19-10P-346
CRUSSADER

Clean Space Days
21.09.2021

Almatech & CSEM

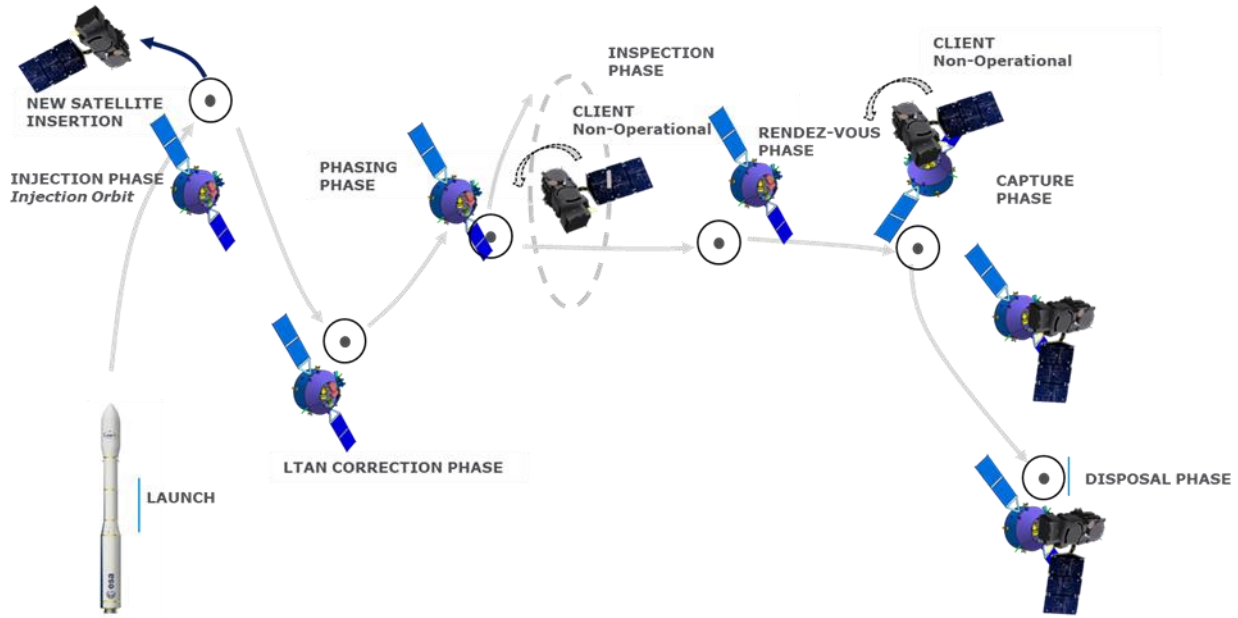
Webex, September 21th, 2021

Outline

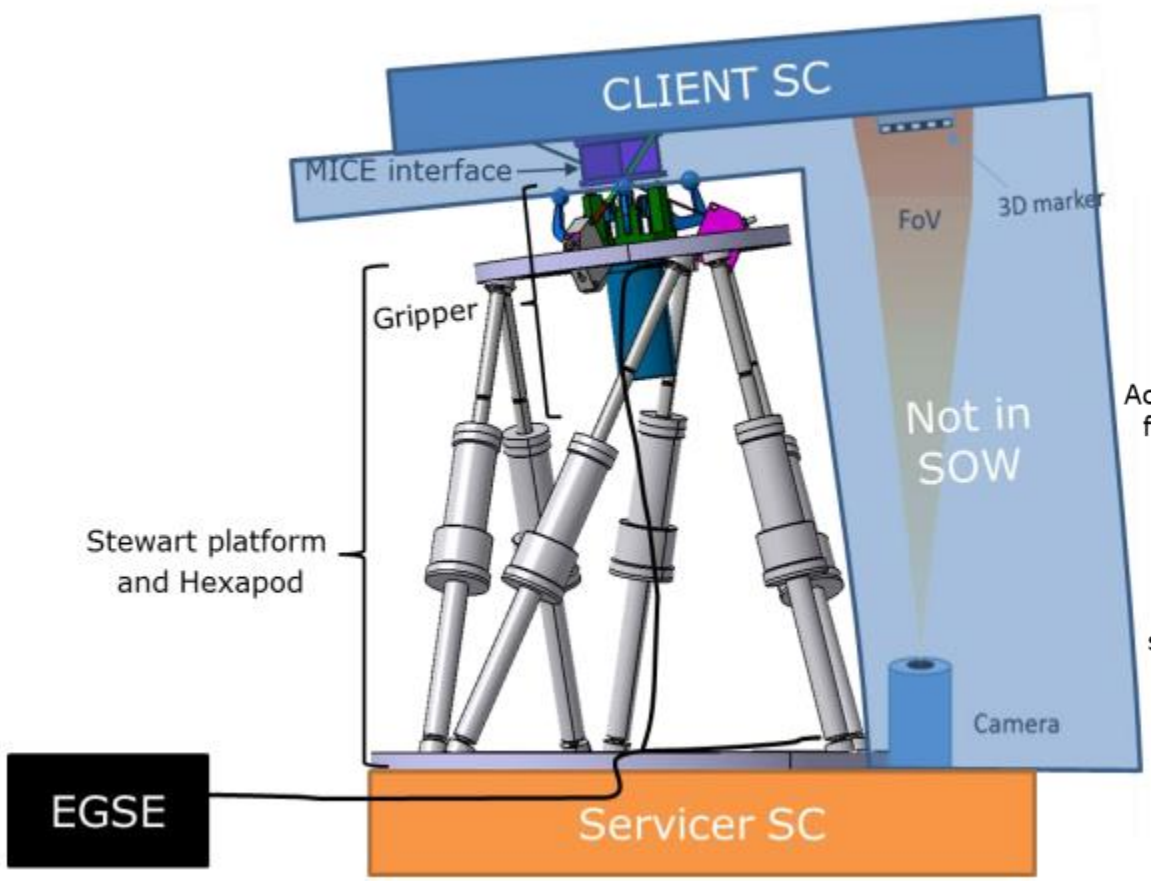
1. Concept of Mission
2. CRUSSADER baseline design concept
3. Main technical challenges
   - GNC Misalignment error
   - Volume of incursion
   - Errors corrections with Fine sensing
   - ESD discharge
4. Next steps

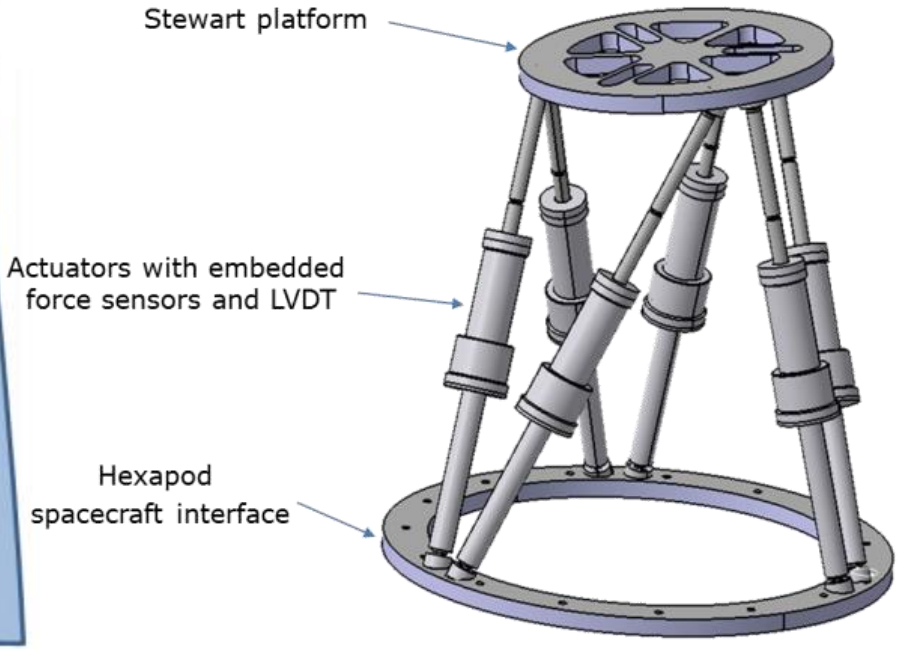
Concept of mission

- CRUSSUADER system will be able to catch Earth observation satellites up to 2 tons and equipped with a standardized interface “MICE”.
- Objective:
  - Catch and deorbit old spacecraft which are in an uncooperative state for replacing them with new ones which will take the same orbit.

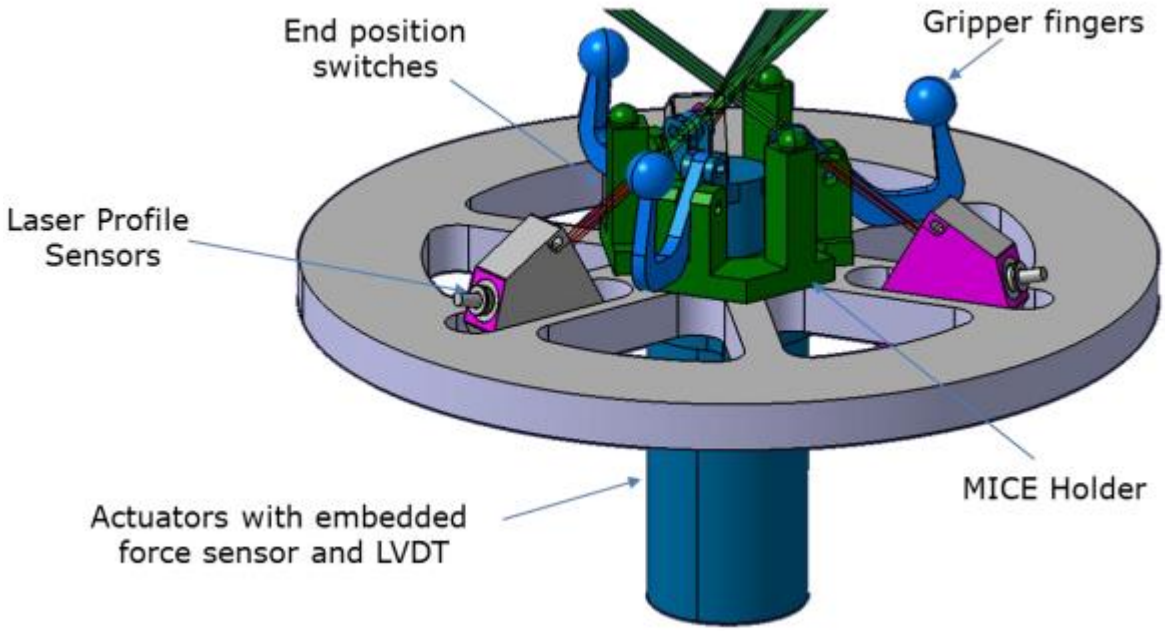


Crussader baseline design concept (1/2)





Crussader baseline design concept (2/2)



Concept design highlights:

- Use of the same actuator architecture as in hexapod
- Embedded LVDT sensors allow to retrieve exact opening status of the gripper
- End position switches allow to confirm closed and open final positions of gripper for hard capture and release phase

Main technical challenges
Misalignment due to GNC relative errors

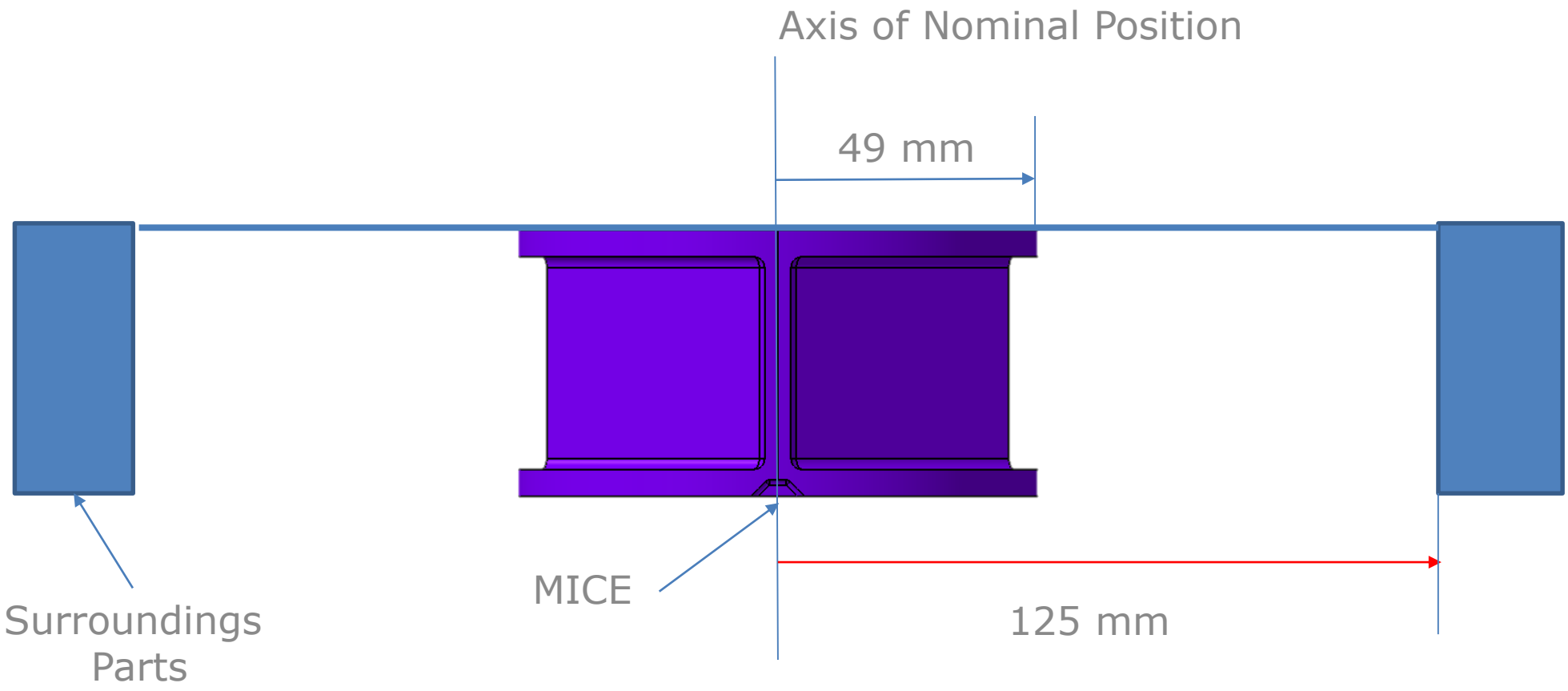
- Errors have to be intended as relative position and attitude errors between servicer and client spacecraft

- Static errors defines the insertion volume of the gripper to be sure to avoid any clash with MICE and surroundings.

- Static errors and Rate errors define the minimal performance of the robotic hexapod

	Maximum Absolute ERROR
Attitude	3 deg
Attitude rate	0.25 deg/s
Position (mm)	20 mm
Position rate (mm/s)	5 mm/s

Main technical challenges
Insertion volume of the gripper



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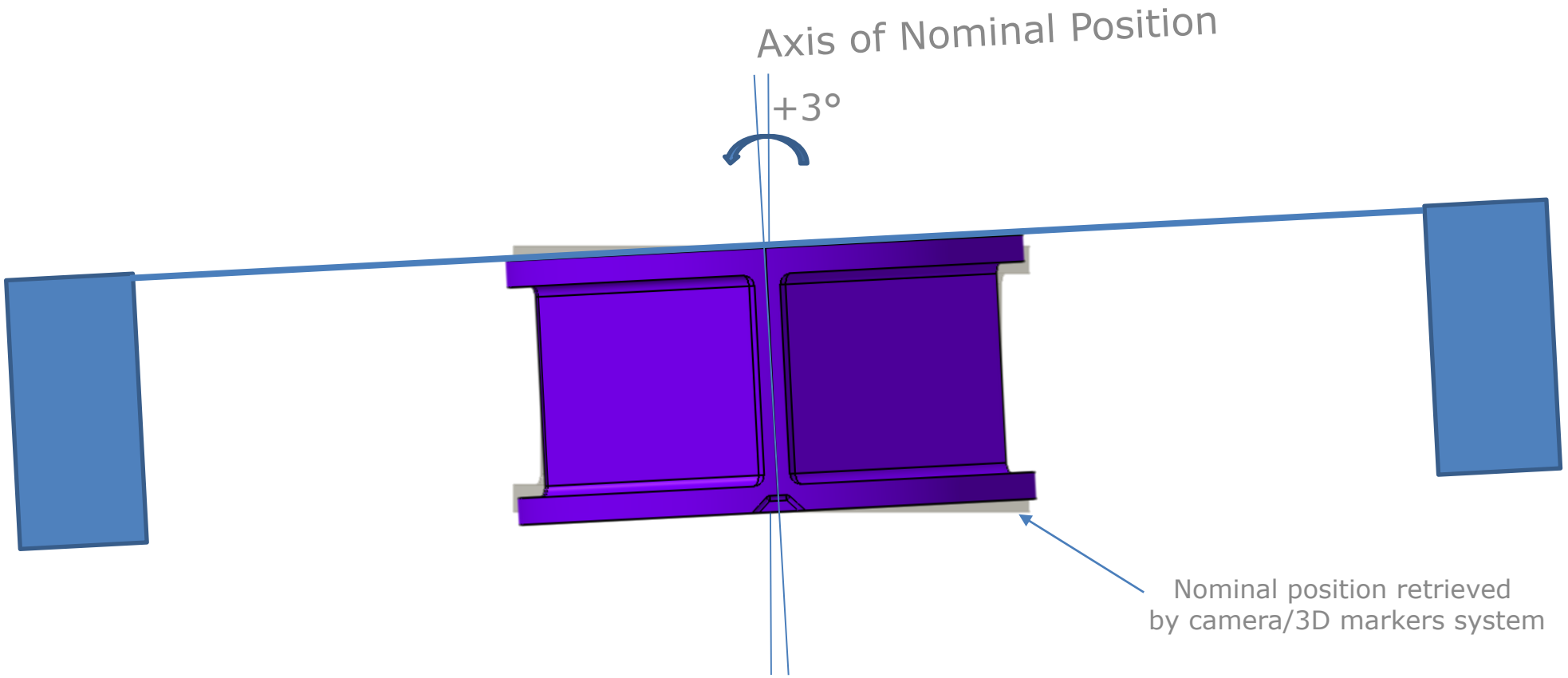

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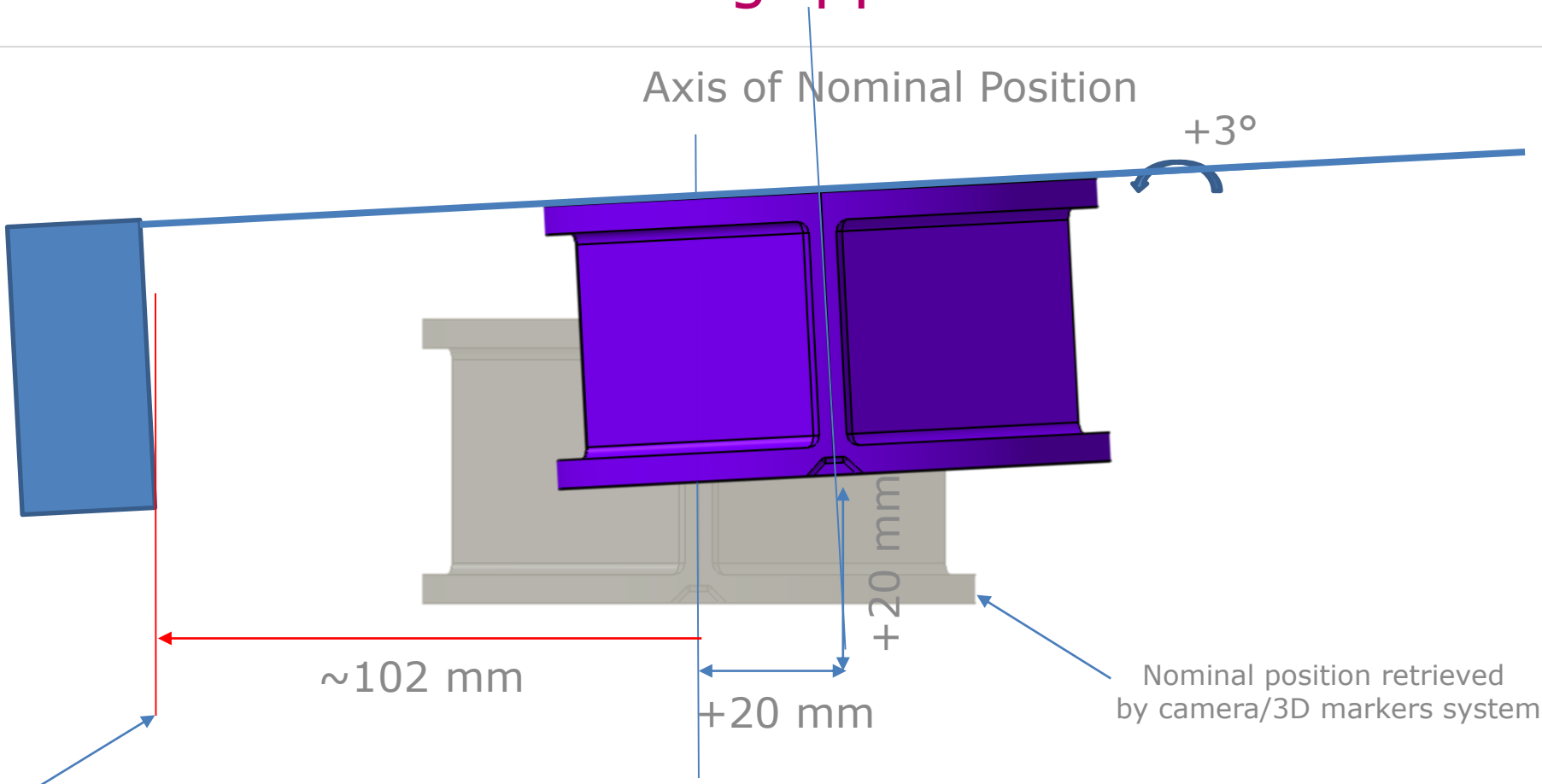
Insertion volume of the gripper



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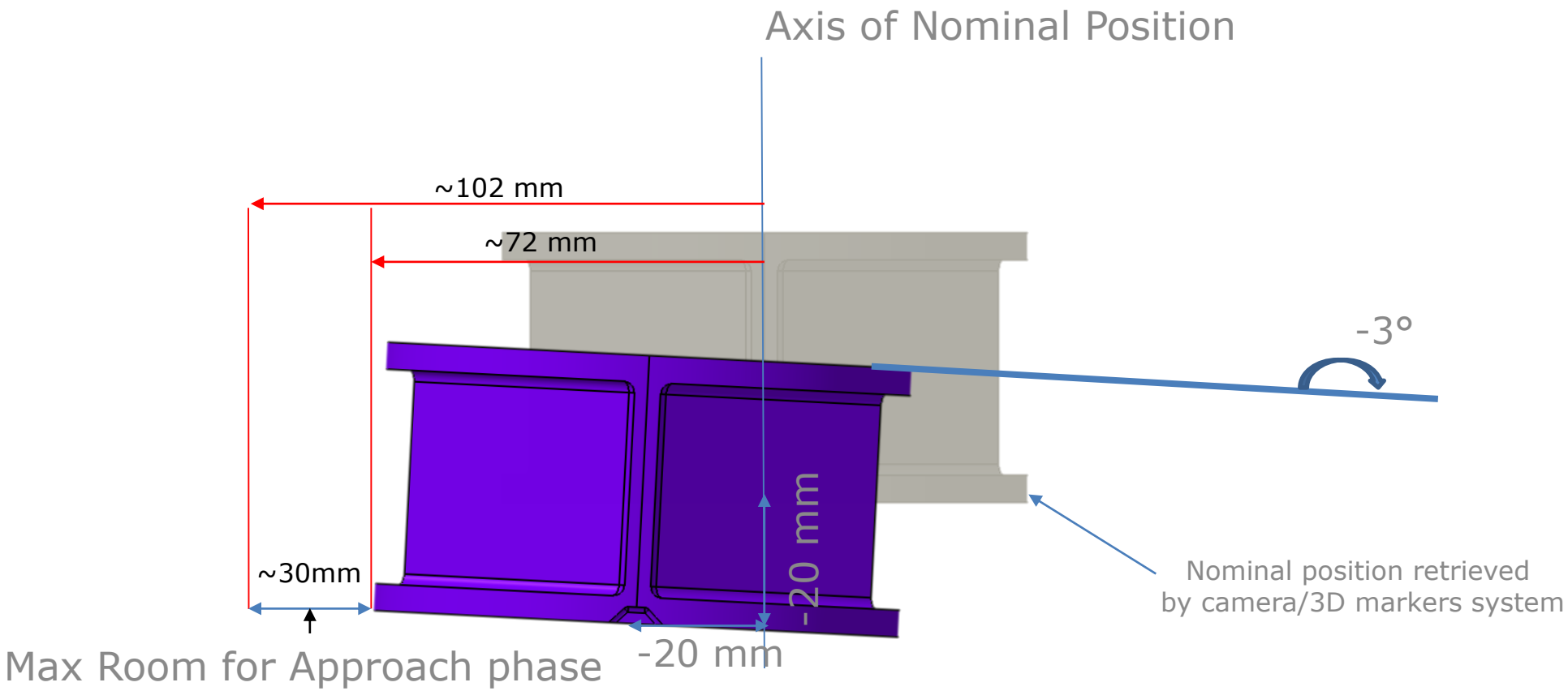

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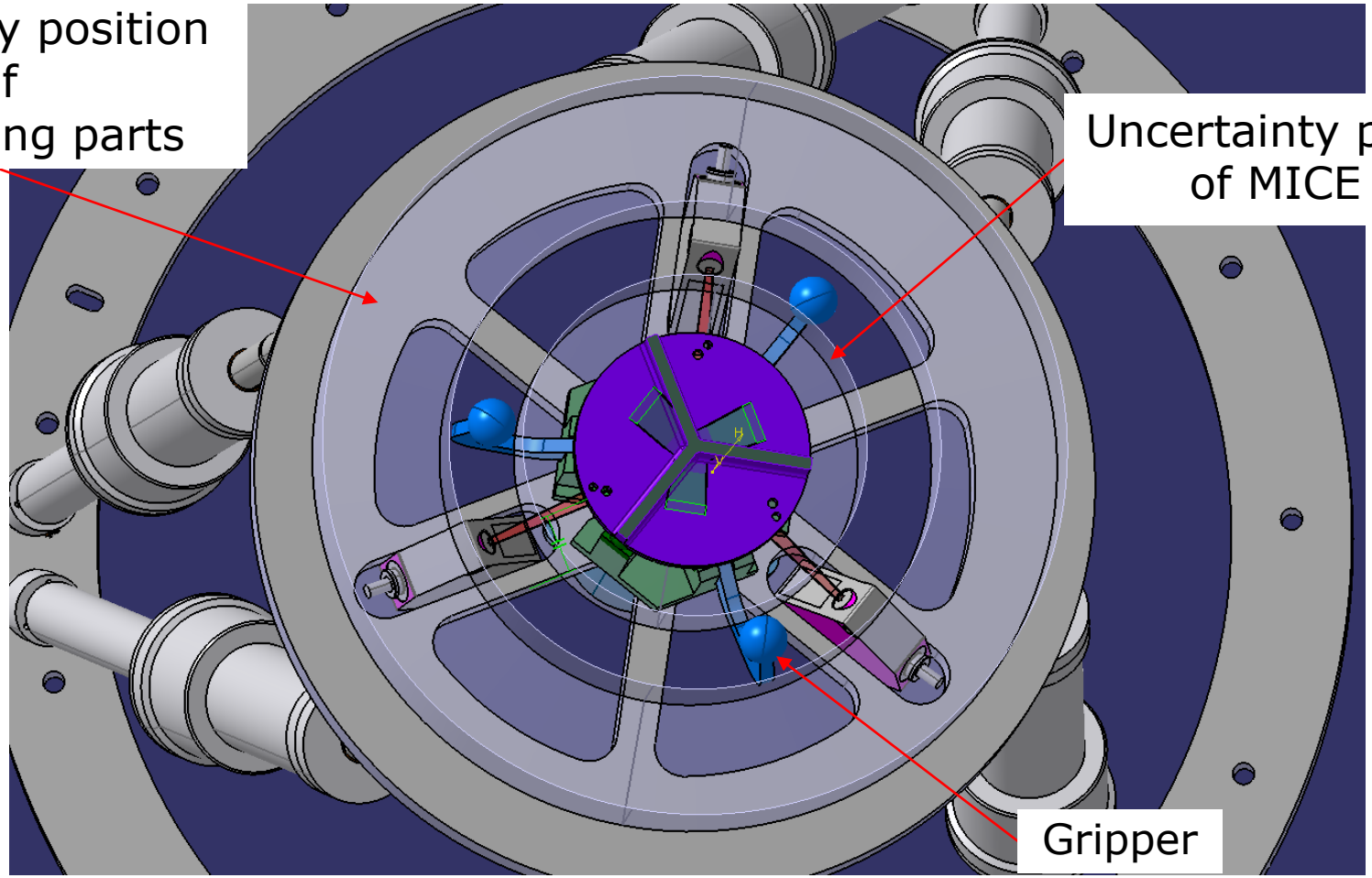

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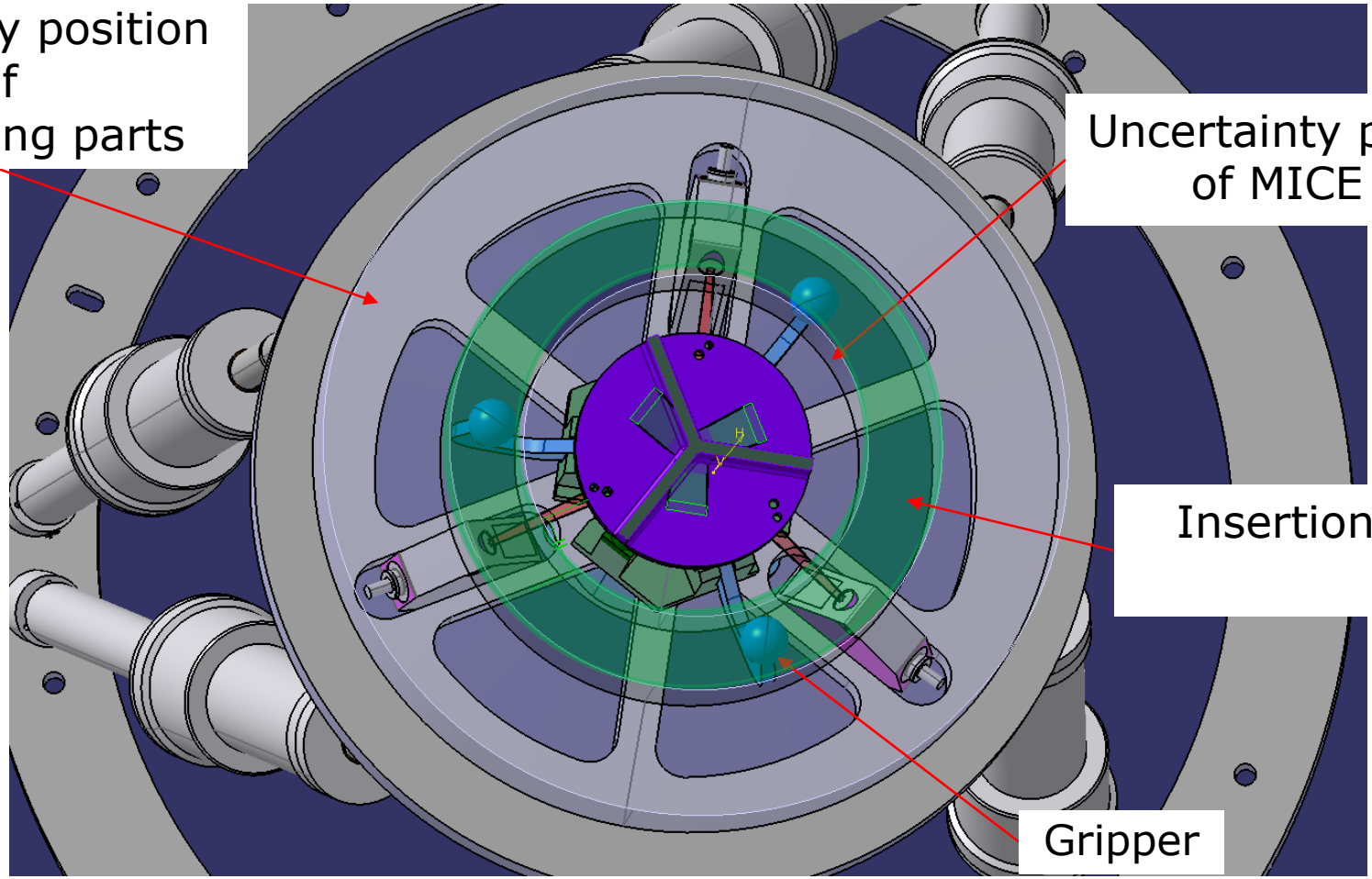
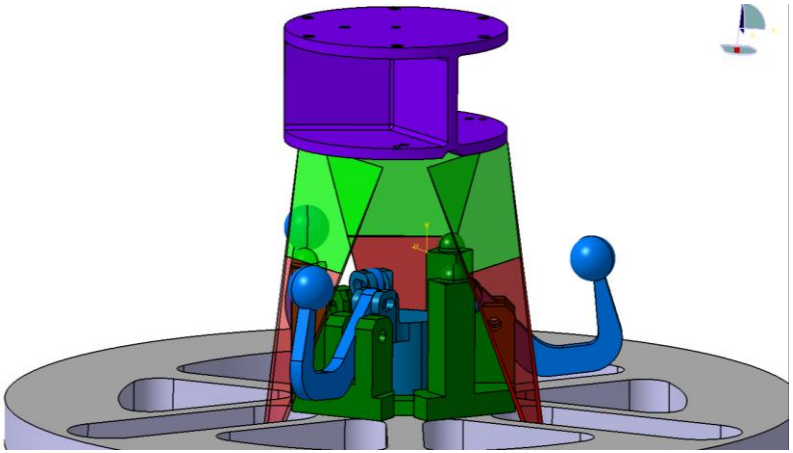
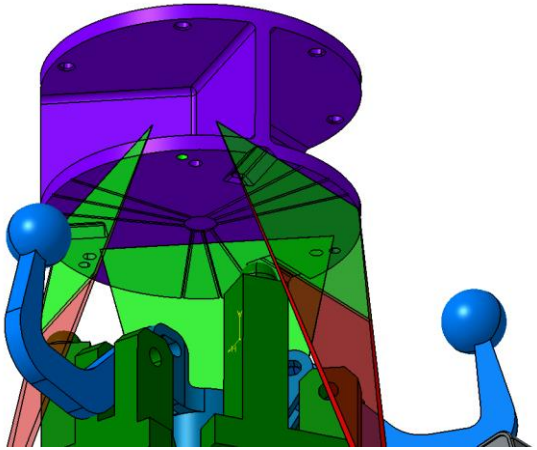


Main technical challenges
Error corrections with fine sensing

- Advantage of laser fine sensing
  - Sensing can be performed far away with high precision
  - Reduction of the loads at level of the end effector and hexpod
  - With small features on the MICE (like grooves), 2 lasers profilometer are enough to know the 6 degrees of freedom
- Drawback
  - Sensors not space qualified





Main technical challenges
ESD discharge

- Difference of electrical potential between servicer and client spacecraft could induce ESD discharge up to 11keV at first contact.
  - Dedicated path for electrical discharge in the CRUSSADER design
  - Finger extremities of the gripper electrically decoupled from motors and electronics sensitive parts.

Next steps

- Make Preliminary design of the CRUSSADER
  - End effector gripper preliminary design
  - Robotic Hexapod preliminary design
- Derisking activities on laser sensors
  - Functional tests in vacuum

Thank you or your Attention !