# ECAL-P Tungsten plates
## Information from the producers

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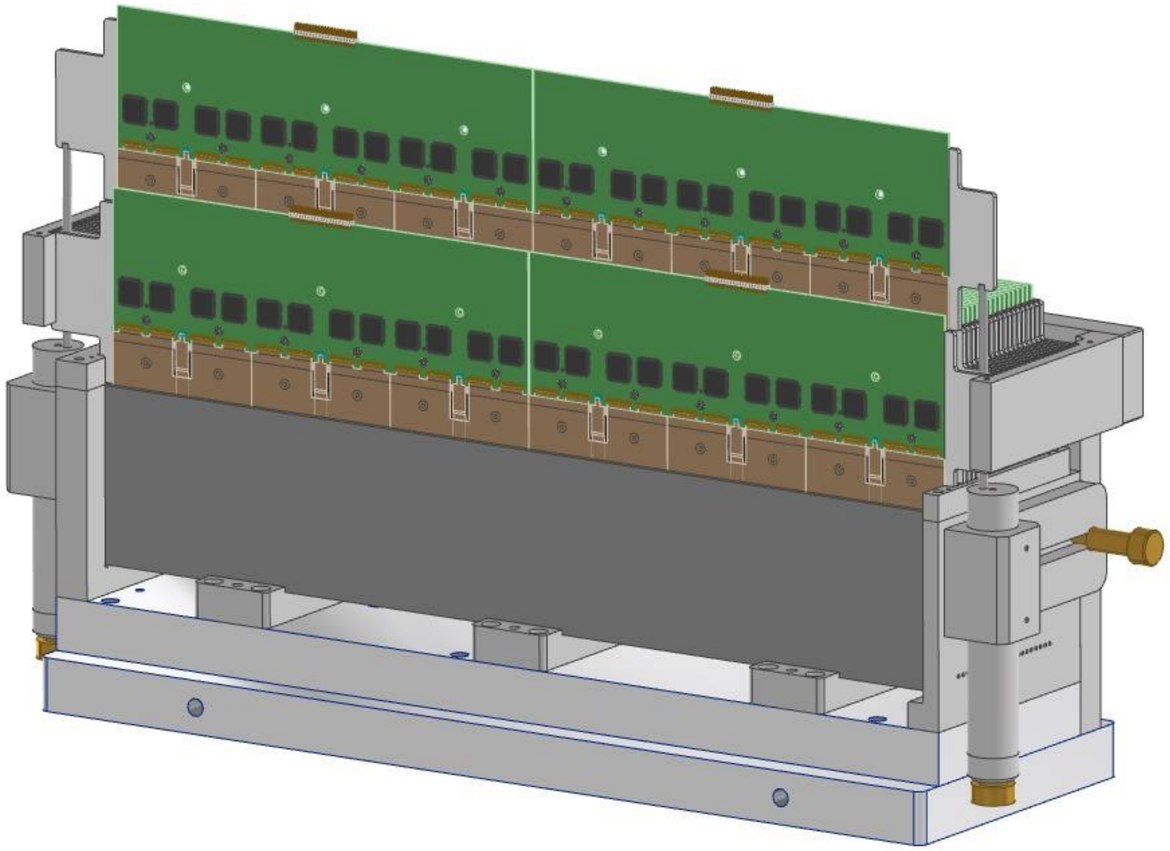
# Requirement for W plate

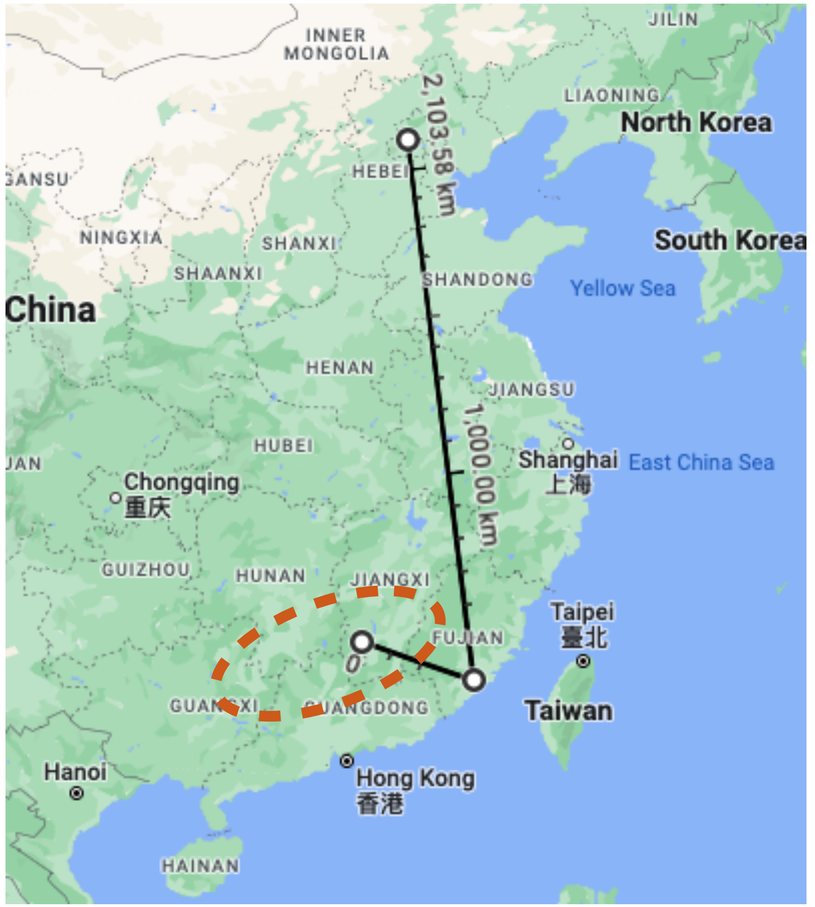


- LHT of W: 550 x 100 x 3.5 $mm^3$
  - LH of Si: 540 x 90 $mm^2$
- Installed onto a comb structure with supports from three sides
- Unlikely to have additional top-side support
- Material: >90% W alloy w/o Fe
- Tolerances: 0.2(L) 0.2(H) 0.05(T)
- Flatness: 0.05(T)
  - Essential to installation of ECAL-P
  - 4.5=3.5+0.32+0.2+0.1×2+0.05×3+0.13

    Carbon supporter  Kapton  Glue  Space

# Producers in China

- China Tungsten Online x Ganzhou Grand Tungsten
  - CTO is a broker who has export permit but does not make products
  - GGT is the contractor who produces plates but cannot export them
- Xiamen Honglu W/Mo Products
  - Partially owned by the state-owned Xiamen Tungsten Group and Korean TaeguTec Group
  - Expertise on W wire
  - Ambitious in the market of experimental physics
- Beijing ATAS Metal Materials
  - Fully state-owned by the CISRI AT&M Group
  - Experience in scientific market (ITER supplier)
- European producers?
  - Polish, Austrian, French, British, ...



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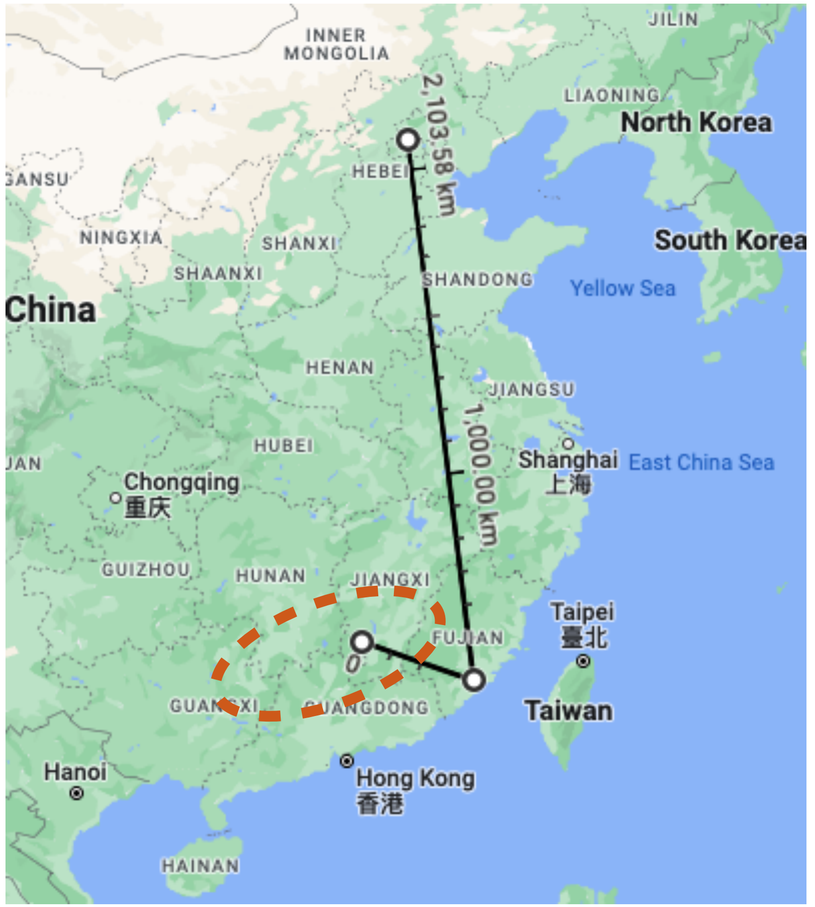

# Things in common

- Method of producing: rolling and grinding
  - Billet (bulk of tungsten) $\rightarrow$ roll into raw tungsten plate $\rightarrow$ cut (by wire/...) $\rightarrow$ grind
- Pure tungsten is better/easier to produce for our dimensions
  - Plastic deformation of alloy during grinding
  - "Redistribution" of Cu/Ni atoms
  - Highly purified W is the easiest to machine, but more expensive

# Ganzhou

- After wire cut out the four edges and two surfaces, raw tungsten plate has
  - tolerance of 0.1 mm on edges, and
  - flatness of 0.5 mm on front/back surfaces
- Grinding into 0.05 mm flatness (never achieved before)
- Interferometer for flatness measurement (but on a relatively small scale)

- After the visit, the broker replied that the producer cannot fulfil our requirements, and they cannot find another company for us.
- (The first company who gave us a quotation.)

# Xiamen (Amoy)

- Also use wire cut (Molybdenum wire)
  - tolerance of 0.2 mm on edges (fast cut), and
  - flatness of 0.5 mm
- Grinding into 0.05 mm flat. (achieved on smaller scales)
  - No grinding table for 550 mm length. Have to do it two times for a plate (agreed to try)
- Feeler scale for flatness measurement
  - A 150x150 coordinate measuring machine (CMM)
- 3D printing (350x350x250 $mm^3$ max.)
  - $>$97% density
  - burr removing by sand wind

- Representatives to visit Berlin in 14-16 November

# Beijing (Peking)

- Factory in Baodi, Tianjin; workshop and measurement in Beijing
- Wire cut only on the four edges, tolerance of 0.2 mm
  - No flatness on front/back surfaces of the tungsten billet
- Grinding from 8 mm to 3.5 mm for 0.1 mm flatness
  - (the best they achieved on an ITER plate 400x200x13 $mm^3$)
- CMM for flatness measurement
  - Both grinding table and CMM has large enough size for us

- Want to sign the contract for trial as soon as possible

# Prices

Link to the price table (on Google Sheets)

- For trial plates: 1k USD per plate after tax (6% import duty and VAT)
- No formal offer for batch plate, but expecting 25% off (~$750 per plate)
- Polish producer's offer with 0.2 flat.: $830 per plate

| | Price tag from the seller | | | | | | Regular price | |
|---|---|---|---|---|---|---|---|---|
| Producer | Material | Dimensions (mm) | Tolerances (mm) | Flatness (mm) | Price per unit | Order amount | EU duty 6% | **Polish 23% VAT** |
| | | | | SAMPLE ORDER | | | | |
| ~~China Tungsten Online~~ | ~~Pure W 99.95~~ | | ~~0.2x0.2x0.05~~ | ~~0.05~~ | ~~$700.00~~ | ~~1~~ | ~~$42.00~~ | ~~**$912.66**~~ |
| Xiamen Honglu W & Mo | Alloy W-Ni-Cu 95-3-2 | 550x100x3.5 | 0.5x0.5x0.05 | 0.05 | $733.00 | 3 | $43.98 | **$955.69** |
| Beijing ATAS Metal Materials | Pure W | | 0.2x0.2x0.05 | 0.10 | $780.33 | 1 | $46.82 | **$1,017.39** |
| | | | | | | | | |
| | | | | BATCH ORDER | | | | |
| ~~China Tungsten Online~~ | ~~Pure W 99.95~~ | | ~~0.2x0.2x0.05~~ | ~~0.05~~ | ~~$536.33~~ | ~~30~~ | ~~$32.18~~ | ~~**$699.27**~~ |
| | | | | | | | | |
| | | ~~550x100x3.5~~ | | | | | | |
| | | | | | | | | |
| Wolften Wrocław | Pure W 99.95 | | | 0.20 | $676.92 | 21 | $0.00 | **$832.61** |
| French supplier | | | | | | | | |
| British supplier | | | | | | | | |
| Austrian supplier | | | | | | | | |

# Glue thickness (just for reference)

- A preliminary measurement by Adrián on the thickness of the glue
  - not the best scale
  - nor the best gluing
- Sandwich of kapton + glue + silicon plate
- Thickness:
  - kapton 90 um
  - round Si plate 280 um (300 um in description)
- Measured glue thickness:
  - 100, 80, 40, 30, 30, 20 (in mm)
  - averaged at $50 \pm 15$ mm

# An idea on a two-plate layer

Reality

10x on $z$

Two plate deformation

3D printing?