Notes on support table requirements

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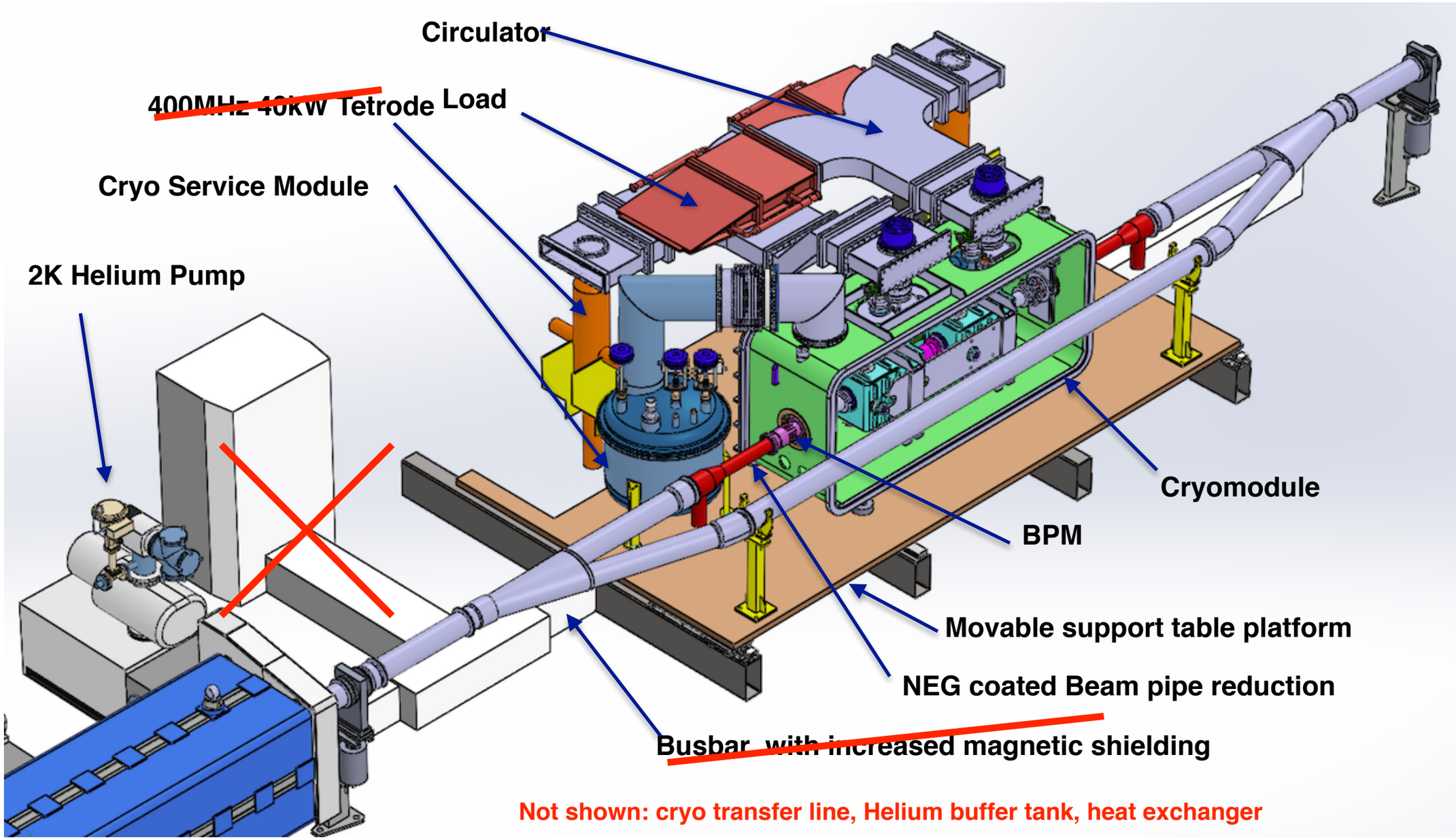
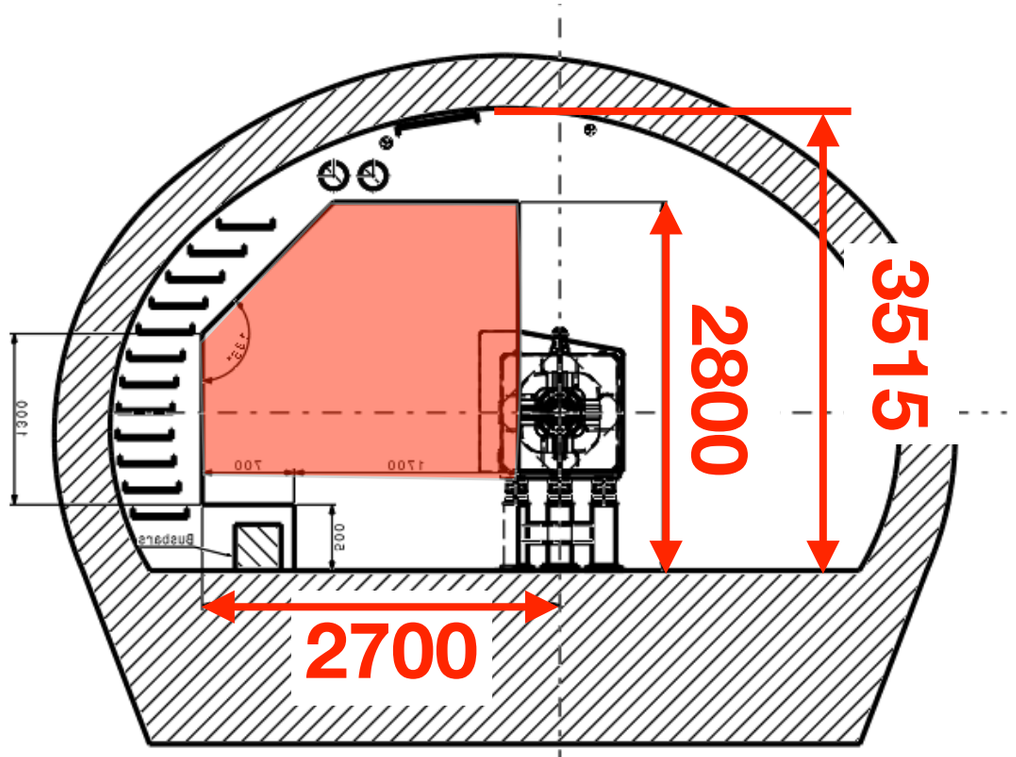
Support table: Conceptual sketch

- **Tetrodes moved of-table: circulator and load can be oriented vertically**
  - Load balancing of table
- **No busbar under table: Simplifies table design**
  - No need for additional magnetic shielding

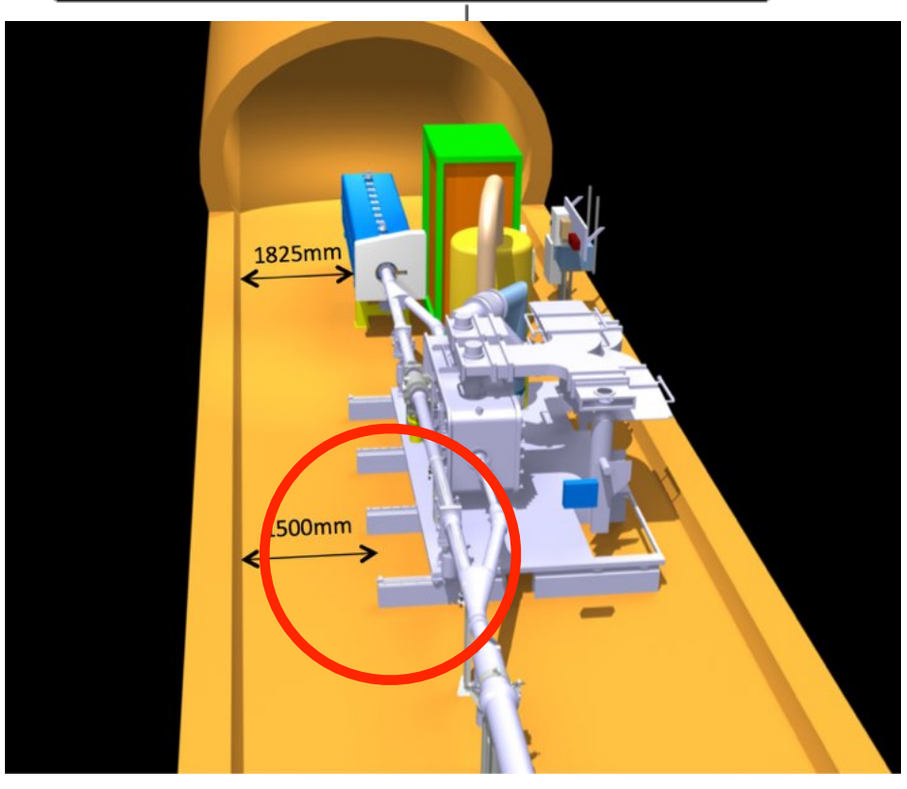


Support table in LSS6

- **Crab location in LSS6 is larger than LSS4, but transport zone is closer**

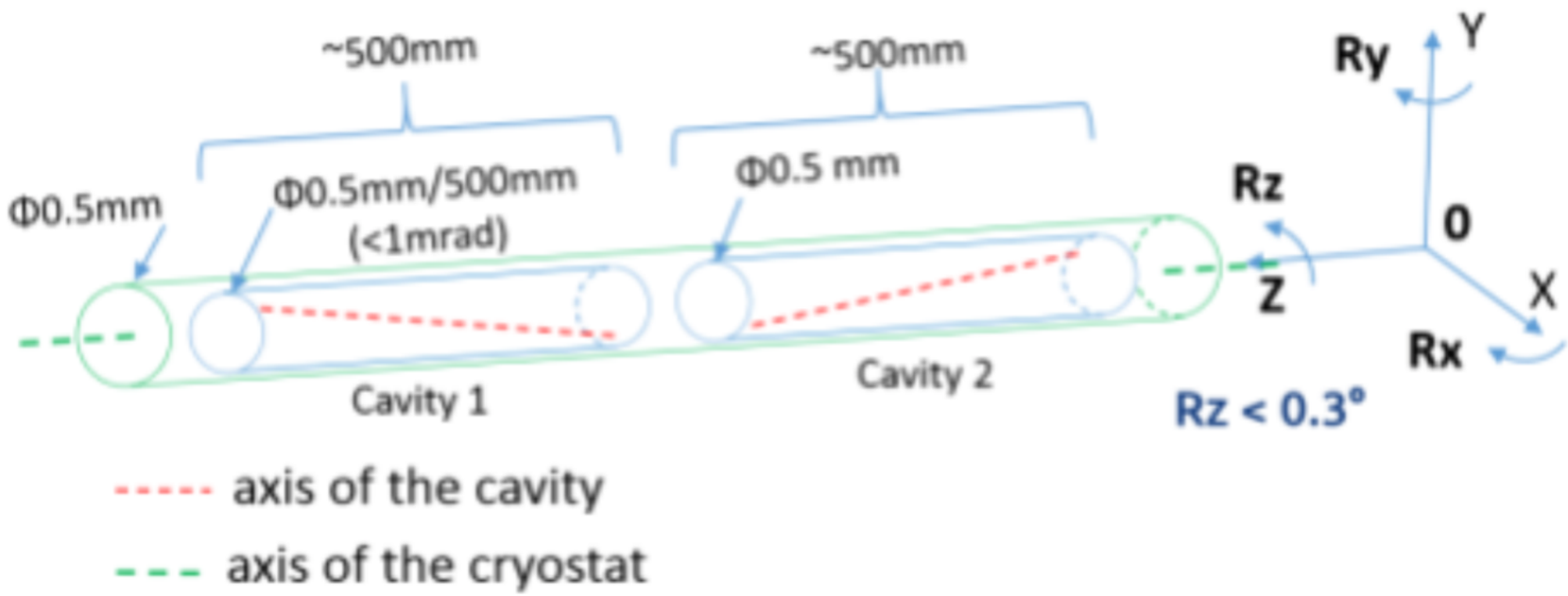


- **Conceptual design now extends into SPS transport lane when CM in-beam position.**
  - **=> FOR SPS access, CM must be in out-of-beam position**
  - **Feet of table must not extend into transport lane**

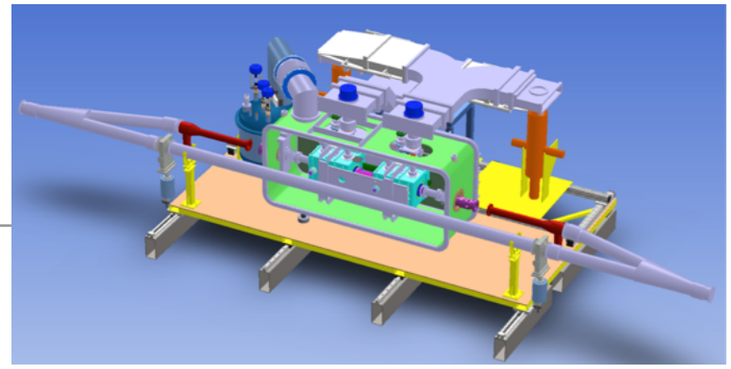


Alignment constraints

- **Alignment Constraints: Assume cavity alignment tolerance transfer to table positioning tolerances**
  - From constraints on the cavity in the CM
    - **Cavity Roll:** rotation in the X-Y plane has to be < 0.3° (3σ) per cavity;
    - **Cavity Yaw** (around y-axis) and **Pitch** (around x-axis) with respect to the cryostat axis should be less than 1 mrad (3 σ),
    - **Transverse displacement of cavities w.r.t each other** inside a cryostat: intra-cavity alignment in the transverse plane with respect to the cryostat axis should not exceed the 0.5 mm (3 σ) tolerance set by the multipolar effects.



Points to note



- **Table must cycle in-out of beam:**
  - This must be done remotely, and mechanism must withstand >1000 cycles
- **Table vertical height fixed: CM height set at installation**
  - CM team axis aligned to expected SPS beam axis
- **Table only to move in horizontal plane**
  - Nominal movement is transverse movement perpendicular to beam axis
    - Drive system must be able to correct for yaw misalignment wrt beam
- **RF Power can support up to a 2mm offset of beam wrt cavity axis.**
  - Should foresee table positioning of user specified offset
- **Table must support/fix ‘prongs’ of Y-chamber.**
  - Also pumping group + bypass line, and BPM
- **Cryo flexible line & power coax must absorb transverse movement without placing excess stress on CM connections or table drive system**
  - Needs input for flexible lines in terms of mechanics and reliability
- **Support of circulators and loads have to be designed.**
  - Can circulators be mounted vertically on table?

Moving into the beam

- **Position Table wrt to beam line**
- **Installation of cryomodule:**
  - Transfer position accuracy of fiduciary marks from CM to table.
    - Ensures CM in-beam position understood in terms of table movement
- **Nominal transverse movement = 510 mm with no vertical change**
  - Home position is the out-of-beam position
- **Movement into beam line**
  - Movement of table must be done remotely =. control and monitor system
  - Duration of movement less than 20 minutes (1/2 LHC ramp down time)
  - Acceleration should not exceed 0.2 g
  - Once beam is injected, beam based alignment can be done
    - Target: cavities' axis is aligned to within 1 σ (0.7 mm) of the beam axis.
    - Cryomodule position may imply correction due to longterm orbit drift
      - SPS orbit drift for coasting beams: up to 6mm

Constraints

- **Load Constraint: Estimated Static load = 500kg**

Object	Mass (kg)	Number	Total Mass (kg)
Cryomodule	3000	1	3000
Cryoservice	500	1	500
Tetrode	250	2	500
RF Load	100	2	200
RF Circulator	604	2	1208
			5408

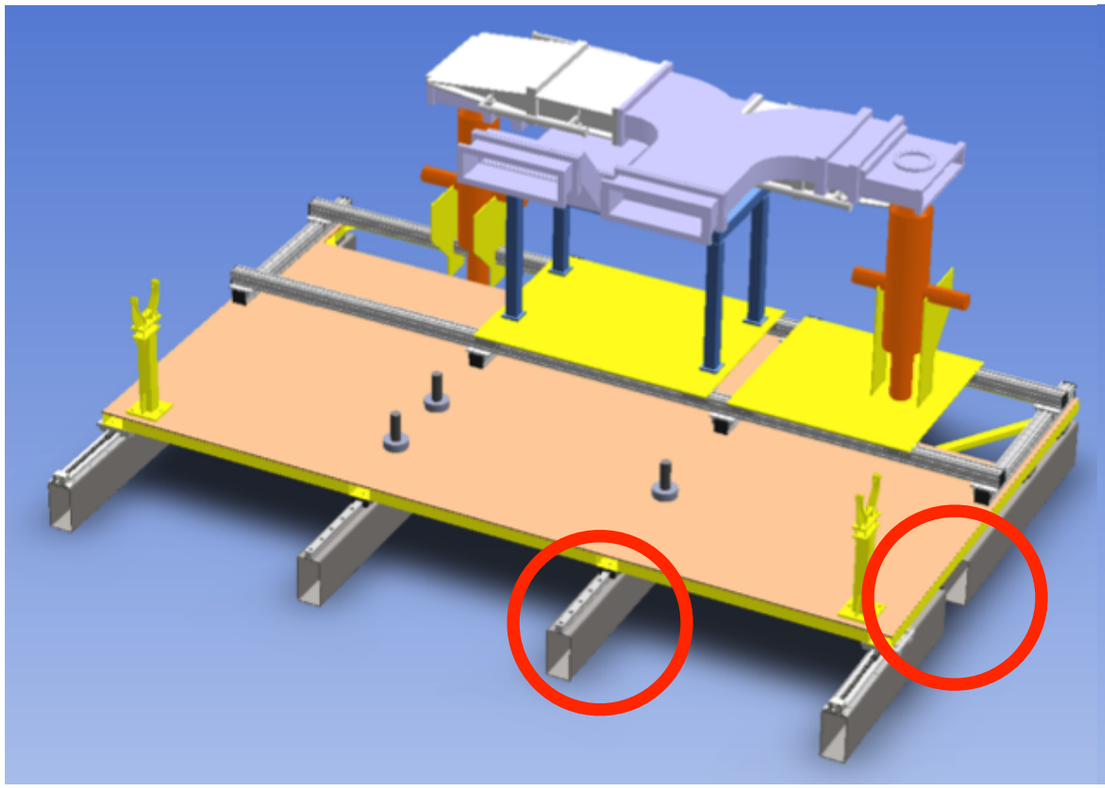
  - Tetrodes now not mounted on the table

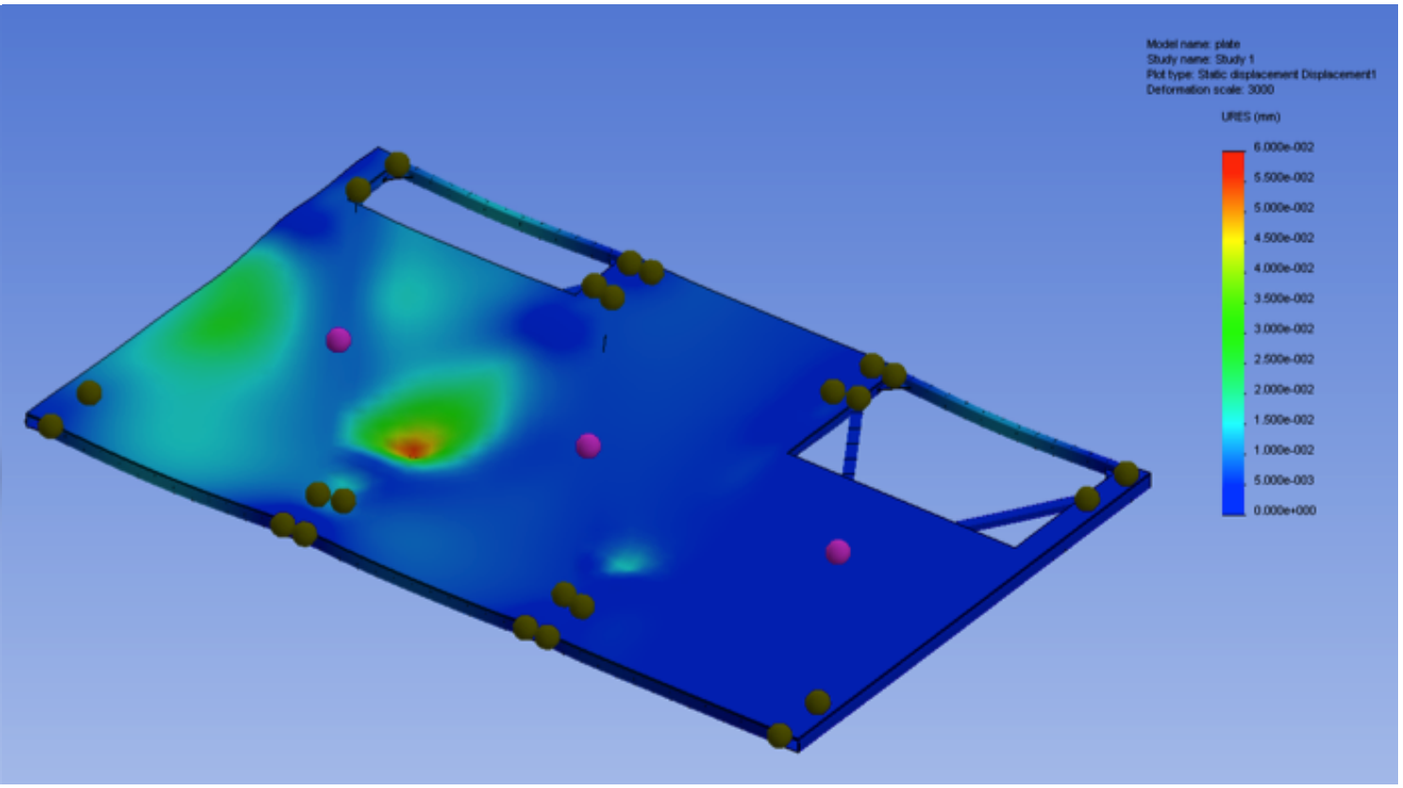
- **Positional constraints**
  - Requirements on positioning the CM wrt to its out-of-beam home position

Description	Amount
Transverse movement range (x)	550 mm
Vertical movement range (y)	50 mm
Positioning accuracy	±500 μm
Horizontal precision	±100 μm
Vertical precision	±100 μm
Flatness resolution	±330 μrad

Conceptual Design

- **Conceptual design studied and simulated with FEA**
  - Eight steel rectangular sections are used to support the transfer table.
  - Table drive system: a ball screw on the two outermost supports
  - Guide rails on other supports: greater support + reduce stress on screws.
  - Supports are directly underneath cryomodule feet
  - Steel frame structure + steel plate used to provide table rigidity.





- Now: No busbar under the table => design can be simplified
- Feet cannot project into transport lane => new conceptual design needed