Magellan PFS ADC

1 Abstract

The ADC for Mike, and PFS, needs to be mounted in front of the focal surface, ideally on a guider in such a way that it can be easily deployed and removed. A mechanism was designed for the deployment of a velocity reference cell and this can be used for the ADC.

The ADC also needs control of the angle of the two prism elements.

2 Guider housings

A Magellan guider is shown in Figure 1.

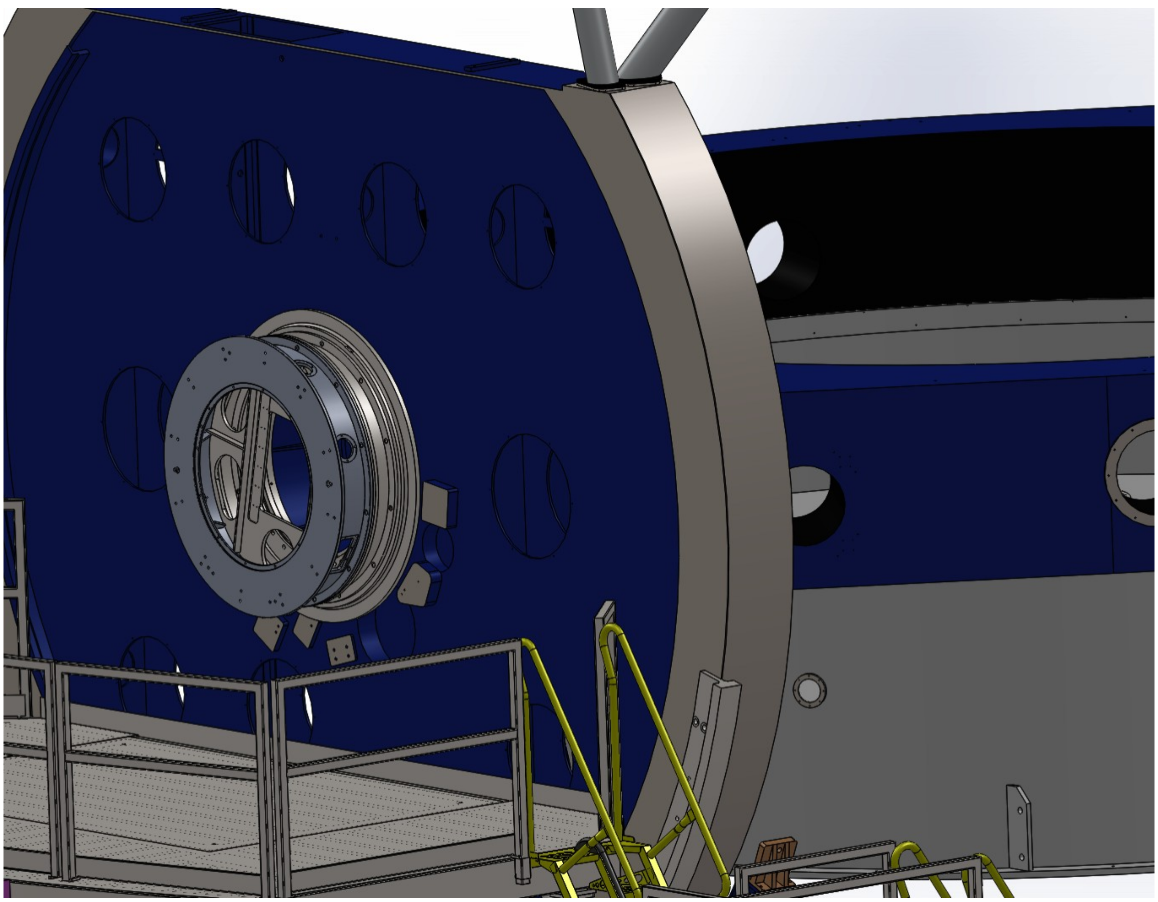

Figure 1 Guider in place

The basic guider assembly is shown in Figure 2

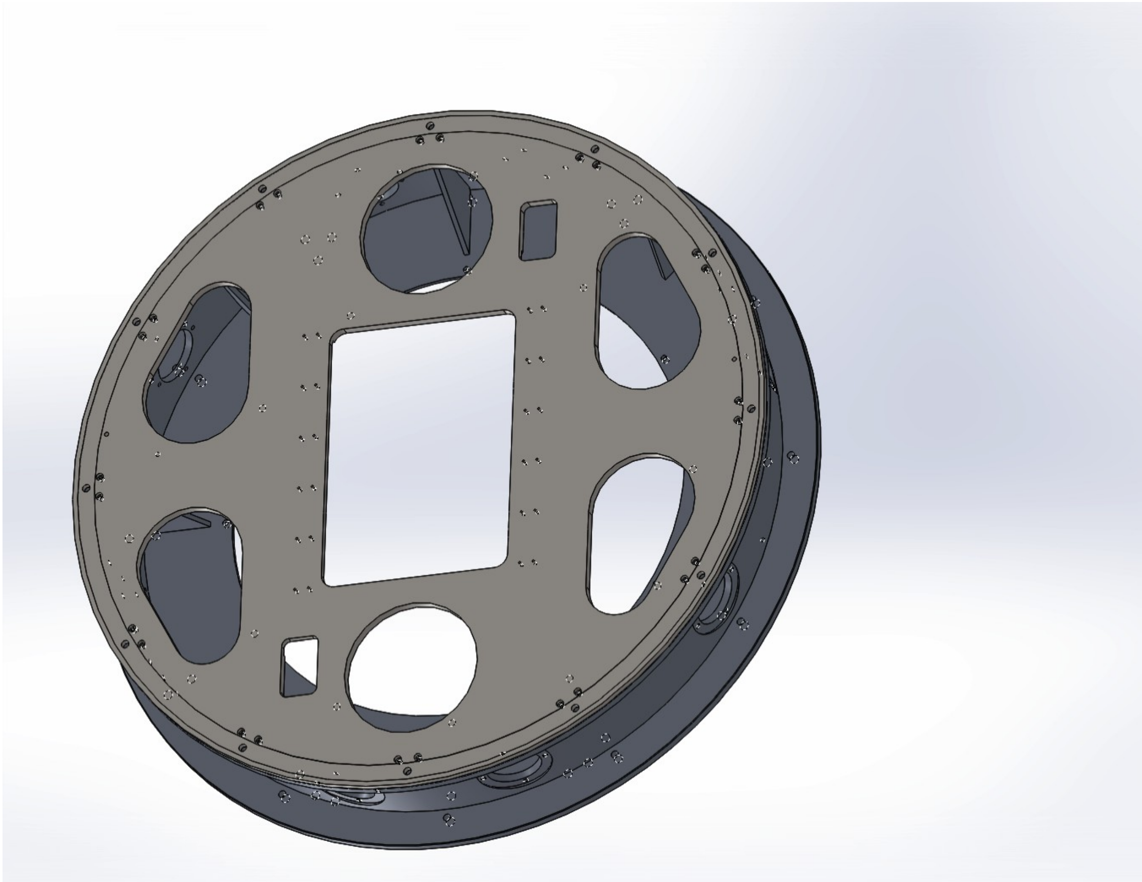

Figure 2 Standard large guider housing

The baseplate for the guider was modified to allow installation and removal of the velocity reference cell by removing some steel structure and machining mounting points for the THK rails, air cylinders and cable chain supports as shown in Figure 3. There might have been a machined surface machined for the THK rails on the guider base plate.

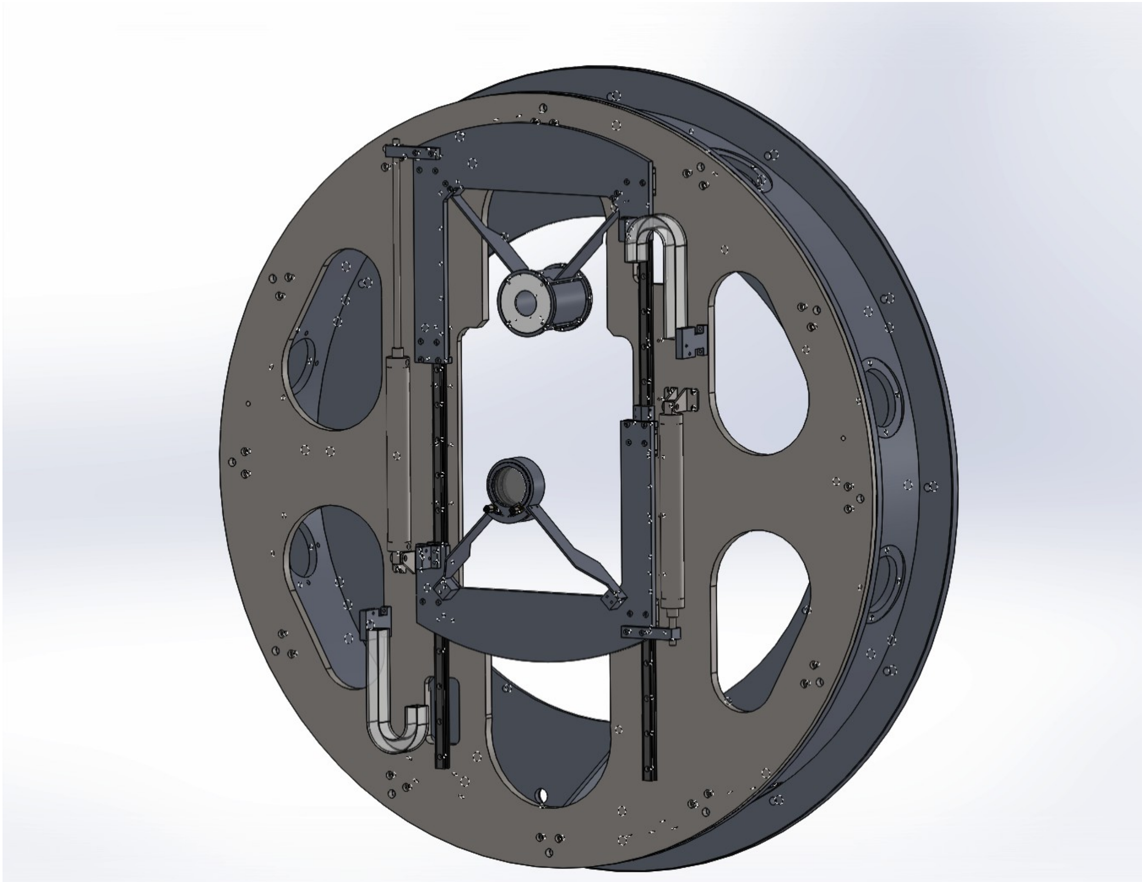

Figure 3 Guider with velocity reference cell and ADC

3 ADC rotation

There seem to be a few ways to control the rotation of the prisms in the ADC.

1. Encode the lens with an absolute encoder that has a 1:1 relationship with the rotation of the lens. So one revolution of a prism produces one revolution of the encoder. This allows the use of a magnetic absolute encoder that has analog outputs, sin and cos. This requires a gear train as the encoder needs to be placed on the axis of the shaft to be encoded. This is shown in Figure 4 and Figure 5

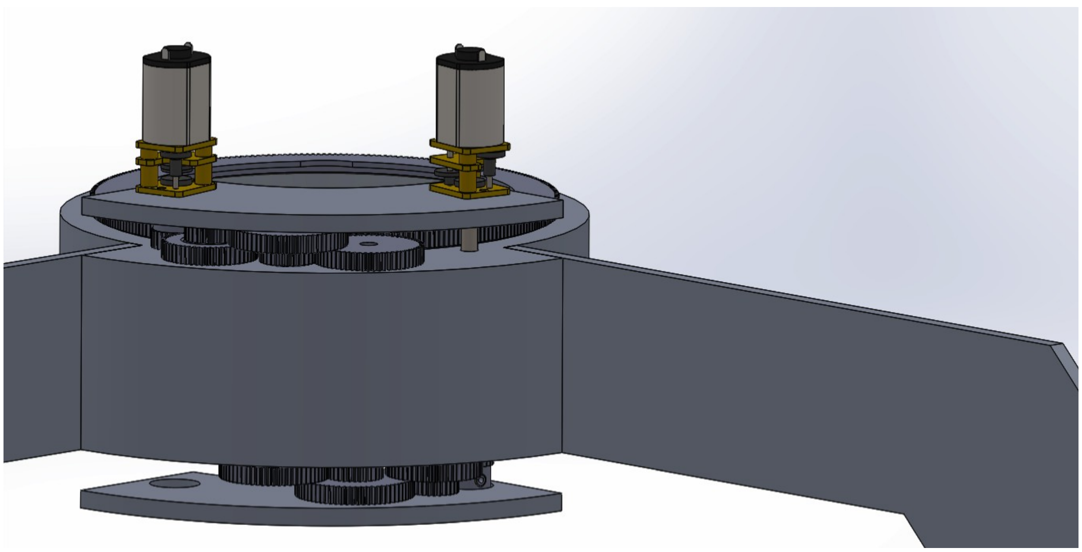

Figure 4 Motors and encoder gear train

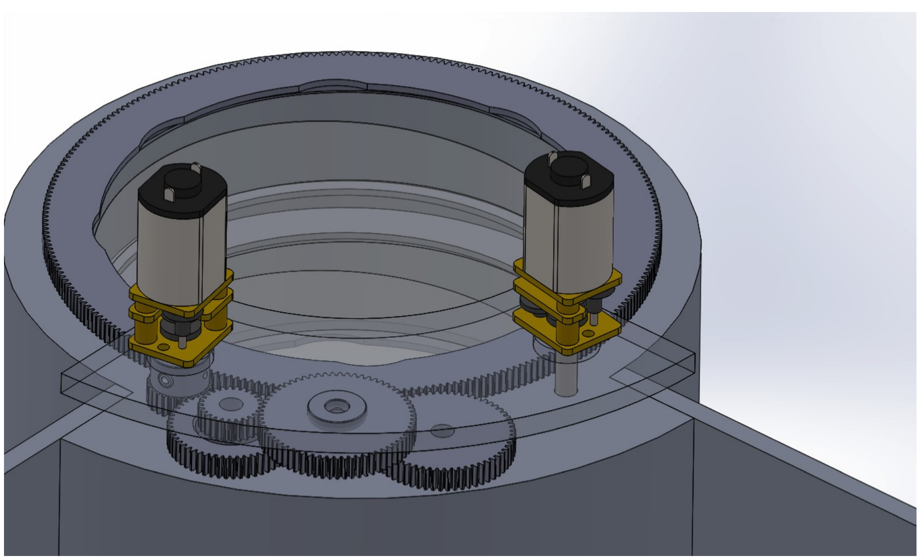

Figure 5 Absolute encoder gear train. 10:1 total. The encoder is on the gear on the right.

2. A multi turn pot that would produce an analog output proportional to the rotation angle. The multi turn pot would allow for two full rotations of the prisms, Figure 6 and Figure 7. The motors and pots are all on one side of the ADC to allow room for the motion of the velocity reference cell.

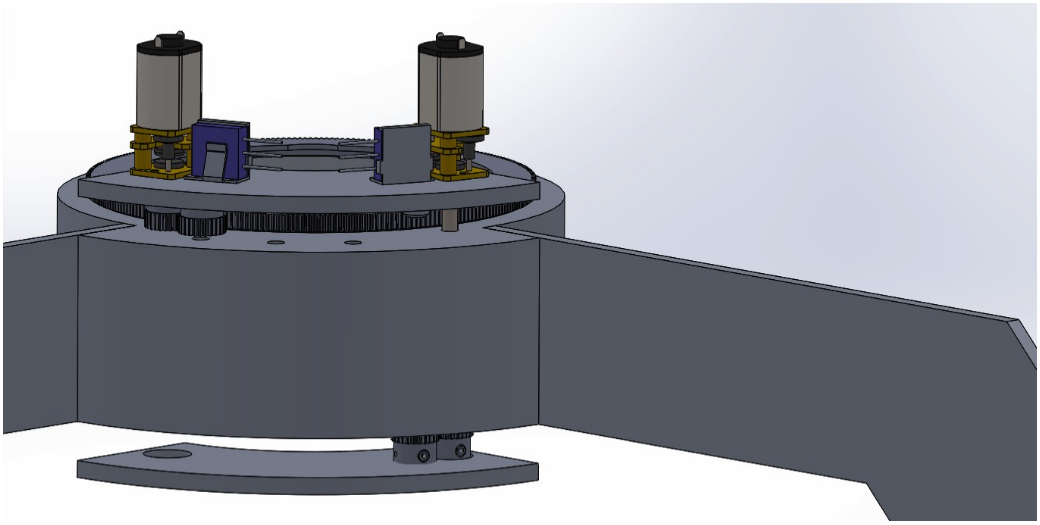

Figure 6 Multi turn pot feedback

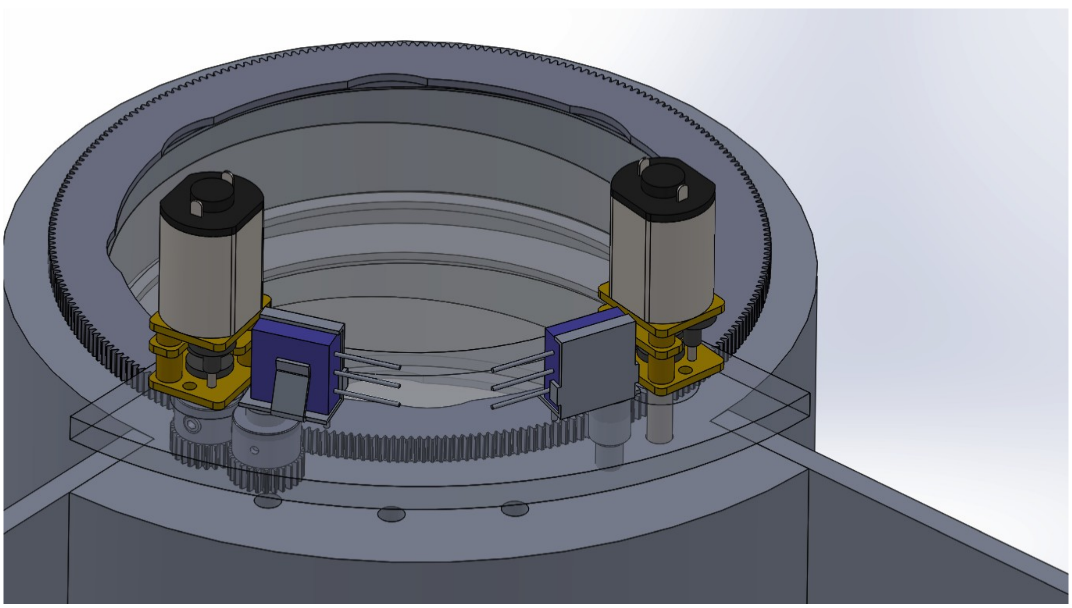

Figure 7 20 turn pot feed back.

3. The motors can be equipped with simple incremental encoders. A simple encoder with 12 counts per revolution, combined with the motor reduction of 100:1 (possibly much higher) and the 10:1 gives 12,000 counts per revolution. A single switch on the OD of the prism is used to indicate the starting point, Figure 8 Figure 9 There will be some backlash as the encoder is on the motor and there will be backlash in the gear train.

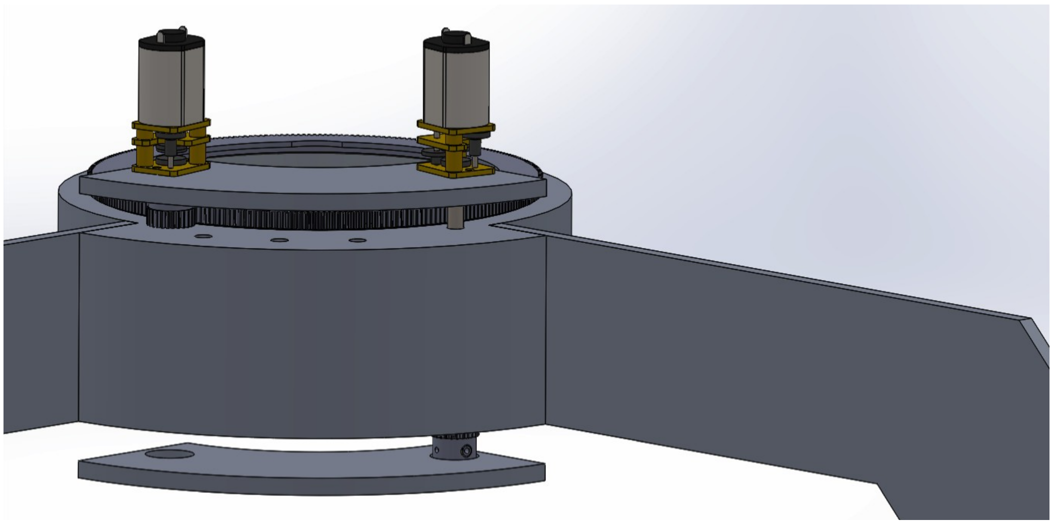

Figure 8 ADC with motor shaft encoder.

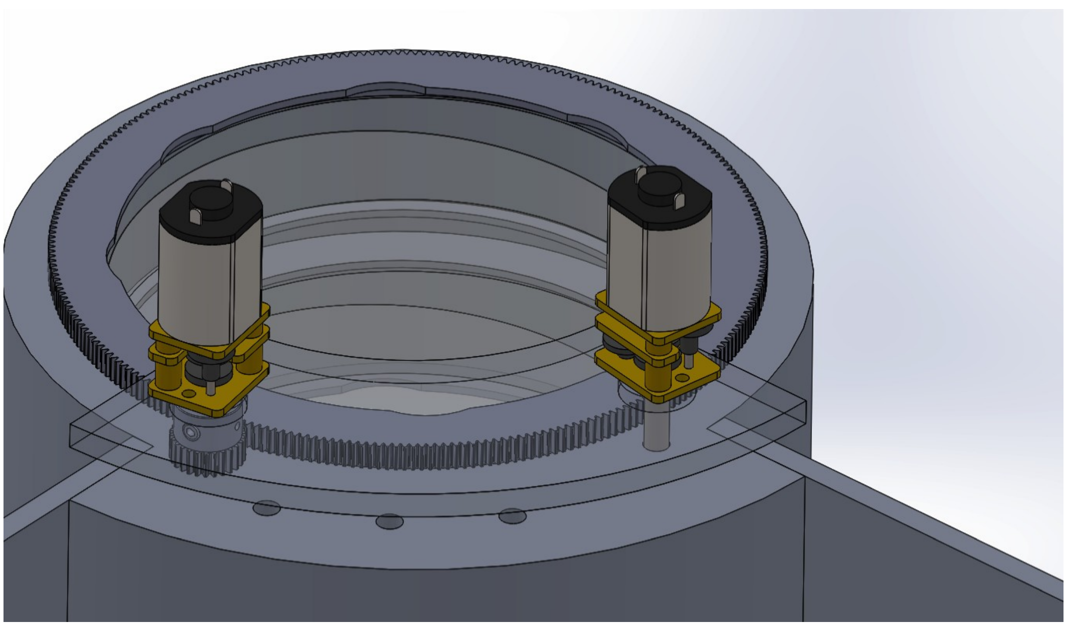

Figure 9 Encoder feedback on back shaft of motors.

4 Bearings

The simple way to do this is with a purchased bearing, Figure 10. These cost about $1200 each.

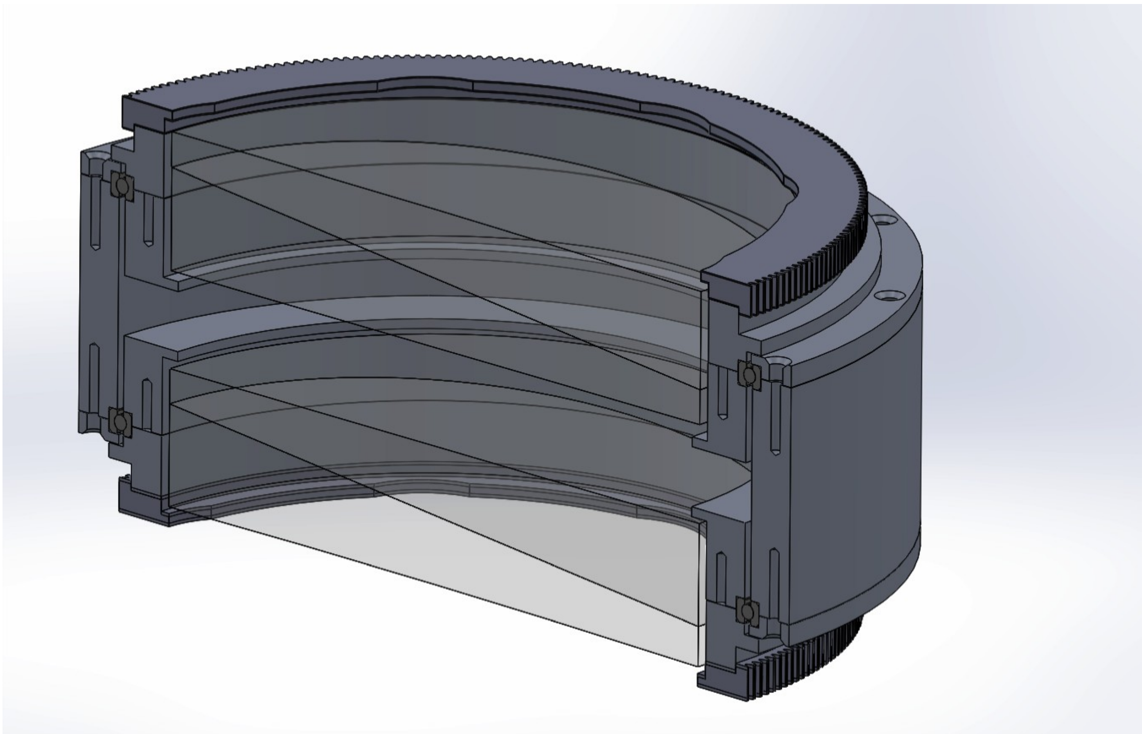

Figure 10 ADC with purchased bearings

I suspect that the bearings could be built in and manufactured by the shop. These bearings have very low loading and probably fairly low accuracy requirements. This makes for a simpler part but perhaps more manufacturing complexity, Figure 11.

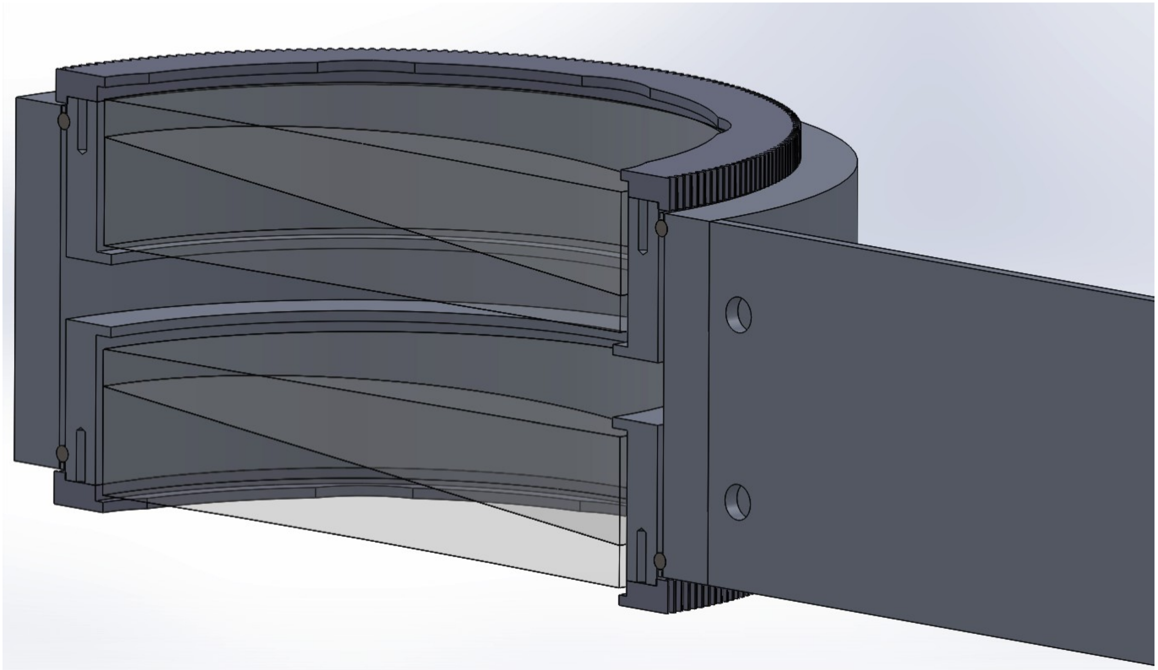

Figure 11 ADC with manufactured bearing

5 PFS ADC 20170704 Design Mods

After some review some modes have been made to the ADC. This uses new gears with stock slim bearings. The new gearing allows the use of a magnetic encoder that produces a sine and cosine output that has a cycle of once per revelation of the ADC element. There are two motors and two encoders.

The motor drives a SDP s1023z-120s060 gear which in turn drives a SDP s1268z-120s420 large diameter gear, a 7:1 reduction from the motor shaft. The motor also drives a SDP s1g84z-120s12 pinion which in turn drives a SDP s1023z-120s084 gear that drives the encoder with a reduction of 7:1 so both outputs have the same scale.

The motor is an inexpensive hobby style DC motor but can be replaced with many other types of motors.

https://www.pololu.com/category/60/micro-metal-gearmotors

The encoder is a Renishaw RLS magnetic encoder RM08.

https://www.rls.si/rm08-super-small-non-contact-rotary-encoder

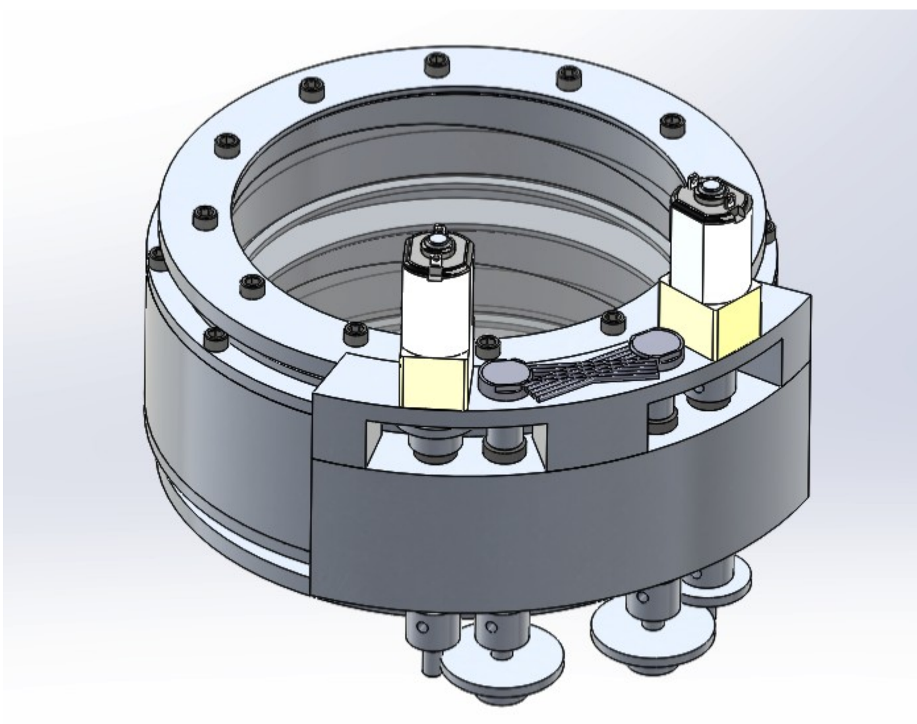

Figure 12 Overall ADC mount.

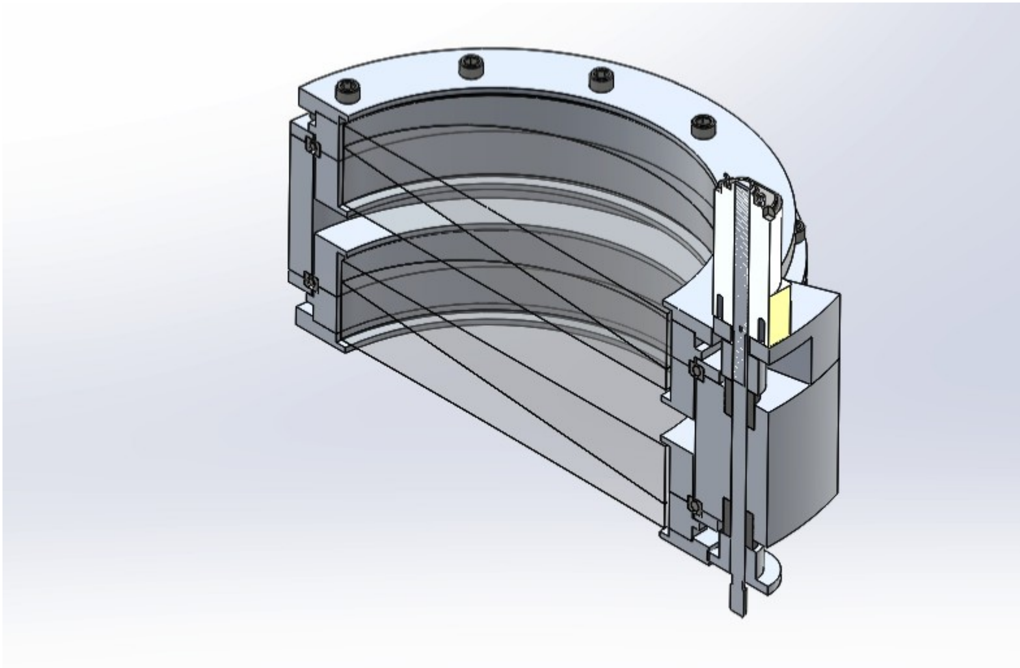

Figure 13 ADC mount showing section through the motor and the gear that drive the lower ADC element.

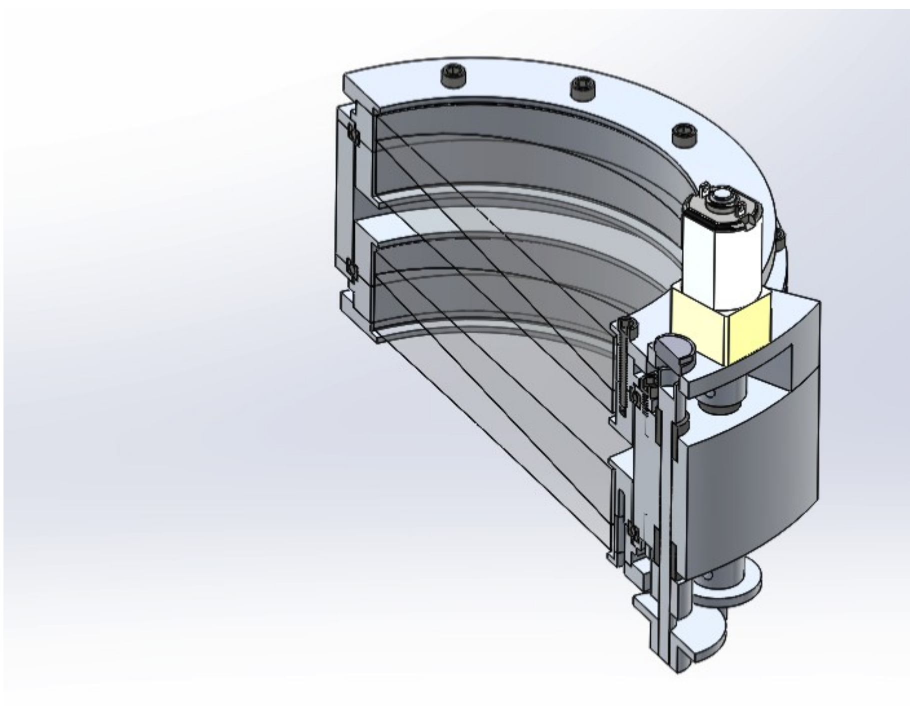

Figure 14 Section through the gear and drive for the magnetic sine/cosine encoder. The gearing produces one revelation of the encoder for each single revolution of the ADC.

This ADC gets mounted on a stage on the platform that supports the guiders on Magellan. These stages can be mounted on either large or small guider platforms.

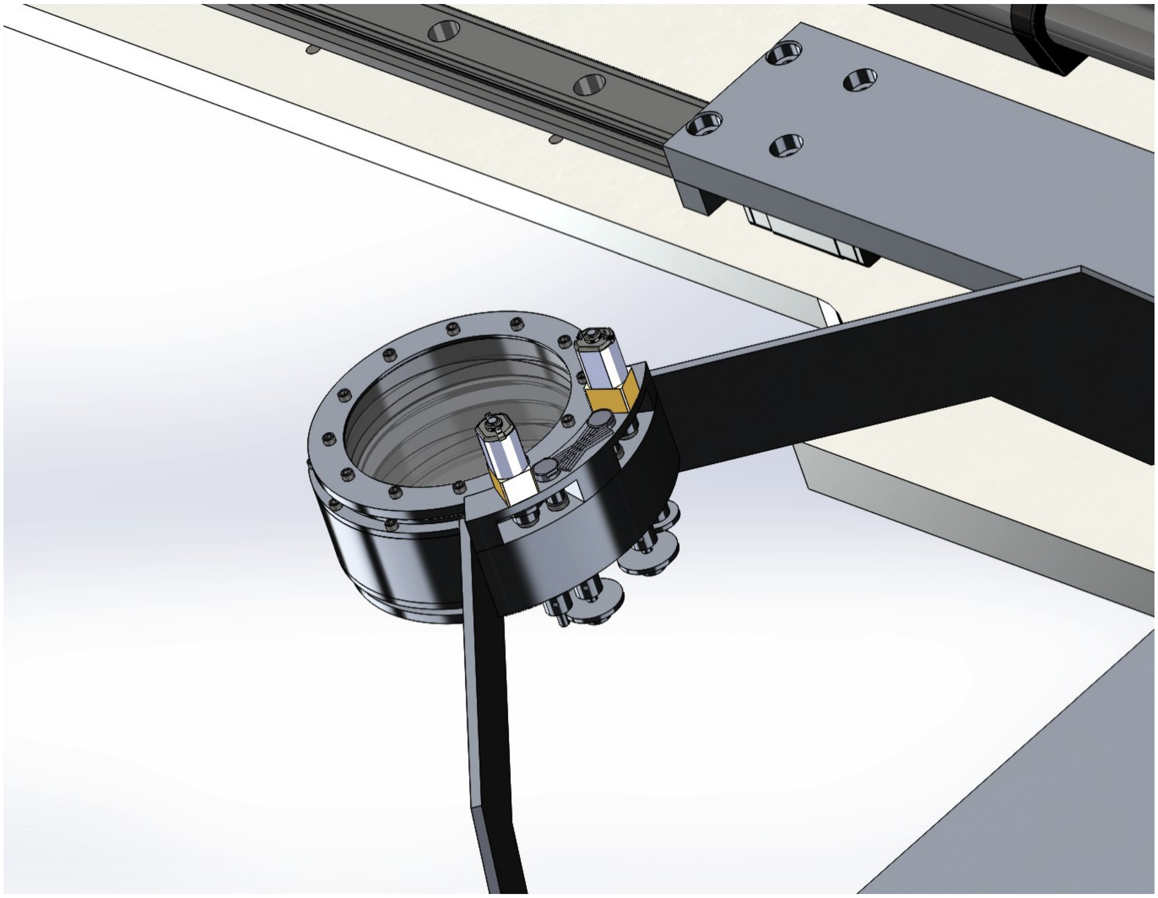

Figure 15 ADC mount on supporting vanes.

The stages are moved in and out of position using electric linear actuators. This allows the control system to only use electrical systems and simple H-bridge drivers.

https://www.progressiveautomations.com/mini-linear-actuator

The stages are attached to the actuators through some springs. When the stages are in the observing position they are pulled up against a stop and the spring is slightly compressed. In the "out" position the spring just loads the stage against the end of the actuator.

At this point the features that need to be added are the limit switches that sense the position of the stages, in or out.

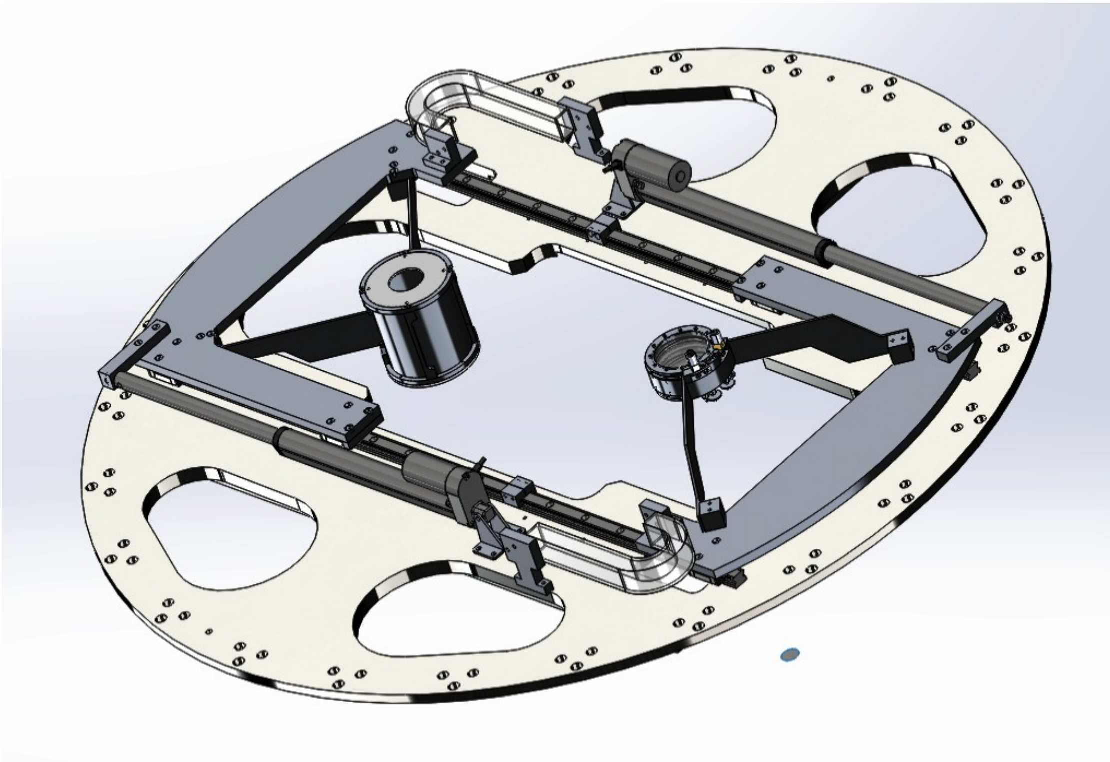

Figure 16 ADC mount (lower right) and reference cell on the upper left, both mounted on slides.

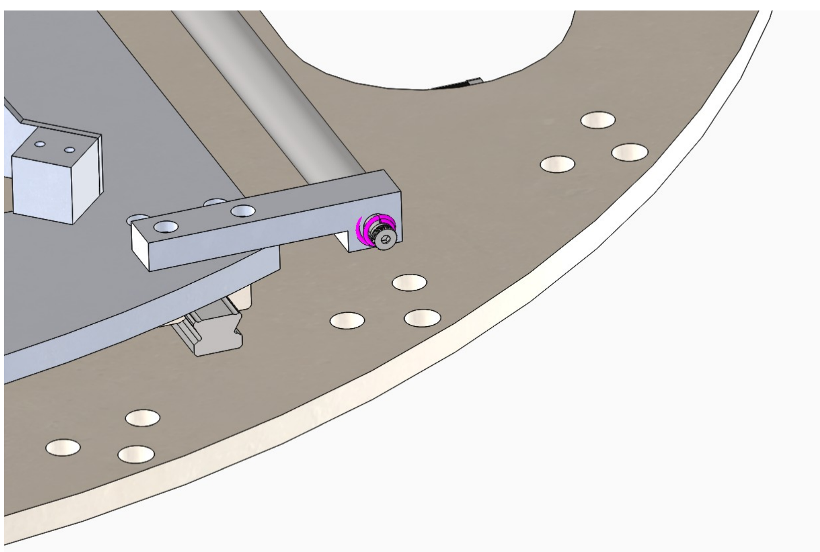

Figure 17 Spring between the actuator and the ADC/Reference cell stages.

6 Simple ADC Mounting 20170829

There has been a request to produce a simple version of the ADC that is bolted onto the current guider as an initial step to the fully implemented version of the new guider/ADC. I came up with a couple of ways to do this.

6.1 Temporary slide mount

The ADC could be mounted on a temporally installed slide. This would be attached to a plate that is bolted on to the guider with some push pull screws to center and produce the correct tilt. It's necessary to be careful in this installation as the mounting surface has not been machined, is not flat, and has no locating features.

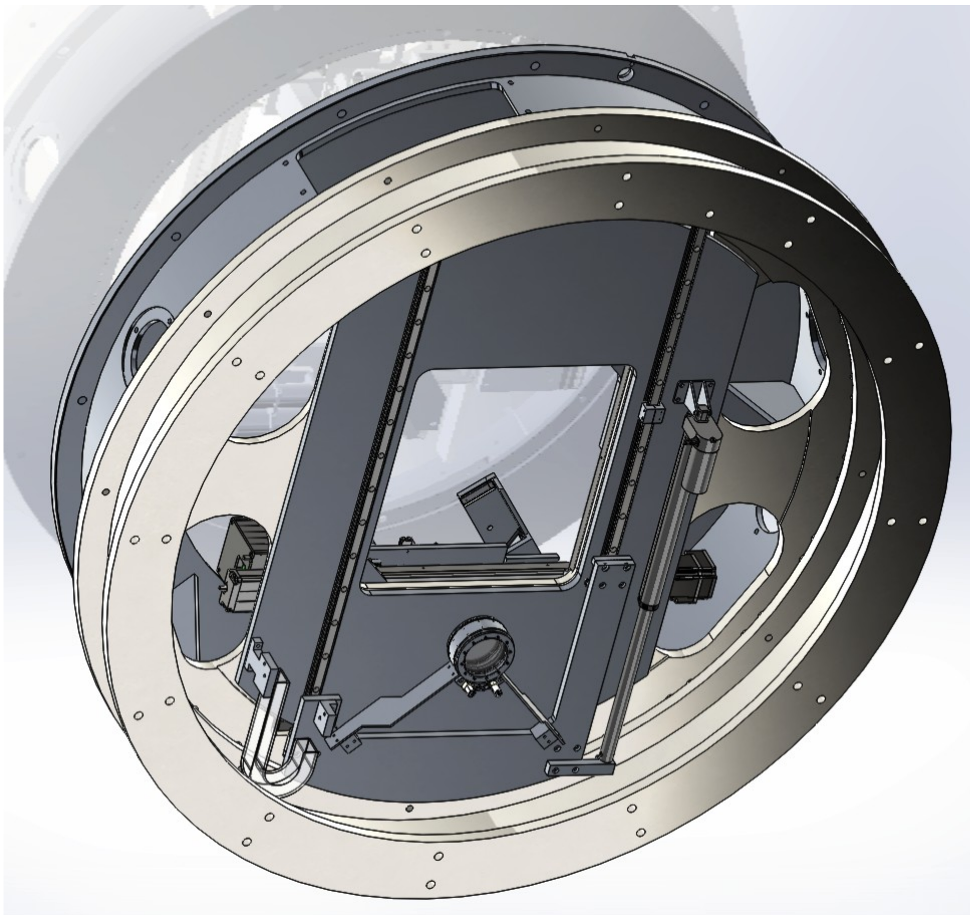

Figure 18 View of the rail mounting plate and ADC support slide.

Switching the ADC in and out could be done with the actuator or manually. This fits inside of the spacer for the guider on Magellan II.

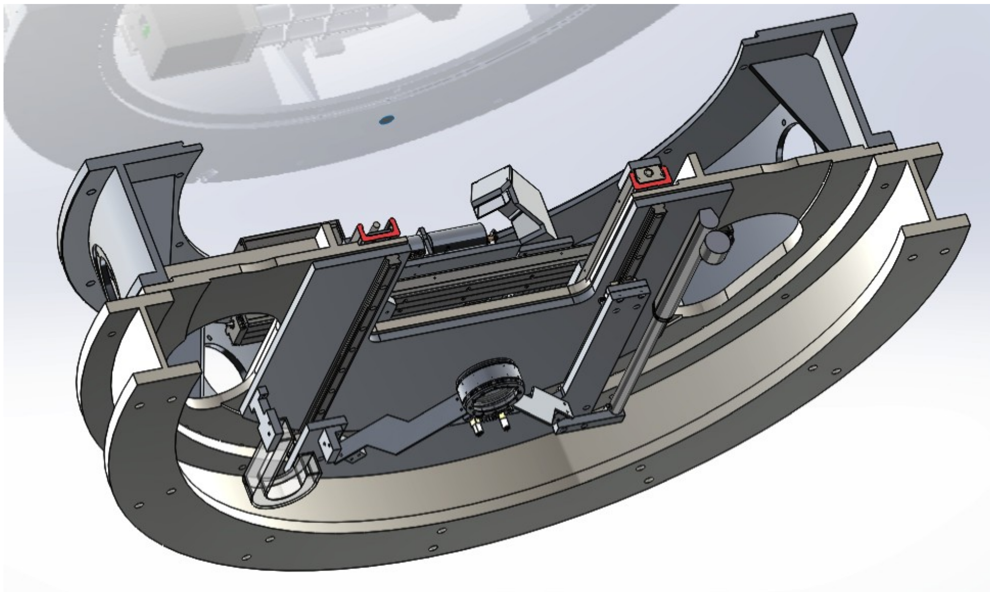

Figure 19 Section from below.

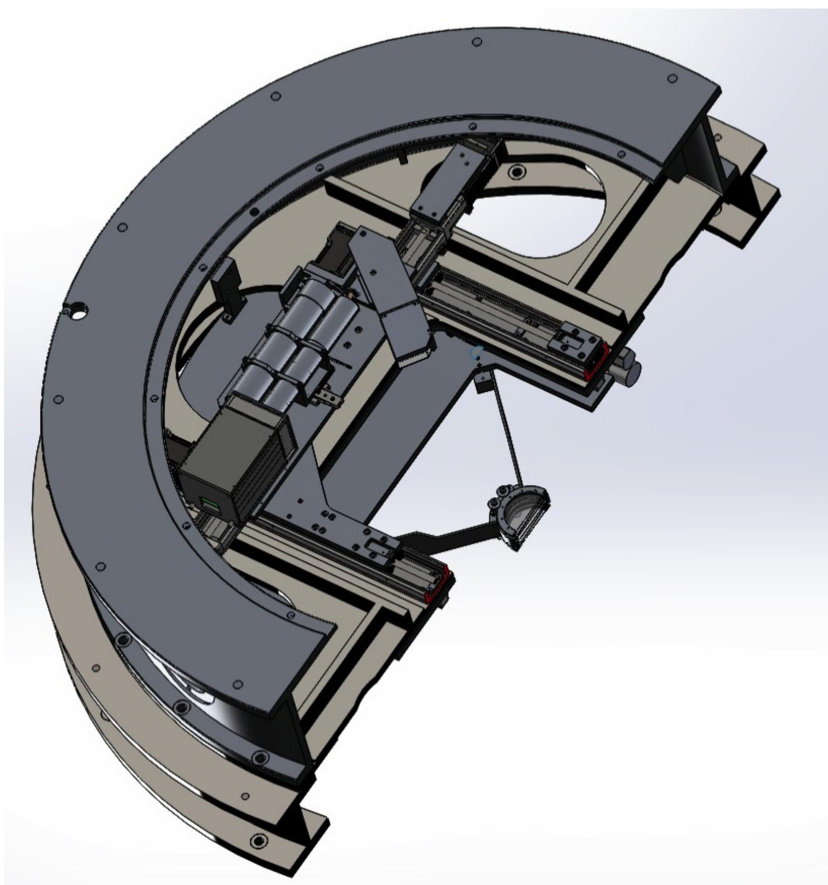

Figure 20 Section from above

6.2 Temporary fixed mount

A simpler solution that requires more manual installation is shown here. In this case mounts for the spider that supports the ADC is attached to plates that are fixed to the machined parts of guider so positioning of the ADC is much simpler. The ADC is attached at two places using some mounting screws and attached to a connector for use.

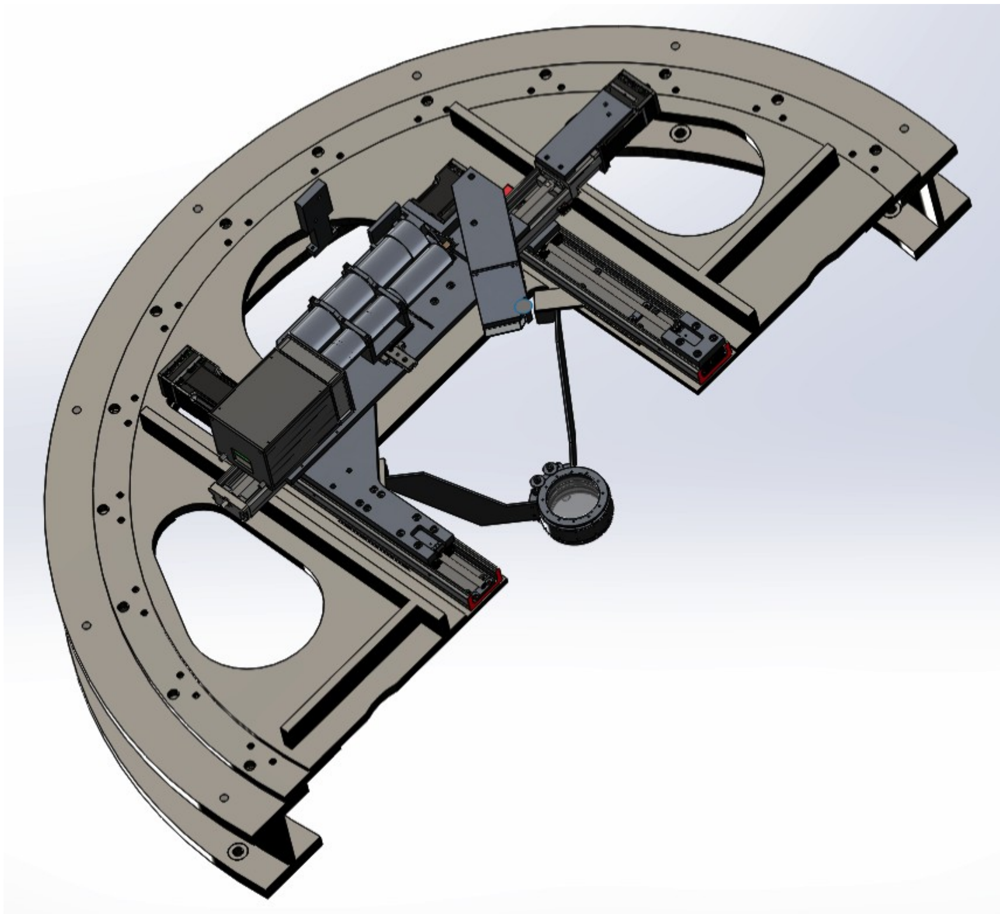

Figure 21 Section of a simple temporary mount

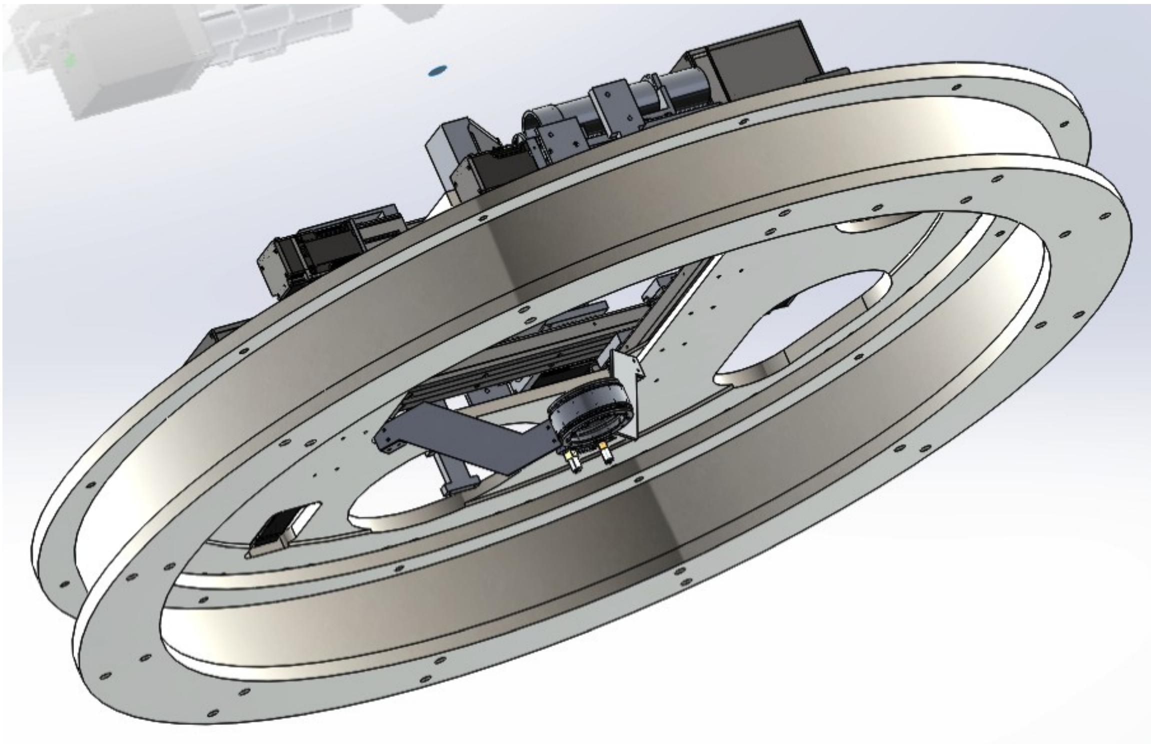

Figure 22 Bottom view of a simple mount.