Concept for pre and final alignment

Module and Beam Dynamics working group meeting
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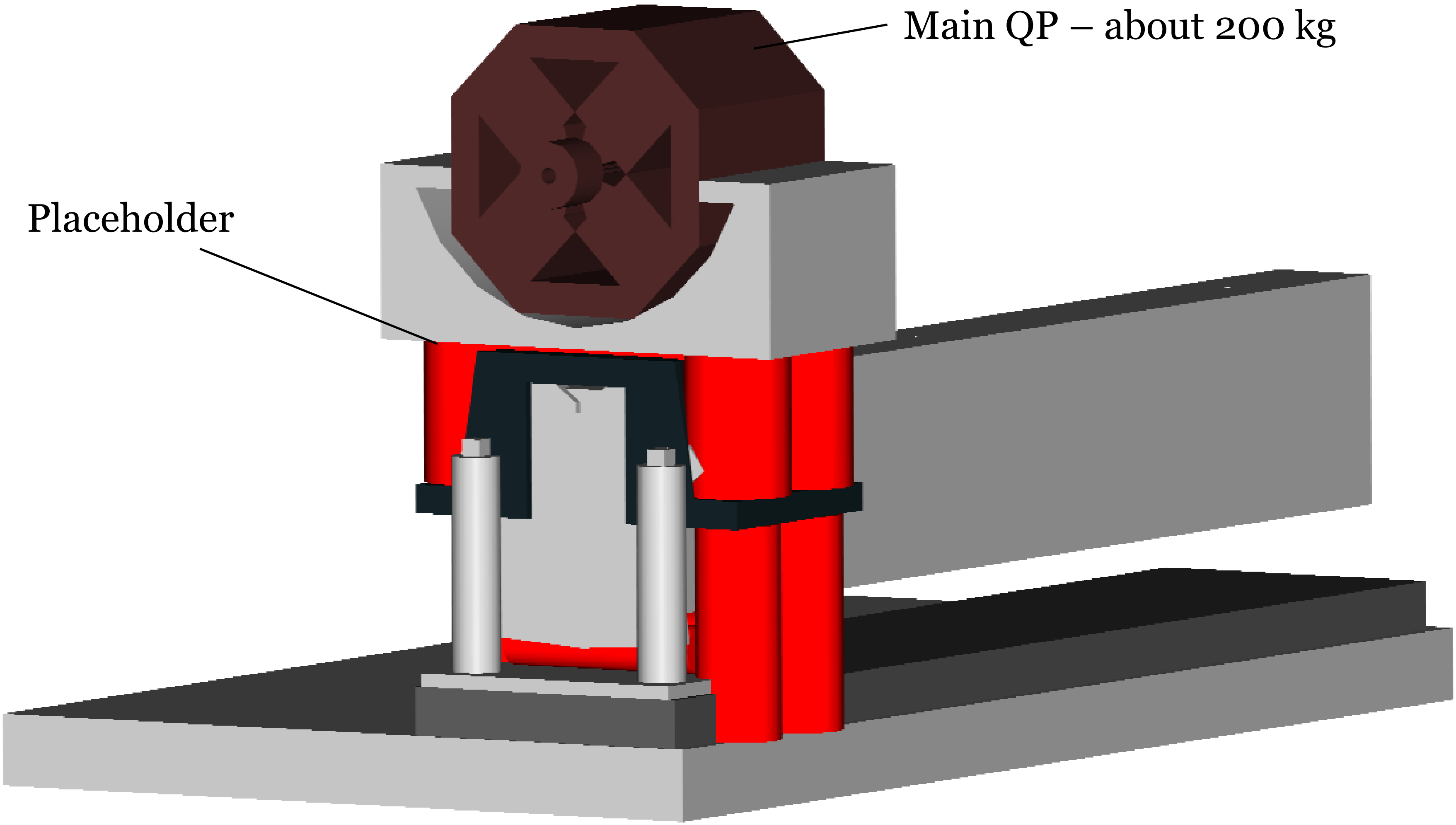
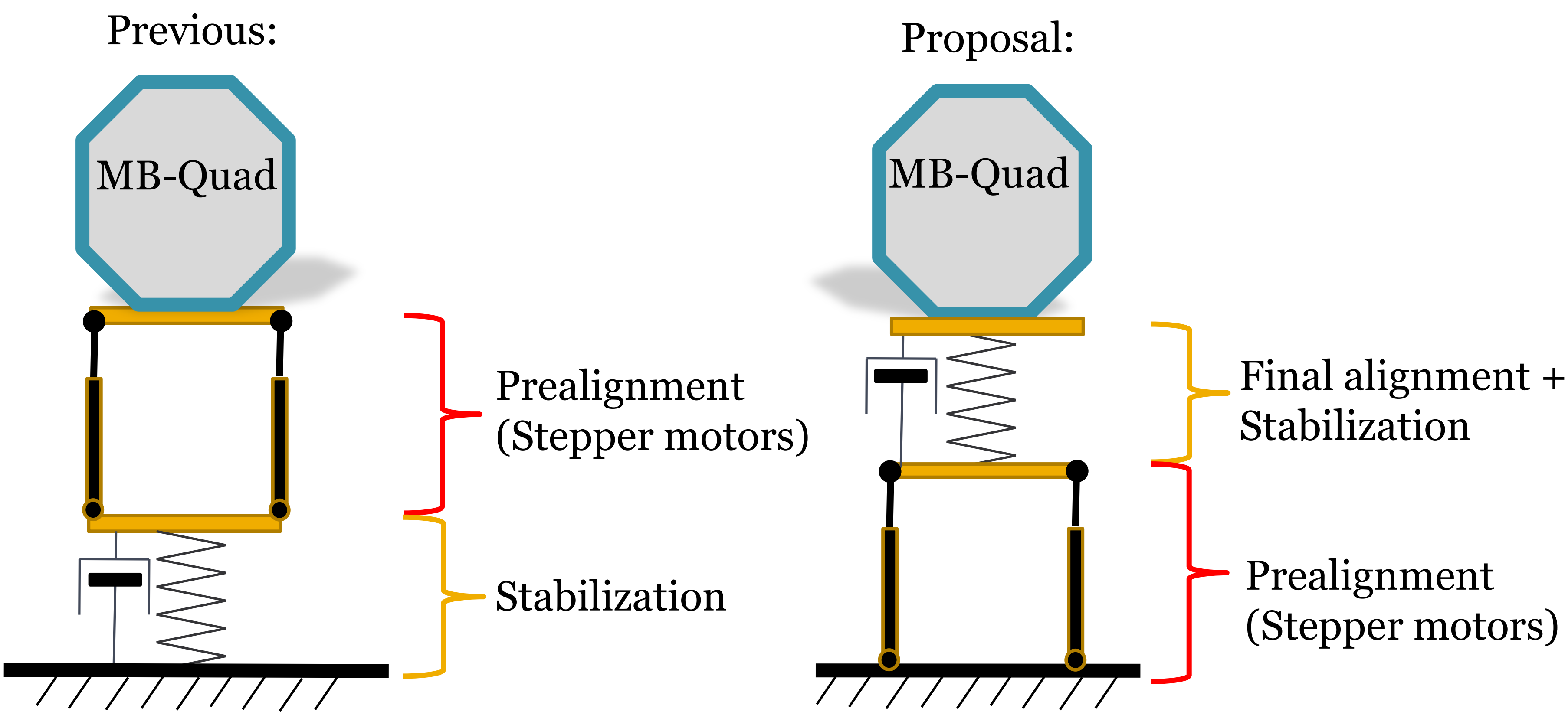
Current situation:



Alignment Concepts:

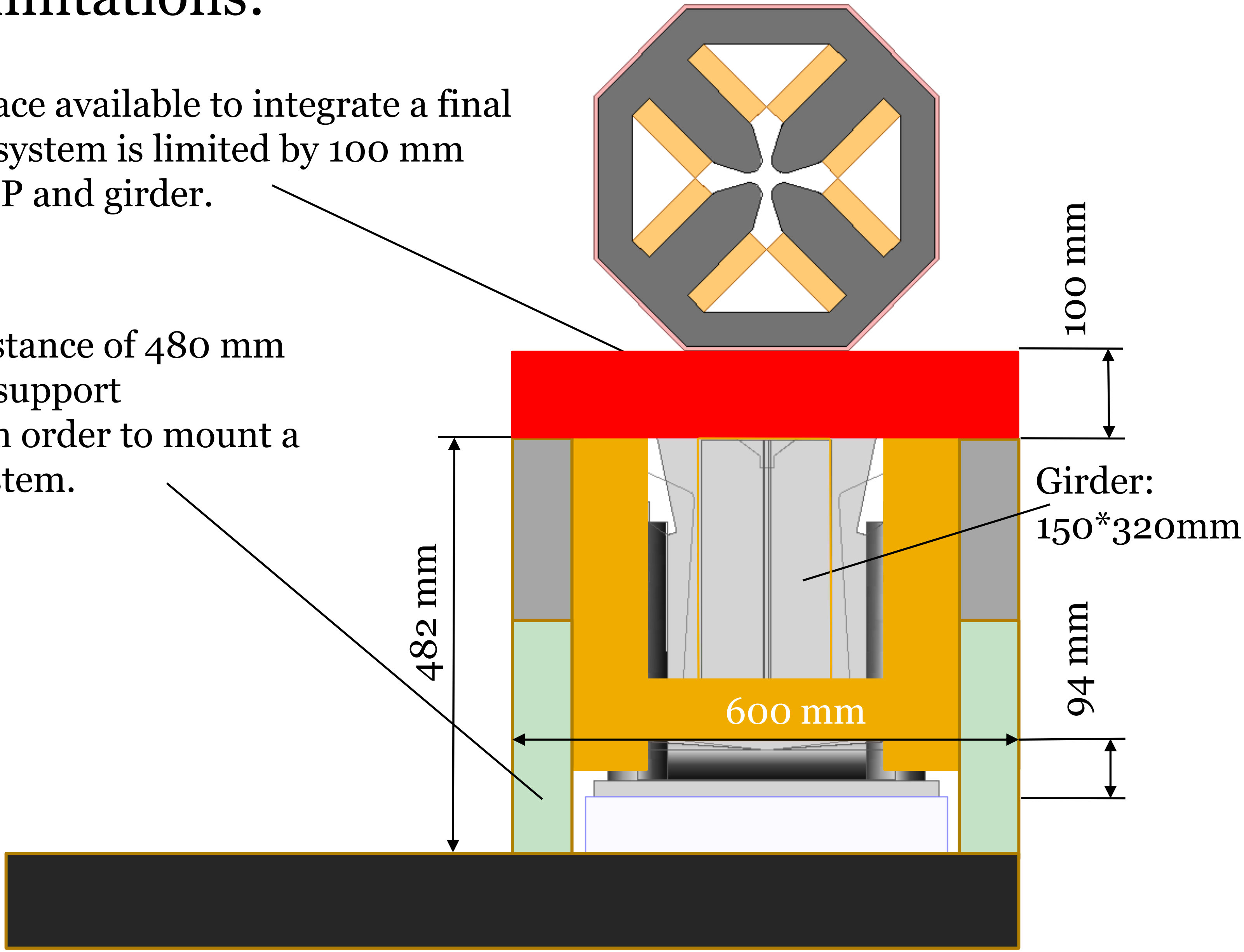


First estimation of the quadrupole weight: 200 kg (acc.to T. Zickler)

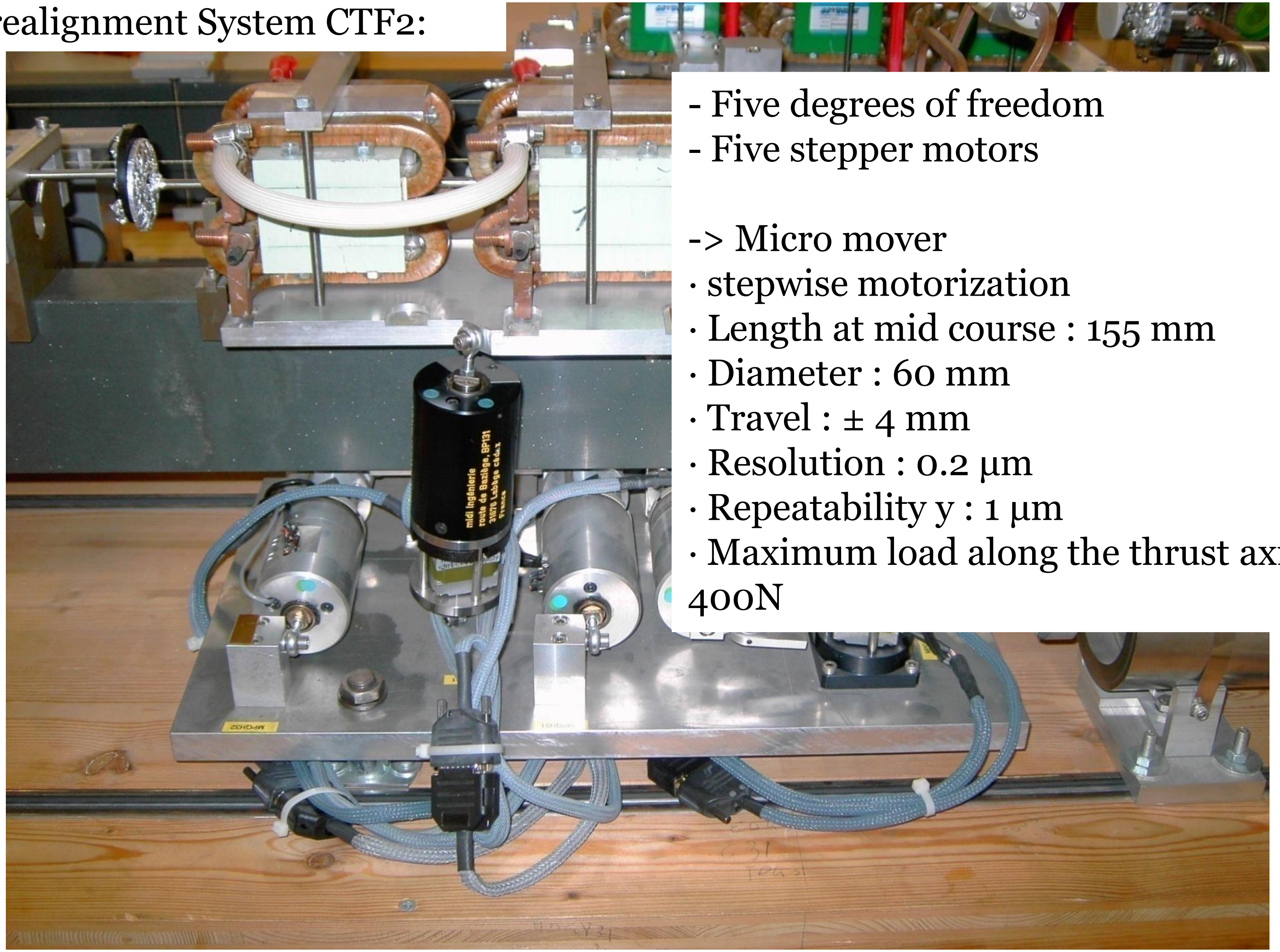
Space limitations:

Vertical space available to integrate a final alignment system is limited by 100 mm between QP and girder.

Vertical distance of 480 mm requires a support structure in order to mount a stepper system.



Prealignment System CTF2:



- Five degrees of freedom
- Five stepper motors

-> Micro mover
· stepwise motorization
· Length at mid course : 155 mm
· Diameter : 60 mm
· Travel : ± 4 mm
· Resolution : 0.2 µm
· Repeatability y : 1 µm
· Maximum load along the thrust axis: 400N

Pre - alignment System (accuracy: < 10 µm):

- Keeping the concept from the CTF2 experience (CLIC Note 553 et.al.)

- Update the design and stepper motor system to the actual state of technology

- Taking into account the quadrupole weight of about 220 kg (incl. fine alignment system)

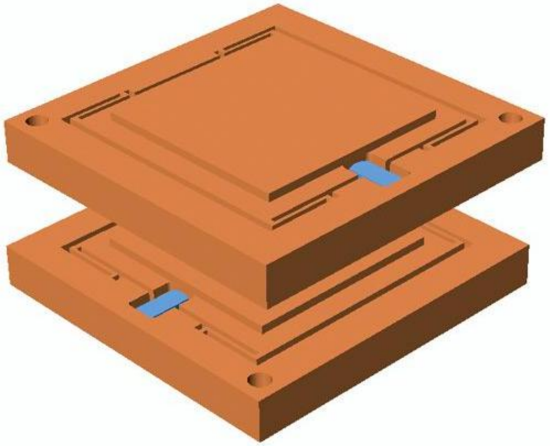
-> Market research in order to find adequate stepper motors:

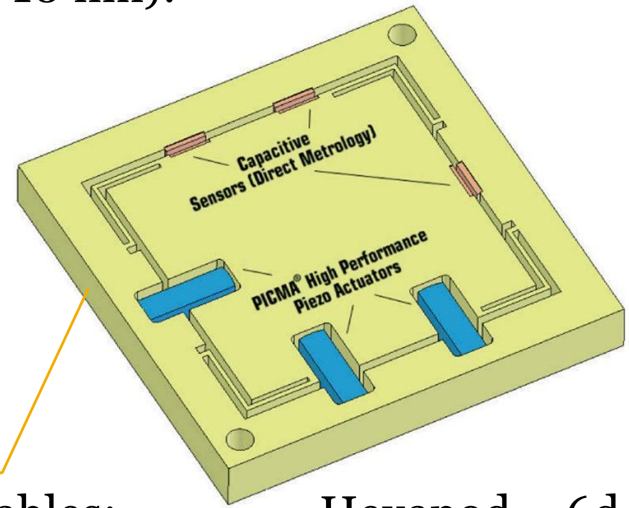
Various acceptable products providing the requirements in order to build a stepper based pre - alignment system with an accuracy to align to better than 10µm.

-> Further steps…

Final - alignment System (accuracy: < 10 nm):

Nano alignment 'available':





X-Y tables:

Hexapod – 6d alignment:

Main issue:

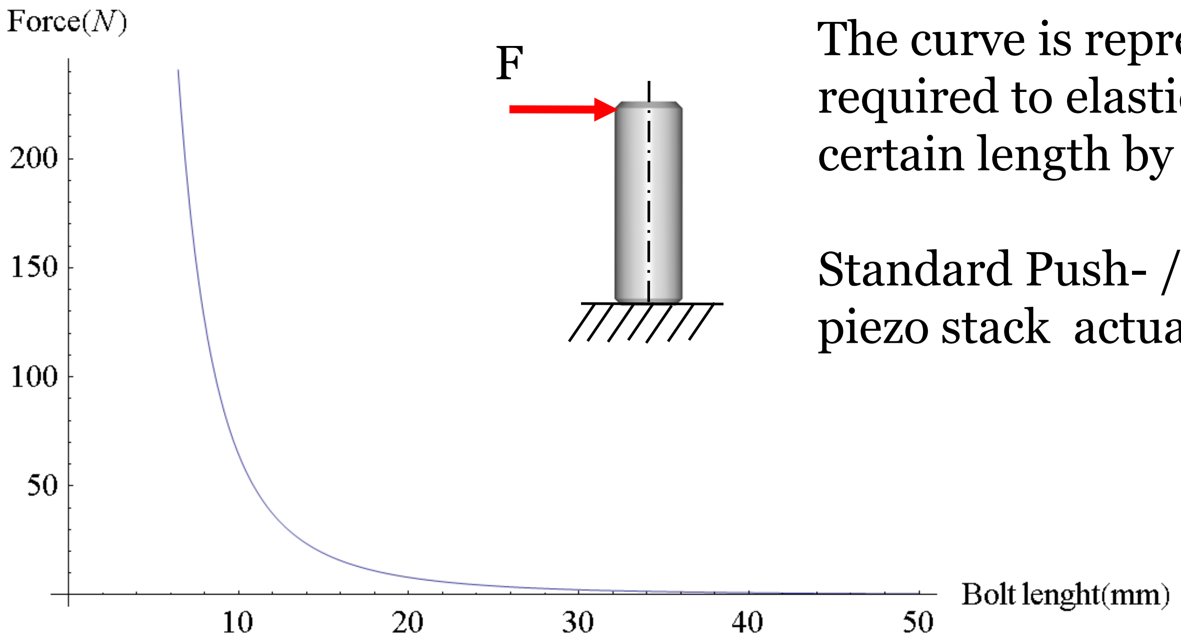
Load capacitance: <= 10 kg or slightly above (not satisfactory for a CLIC aligment system)

Concept: Combining nano alignment and stabilization for both, vertical and horizontal motion. Developing a fine alignment and stabilization system according to CLIC specifications .

Possible approach:

Controlled deformation of a defined object using piezo ceramics.

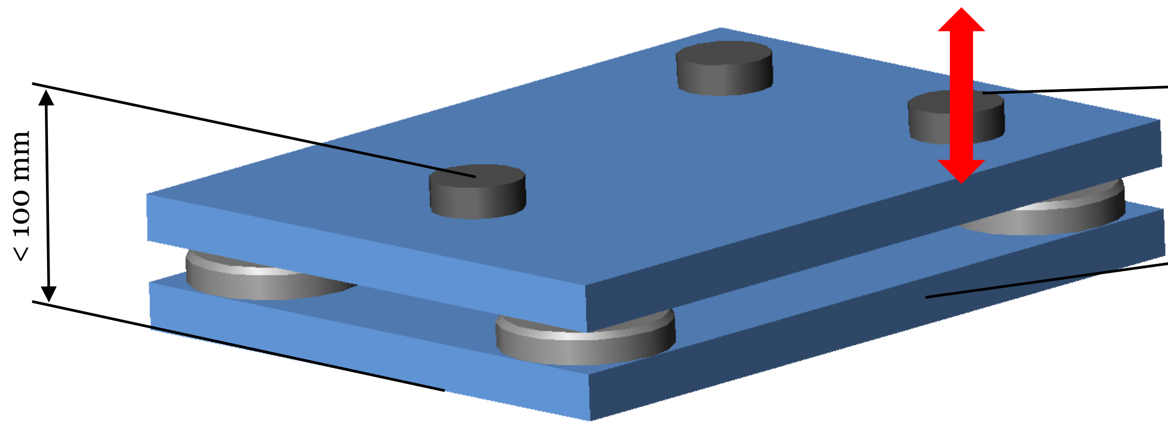
E.g. Al – bolt (standard alloy, Youngs Modulus 70000 N/mm²), diameter 5 mm



The curve is representing the Force F required to elastically deform a bolt of certain length by a magnitude of 10 µm.

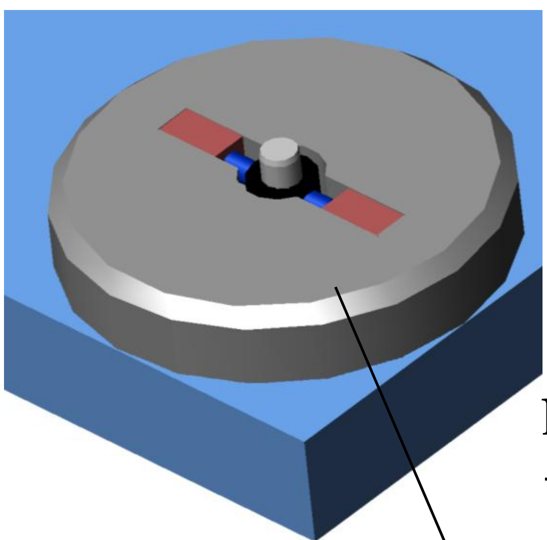
Standard Push- /pull force capacity of small piezo stack actuators is about 1000 N

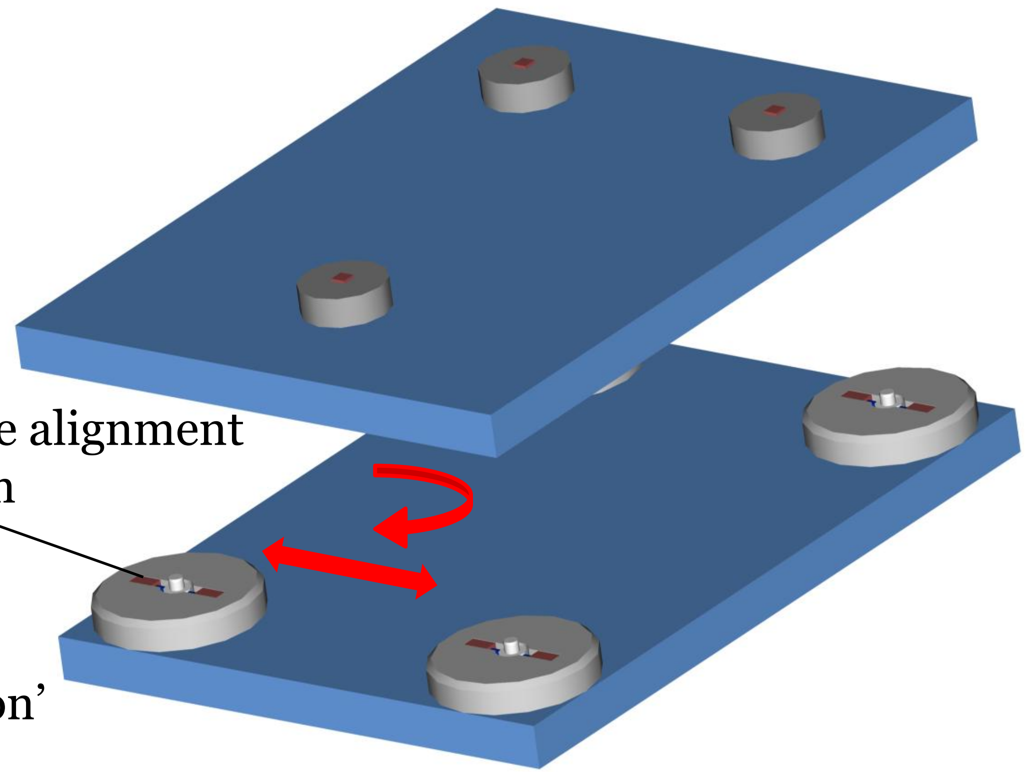
Final - alignment



Vertical fine alignment + Stabilization (Piezo)

Includes supporting points for pre alignment





horizontal fine alignment + Stabilization

Two piezo stacks, precise supports applying Force (elastic deformation on bolt) ‘with or without synchronization’

Possible Piezo: PI (Physikinstrumente, D-Karlsruhe)

PICMA Monolithic Multilayer Piezo Actuator (LVPZT)

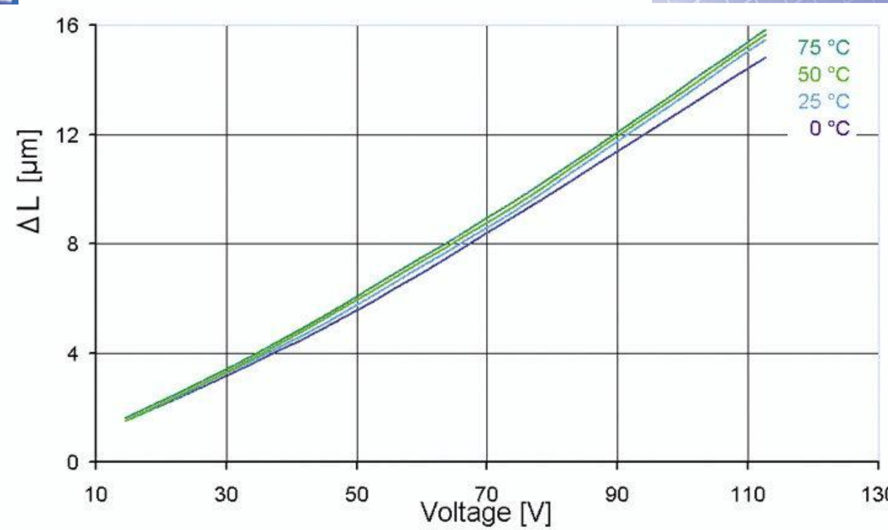
Application Examples

- Precision mechanics and mechanical engineering
- Nanopositioning / high-speed switching
- Active and adaptive optics
- Vibration cancellation
- Pneumatic & hydraulic valves
- Metrology / interferometry
- Life sciences, medicine and biology

P-885.50 (5 x 5 x 18mm)
Max. displacement: 18 µm ±10%

Force: 900N

Costs: 350 Chf



http://www.physikinstrumente.com/en/products/prdetail.php?sortnr=100810

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Design and Feasibility study:

CAD: Design and support optimization

FEA et al.:
- Optimizing the structural stability and interconnection between the two alignment plates.
- Optimize actuator support and bolt dimensions
- Modal analysis,
- Control Technology
- Estimate thermal influence

Prototyping:
- First mockup (CERN workshop), production limitations
- Component selection (In collaboration with?)
- Prototype (In collaboration)

LAB test:
- First Lab tests using a mockup

~Additionally ~

Important question: - Environment for nanometer precision measurements?

Operating schedule:

CAD	FEA	Prototyping	LAB test
15.02.2008 – 04.04.2008	09.03.2008 – 25.04.2008	20.04.2008 – 06.06.2008	Start from June 2008