FLEXURE OF THE ROTATION CRADLE

Spartan IR Camera for the SOAR Telescope

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This report summarizes the additions made to the existing rotation stage cradle design in order to support the mirrors and arm, for which the requirement on flexure is more stringent.

1 Purpose

A cradle has already been designed to hold the rotation stages for the filter wheels. Two mirror assemblies (Fig. 1) must also be rotated using the same type of rotation stage. The purpose then is to reinforce the existing rotation stage design making it more rigid. This would allow the same basic cradle design to be used for both the filter wheels and the more massive mirror assemblies with only minor changes to the design.

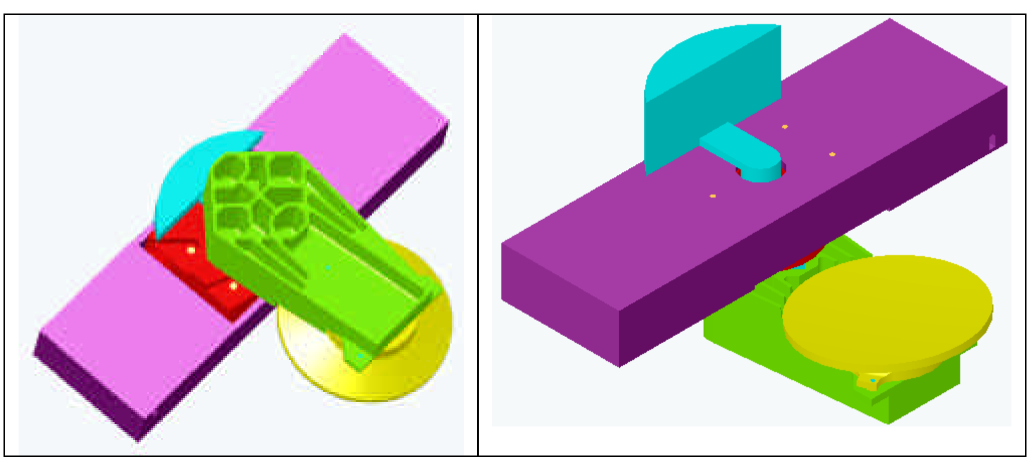

Figure 1 Mirror assembly. The cradle (purple) holds the rotation stage (red), which holds the arm (green), the collimator (yellow), and the counter-weight (cyan).

1.1 Requirements

- The mirror and arm by themselves rotate less than 4ì rad.
- When combined with the arm, rotation stage, and cradle, the mirror must not rotate more than 6µrad.

2 Model

To accurately represent the arm and the mirror while reducing the length of the analysis, a simple object with mass and center of mass equal to that the of the rotation stage was attached to the cradle. A force of 20N representing the 2 kg load of the arm and mirror was then placed on the outer surface of the cube representing the rotation stage. With this force, a torque similar to that applied by the arm and mirror was placed on the cradle while still keeping CPU time of the analysis relatively short. The rotation stage and cradle are joined at three pads. The results did not change when the size of the pads changed from a 5-mm square to a 20-mm square.

When in use, gravity will be in a plane parallel to the feet of the cradle. Two extreme cases, gravity perpendicular to the face of the cradle and parallel to its surface, were run. Gravity parallel to the face is the more difficult case.

3 Results

With the original design of the rotation stage, the rotation due to gravity is 1.8 ì rad. (See Table 1 and Figure 2.)

A wall placed across the cradle near the edge of the rotation stage stiffens the cradle. The rotation with a 1/4-in wide reinforcing wall of the full height of the cradle is 0.9ì rad, which is a factor of 2 better than having no wall. A wall will be used.

Table 1 Rotation vs dimension of the wall. The displacement is given at the three feet of the rotation stage. Feet A and A' are separated by 50mm. Foot B is 100mm from the line joining the other feet.

Wall	Displacement @ (A, A',B) [nm]	Rotation [ì rad]
6.4×1mm	(55,–33,9)	1.8
6.4×50mm	(18,–29,–6)	0.9
6.4×10mm	(41,–29,–3)	1.4

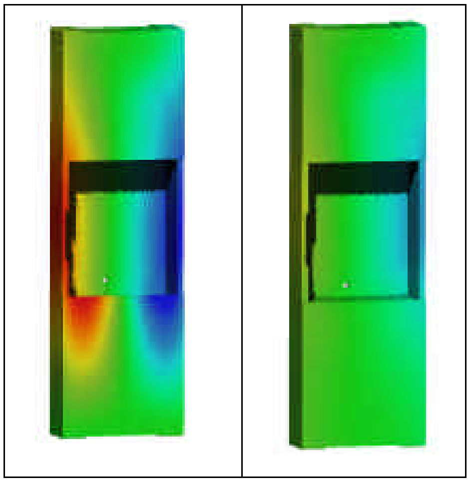

Figure 2 Displacement towards viewer with gravity to the right for a cradle with a stiffening wall (right) and without it (left). The extremes are +100nm (red) and –100nm (blue).