K1DM3 Technical Note 872-LTN1030

Potential Interferences

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C.Ratliff & G. Cabak

1 Introduction

With the outer drum fit up and alignment testing on site at Keck 1, we found interferences that were unexpected. The main reason for this problem was lack of information about structures within the tertiary tower, primarily incomplete CAD.

In this document, we will describe how we have addressed the possibility of interferences. We will also look at where we expect to be close to interfering.

2 Discussion on Interferences

Below is a figure showing K1DM3 with a “keep in” volume that is a semi-transparent blue and surrounds K1DM3. Here we will look at areas where K1DM3 protrudes or is close to protruding through this keep in volume.

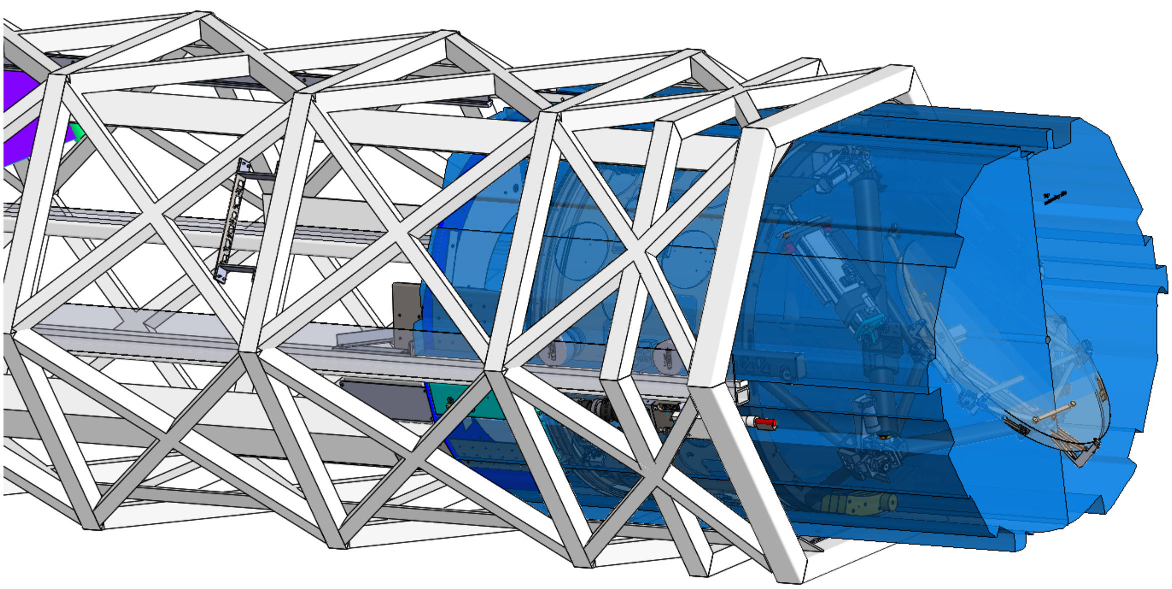

Figure 11 – Blue Semi-Transparent Keep In Volume

The keep in volume was created empirically by using foam core and running it through the tertiary tower on the tertiary tower rails. Material was trimmed off of the foam core template as interferences stopped forward progress through the tertiary tower. Figure 2 below shows a photograph capturing part of the foam core pull through procedure. One person behind pushes on the outer drum mounted with foam core as the person in front of the foam core, cuts away foam core material as the template is shuttled through the tertiary tower.

Figure 2 – Jim Ward commencing to push foam core through the tertiary tower, another person is further up the tertiary tower to cut away interfering material

The foam core two dimensional representation was converted to a 3D CAD solid by using a coordinate measuring machine to measure the foam core perimeter. This x-y position information was then used to make an extruded version of the foam core template.

There is some error involved in the creation of this foam core model. When cutting the foam core, more material must be removed than desired to provide clearance, a slip fit all the way around is not practical to achieve unless cutting times are very long. In general cutting with a razor blade we are close to +/-5mm of the perfect shape, worse in some areas where access is difficult like under the rails.

Additional error is introduced if there is future adjustment of the steel wheels, it would shift the foam core up or down or side to side as much as the wheels are adjusted in each direction. I would expect this error to be less than 4mm

The items that are protruding the keep in volume below are protruding either because they will be removed when shuttling through the tower or are interfacing with the tower (steel rollers and defining points)

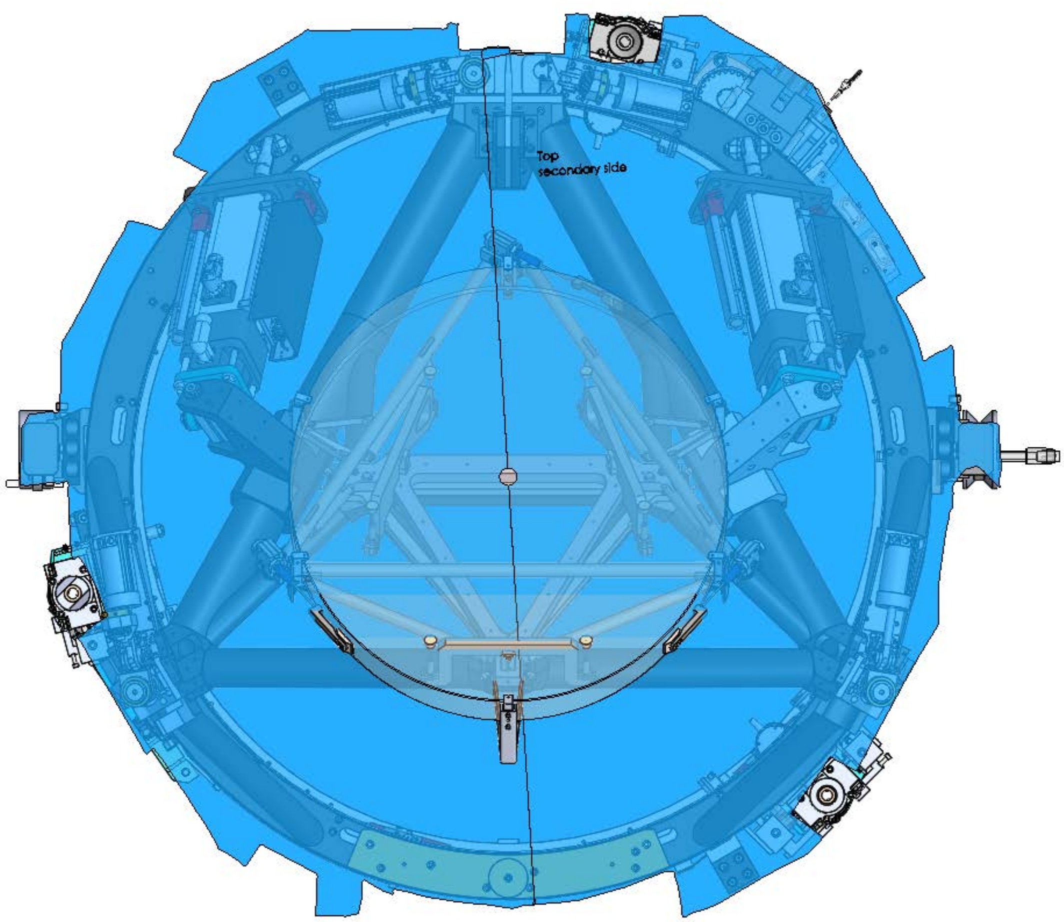

Figure 3 – K1DM3 and Keep In Volume

There are some areas where we will be very close to grazing items on the tertiary tower and they are shown in the two figures below. Figure 4 shows the “skids” that guide the swing-arm to its kinematic coupling that will come very close, but should not interfere with the tertiary tower.

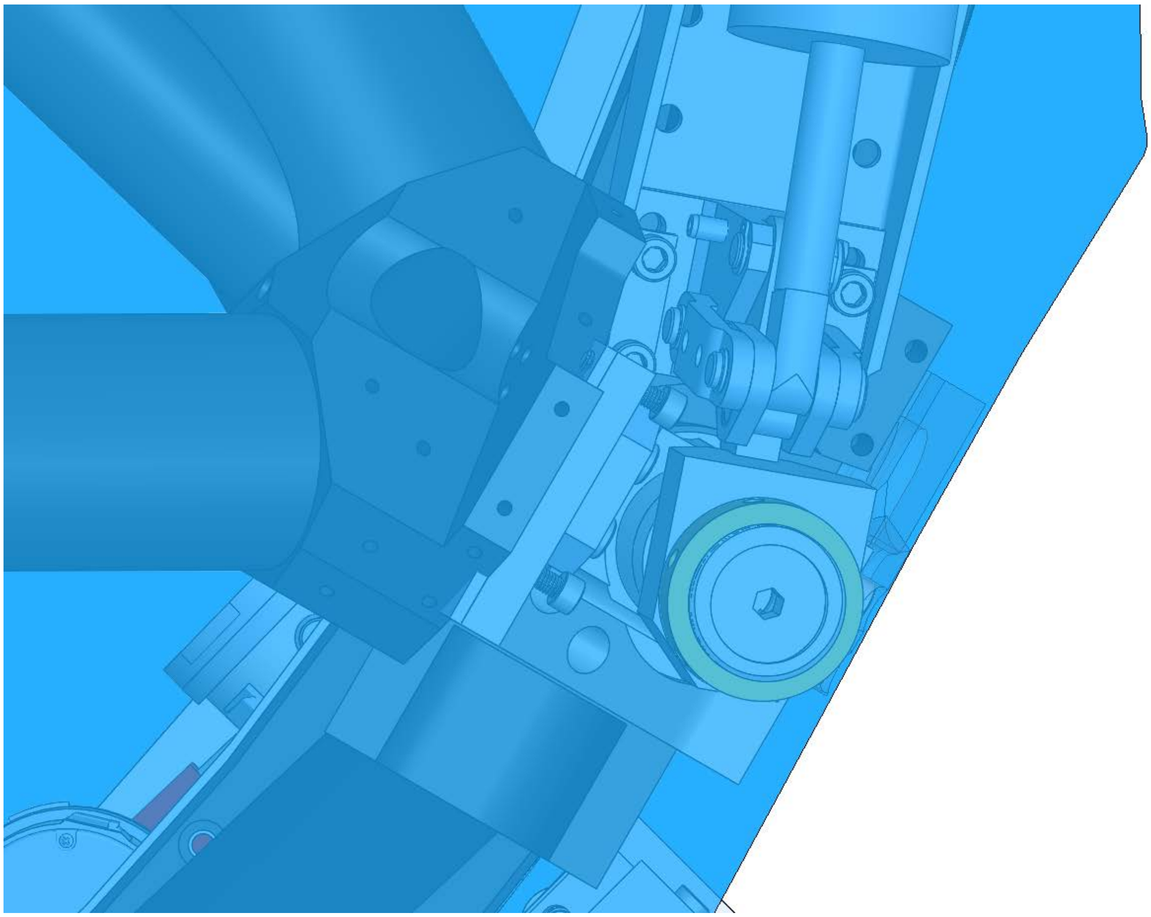

Figure 4 – Skids Adjacent to Keep In Volume

Another area that comes very close to the chain drive system in the tertiary tower is shown in the figure below. It looks like there will be interference, but it is very likely a case of over ambitious foam core removal. We do not exceed the envelope of the existing M3 in this area.

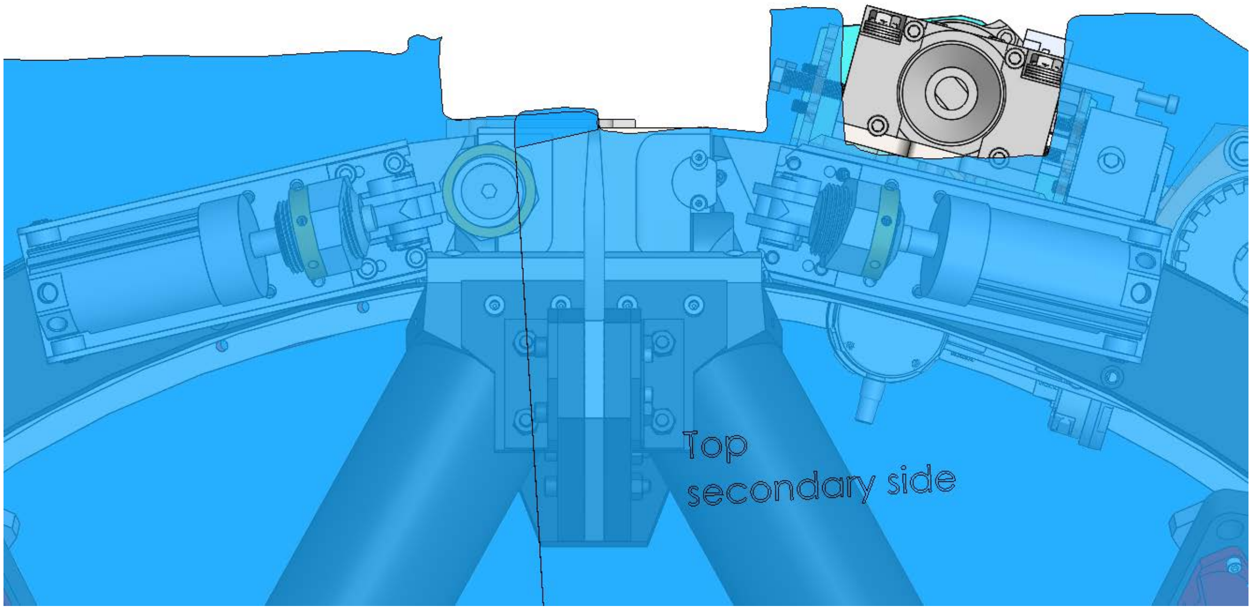

Figure 5 – Hinge Adjacent to Keep In Volume

Figure 6 below shows why we cannot have the mirror face down for the process of shuttling through the tertiary tower. The bipod weldment would run into the ADC defining points. The original design intent was to have the mirror face up like the existing M3. In midyear 2017 it was proposed for the mirror to face down when shuttling through the tower, upon further investigation the interference situation was discovered, so the mirror will face up like the existing M3.

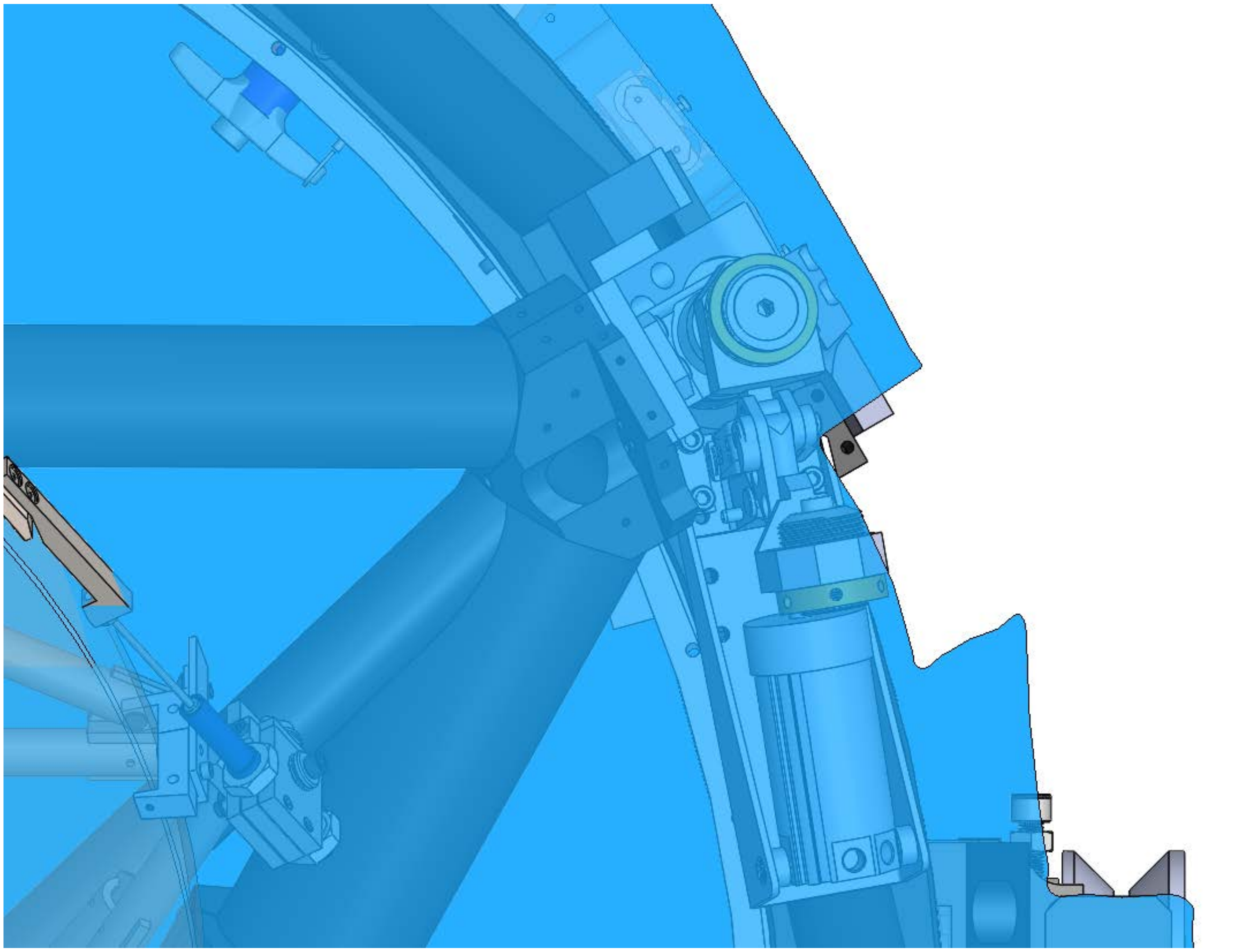

Figure 6 – Interference of Bipod Weldment and ADC Defining Point, Only If Mirror Faces Down During Shuttling

Guide Mechanisms

Due to the compliance of the hinge and actuator that allow the kinematic coupling to function properly, there is a possibility of the swing arm interfering with bipod weldment assembly if an excessive lateral load is placed on the swing arm. Here is a list of items that could cause an excessive lateral load: 1) A person pushing laterally on the swingarm during deploy 2) A slave actuator with excessive trailing error 3) deploying in a gravity non-neutral situation where the inner drum does not have the mirror facing directly up or down. It should be noted that none of these items are normal modes of operation.

The black Delrin “skids” shown below help guide the swing arm into the kinematic coupling without touching the swingarm when engaged in the kinematic coupling. The intent is to eliminate the possibility of metal to metal contact/interference if the swing arm has a side load.

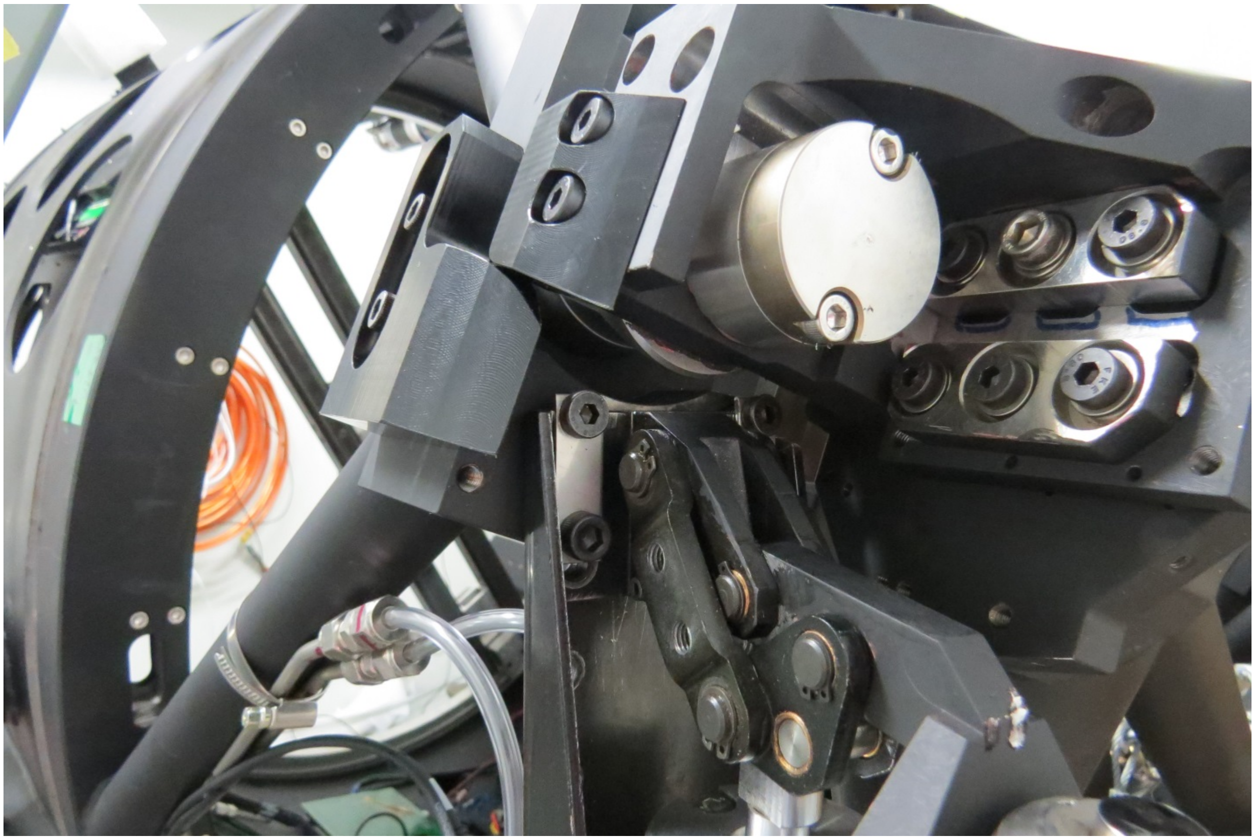

Figure 7 – Delrin “Skids” to Guide Swingarm

3 Conclusion

We have taken steps to reduce the risk of interference when installing K1DM3. Ensuring we minimize LRIS vignetting to under 0.1% while not interfering with the the tertiary tower has been one of the main challenges of this project during the design phase.

Doing the outer drum fit up eliminated the risk of the outer drum itself interfering. The foam core mock-up helped give us a keep in volume when designing and should ensure we clear unless there is significant adjustment of position of the wheels. The movement would have to be such that we move the axis of the outer drum relative to the tertiary tower axis and this is unlikely even though the tertiary tower rails were replaced. Keck and UCO did a layout and determined that even though one rail changed from a v shape to a round rail, the wheel position should not move (verify Keck did not have to move existing M3 wheel after installation of new rails).

Figure 3 - Location and orientation of the accelerometers for the test. White traces on all the plots represent the lateral accelerometer in the plane of the mirror. The red traces are from the unit pointing away (normal) from the mirror

Figure 4 - A lateral push when deployed

Figure 5 - A normal push when deployed

Figure 6 - Deployed configuration. Lateral push response.

Figure 7 - Deployed configuration. Normal push reponse showing wobbling of the hex ring.

Figure 8 - Deployed configuration. Response due to push on hex ring.

Figure 9 - Deployed configuration at right Nasymth. Normal push.

Figure 10 - Deployed at right Nasmyth. Lateral push.

Figure 11 - Deployed at right Nasmyth. Normal push response.

Figure 12 - Deployed at right Nasmyth. Lateral push reponse.