Keck Adaptive Optics Note # 767 - Draft
AO Enclosure Preliminary Design

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1. Scope and objectives

The scope of the preliminary design of the AO enclosure includes mating the AO bench correctly to the AO enclosure (including instruments) and conceptualizing the integration of all of the new and existing AO enclosure support systems, including electronics and controls, cable routing, the thermal management system, the air quality control system, and an infrastructure for a maintenance system. An analysis of the current and future utility requirements will also be made in order to identify any shortcomings for the new system. Lastly, since much of the infrastructure already exists, a portion of this design work was allotted towards identifying any interference that may require attention during the detailed design phase.

2. Requirements

The majority of the requirements for this system are flow-down requirements from both the AO bench and the telescope/dome requirements. Additional requirements include a maintenance system design and a class 10000 clean room environment for the AO enclosure.

3. Design Architecture

3.1. AO enclosure geometry: the solid model of the present enclosure model was adjusted such that it meets size requirements for the nasmyth platform while completely enclosing the AO system. Figures 1 and 2 show and isometric and top view, respectively. The main objective of this task was to identify interferences between the NGAO system design and the existing AO enclosure. Interferences that will require addressing in detailed design include: 1) Davinci instrument dewar and the AO enclosure wall, 2) the LGS WFS and the interior wall shared with the electronics room, and 3) a possible interference between the snout of the AO bench and the outer wall of the AO enclosure.

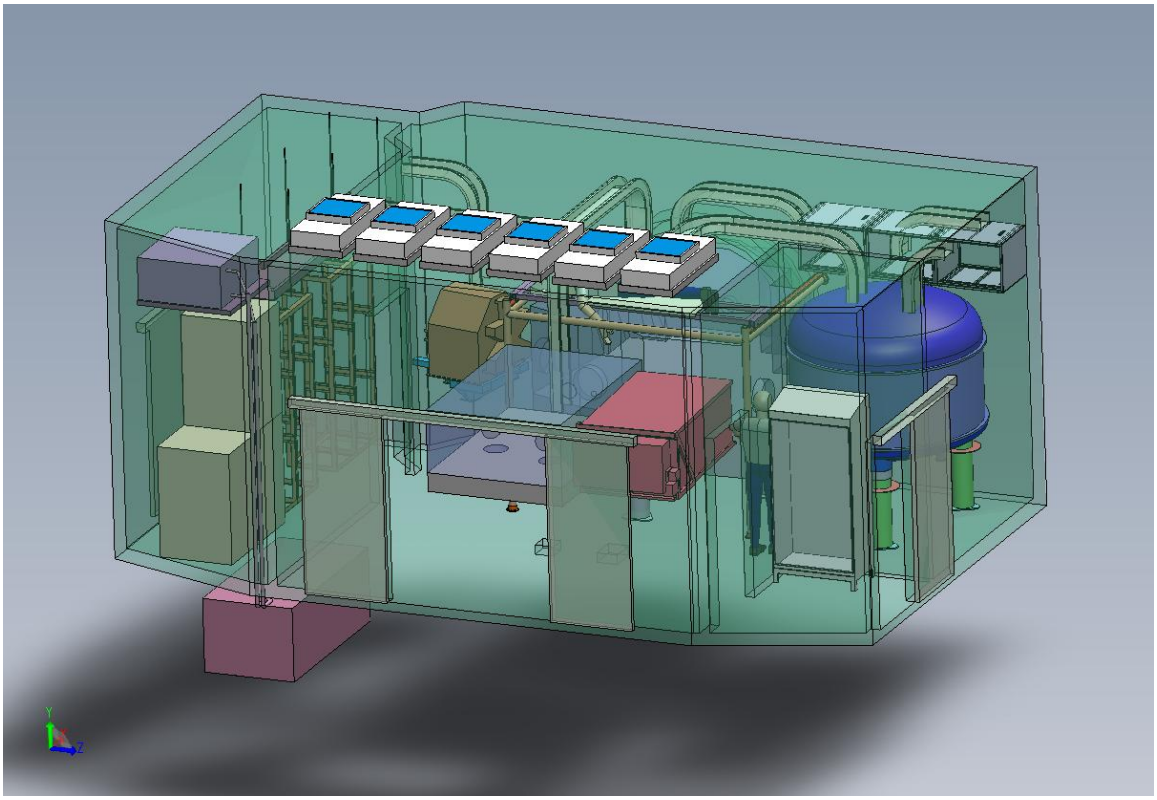

Figure 1. an isometric view of the AO enclosure with most subsystems integrated. The only remaining systems are related to the thermal management systems for the AO bench cold enclosure and the AO enclosure. Note the life-size figures placed in the model for perspective, the gowning room at front right, the electronics room on the left, and the air quality system consisting of six HEPA units on the roof.

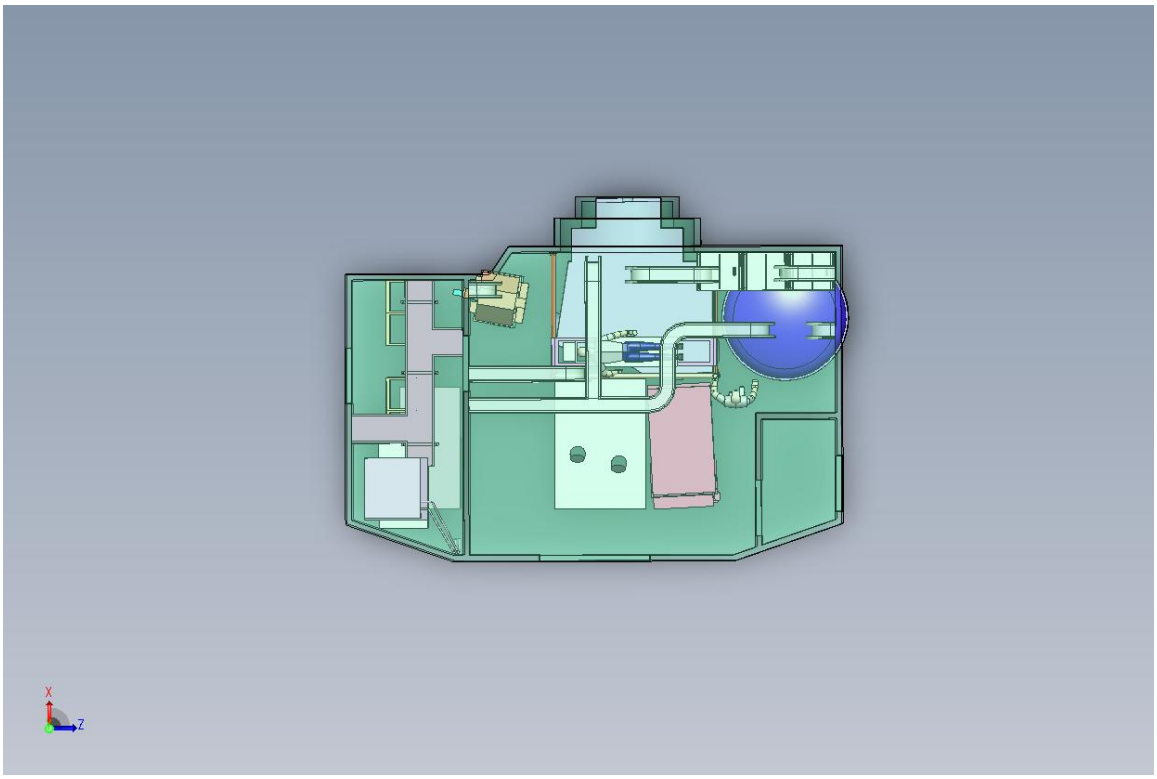

Figure 2. The AO enclosure from above. The interference between the enclosure and the Davinci dewar, and the LGS WFS are clear. These have been remedied through adjustment of walls, which will require review to determine the overall impact on project cost

3.2. Electronics racks placement: electronics racks were placed using the existing electronics room as a starting point, and adding racks in appropriate locations as required. The most critical placement was the control racks for the deformable mirrors, which have a limited cable length and require co-located controls. (Need input from Ed. W.)

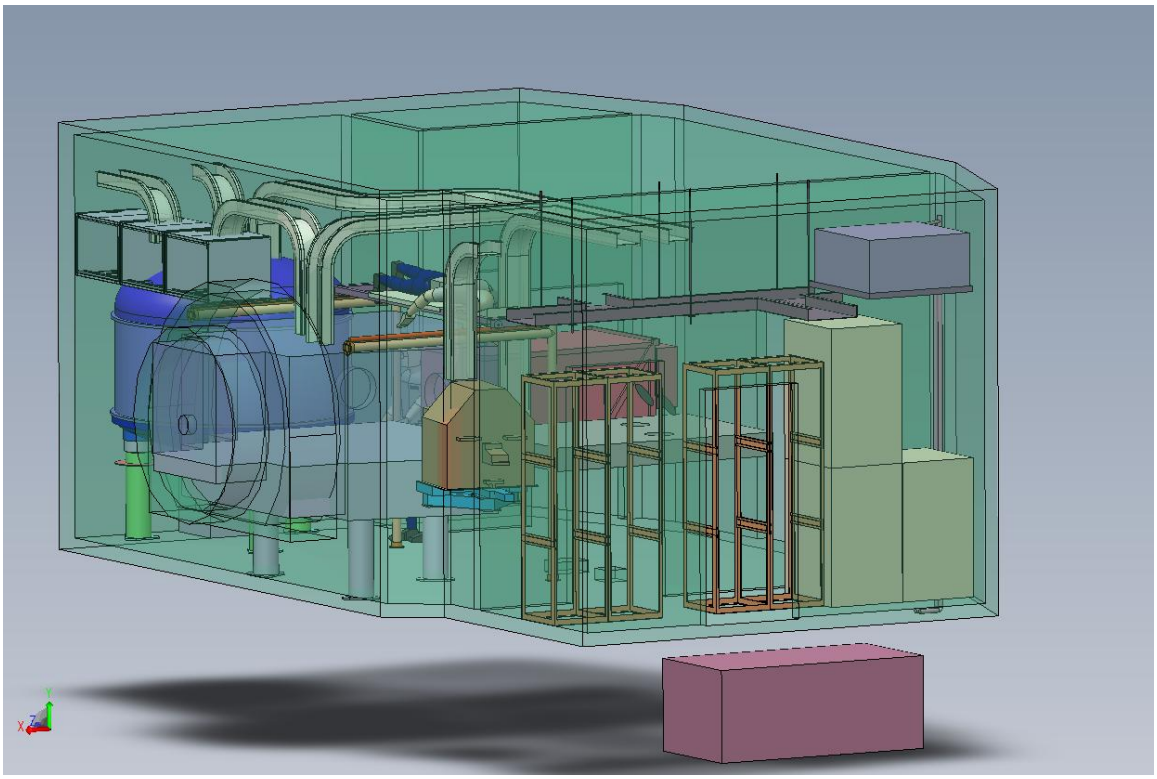

Figure 3. Shows the electronics room in the front of the model, with the cable tray runs visible near the roof in the background.

3.3. Cable routing: cable routes were identified and cable trays were added to the model as shown in all figures (need input from Ed.W)

3.4. Thermal management system (need input from Ed W.): The thermal management system will most likely consist of one heat exchanger residing in the AO enclosure, and another in the electronics room. These will be connected to the facility 0C glycol system.

3.5. Air quality control system: The requirement for the AO room is class 10000 air quality. Based on industry standards for this class of clean room (1.25 air changes per minute), and the volume of the AO room (3297 ft^3), a total of ~ 4100 CFM air volume flow rate is required. A standard, off the shelf HEPA unit will typically provide 640 CFM, so six of these units would be required. The units use a very low vibration centrifugal fan, but a precise vibration spectrum and analysis would be required during detailed design to determine the amount and type of vibration isolation that would be required. Because there will be some heating through convection of the air in the AO room, the air my need to be re-circulated and cooled using the thermal management system described in section 3.4 in order to meet the thermal requirements of the dome. Figure 4, below, shows the six HEPA units located on the roof of the enclosure.

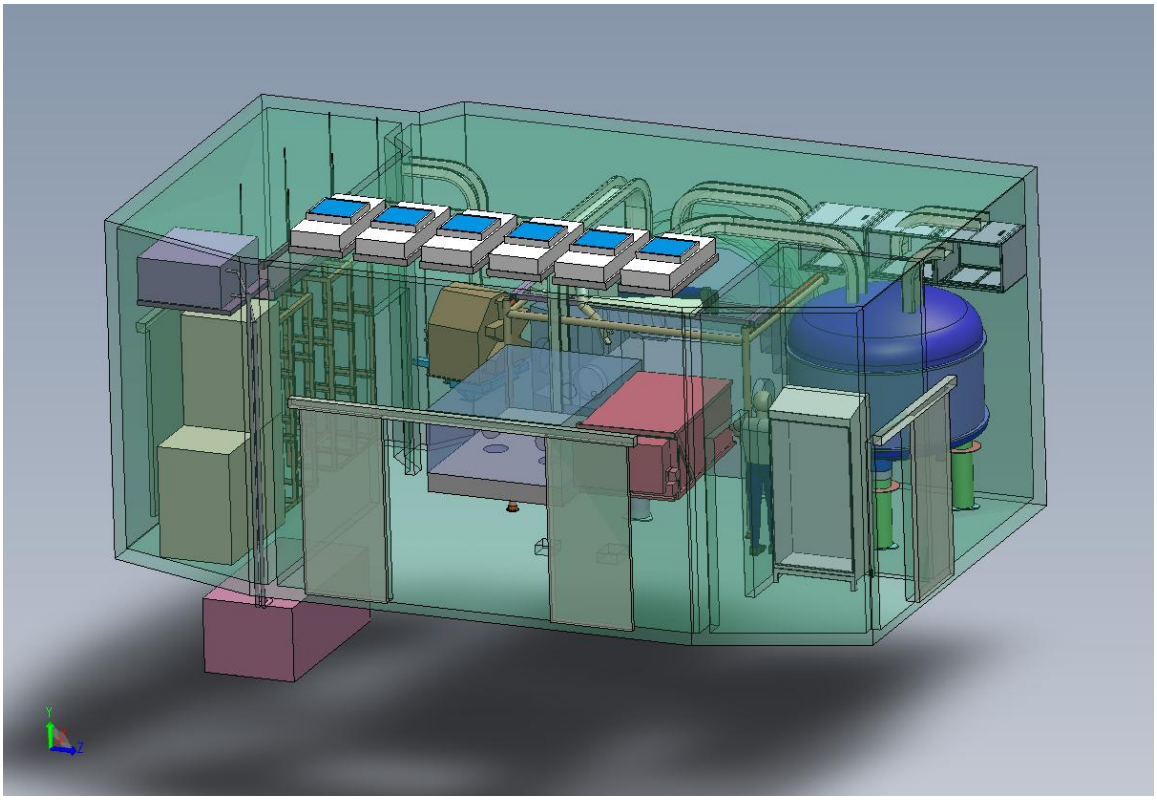

Figure 4. Six HEPA units - located on the roof of the AO enclosure - with centrifugal fans provide the 4100 CFM required to achieve 1.25 air changes per minute, which is the industry standard for a class 10000 clean room.

3.6. Maintenance system: the maintenance requirements for the AO bench were assessed, and a conceptual design for a maintenance system was developed. The concept is based on a permanent rolling scaffold that straddles the bench, shown in figure 5. As well, the cold enclosure will have removable panels on the top and two sides for maintenance access to the bench.

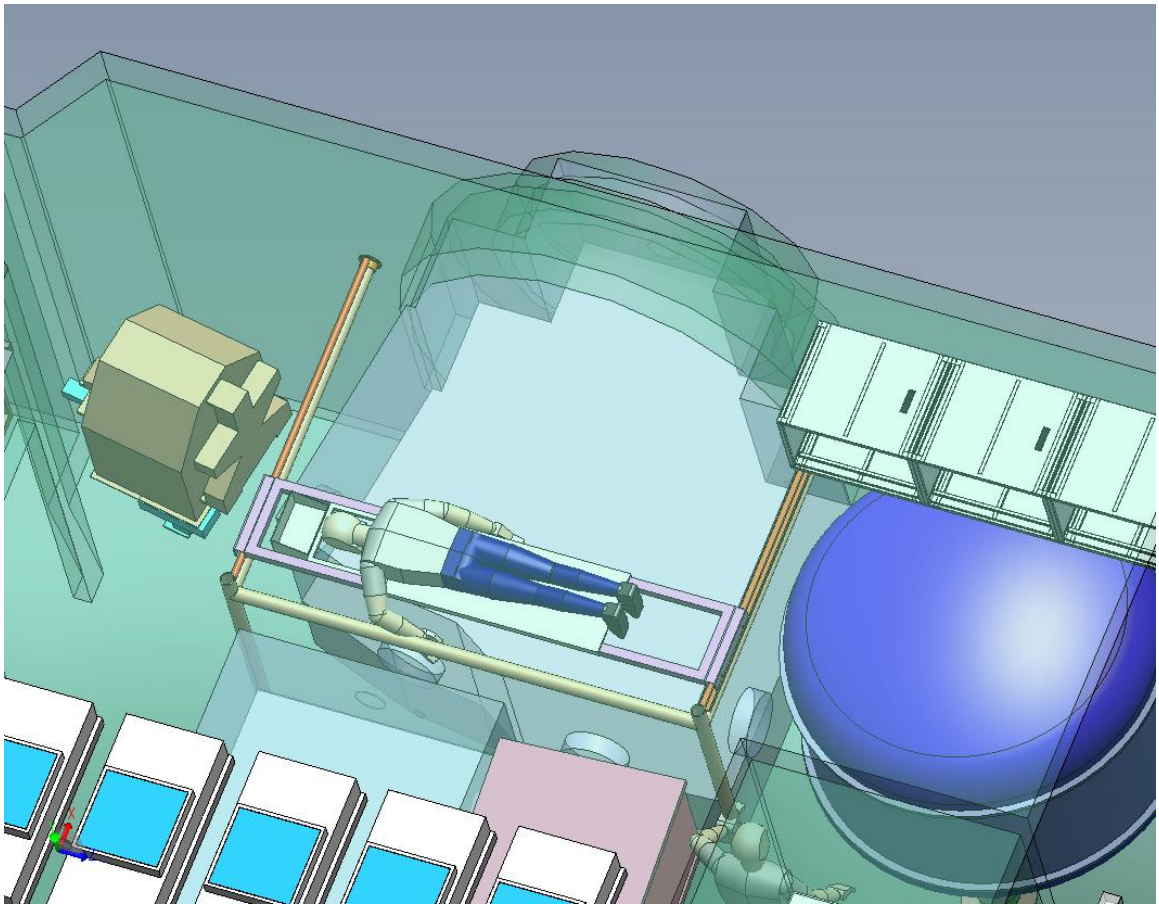

Figure 5. An overhead view of the proposed maintenance support system, consisting of a rolling scaffold where maintenance personnel can position themselves above the AO bench as required. The cold enclosure will also have removable panels for direct access to the AO bench.

3.7. Utilities: (need input from Ed. W)

3.8. Gowning Room: the gowning room will need to conform to class 10000 clean room standards, and allow two personnel to gown simultaneously. The gowning room concept is shown in figure 6.

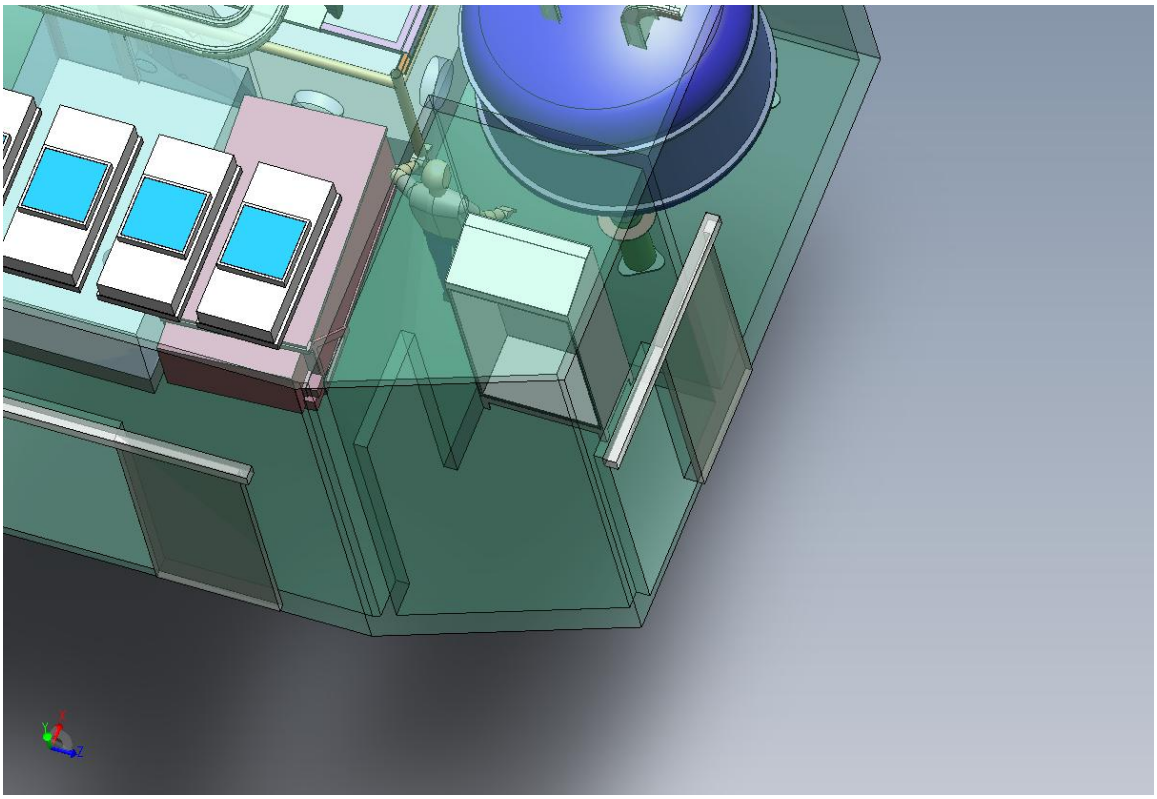

Figure 6. The gowning room, with dual doors will need to conform to typical clean room standards. Shown here with a cabinet for clean room apparel.

4. Detailed analysis

As described in the scope of this preliminary design, the objective is to conceptualize the systems in the enclosure, identify interferences, and check that existing utilities are sufficient for the new system. It is recommended that detailed analysis be performed on the thermal management system and air quality control system in the detailed design phase, as these systems present some of the more critical issues with respect to overall system performance.

5. System costs

Completion of the thermal management system conceptual design is required to complete a cost estimate for the AO enclosure work.

6. Detailed design

The detailed design phase should focus on designing the necessary infrastructure to eliminate the identified interferences in the system, detailed design and analysis of the air quality control system, detailed design and analysis of the thermal management system, and system requirements for utility drops.