TRD chamber type 5 production

TRD retreat, Dorfweil/Taunus, 07 November 2023

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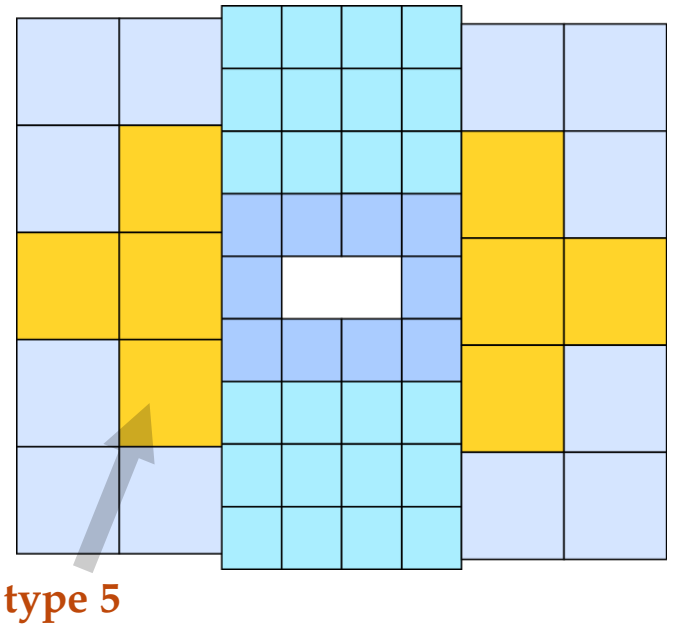
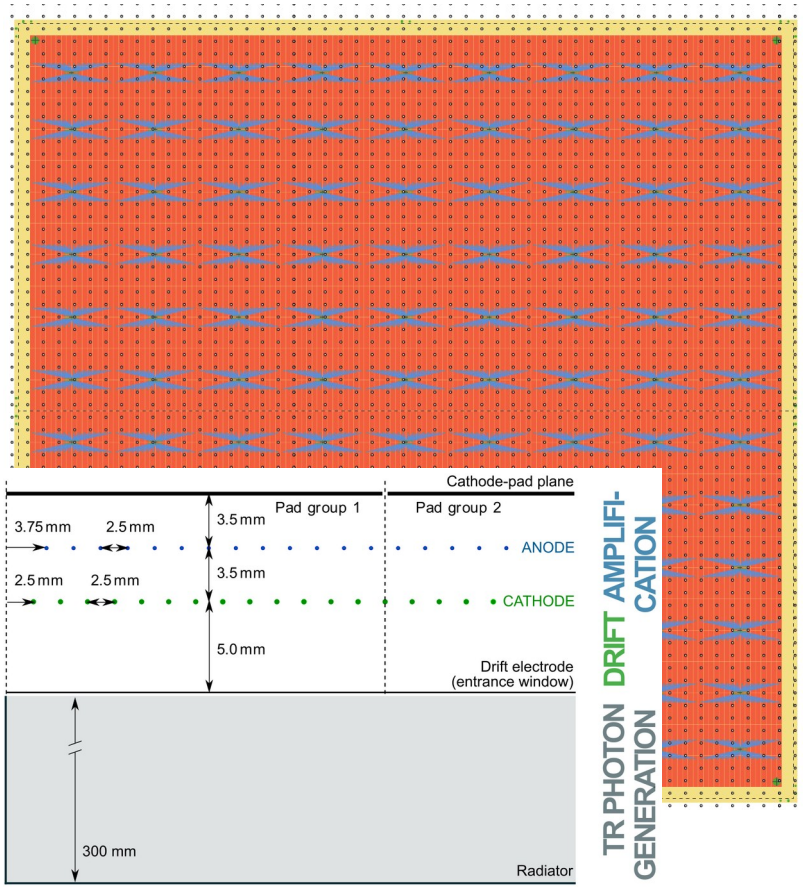
overview

- **production status**
- **production step details**
- **QA**
- **issues**

type 5, design count

- **32+3 TRD chambers**, 990 mm x 990 mm, 144 x 24 pads
- highest pad granularity of outer TRD, 6.7 mm x 40 mm
- 2 preseries chambers produced, shall serve as base for PRR measurements
- component production ongoing: backpannel carriers, entrance windows





production status, type 5

- split production
  Ms entrance window, backpanel referencing, padplane glueing
  Fra wire winding & mounting (both layers), chamber closing

entrance windows
22 / 35

backpanel carriers
10 / 35

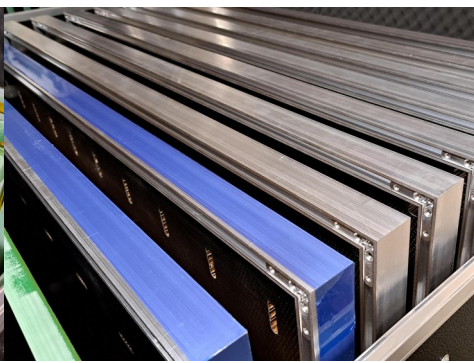
backpanels with padplane
2 / 35

chambers wired & closed
2 / 35

- timeline (target):
  - scale up to 1 chamber per week, starting early 2024
  - required: preseries confirmation & PRR

- transport
  - batches of 5 to 10 (windows + backpanels) Ms → Fra
  - further component boxes are being prepared
  - keep boxes @IKF for storage?

  - return 5 to 10 chambers to Ms for QA & storage
  - transport containment t.b.d.



component: entrance window

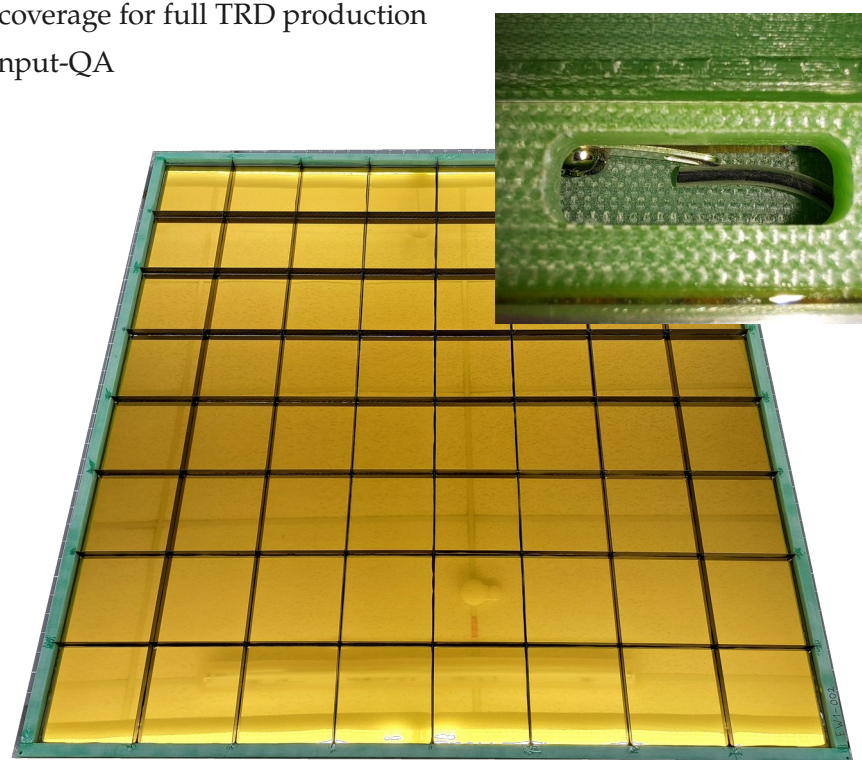
- entrance window foil
  - new batch of Al-coated polyimide (*Kapton*, 25 μm) foil received, sufficient coverage for full TRD production
  - Al-coating ~ 50 ... 100 nm strongly depends on foil conditions → accurate input-QA
  - Al layer as moisture barrier, defined by thickness and homogeneity
  - optical inspection: screening agrees with earlier production,
    Al weighting: ~ 70 ... 80 nm,
    humidity transmission: talk Felix, ~ compatible range

    → *input parameter for gas system demands*

- pre-stretching of foil on thermal desk, acrylic glas
  - flatness optimised by symmetrical design
  - PID controller for temperature, constant ΔT
  - monitor stretcher expansion, replace if necessary

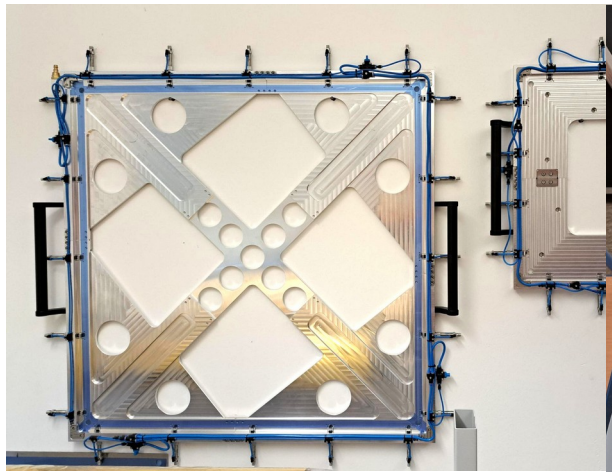
- cut of foil 2 mm behind outer edge, HV safety

- *re-order window ledges after partial usage for test chambers*

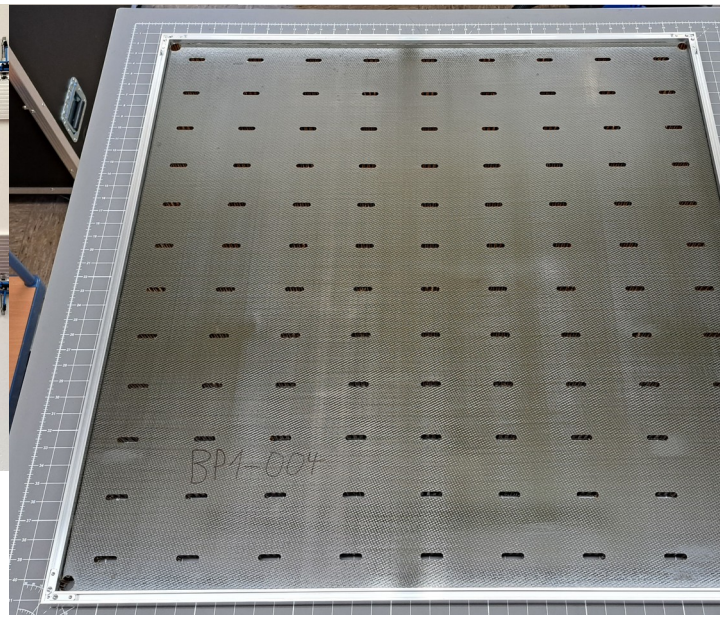


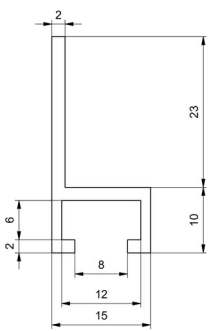
component: backpanel carrier

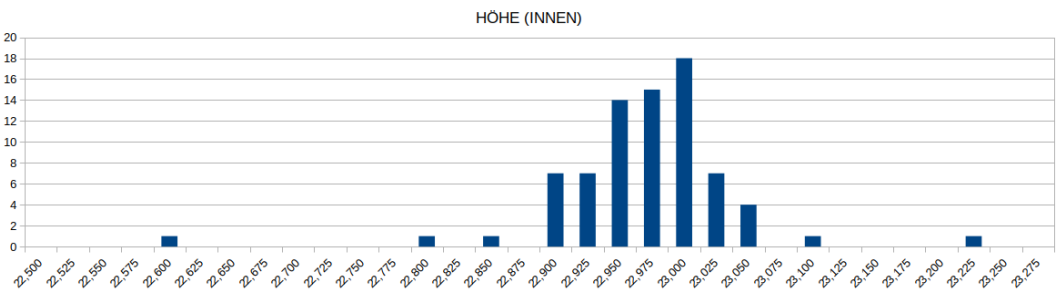
- revised Al frame,
  extrusion according to own design,
  profile notch integrated
  (e.g. gas inlet fixation)
- height matching
  honeycomb ↔ Al profile
- signal cable openings by water jet cut,
  inhouse



frame positioning tool





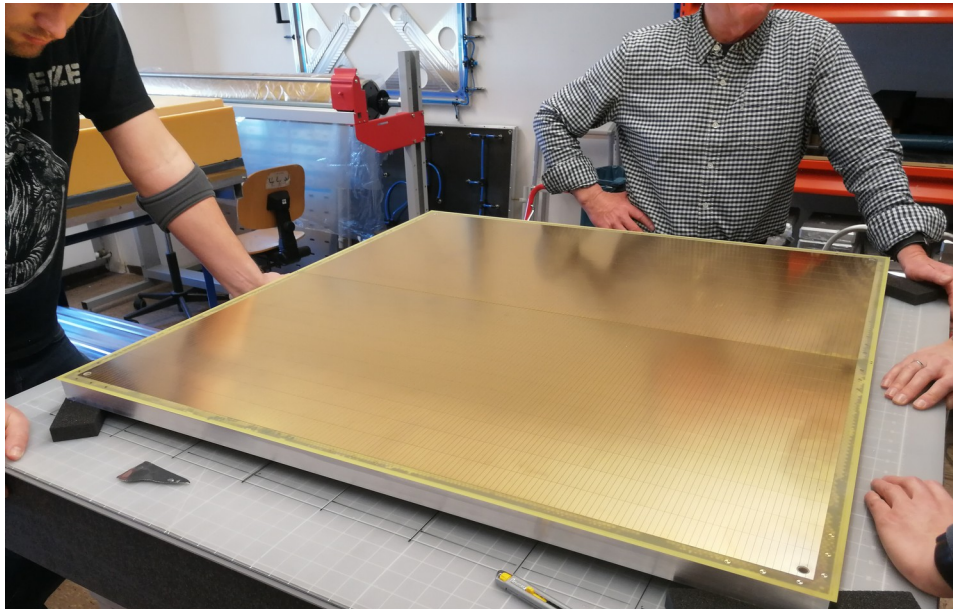


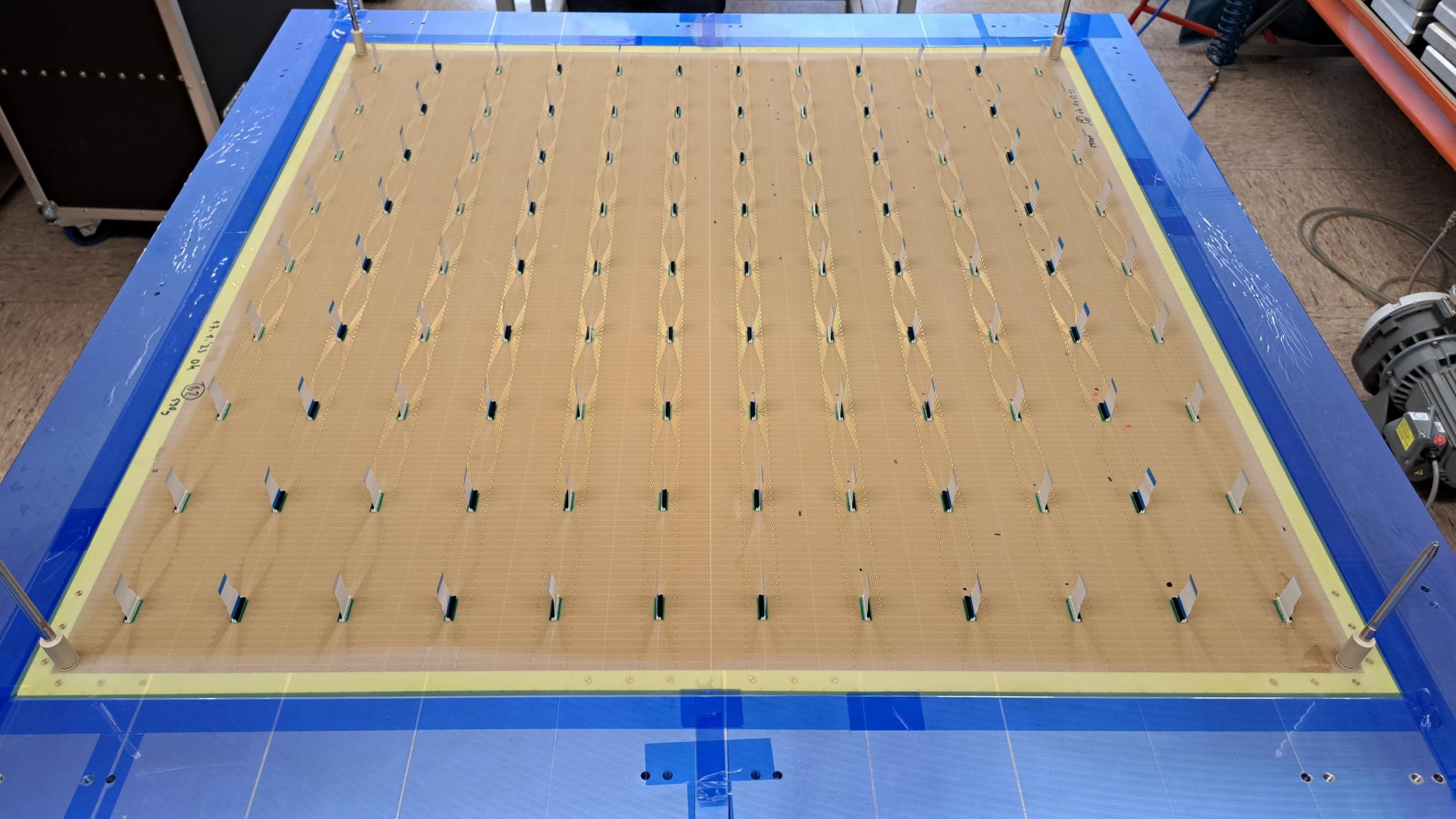
component: backpanel

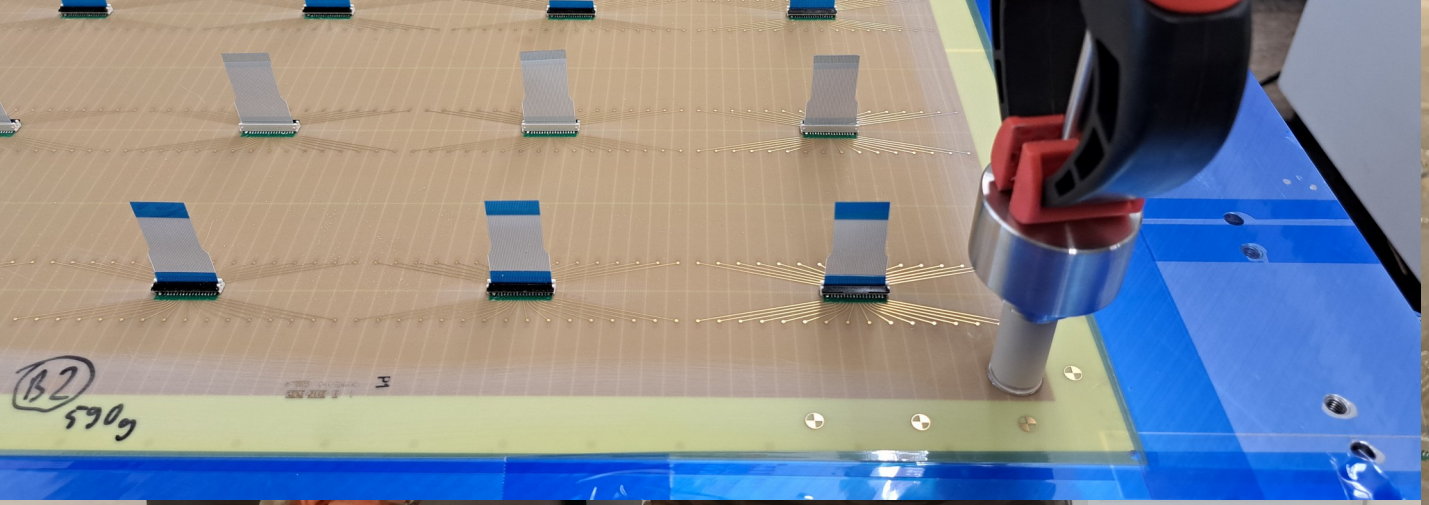
- padplane
  - 4-layered PCB, intrinsic gas tightness by displacedvias
  - 2 segments per chamber
    alignment using gas mounts in PCB
  - ENIG surface, 0.05 to 0.10 μm Au
  - external/automatised soldering of signal connectors

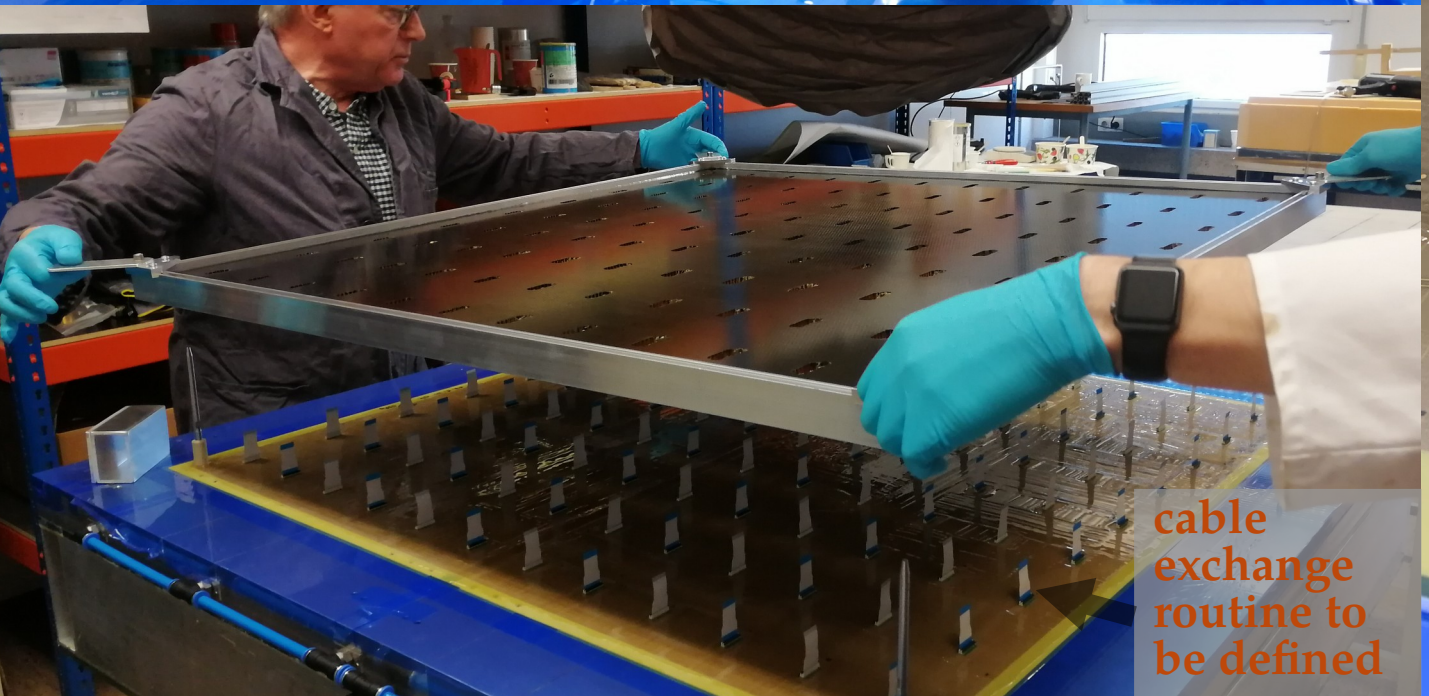
- revised glueing process:
  no carrier foil, directly on vacuum table
  - glueing test to honeycomb:
    < 20 μm flatness (segment edge),
    < 10 μm within segments
  - epoxy Araldite 2011: ~ 400 g/m², monitored

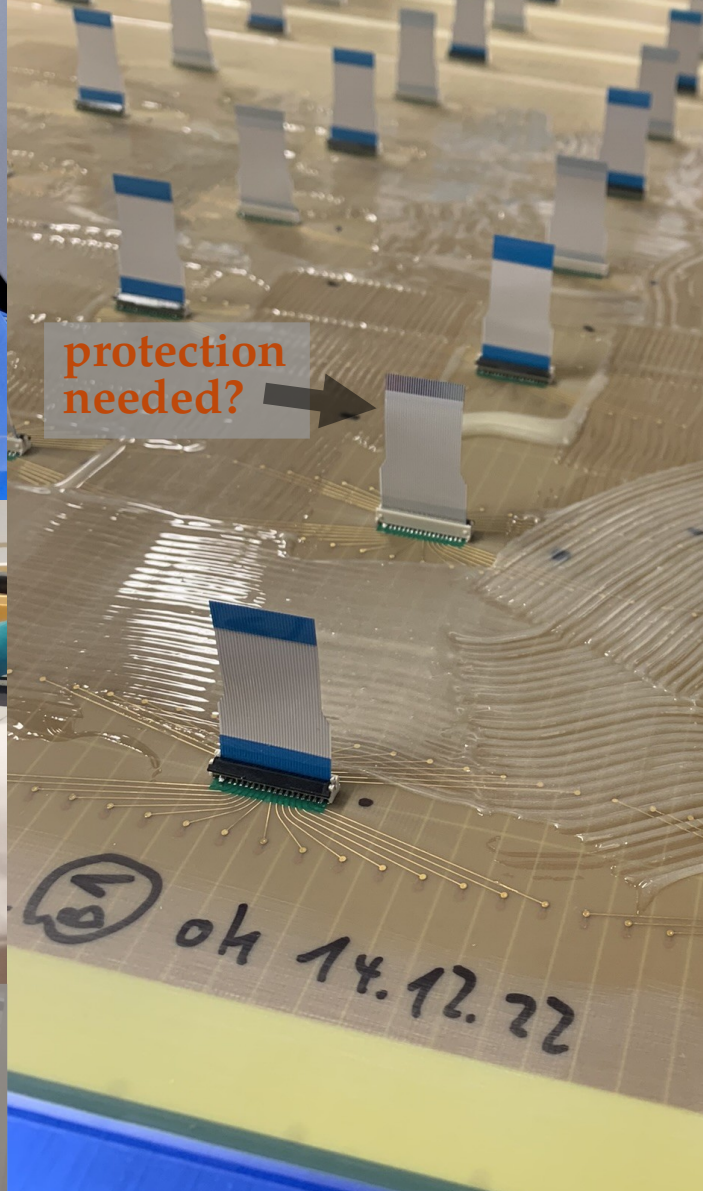
- batches: 8 half *v1* + 10 half *v2* + 52 half *v2*
  - *v1* design problematic during ENIG handling, contact curing @Ms
  - *v2* with change of Cu balance, improve handling for manufacturer





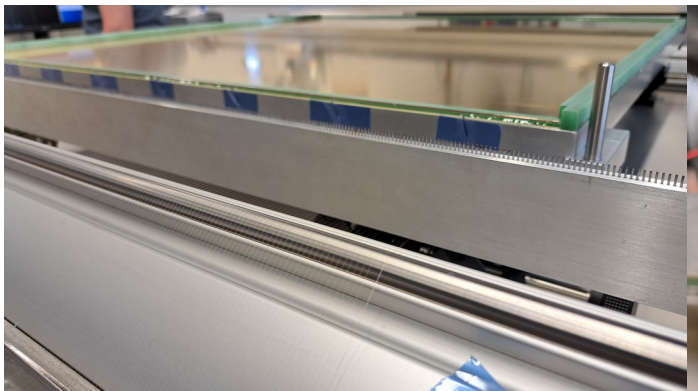

B2
590g

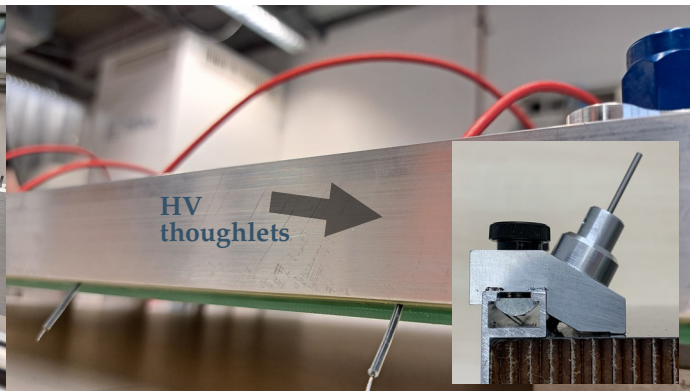

cable
exchange
routine to
be defined

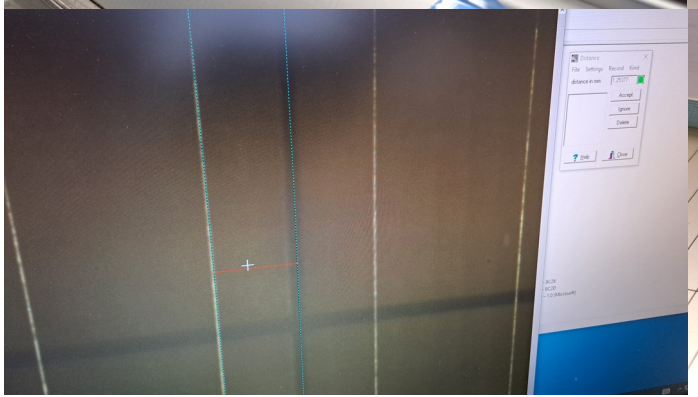

protection
needed?
oh 14.12.22

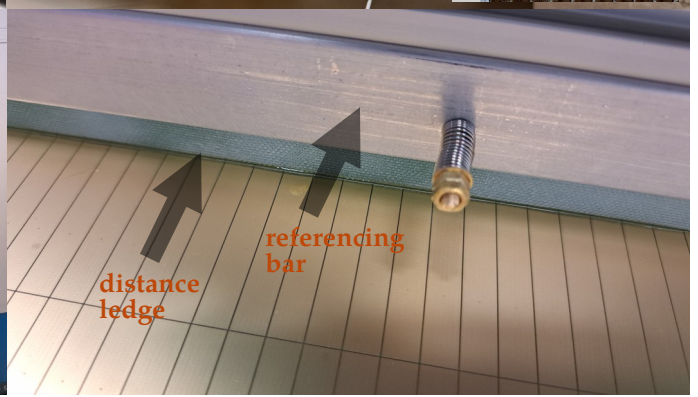
component: wire system

- layer alignment
  - pitch regularisation and positioning with precision comb
  - outermost cathode: 2.5 mm from ledge
  - outermost anode: 1.25/3.75 mm
  - define tolerance
- wire ledge system
  - new referencing bar developed
  - revised glue dosing (gas tightness), define
- wire contacting
  - new drilling tool for HV throughlets
  - 8 anode segments (decoupling)
- atmosphere: 23 … 30 °C, < 30% rH for HV-safe epoxy



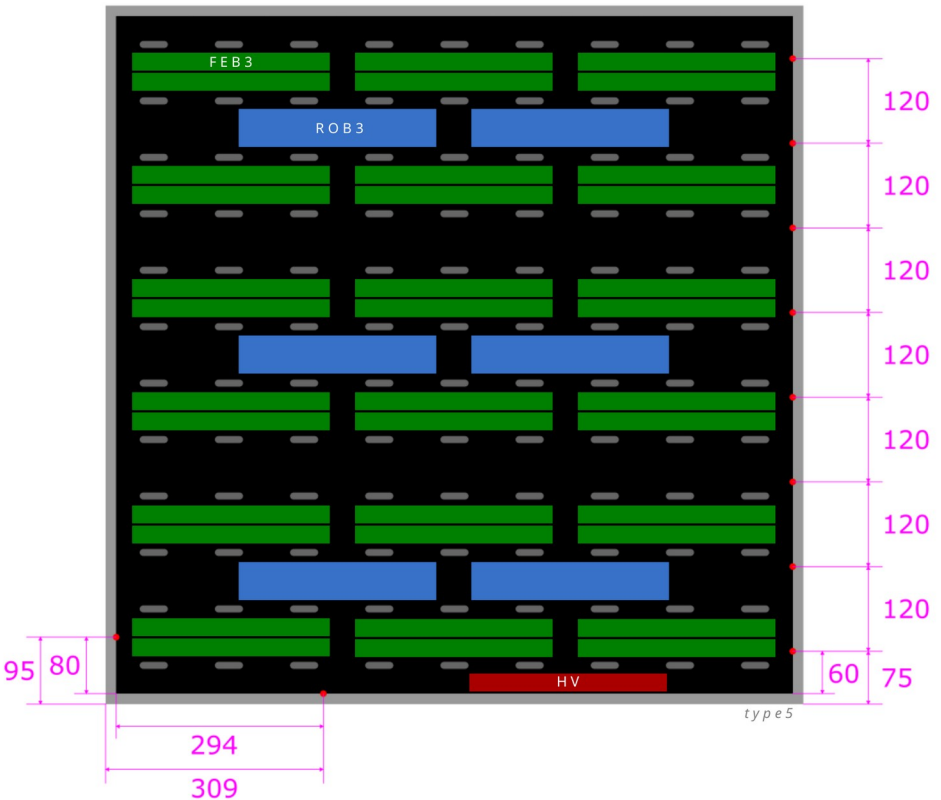






type 5, outlook, backside layout

- HV contacting arranged according to drawing (this slide)
- FEB and ROB arrangement to be confirmed, depending on layout
  - FEB layout @ Fra,
    ROB project started @ Ms



QA

- regular measurements:
  - gas tightness, direct measurement (talk Felix)
    → every chamber

    available,
    first chamber: (0.83 ± 0.33) ml/h
  - humidity collection (talk Felix)
    → first 10 chambers, then define

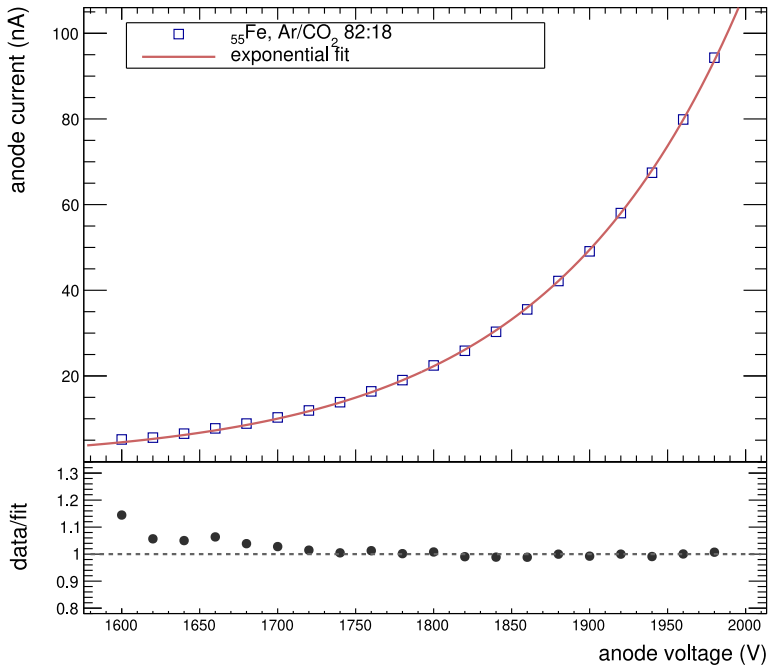
    available, clarify dependencies
  - gas gain scan
    → every chamber

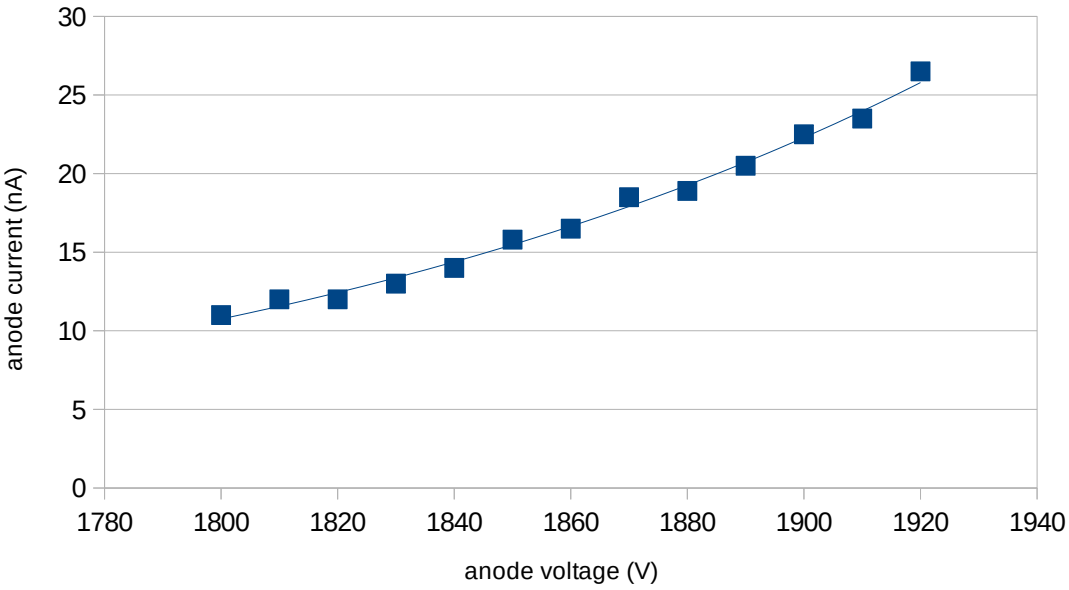
    auto-test stand available, awaiting new ^{55}Fe source
  - readout test
    → every chamber

    after FEE equipment, single-FEB test before

- install comprehensive test stand in Ms

“chamber 0”, begin of gain scan





prototype chamber, type 8/2016, scan 2020

~1 source halftime in between

first chamber, type 5

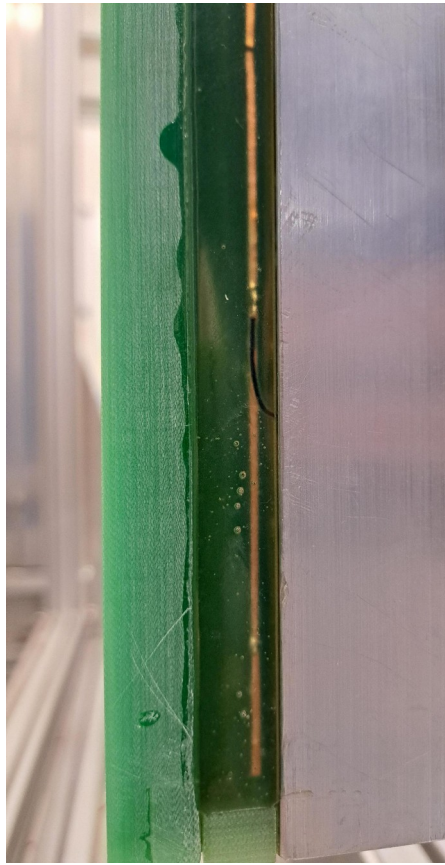
“chamber 0”, HV situation

- chamber HV stable over hours @ 1900 | -500 V
  with 7 of 8 anode segments connected
- dark currents < 150 nA

- with 8 of 8 segment connected, trips reproducible @ 1100 … 1200 V
  - instant current rise
  - few times such trip triggered LV-current behaviour,
    which then cures

- gravitational sag of outermost wire should not be relevant, ~ 40 μm

- strategy:
  - exclude electrostatic sag by comparison to segment on other side
  - reconsider 1.25/3.75 mm anode-to-ledge question
  - optical inspection of wire contacting region
  - consider HV test series with epoxy batch
  - identify current (charge) path



summary

PRODUCTION

- chamber production type 5,
  32 +3 chambers
  - 2 chambers produced
  - production of components ongoing in advance,
    i.e. entrance windows and backpanel carriers
- transport modus Ms ↔ Fra suggested
- presentation of production step details
- touched given and open value defintions,
  e.g. glue dosing amounts

QA AND ISSUES

- QA being commissioned, further deploy test stand in next weeks
  - awaiting new ^{55}Fe source for spatially resolved (pad) gain map
  - gas tightness and humidity measurements available
- gas tightness measured within limits,
- first chamber shows good HV stability
  except for one anode segment
  - test strategy being followed

END

(backup following)

direct wire pitch measure?

- wire tension device can extract also wire positions
  - main uncertainties from linear drive,
    but not from actual wire positions
  - improvement of linear drive?
    might not be necessary, documentary only.