Packaging constraints for d-NIRI and LGS WFS's in Split Relay architecture
Verison 0.2

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Contents

List of Figures

List of Tables

1 Introduction

The NGAO systems engineering team came up with five architectures during the course of meeting #8. The team had doubts about being able to package Split Relay Architecture within the geometric constraints of the Keck telescopic structure.It is expected that the IWG will use this document as a reference for designing d-NIRI if Split Relay Architecture was chosen. Due to the limited scope and time alloted for this work package, a fully reflective OAP relay was not incorporated in the mechanical model or allocate envelopes for the other science instrument.

The packaging constraint for the Stimulus/ Telescope Simulator, Vibration sensors, and the space available for d-NIRI and LGS WFS's. The system arch. team did cast their doubts on the front end of the relay and this issue is addressed here. The packaging issue is dealt in this note by allocating volume envelopes to the critical components.

A e-drawing of the d-NIRI envelope and partial structural description of the telescope can be found at : `http://www.oir.caltech.edu/twiki_oir/pub/Keck/NGAO/SystemArchitecture/NGAO_split_relay.EASM`.

Figures 1 and 2 shows the zoomed in view from the aforementioned e-drawing and a schematic with some dimensions. The constraint on d-NIRI is quite rigid, it will need to be mounted on a load bearing structure that has bearings as shown in the figure and a worm drive will need to be designed to drive the unit to track objects on the sky. The LGS WFSs are indicated in gold and can be longer, it also needs to rotate and can be mounted on an arch like structure.

2 Conclusions

Packaging split relay is possible with sufficient engineering subject to the following conditions.

1. First order look at d-NIRI's layout suggests that the instrument needs about 200 mm of clearance from the Nasmyth axis to the focal plane. The LGS WFS's will need to be after d-NIRI to minimize the number of surfaces that d-NIRI looks through. Secondly, the LGS WFS's are at least 0.5 m is length and need a two stage translation mechanism to working with changing in DEC angle and change in WFS sampling (# of sub-aps). There is not enough space to get all this in the elevation bearing with appropriate rigidity to mitigate flexure effects.
2. The focal plane is 210 mm from the Nasmyth axis (useful # for IWG to see if d-NIRI can cope with this). The envelope of the instrument is 175 mm from the Nasmyth axis to make room for the pick-off mechanism.
3. d-NIRI must fit into a cylindrical volume of 1050 mm diameter and 575 mm length. The instrument support structure will need to rest on the Nasmyth platform. A

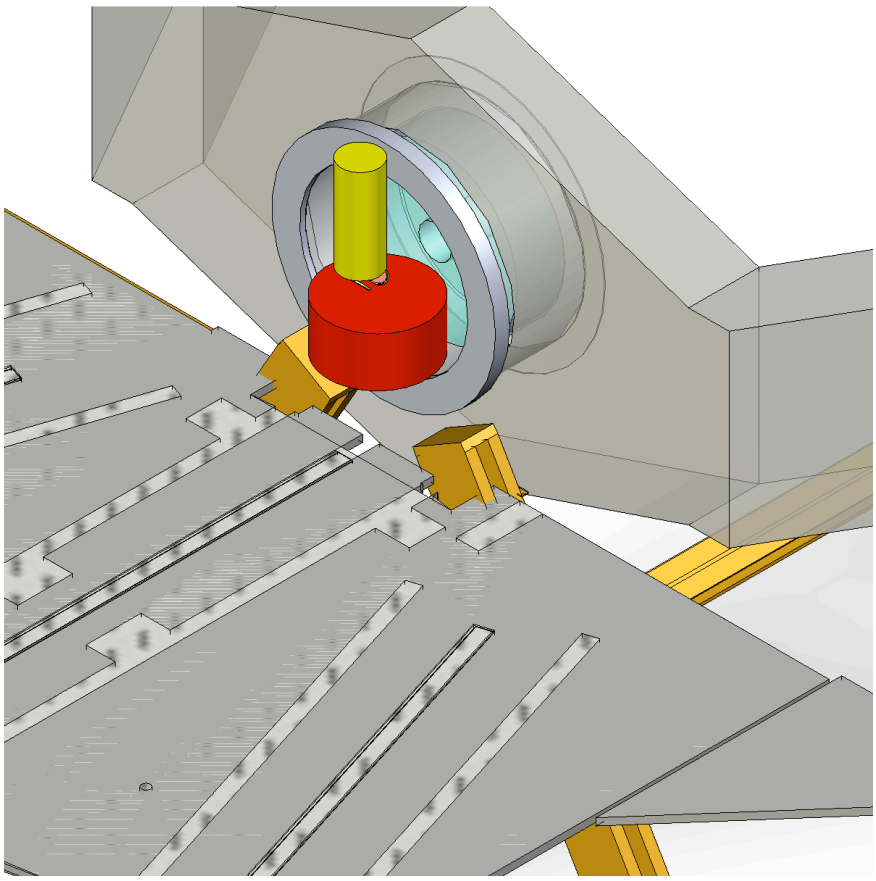

Figure 1: Zoomed in perspective view of envelopes - Red envelope is the d-NIRI volume, bright yellow indicates the LGS WFS's volume and the transparent cyan disk with a central hole shows the volume where the calibration unit, telescope simulation and vibration measurement units need to reside.

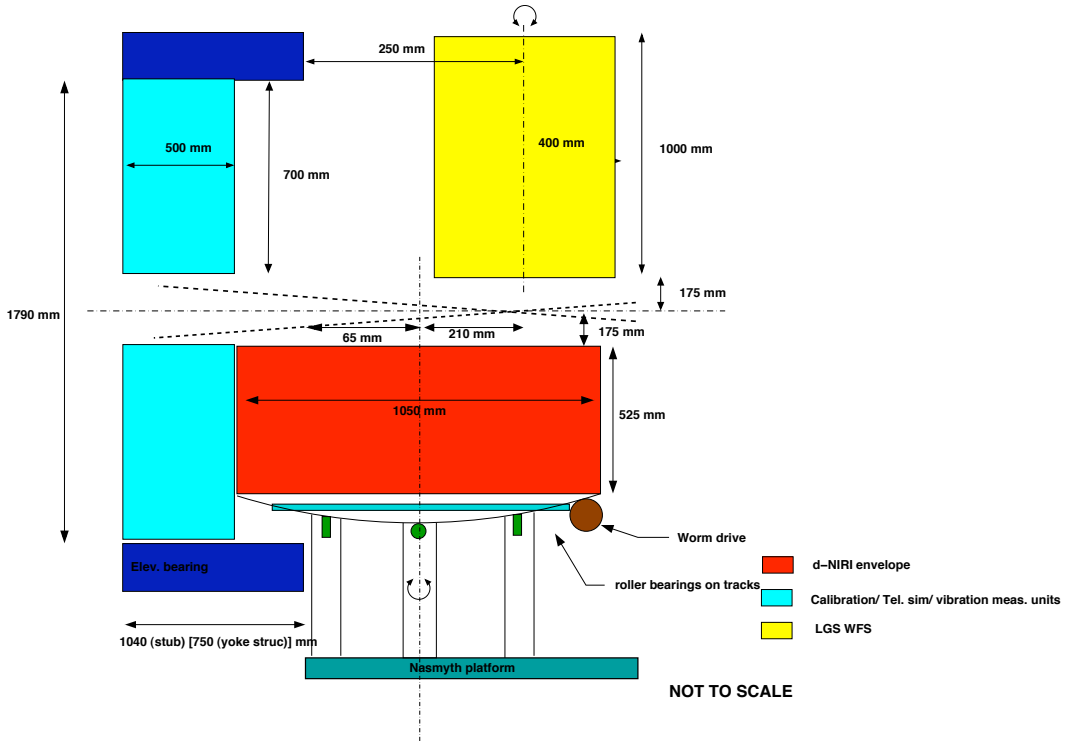

Figure 2: A schematic of the perspective view shown in fig. 1 with call outs and dimensions

worm drive with a appropriate gear ratio to and range of operating speed will need to be designed.

4. LGS WFS's envelope can be above Nasmyth axis by about 175 mm.
5. Vibration measuring/ compensating, misc. calibration and telescope simulator units need to fit within a cylinder of 200 mm length by 1.79 m dia. This cylindrical portion is located on the far side of the AO bench (closer to the Tertiary mirror) the elev. bearing. The units will need to be mounted to the yoke structure without having any rigid contact with the elev. bearing if the units need to work while tracking (for e.g. vibration measurement units). The telescope simulator may have the option of being rigidly attached to the elevation bearing (if the bearing can take the additional load). There is sufficient space for brackets to be built to attach the cyan envelope to the yoke.

In essence, the Split Relay Architecture can be made to work with *enough engineering effort*. The IWG has to confirm that d-NIRI can fit into the envelope suggested in this document, this is a hard bound constraint with little leeway. The cost of d-NIRI may be higher because of the increased volume and drive mechanism constraints. More structural analysis may be needed to work out the details of mounting the different bits. The AO system optical relay can be easily incorporated in the above scheme when an folded OAP relay design is completed.