

# Structure Manufacturing, Achievements and Challenges

M.Taborelli

- Technology
- Shape accuracy
- Surface quality
- Assembly accuracy

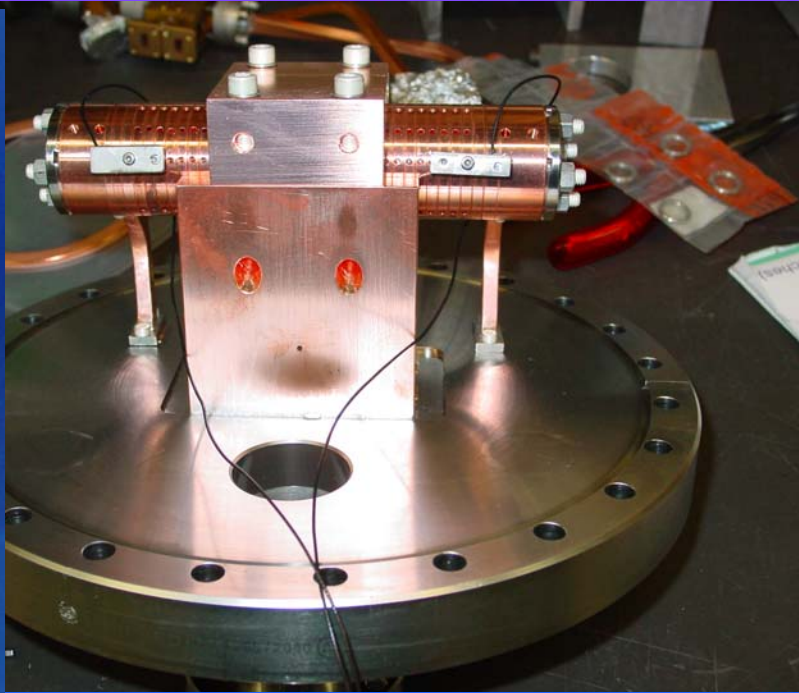
Contributions of :

G.Arnau-Izquierdo, A.Cherif, D.Glaude, R.Leuxe,  
J.Huopana, S.Mathot, CLIC study team

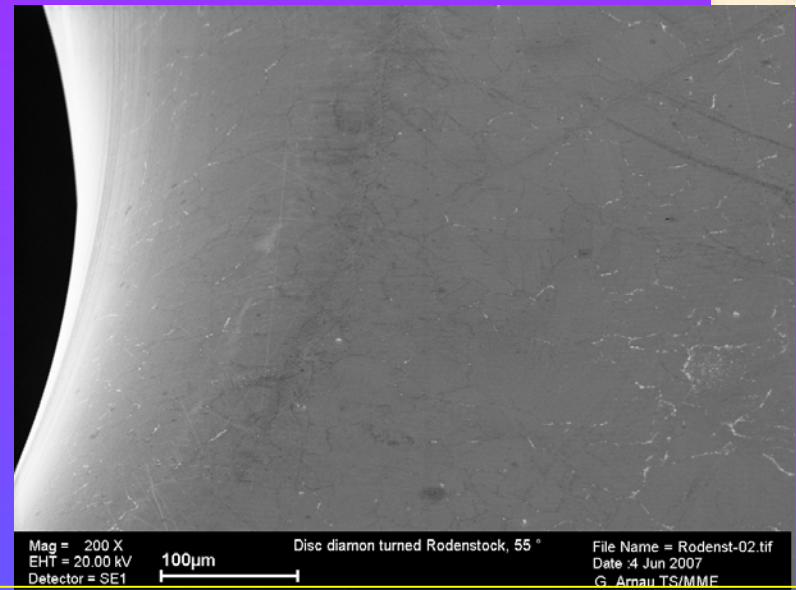
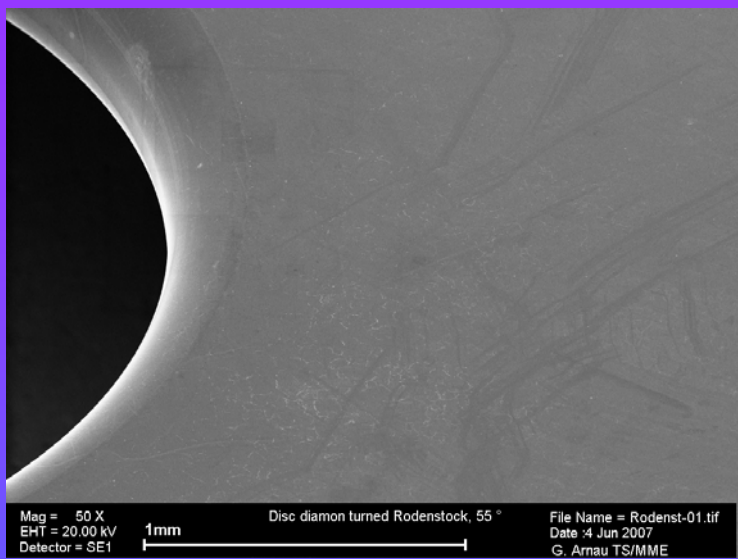
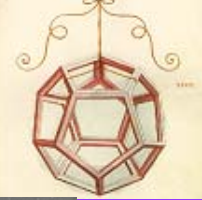
# Copper, disc structures



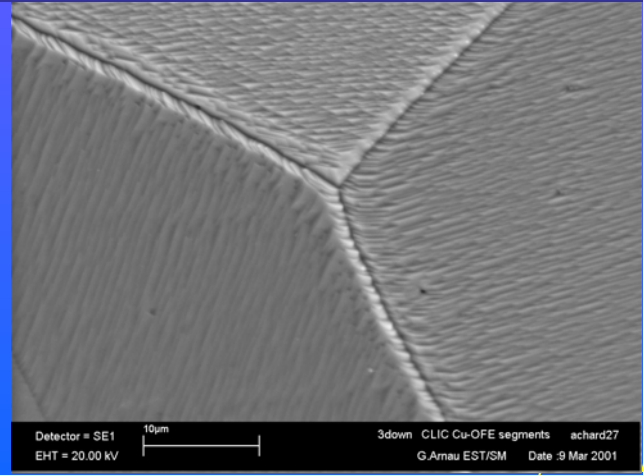
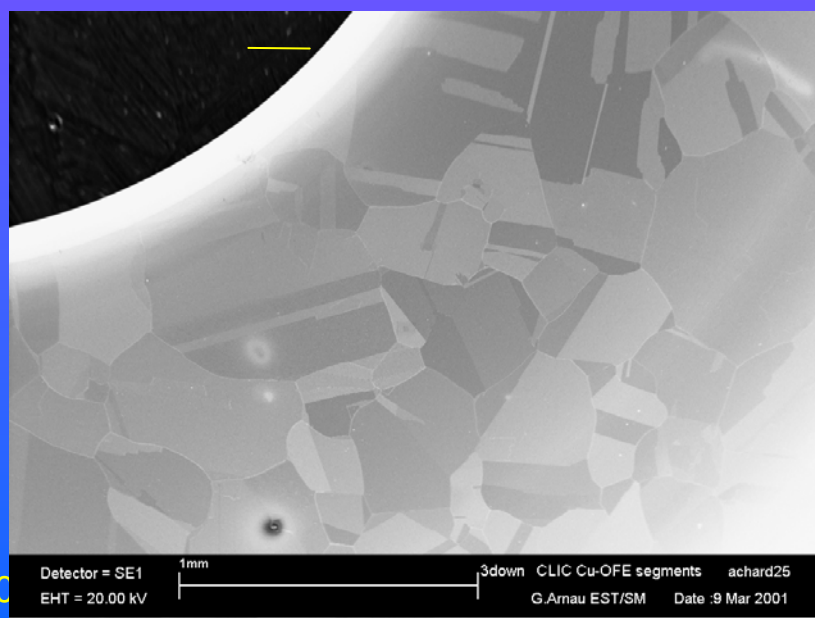
- Machining by **diamond turning**: shape accuracy of  $2-3\mu\text{m}$  in the iris region
- alignment of the discs on V-shaped marble before assembly in a stack: use external disc surface as reference.
- assembly by vacuum brazing (T up to  $820\text{C}$ ) or by bolting
- no rf-damping by design

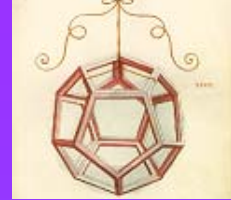


# 30 GHz copper structures: surface quality



Recrystallization after thermal treatment (vacuum brazing cycle at 820 C)



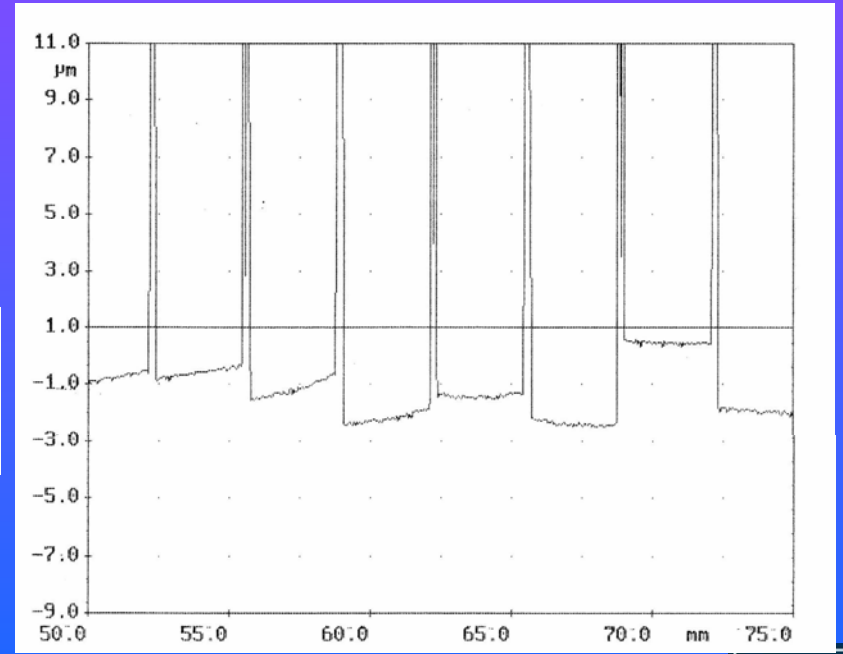
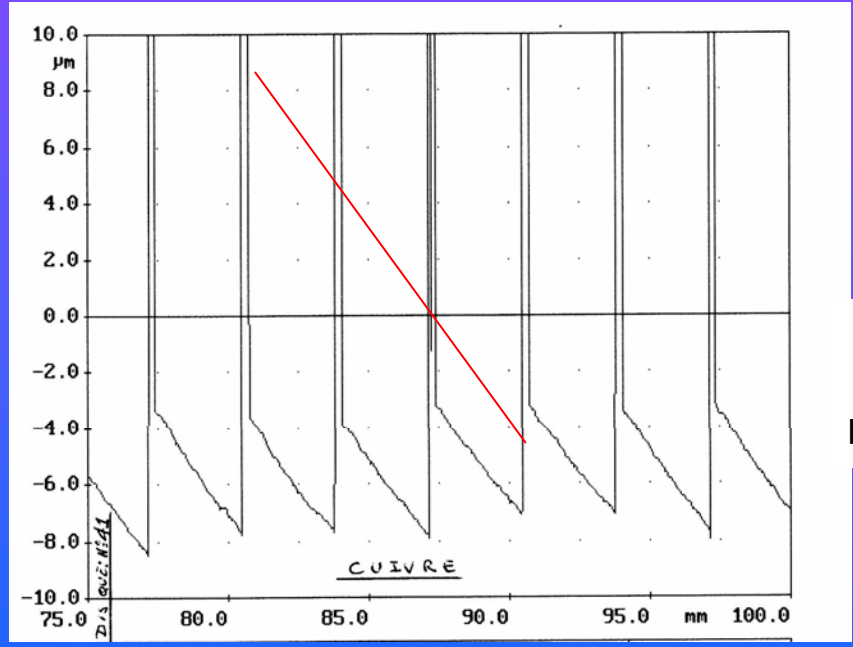


Achieved accuracy for brazing assembly of disc structures: better than 5  $\mu\text{m}$

The type of error depends on the assembly procedure

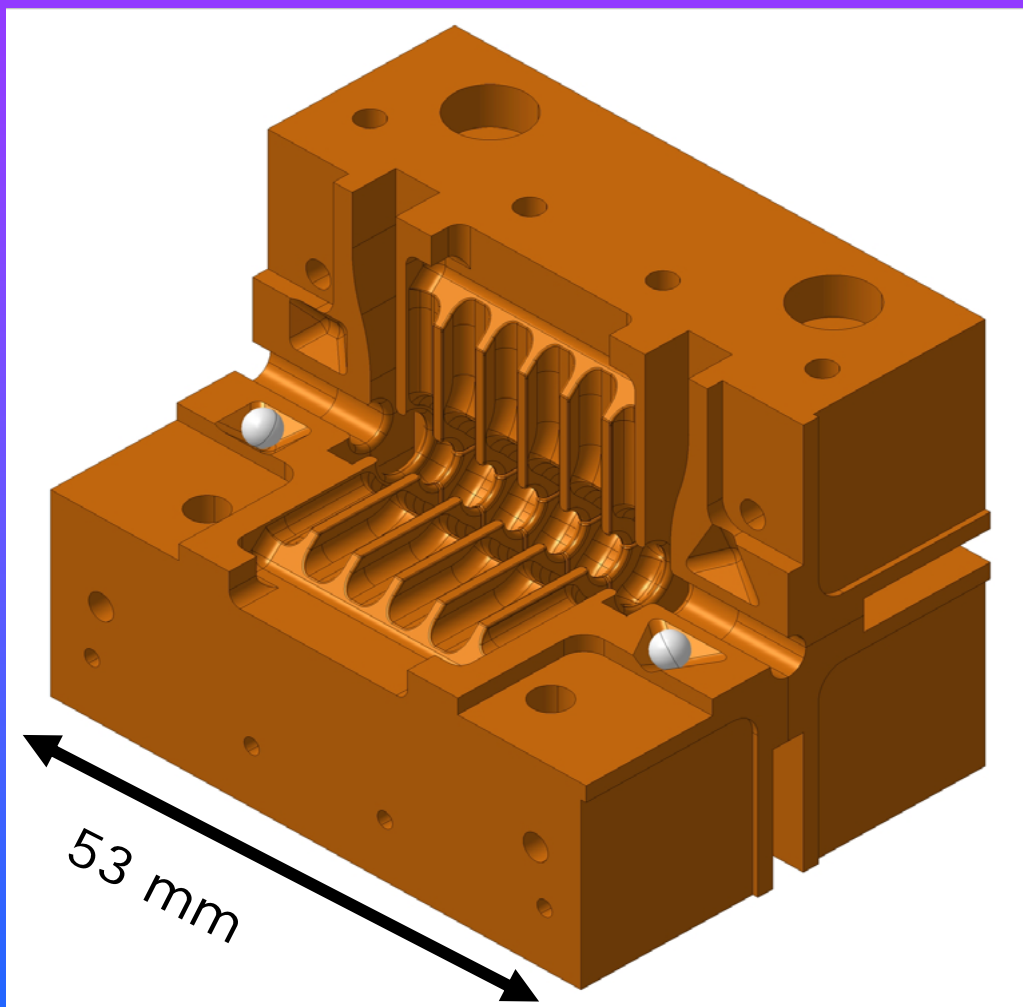
Bookshelving: assembly on aslope V-bench gives "tilted" discs

Smaller and random error: assembly on vertical V-bench, as a tower





## Copper quadrant structures: example 30GHz



- machining by 3D milling: carbide tools or single crystal diamond tools

- alignment of the quadrants still under study

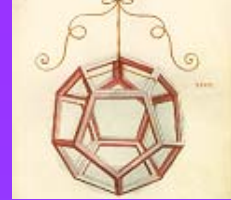
- assembly by bolting

- rf-damping implemented in the design

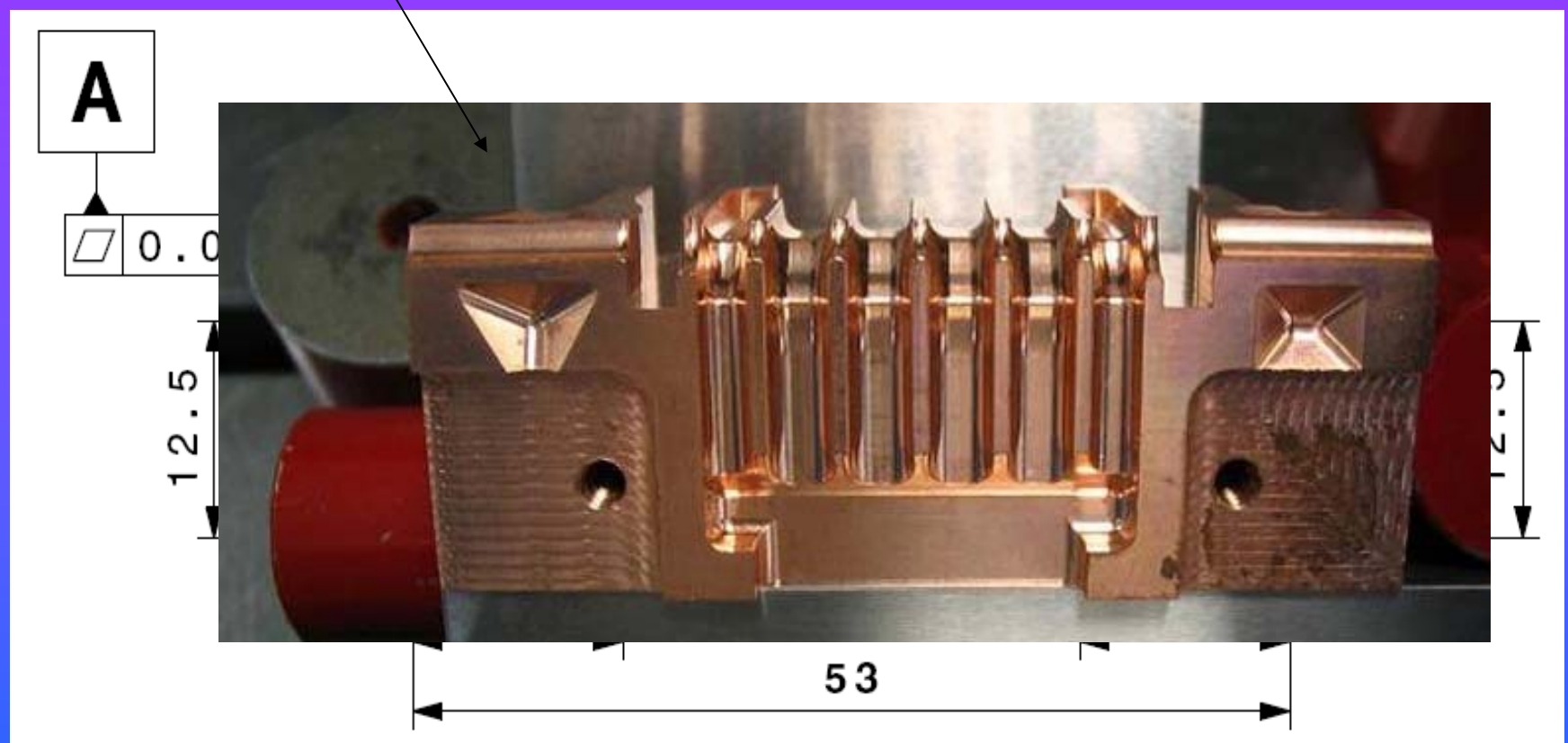
- target accuracy: 1  $\mu\text{m}$  on shape!!!**



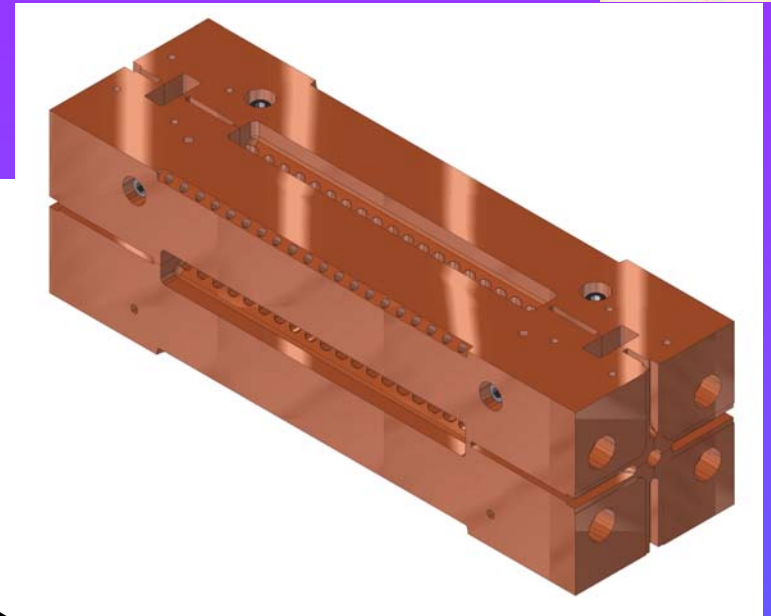
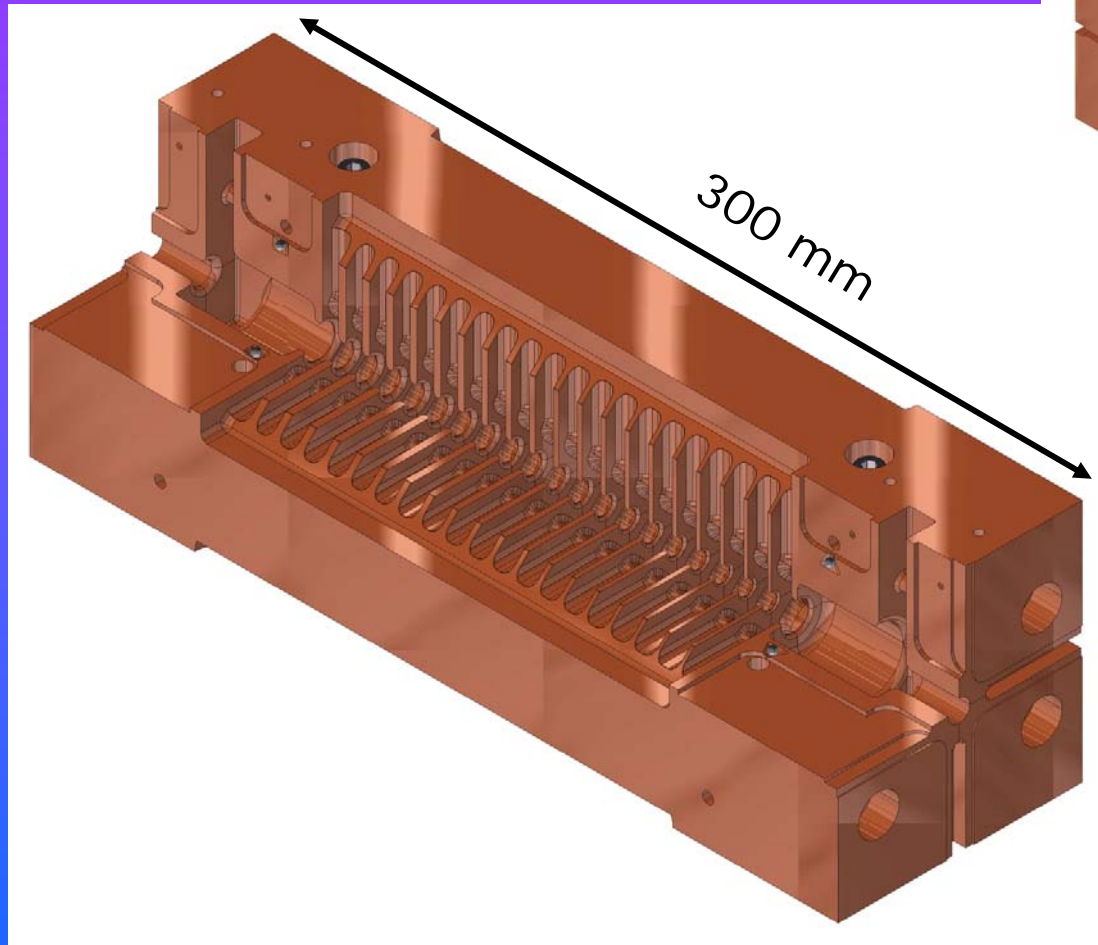
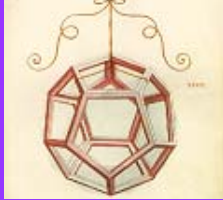
Accuracy:

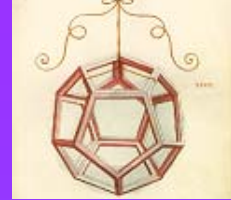


Present specifications: 5  $\mu\text{m}$  **shape** tolerance  
(.....the best that can be done)

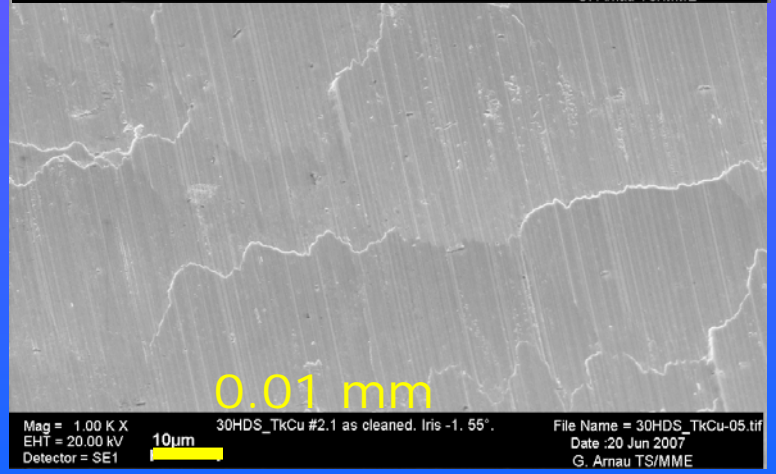
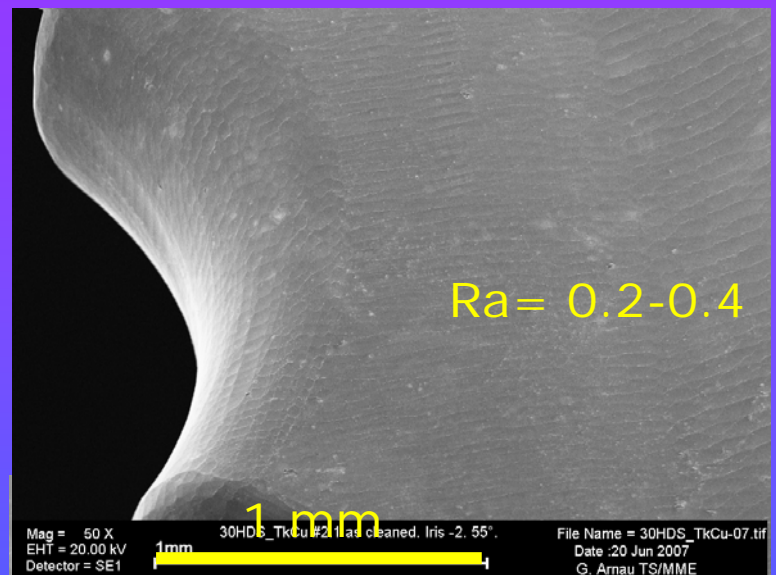


# 11.4 GHz Vg1 structure in production (11WDSQVg1)

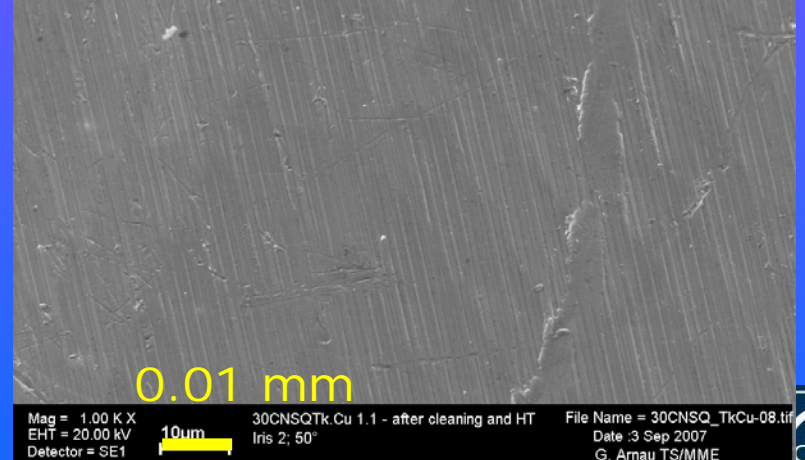
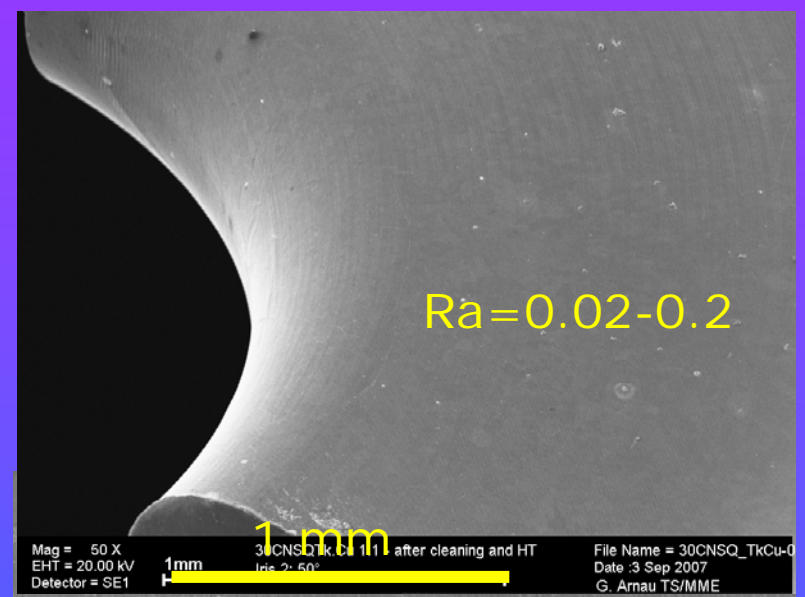




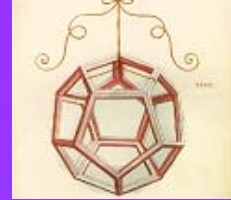
### Conventional tools milling



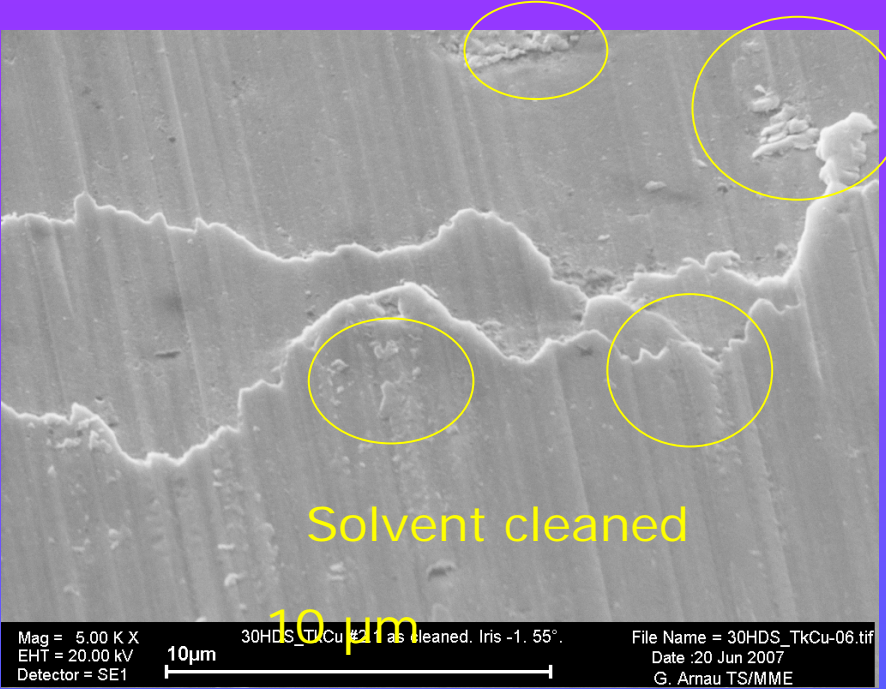
### Diamond milling



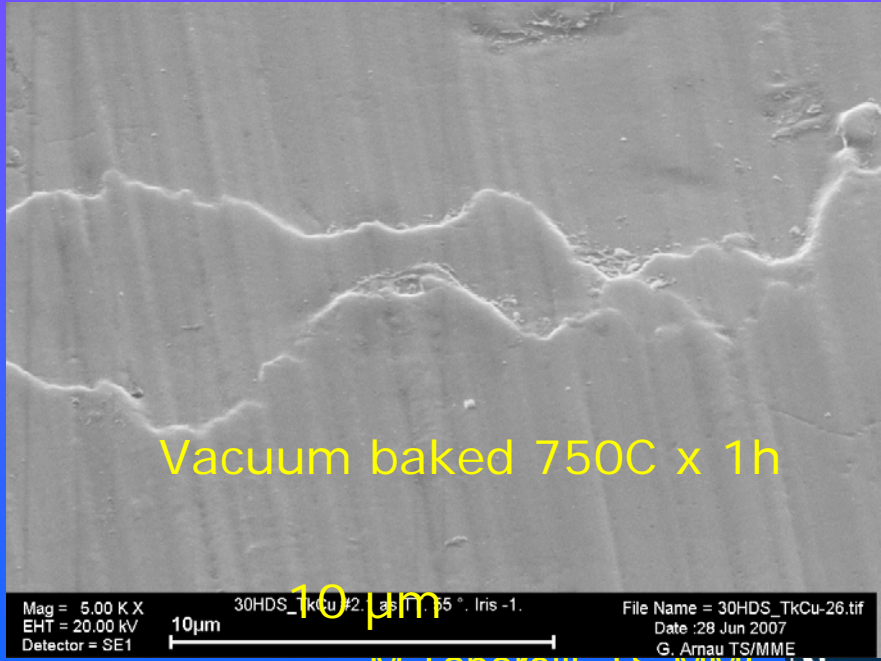


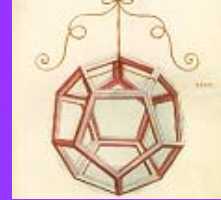


## Effect of thermal treatment



Milled surface  
(carbide tools)



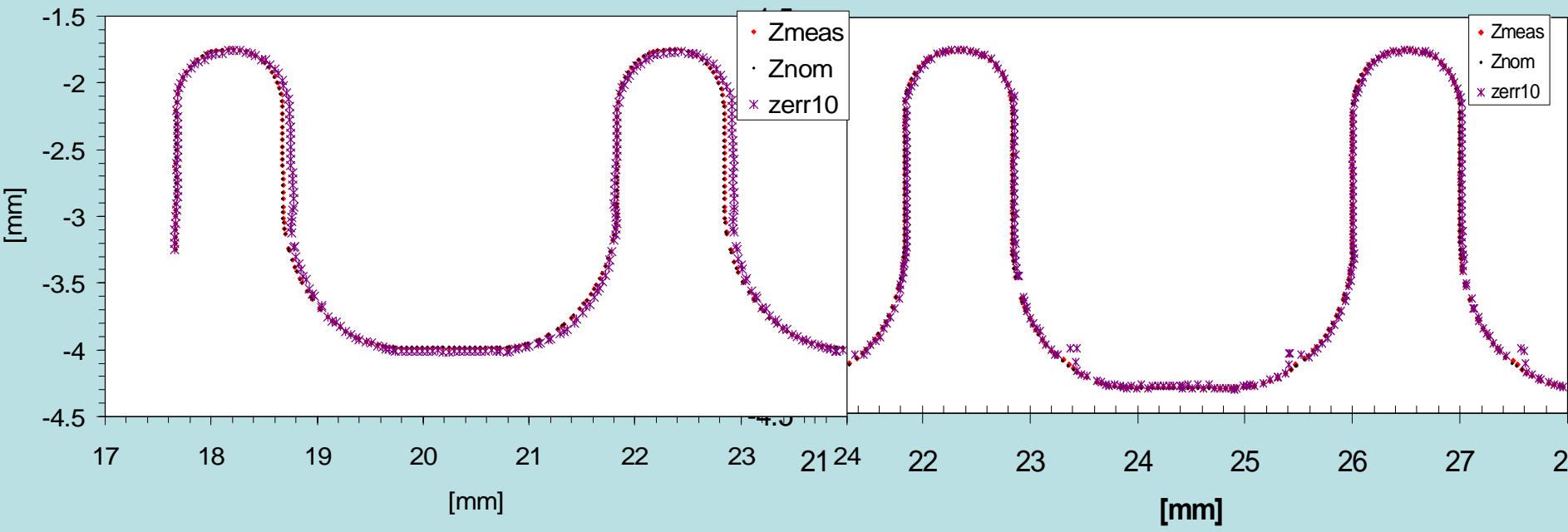


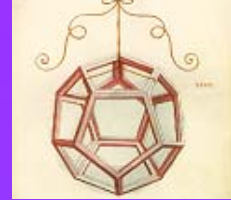
## Metrology on copper quadrants

Measurement: coordinate measuring machine, contact with 0.1N force, accuracy +/-3 μm (at CERN), scan pt. by pt. on the surface .....in parallel with RF low power control

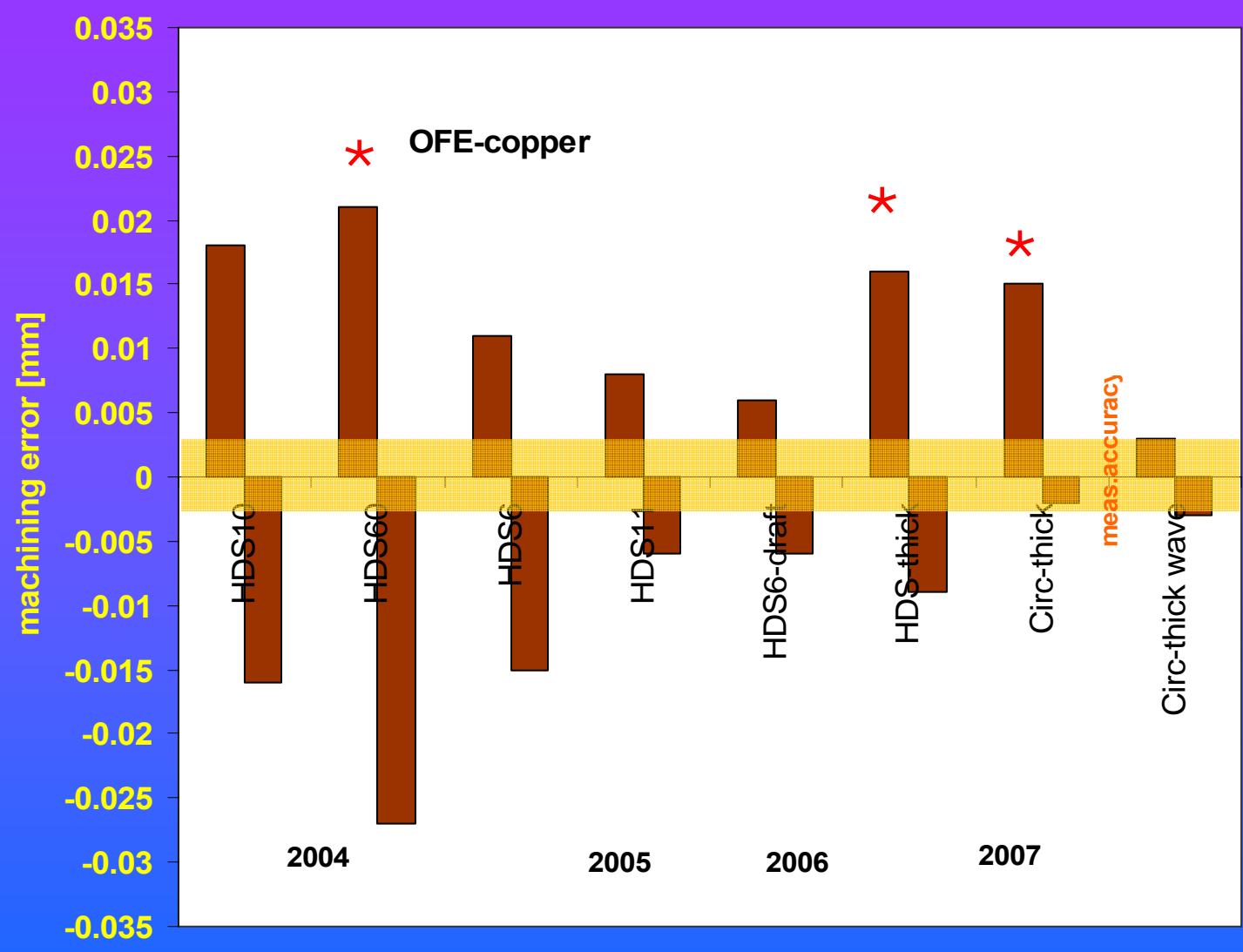
### HDS-thick

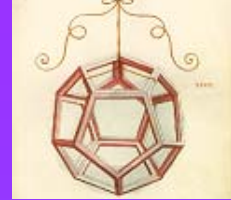
### Circular-thick



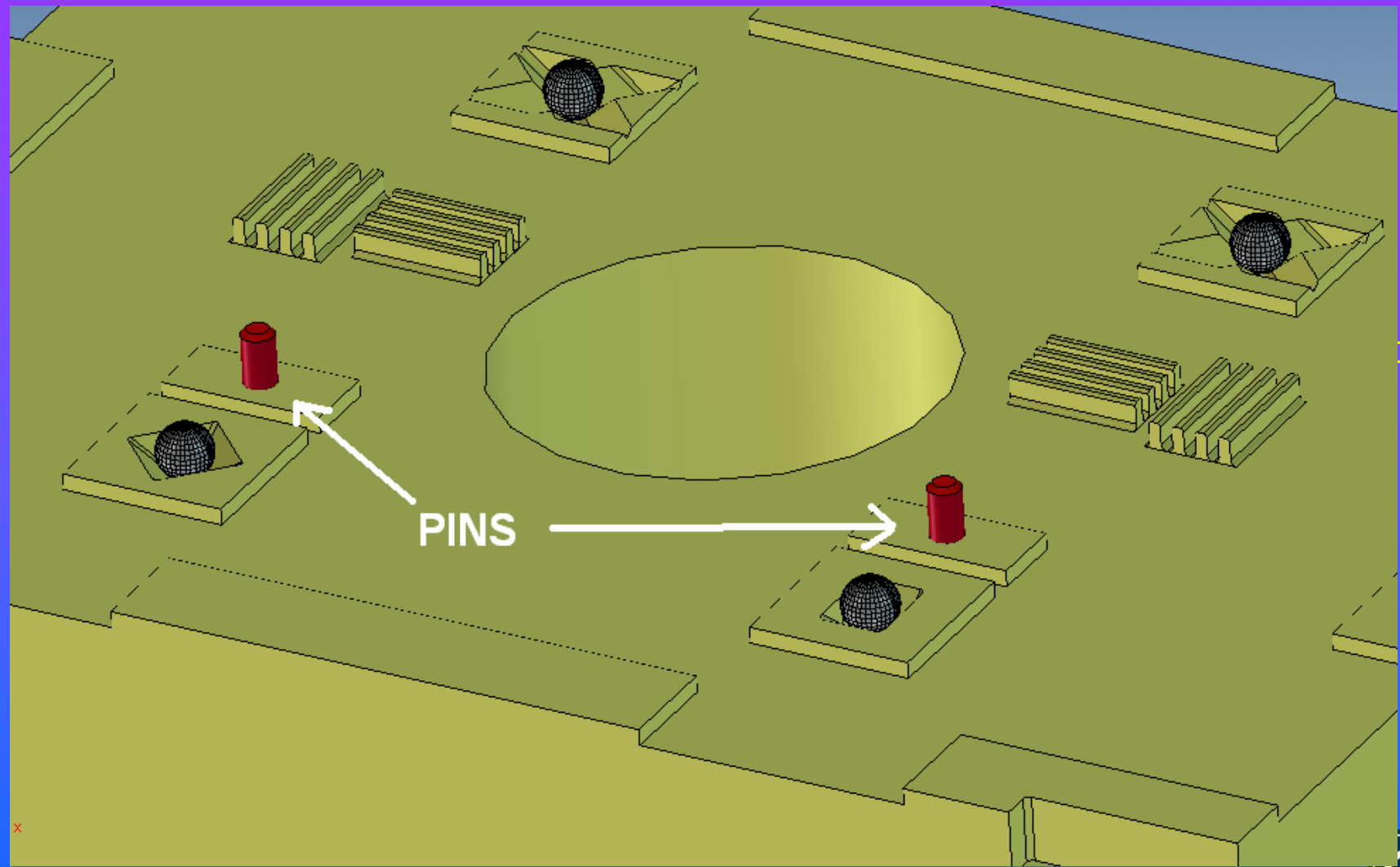


# Achieved shape accuracy, milled parts



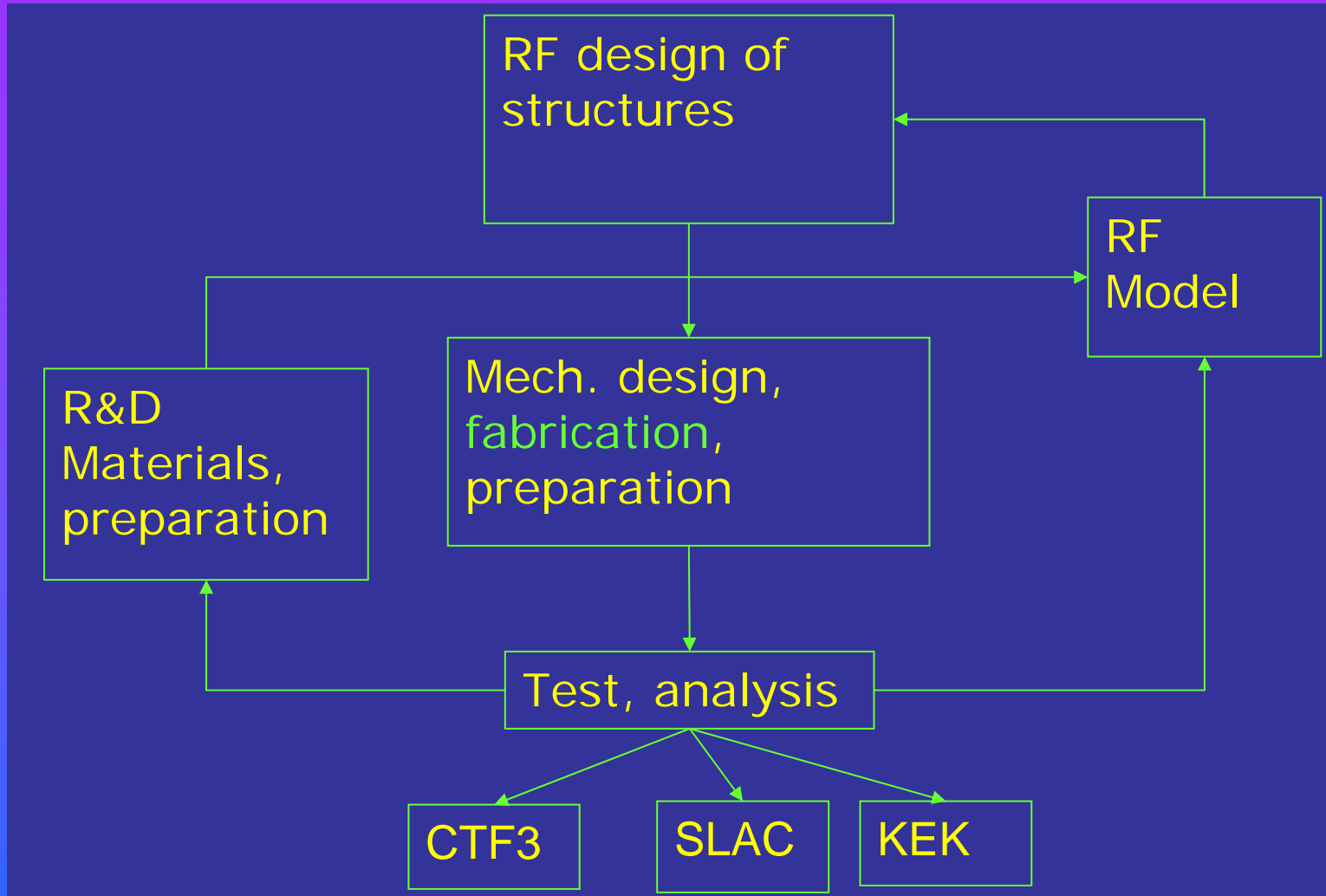
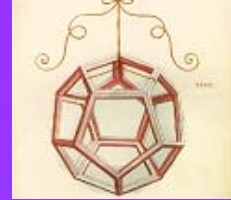


# Alignment: "universal" test piece





# Production of structures



The goal is the fabrication of 1 geometry in 4 months and 10 geometries per year; in 2007: 4 received (1 Ordered 2006) + 3 in fabrication