeamCal

CLIC bunch trains: 156 ns (312 bunches)

CLIC 380 GeV (data without safety factor!)	Cell size [mm^2]	**Occupancy per train (average – maximal)**
LumiCal	4 x 13-44	**1 - 9**
BeamCal	8 x 8	**8 - 36**

Occupancies in LumiCal and BeamCal

CLIC bunch trains: 156 ns (312 bunches)

CLIC 3 TeV **(data without safety factor!)**	Cell size [mm^2]	**Occupancy per train (average – maximal)**
LumiCal	4 x 13-44	**4 - 22**
BeamCal	8 x 8	**120 - 320**

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N.B. in 2011/2012, a readout solution was worked out by Szymon + Marek
-> CLIC needs (10 ns sampling) fulfilled for occupancy ≤ 5
(uniform time distribution of pulses)

main issues today:
- higher occupancies, or non uniform distribution of pulses
- high dynamic range of pulse amplitudes

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towards a PIXELATED LumiCal ?

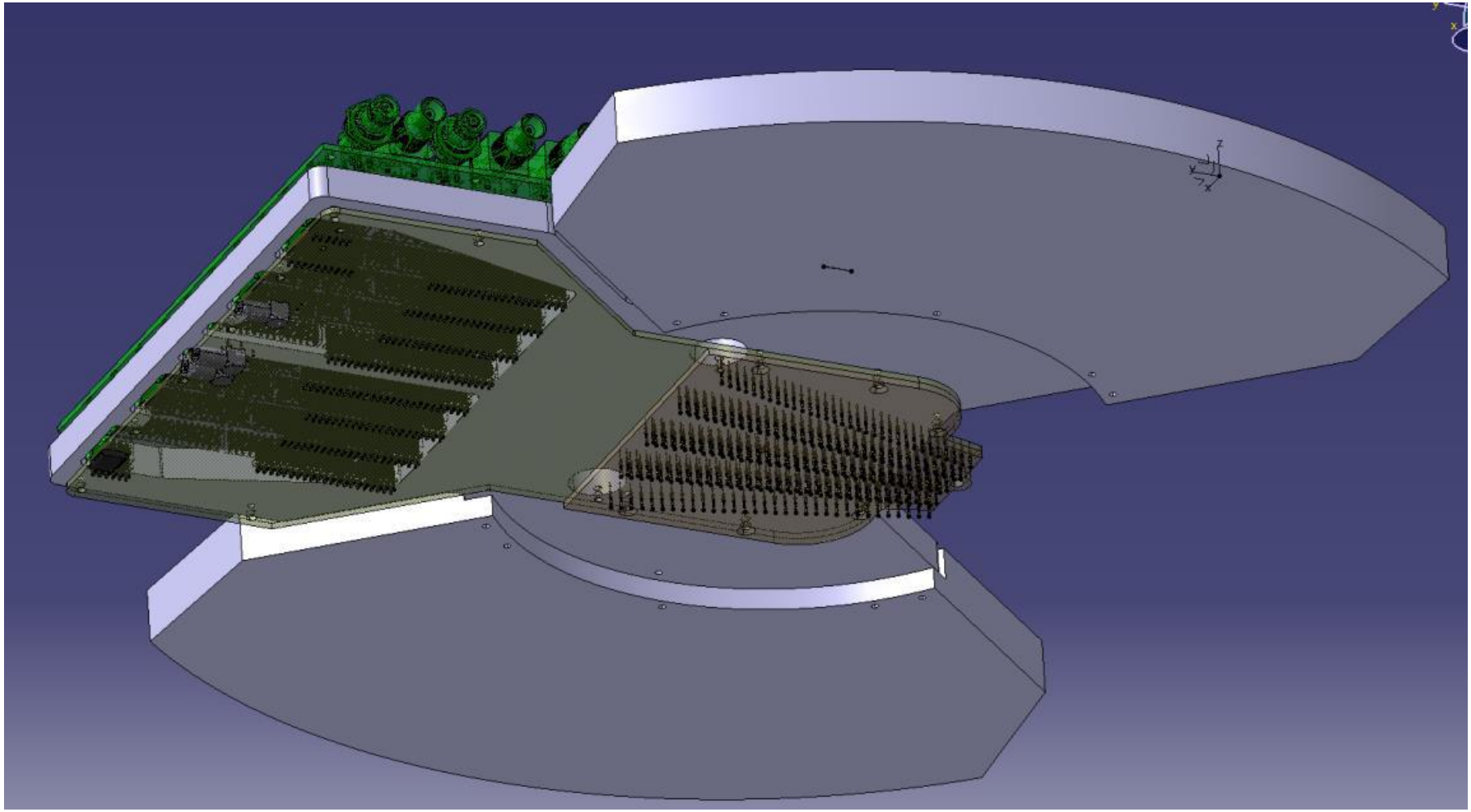
solution for BeamCal ?

News from CERN EP-LCD

Contribute to non-LC projects, explore synergies

- Participation in FCC-hh (vertexing, flavor tagging, ILCsoft) -> **3 LCD notes**
- Participation in FCC-ee (detector model CLD, performances, ILCsoft) -> **50 pages in the FCC-ee CDR**
- Participation in CMS HGCAL (silicon sensors, cf. CLICdet calorimetry
  ->> probe/switch cards for sensor testing ->> FCAL)
- Participation in a future CERN EP R&D project
  (silicon sensors, fine-grained calorimetry, software)

System for LumiCal sensors

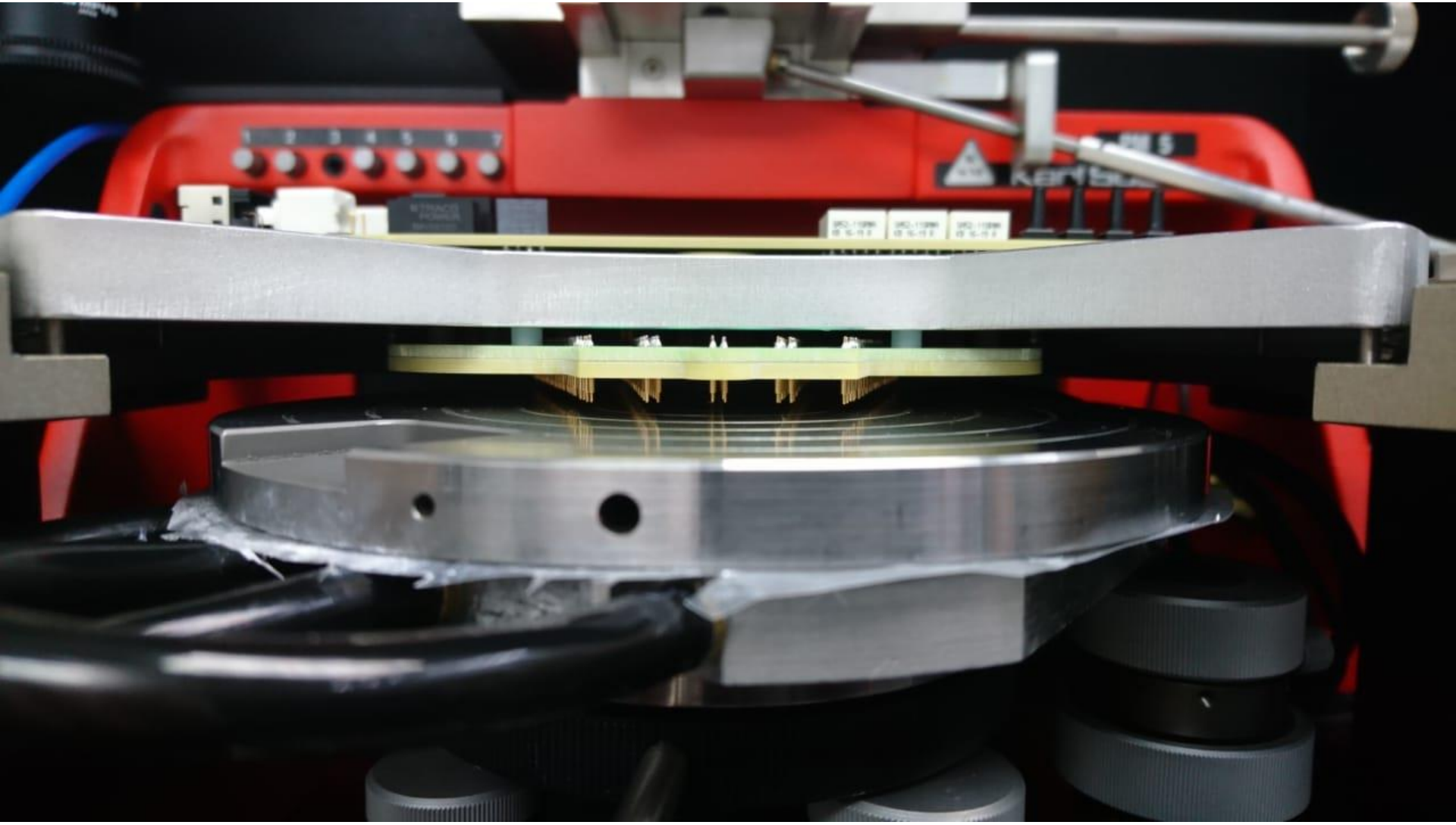


Drawing of LumiCal probe- and switching cards, with adapter (view from below)

System for LumiCal sensors

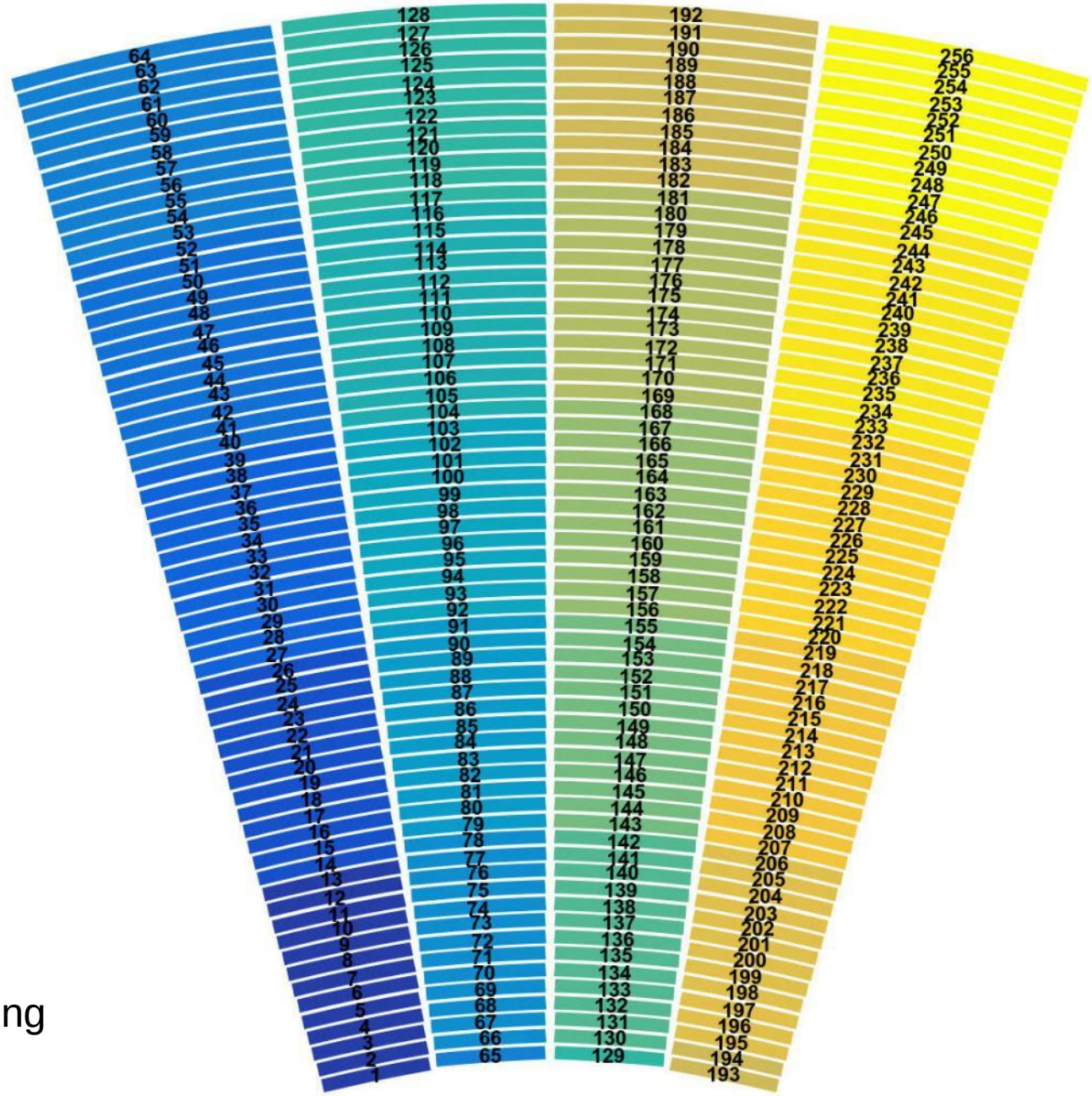
as installed in Tel Aviv

System for LumiCal sensors – in Tel Aviv



LumiCal sensor implementation in HexPlot

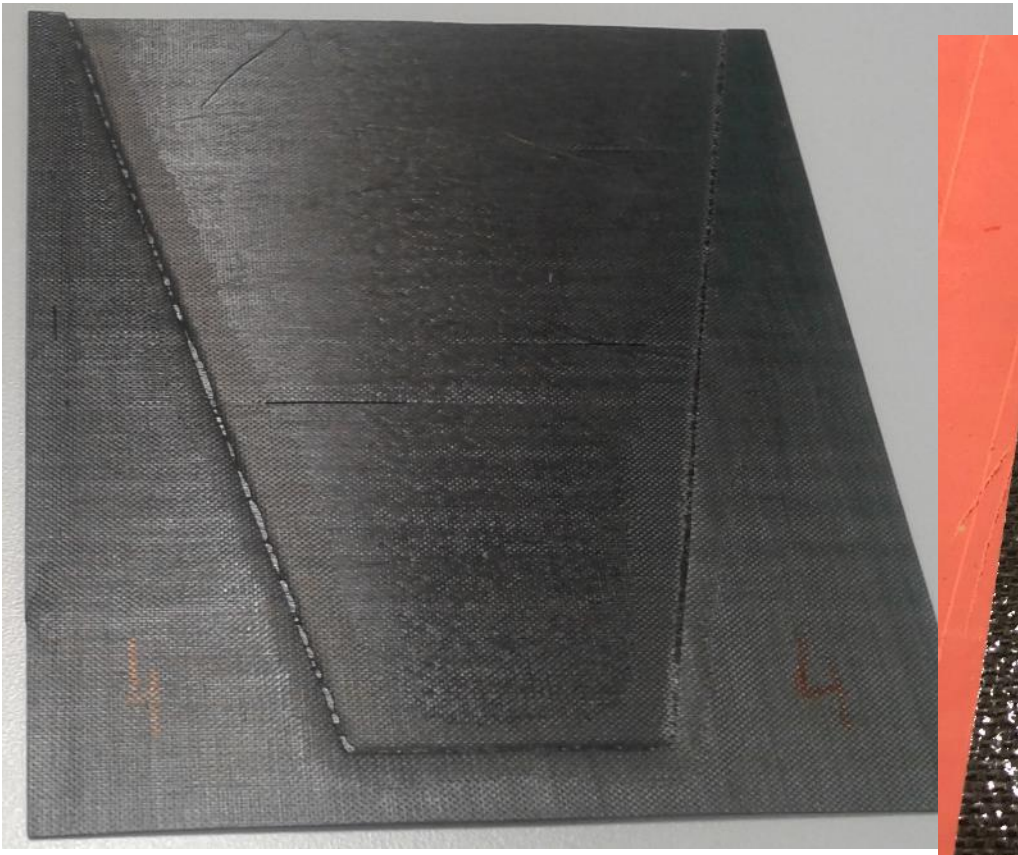
(dummy result)



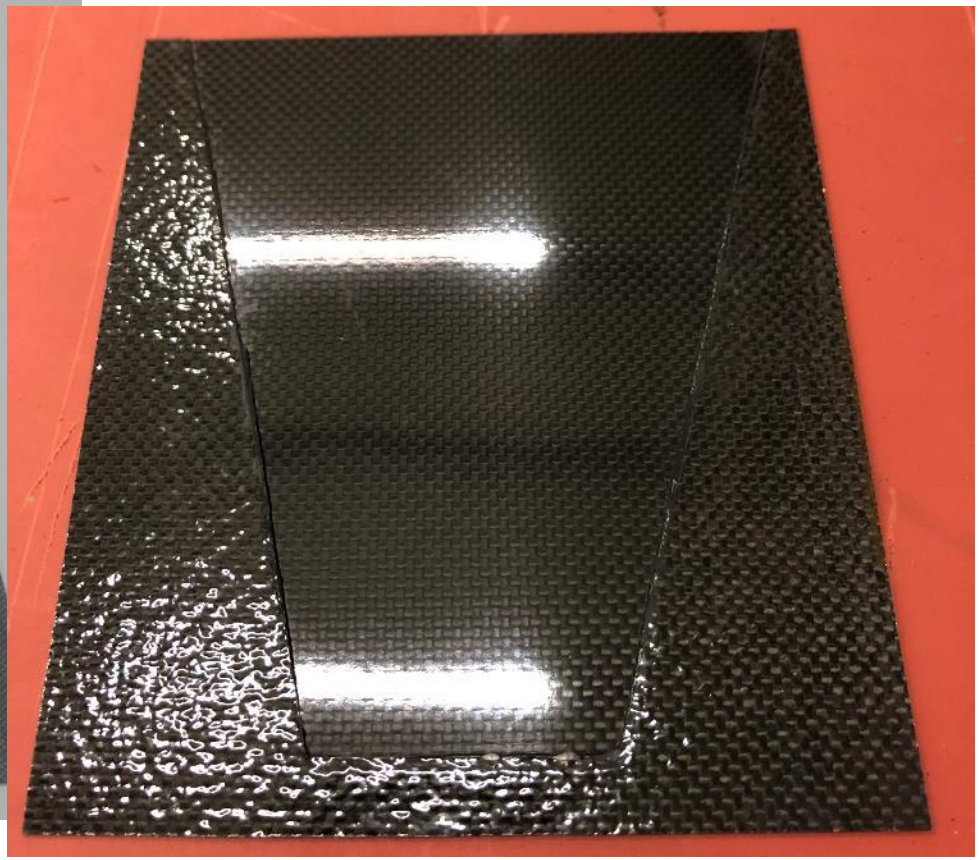
N.B.

Eva Sicking will visit Tel Aviv to help with starting the measurements

Carbon-fibre envelopes for compact sensor modules



"old" carbon fibre envelop
(plies with single-direction fibres)
was used in test beam campaigns

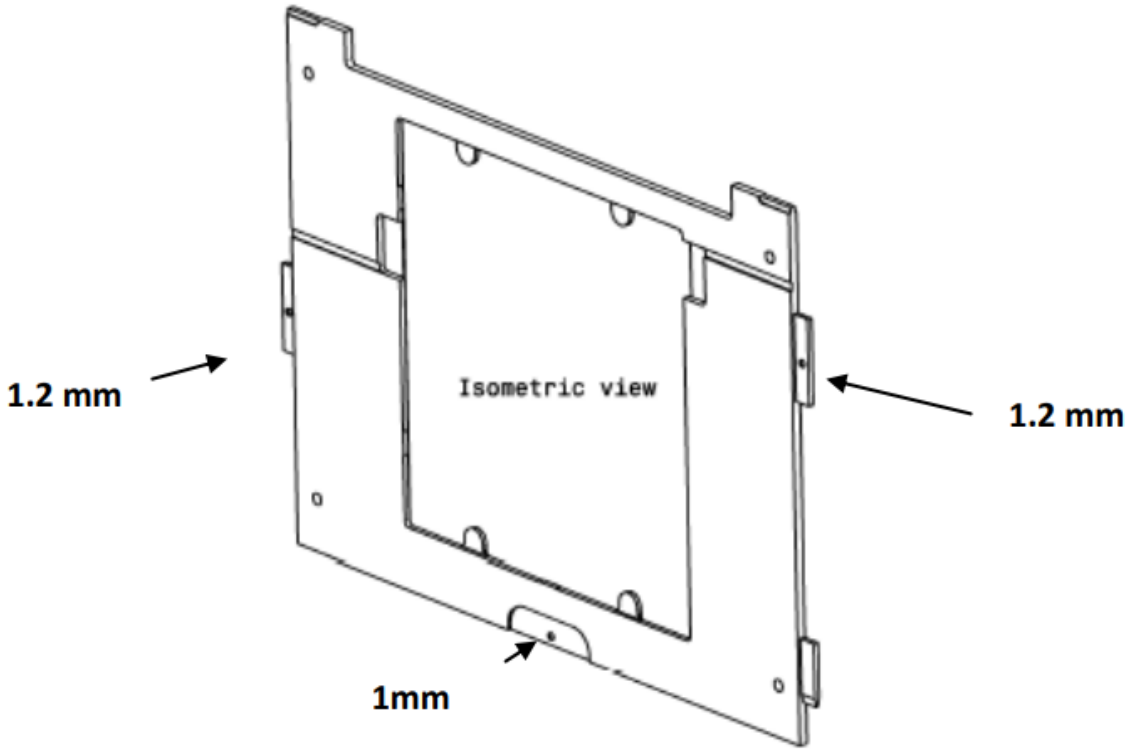


new carbon fibre envelop
(plies with woven fibres)
15 of these to be produced

Next: **W plates**
(25 plates on the way from JINR to CERN)

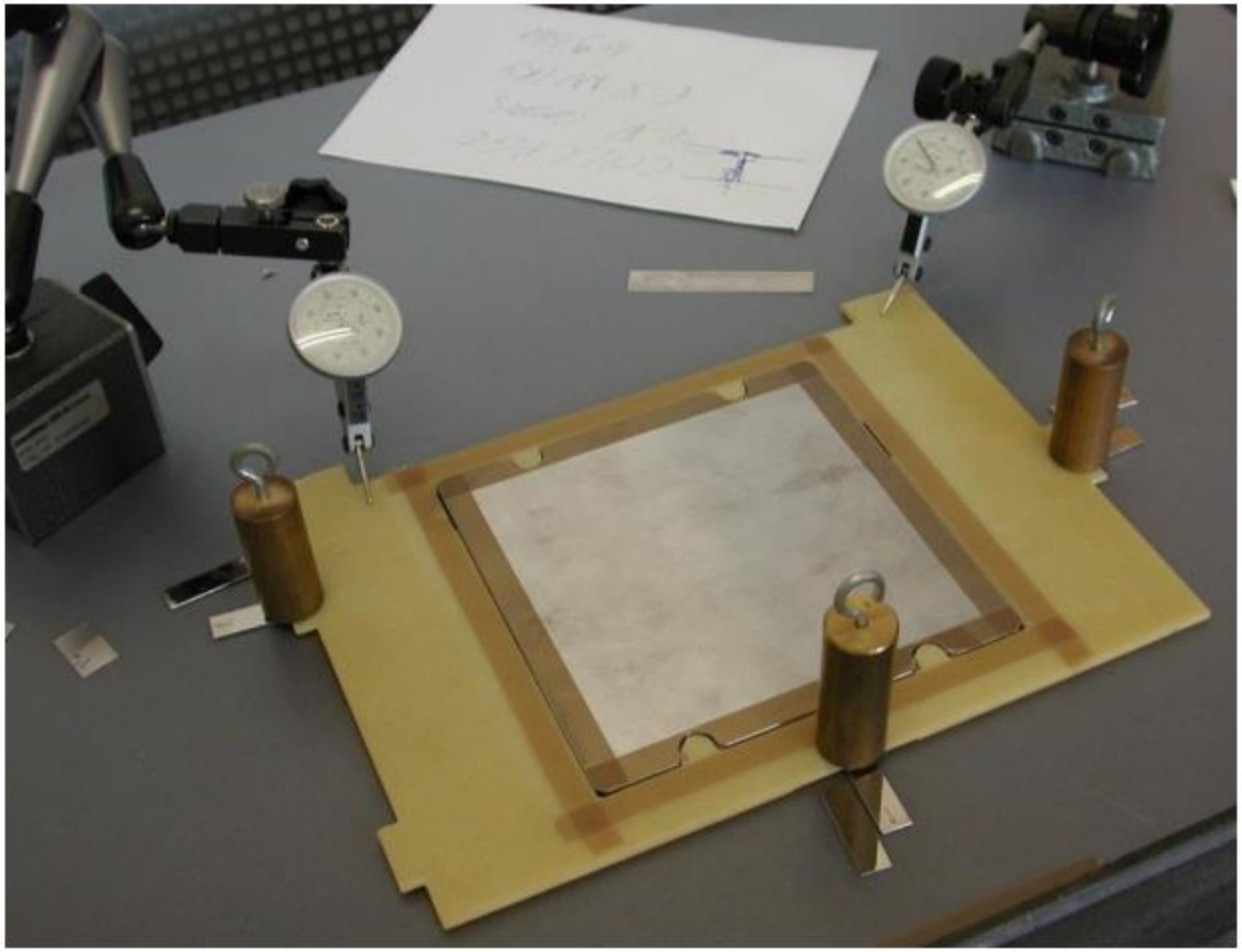
Assembly procedure documented by F.X. Nuiry – **in 2013**
https://edms.cern.ch/ui/file/1475879/1/Tungsten_glueing_to_Permaglass.pdf

8	Install 3 cleaned leveling pads around the tungsten plate (where permaglas bearings will be put). **Levelling pad thicknesses=1.1mm, 1.1 mm, and 0.9mm.**



Next: **W plates** assembly

Leave the system 3 days without moving it, for polymerization.



Next:
mechanical infrastructure
to be assembled for test-beam,
with tungsten plates, sensor modules
and auxiliaries

to be discussed at this meeting

Thanks for your attention !

CLIC Cake by Mirka Vanat
23 August 2018