

## Abstract

Since access in Ignitor is through the limited width of the equatorial ports, the use of remote handling (RH) technology for any in-vessel intervention is required, even before the vessel becomes activated. In particular, the first wall of Ignitor, which is made of TZM (Molybdenum) tiles mounted on Inconel tile-carriers covering the entire plasma chamber, has been designed to be installed and replaced entirely by the RH system. The presence of radiation screens inside the cryostat and around the ports ensure a sufficiently low level of activation around the machine to avoid the need of ex-vessel RH techniques. The in-vessel RH system is based on two transporters carrying an articulated boom with end-effectors, supported by a movable structure over a transport system that can be lifted and set in position adjacent to two opposite horizontal ports. The design of the in-vessel RH system, of the boom and its enclosure, and of the most significant end-effectors (welding and cutting tools, and tools for the removal and handling of tile carriers) has been completed. A series of other dedicated tools for installation and maintenances of diagnostics components, of the RF antennas, vacuum cleaners, tools for general inspection and metrology are included in the design.

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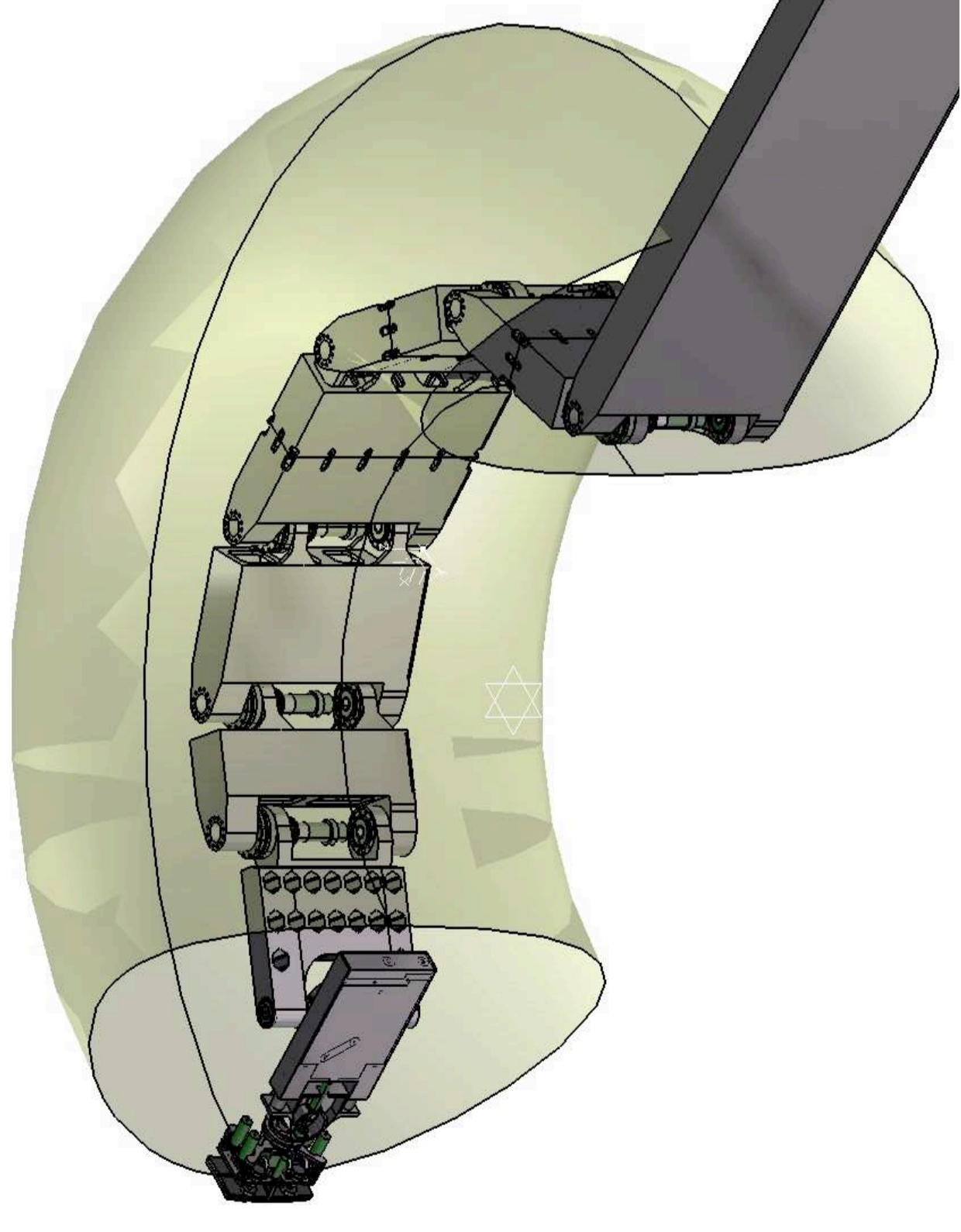


Figure 1. - Fully extended boom inside the PC.

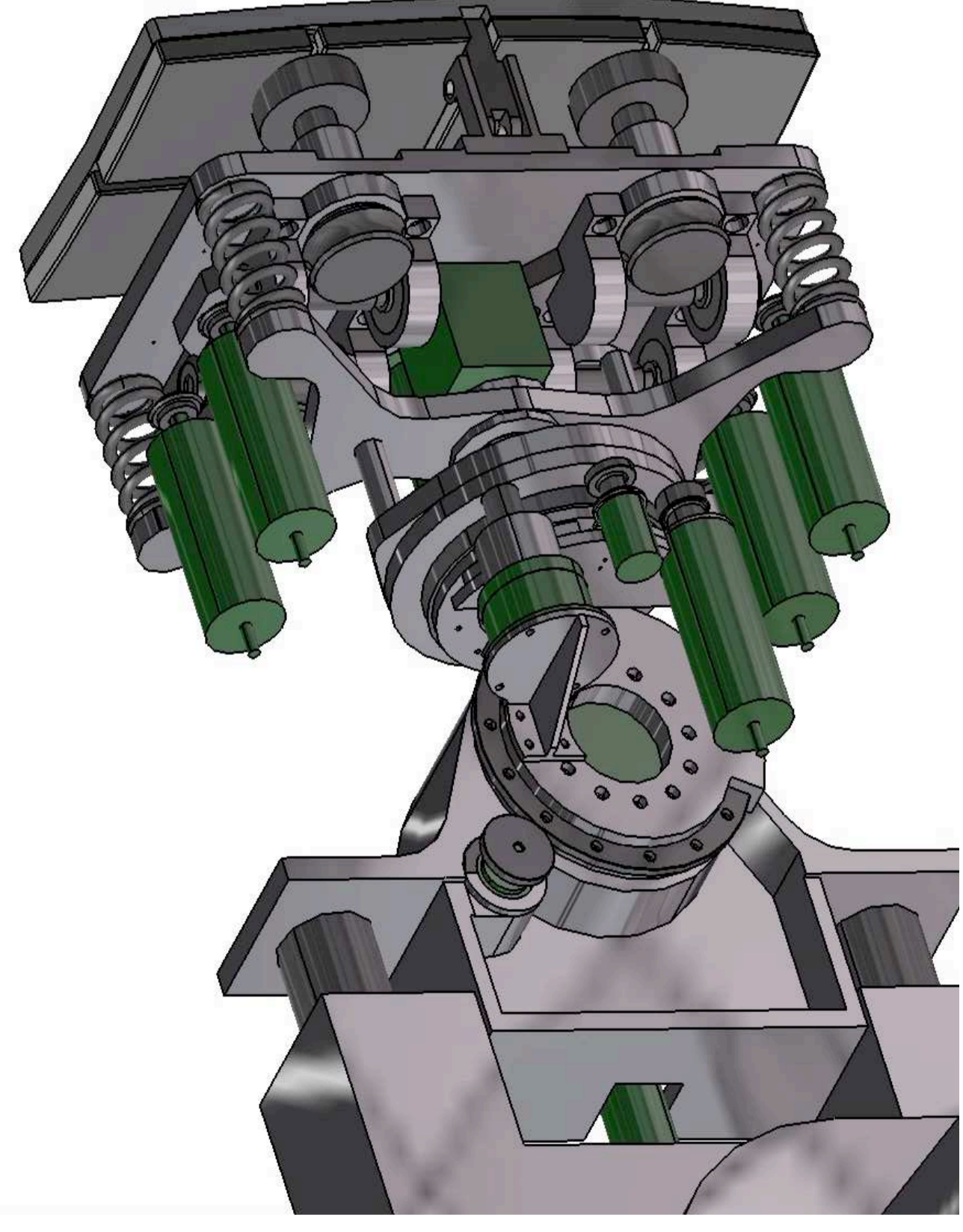


Figure 2. - End effector for tile carrier.

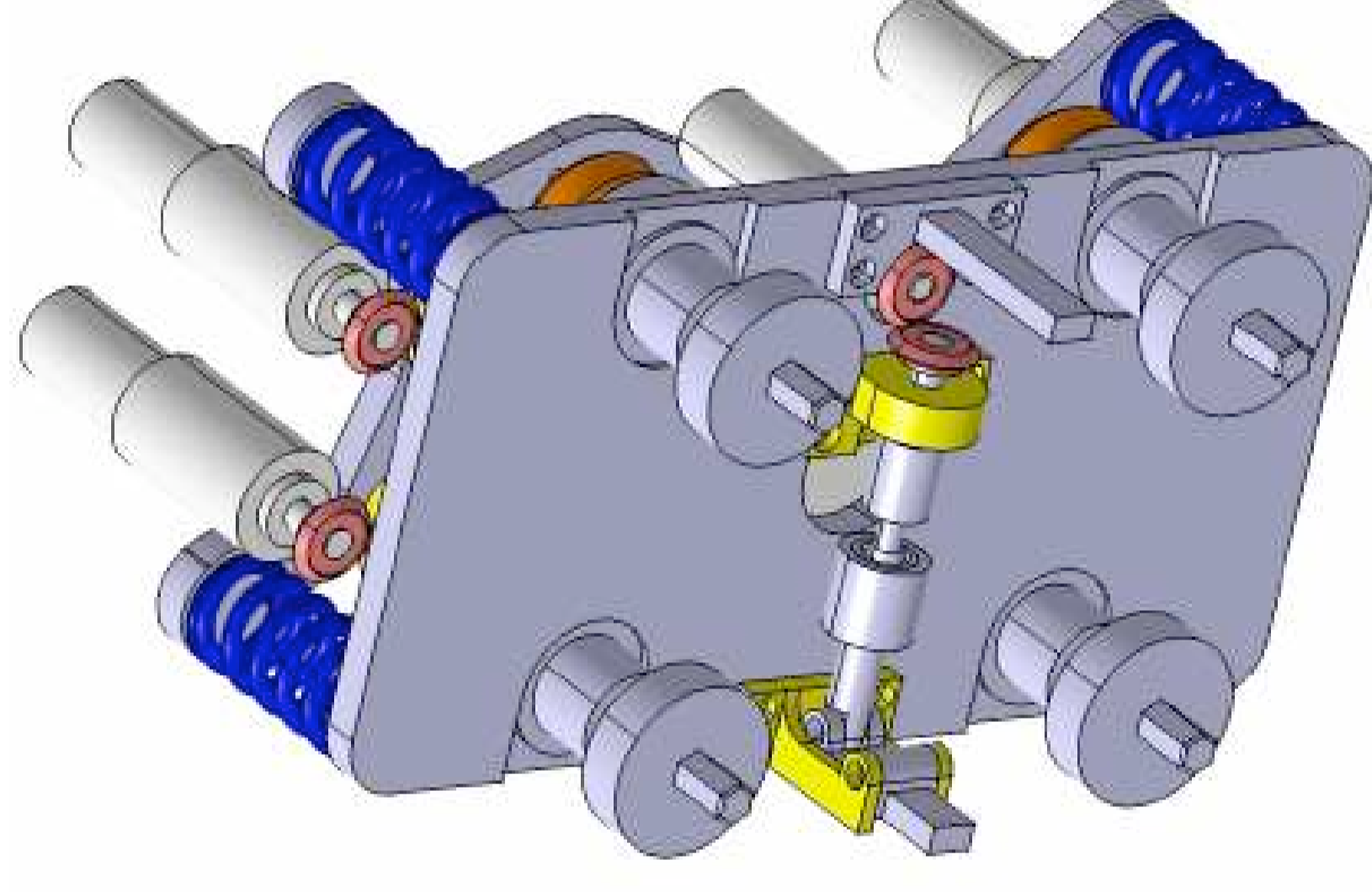


Figure 3. - Detail of coupling for the tile carrier End effector

## Remote Handling System

The in-vessel RHS is based on two Transporters made up of an articulated boom with end-effectors (Fig. 1), a support structure and a transport system. The transporters are supported by a movable support structure, which can be lifted and set in position adjacent to the working horizontal ports. The structure is set level and rigidly docked to the machine structure. Two opposite ports will be made available for RH interventions. The support structure has two different platforms; one is used to receive the sealed and shielded casks of the components removed from the vessel and the other for trays carrying the new item to be introduced. The casks are enclosed in a container in order to allow, if necessary, uncontaminated transport inside the hot cell when first wall maintenance is needed.

The transporter is provided with two TV cameras plus one optical fibre in order to inspect the wall details. Lightening will be provided through the vertical ports.

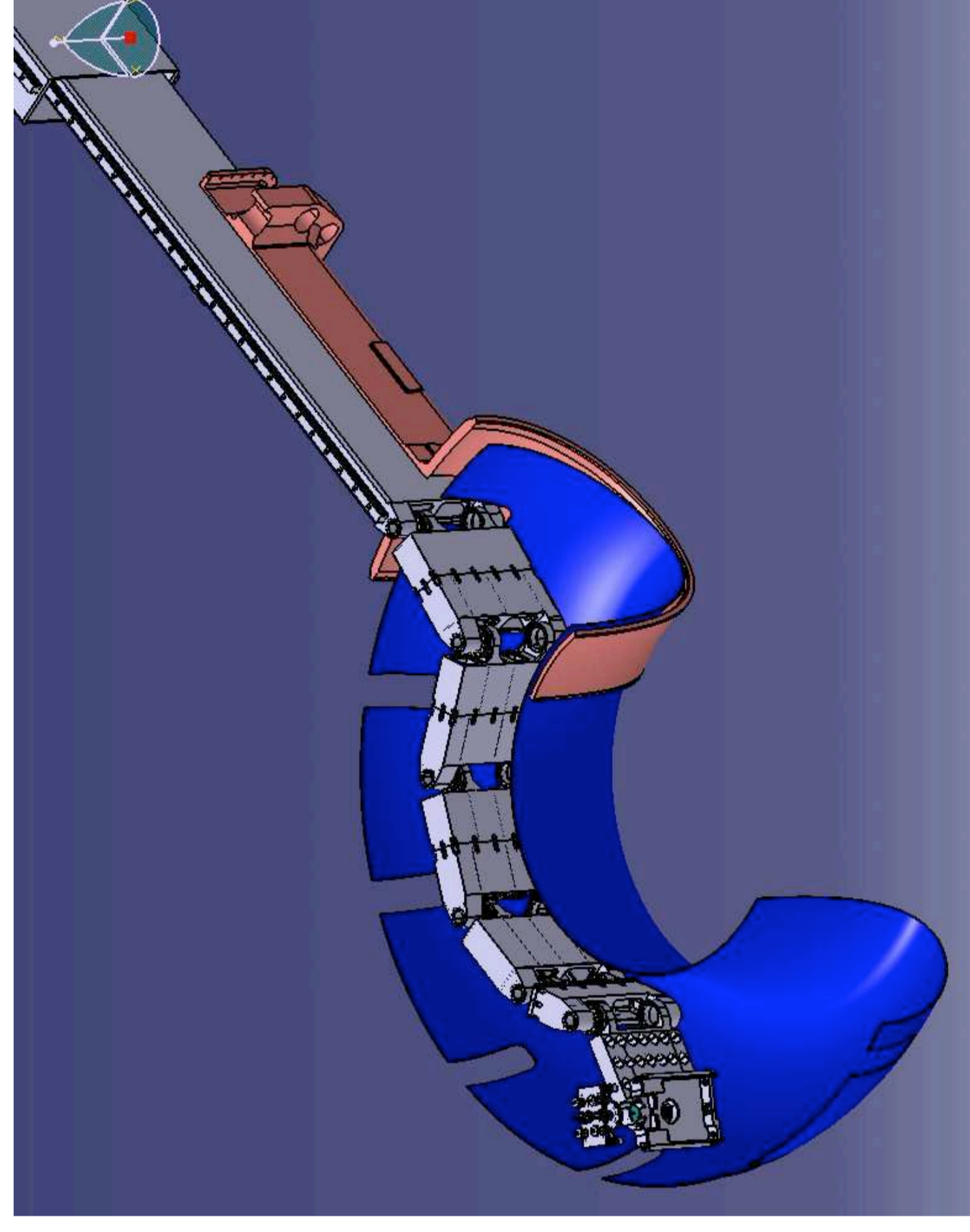
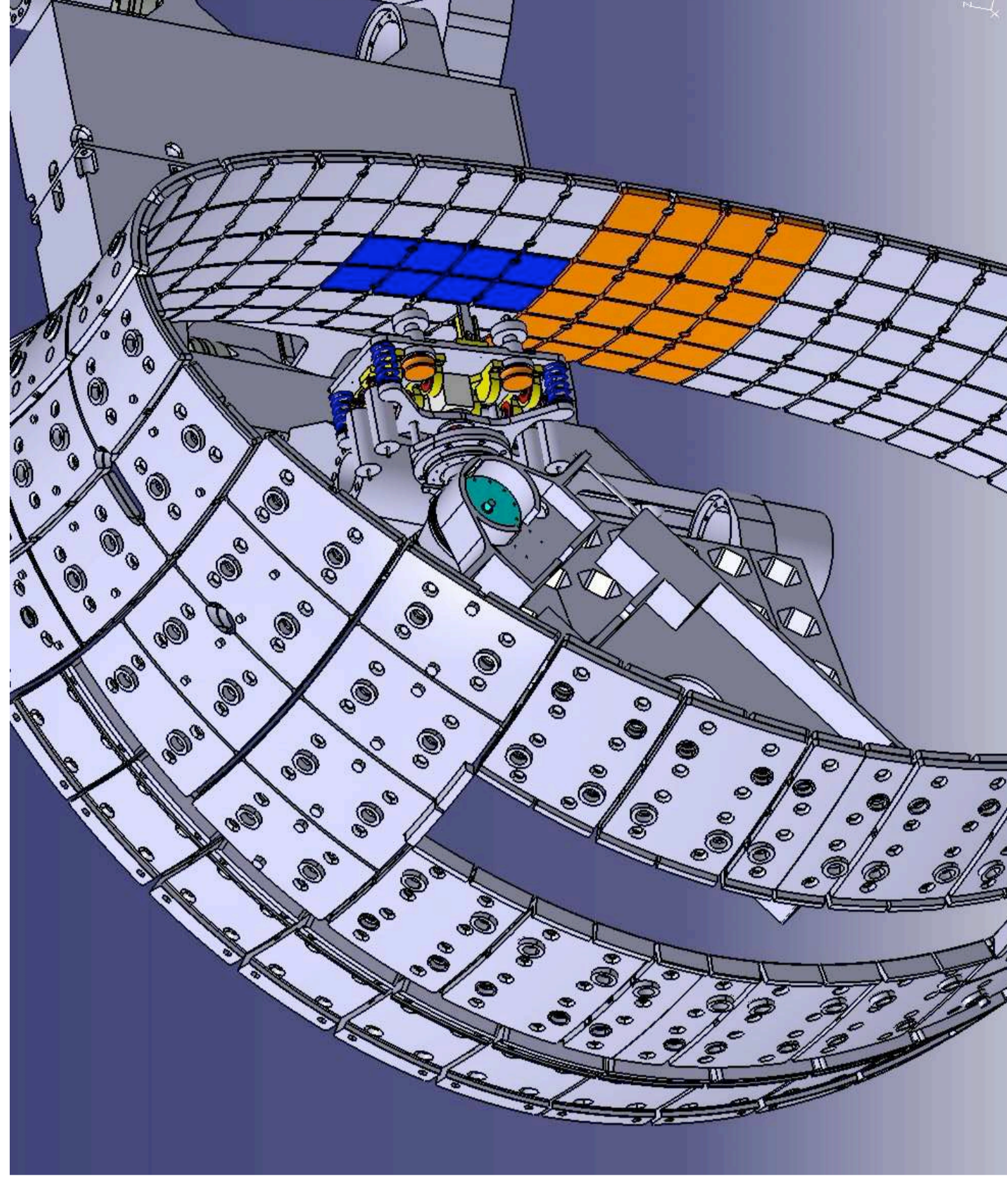


Figure 4. - The fully extended boom in operation inside the PC.

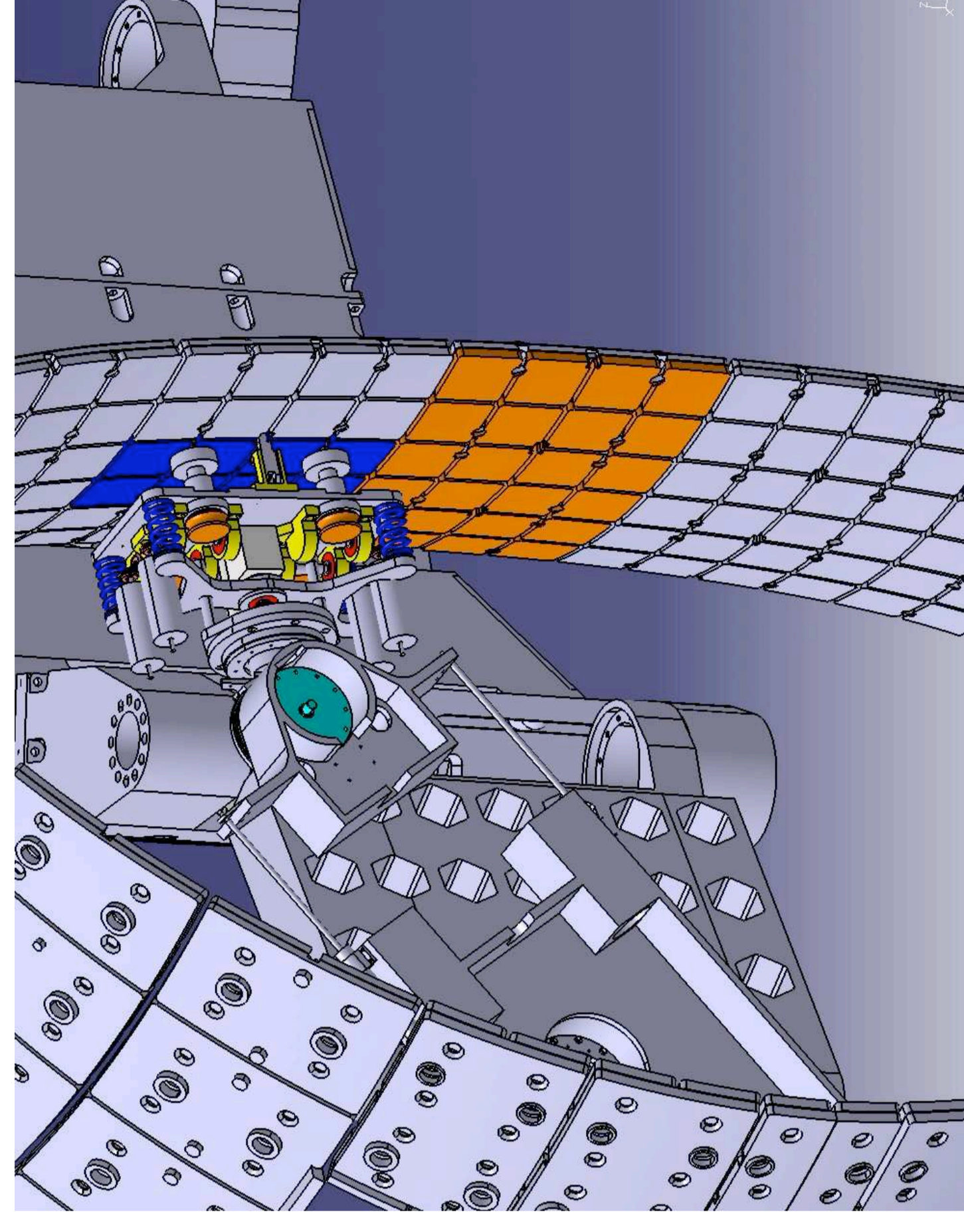
The design of the in vessel RHS, based on two port concept, with the boom and its enclosure has been finalized.

The tile carrier end-effectors have been designed to optimize the installation and removal of the tile carriers (Fig. 2, Fig. 3).

The design is referred to a 3D Mock-up simulation inside the plasma chamber with the entire boom (Fig. 4). This allows to analyze the boom kinematics to cover all position with the various end-effectors and to start the study of the Remote Handling task operation (Figs 5a, b). Further, a failure analysis of the boom components to define a recovery procedure has been developed.



(a)



(b)

Figures 5. - The approach to the first wall (a) and positioning of the tile carrier (b).