CLIC RF Distribution and Active Alignment

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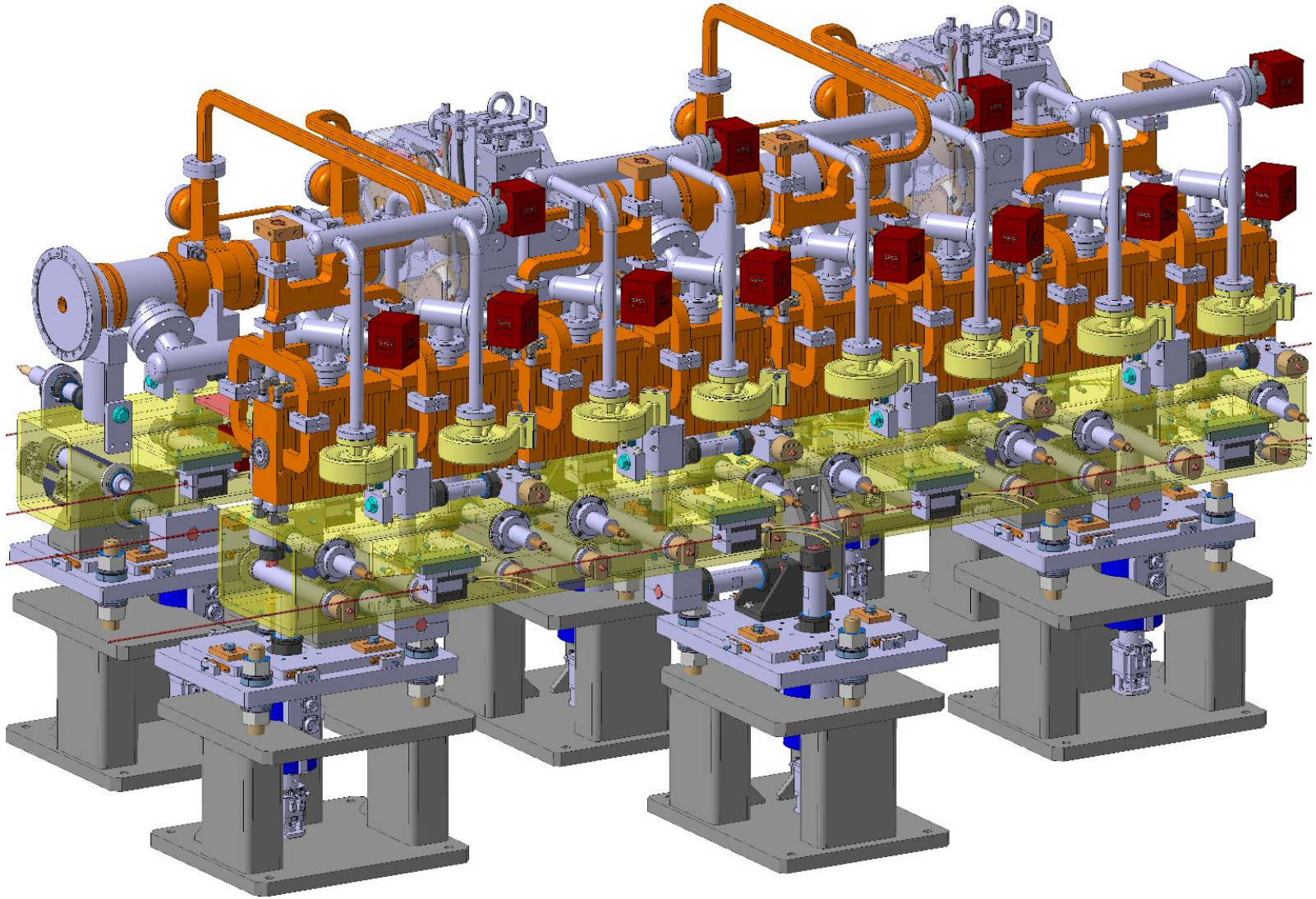
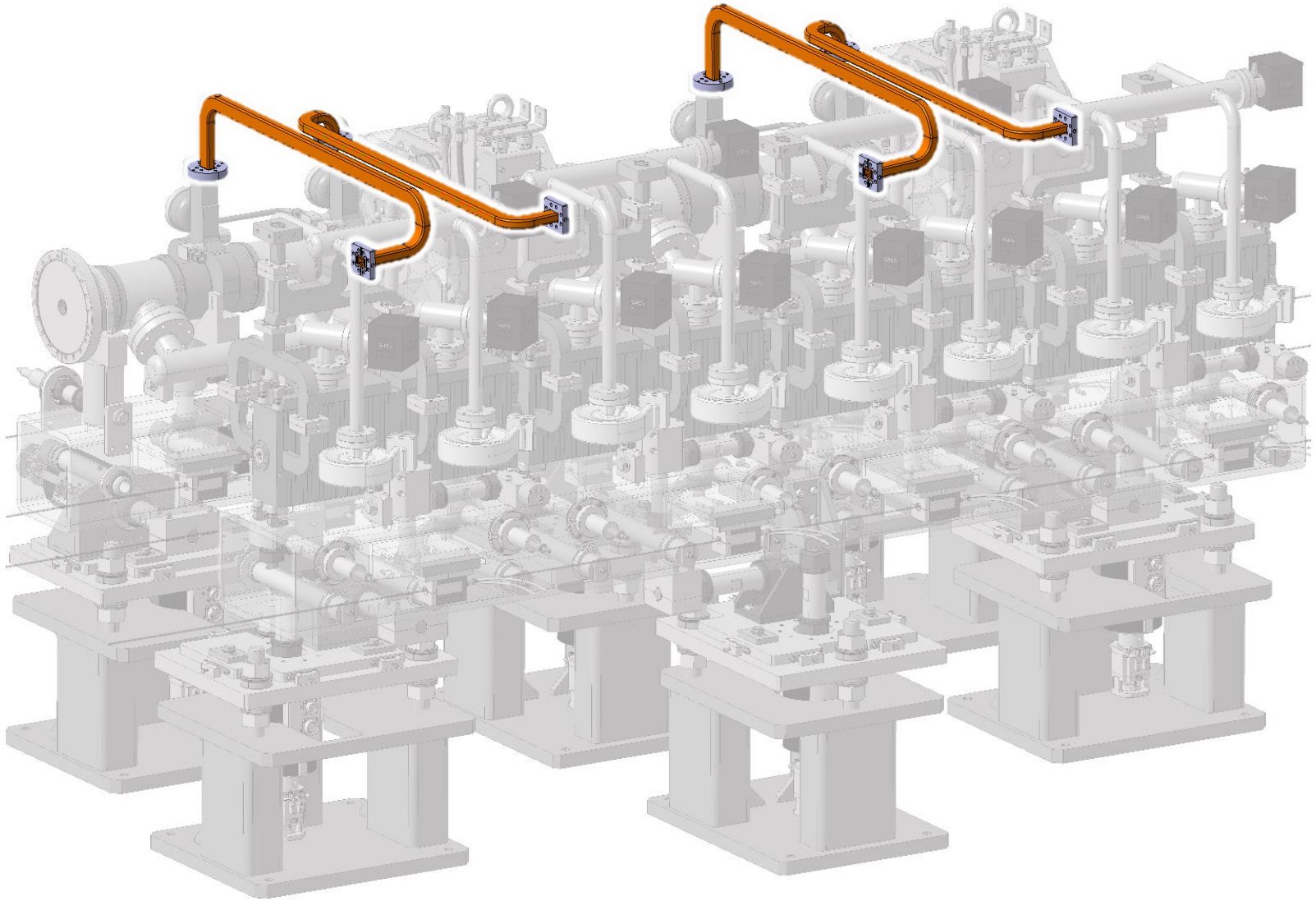
TBM

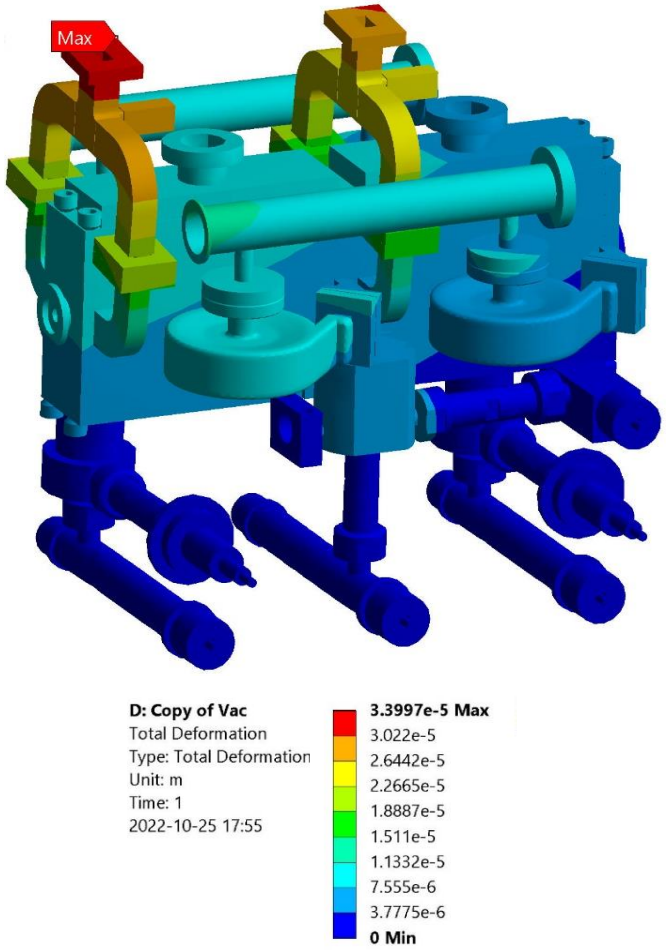


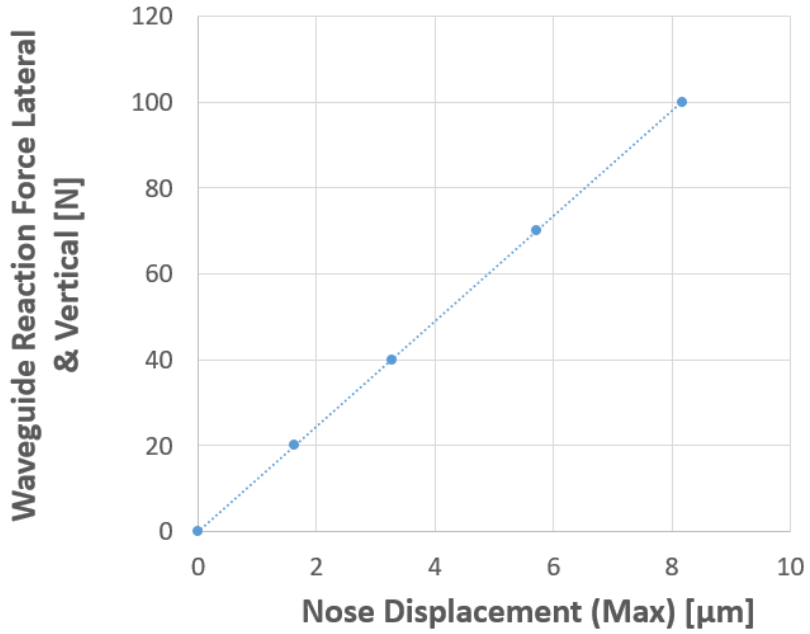
Beam Interconnecting Waveguides



Waveguide Constraints

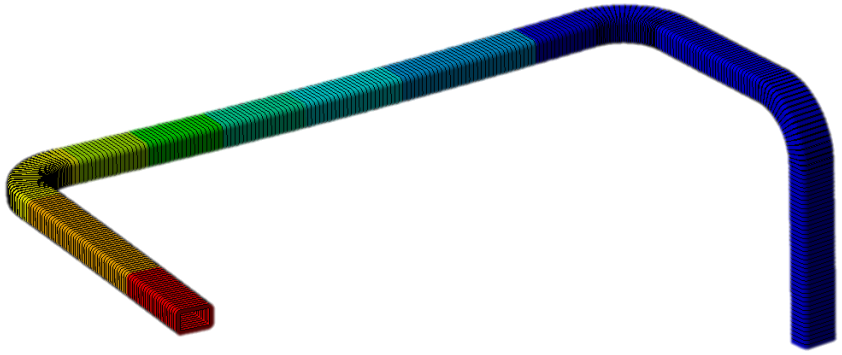
- Waveguide profile
  - Single-height
  - Double-height
  - Square
- Active adjustment range
- Allowable reaction force on structures
  - The displacement of the structure disks when a vertical and lateral force is applied to the waveguide flanges
  - 10N ~10µm
  - 20N used as a limit

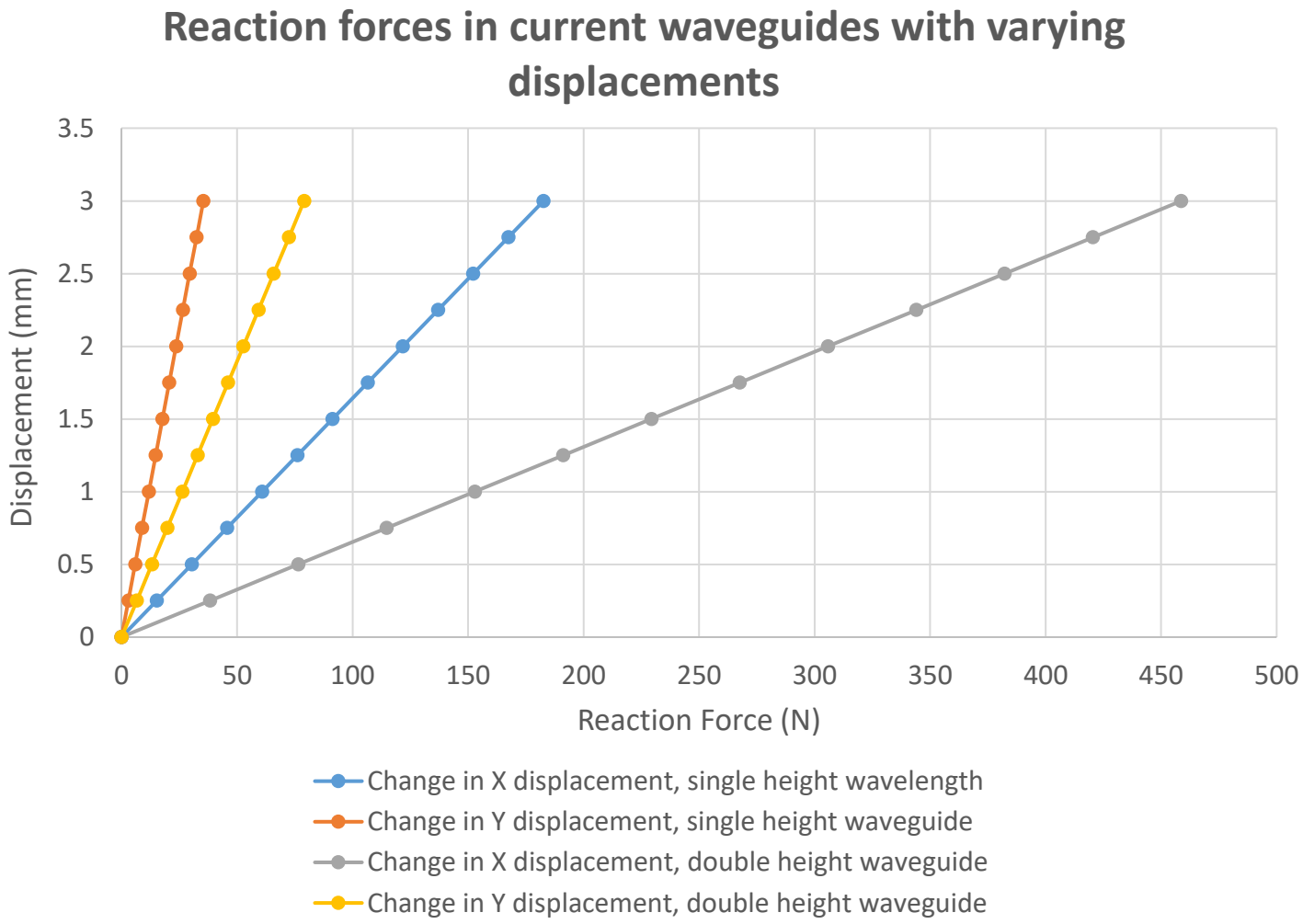




Waveguide analysis

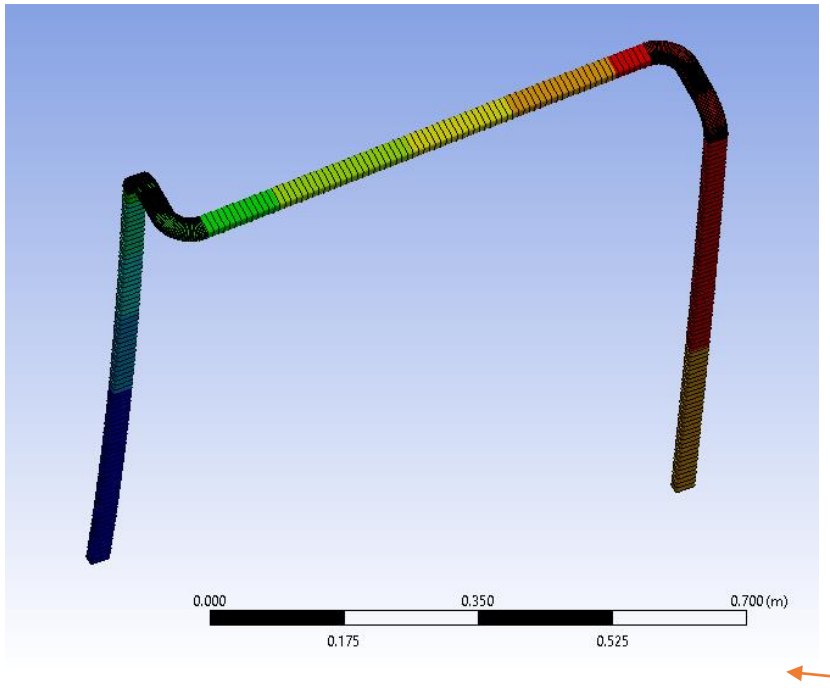
- Threshold to hit 20N reaction forces in single and double-height waveguides:
  - ±0.3mm for Single Height
  - ±0.15mm for Double Height
  - Waveguide length ~1.1m

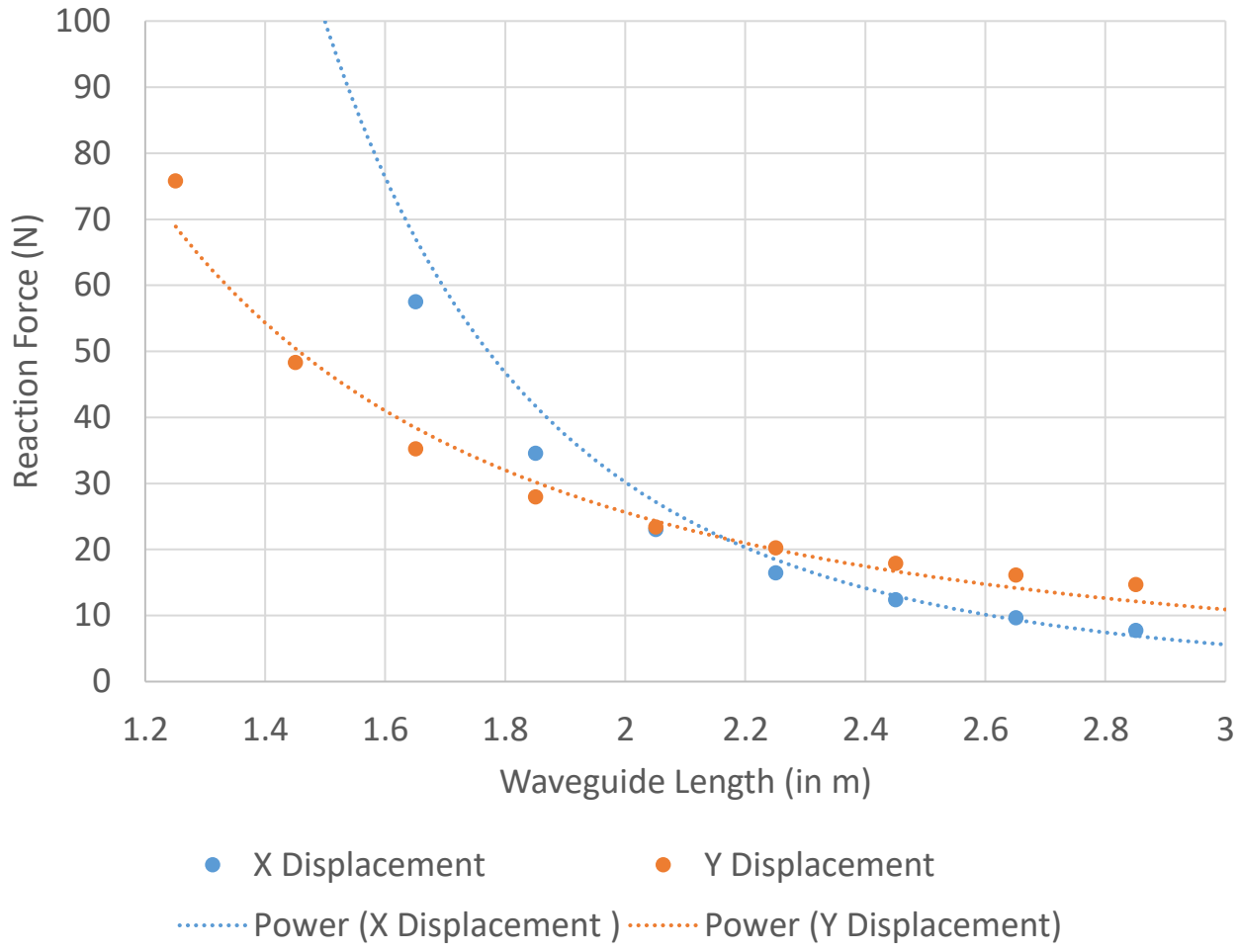




Possible Waveguide Optimisation

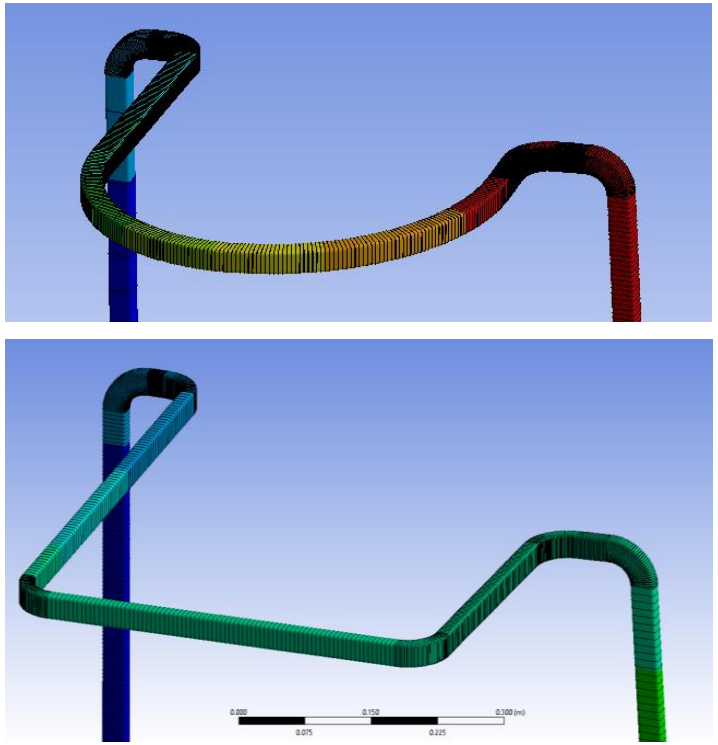
- Close to original design
  - Only four bends
  - Increased length (height)
- Assumed the full 3mm offset

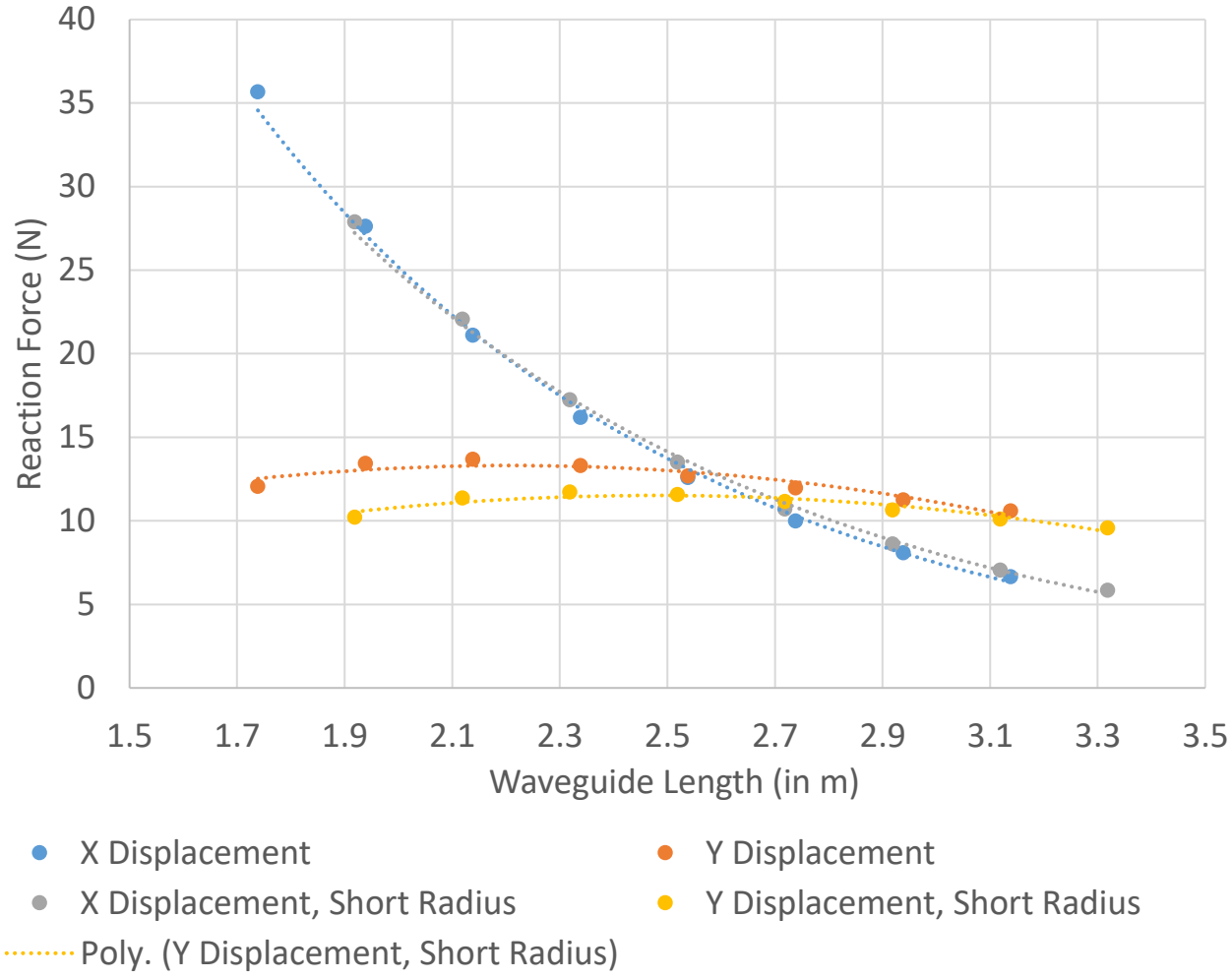




Possible Waveguide Optimisation

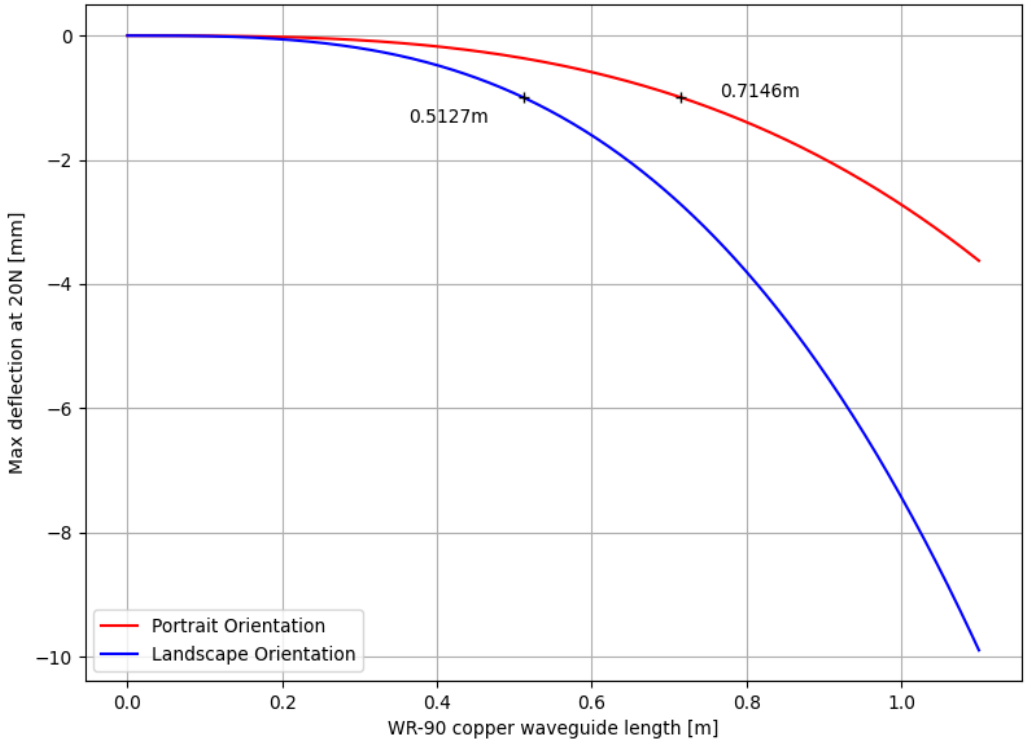
- Further away from original design
  - Increases the number of to bends 6
  - Increased length (height)
- Assumed the full 3mm offset



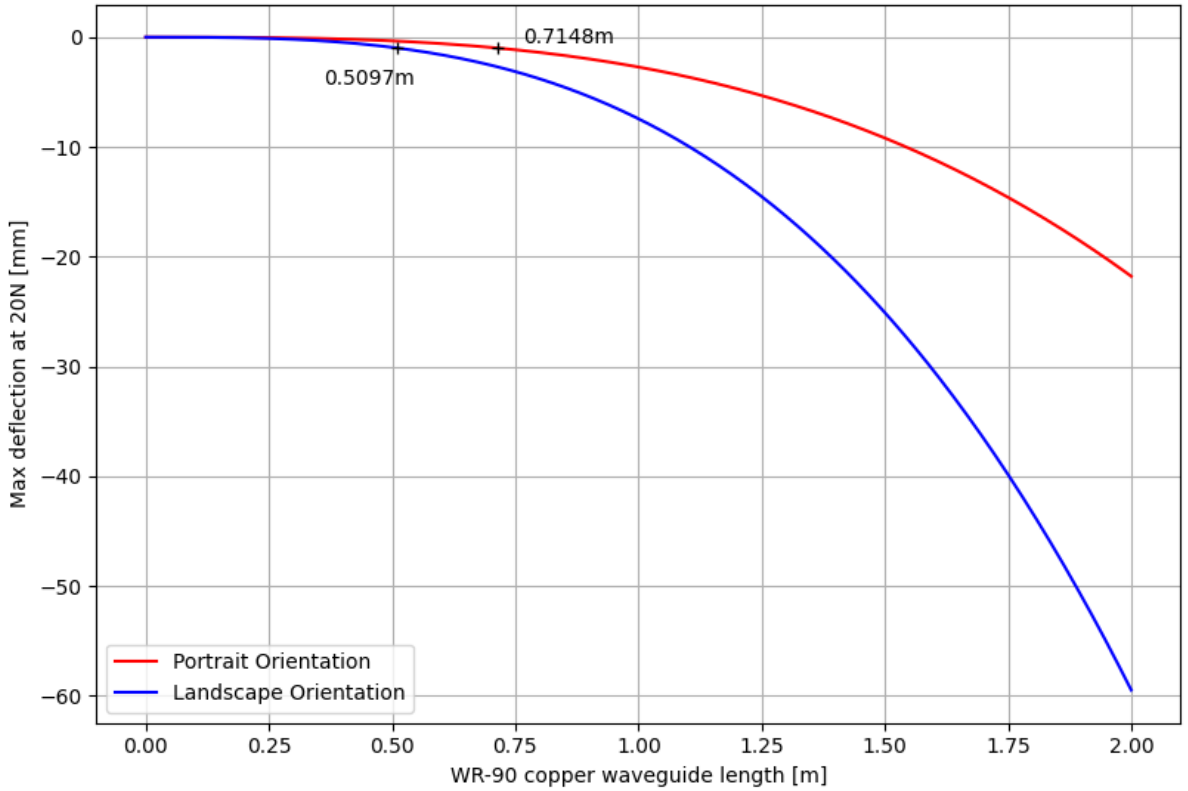


Possible Waveguide Optimisation

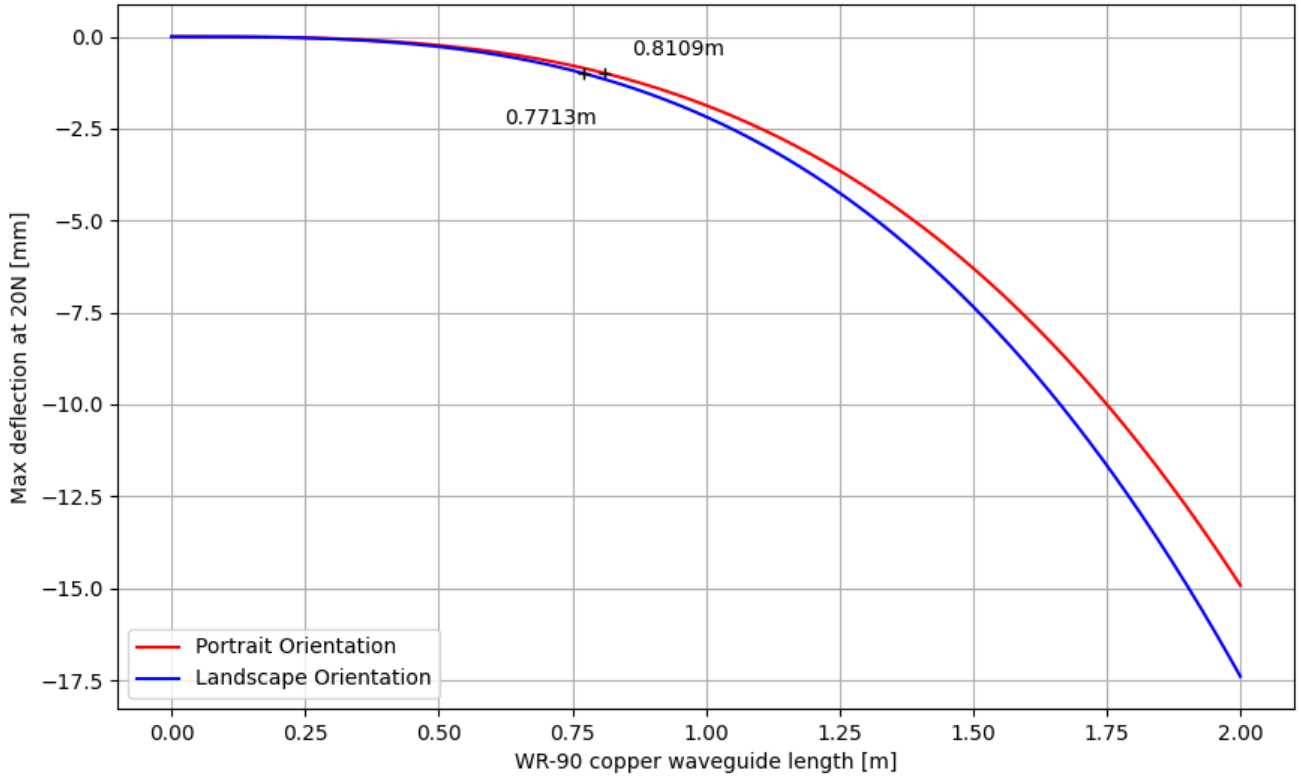
- The original (current) waveguide design:
  - 1.1m length
  - 4 right angle corners
  - 20N reaction force after:
    - ±0.3mm for Single Height
    - ±0.15mm for Double Height
- The much longer waveguide design:
  - 2.2m length
  - 4 right angle corners
  - 20N reaction force after:
    - ±3.0mm for Single Height
- If we decide the required active alignment range, we can determine the length of waveguide required.
- Presumably between 1-2m
    - Relationship is approximately exponential



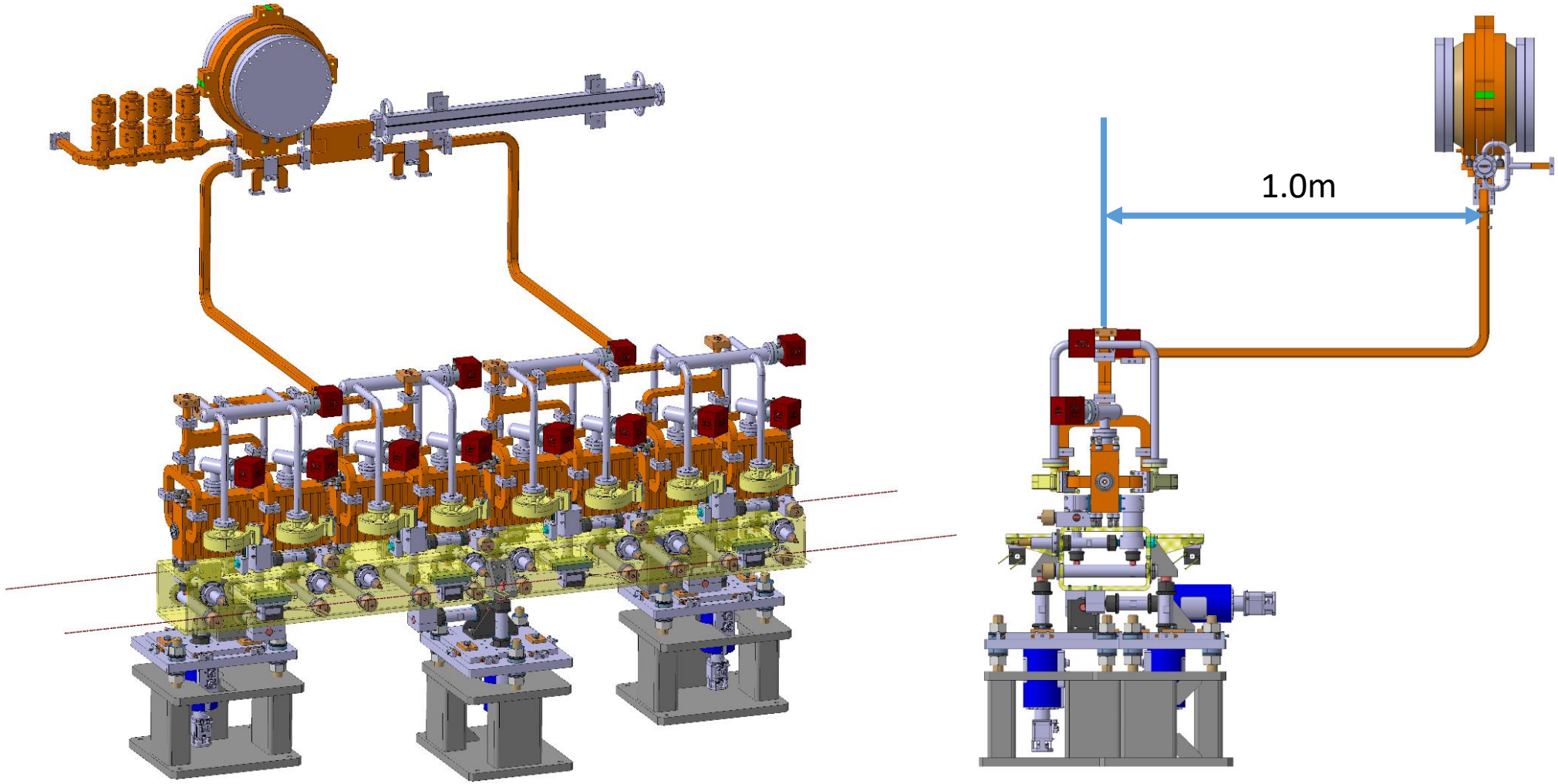
SH WR 90


0.7148m
0.5097m
0
−10
−20
−30
−40
−50
−60
Max deflection at 20N [mm]
Portrait Orientation
Landscape Orientation
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
WR-90 copper waveguide length [m]

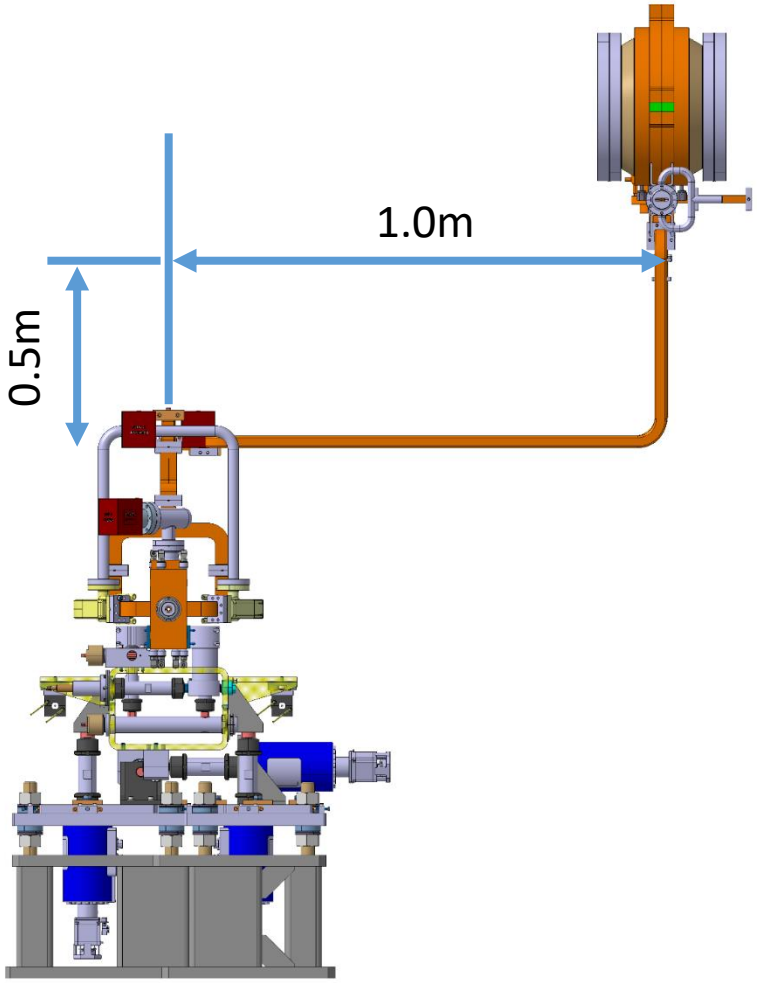
DH WR 90


0.0
−2.5
−5.0
−7.5
−10.0
−12.5
−15.0
−17.5
Max deflection at 20N [mm]
0.8109m
0.7713m
Portrait Orientation
Landscape Orientation
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
WR-90 copper waveguide length [m]

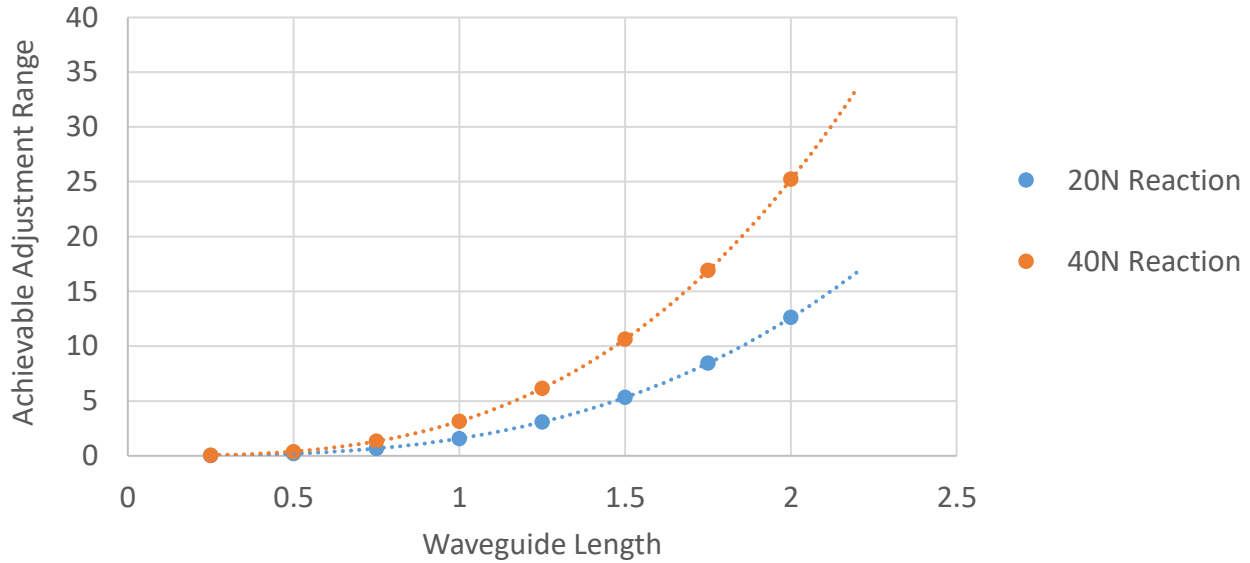
Klystron CLIC Layout



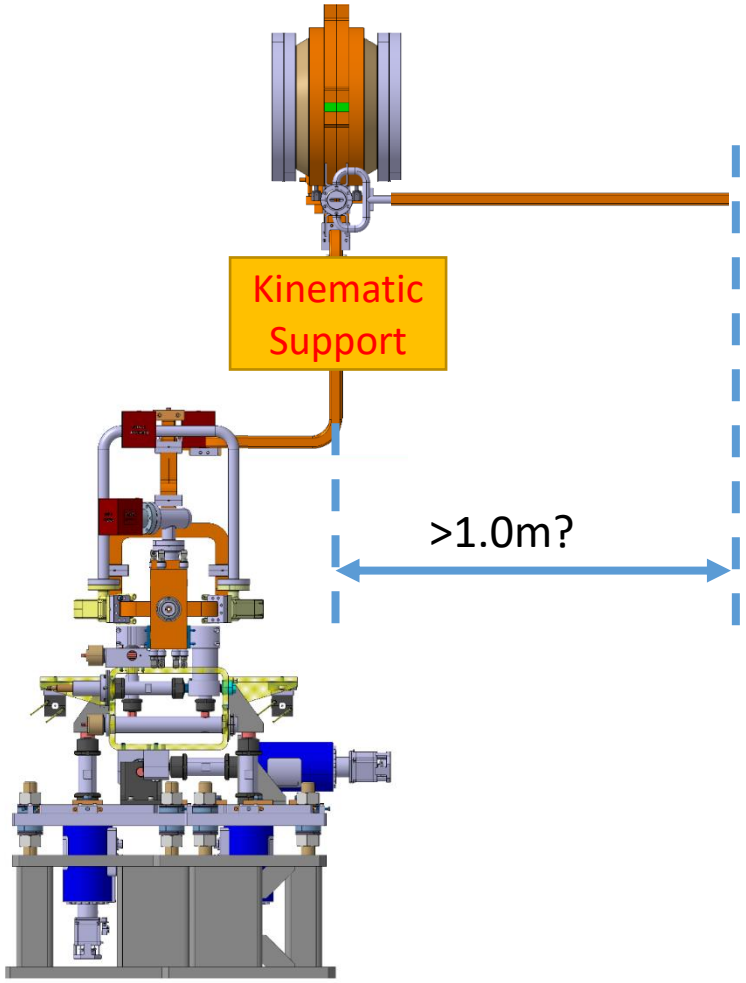
Wall Mounted BOC



- Simple cantilever beam hand calculations
  - Likely a over simplification
- 1m of double height waveguide will bend:
  - 1.58mm at 20N
  - 3.16mm at 40N

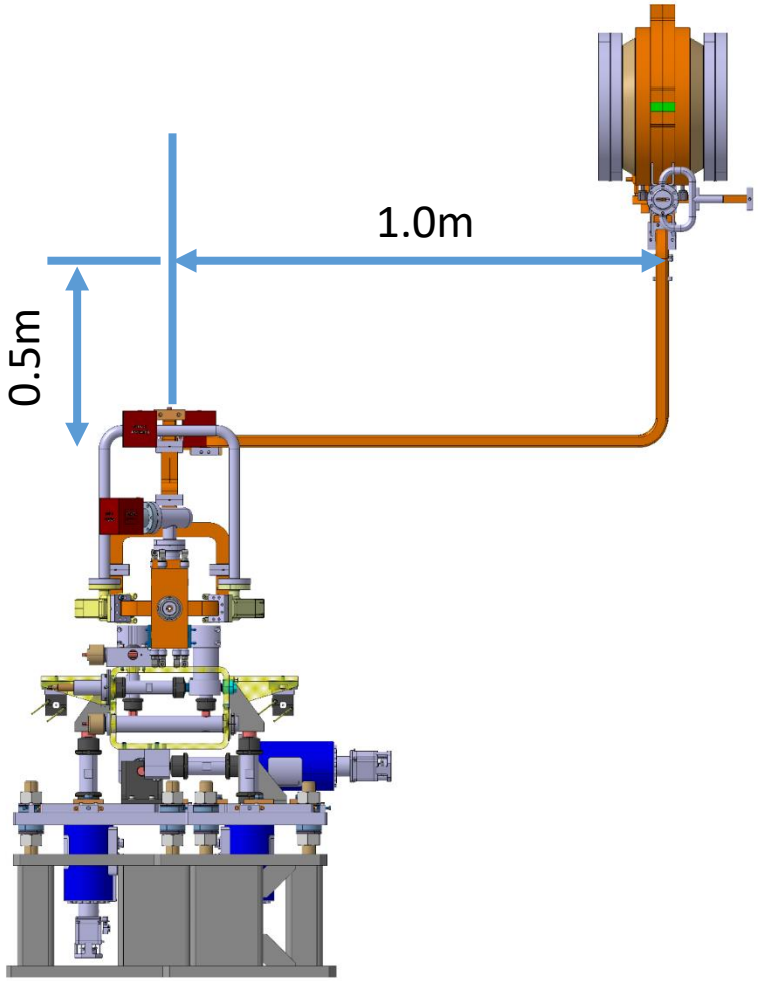


Module Mounted BOC



- The BOC can be mounted on the girder, or more likely mounted on a kinematic support very close to the girder
  - Similar to DEFT
  - The support can accommodate a few millimetres of translation
    - E.g. a flexure based system
- Previous calculations are still valid, if the waveguide is double-height
  - If it is circular, I would need to repeat the calculations
- 1m of double height waveguide will bend:
  - 1.58mm at 20N
  - 3.16mm at 40N
- 2m of double height waveguide will bend:
  - 6.32mm at 20N
  - 12.63mm at 40N

Wall Mounted BOC



- I have done a very quick beam based analysis
  - Predicts 0.21mm compared to 0.29mm hand calculations (z – short)
  - Predicts 5.15mm compared to 4.8mm hand calculations (x – hypotenuse)
  - Predicts 3.34mm compared to 3.16mm hand calculations (y – long)
- Broadly matches the hand calculations