Assembly Outline

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The alignment of the demo coronagraph requires some familiarity with standard optical alignment techniques and the use of standard optics mounts, as well as good judgment as to when PSFs and images are in good focus. For cost reasons, most mounts in BabyCAT do not have adjustment actuators. As a result, adjustments have to be made by carefully sliding mounts across the breadboard and by sliding posts up and down in post holders. Care is required when performing these movements and when screwing down mounts in their final location.

The final goal is a demonstration that is visually instructive regarding the operation of a coronagraph for exo-planet imaging. Precision alignments may not strictly be necessary to achieve this. However, experience has shown that some care and finesse is needed to align the system well. Otherwise, there will be appreciable aberrations (primarily astigmatism) visible in the system PSF and the “star” light will not be effectively rejected. It is also possible to have a system that is nearly aligned, but a mechanical interference presents itself when attempting to, for example, perform final focusing on the Lyot stop. Multiple iterations of the alignment procedure may be required to achieve good optical alignment without any interferences.

Be sure to have a sheet of **lens tissue or a business card on hand so that the beam path can be traced out.**

1. Set height of optics and laser to match the (arbitrarily set) height of the focal-plane mask (FPM).

2. Use the laser to define the initial optical axis, roughly aligning the system aperture and the first spherical mirror to the beam.

3. Set the relative positions of the FPM and first spherical mirror, and the tip and tilt of the spherical mirror.

4. Roughly align the FPM aperture to the focus produced by the first spherical mirror. Auxiliary optics (re-imaging lens) are used to image this onto one of the cameras (temporarily placed). The tip and tilt of the FPM also need to be adjusted at the same time to make sure that the reflected beam falls in an appropriate location on the second spherical mirror.

5. Adjust the position and tip/tilt of the second spherical mirror so that the beam is roughly collimated and passes near the FPM, roughly parallel to the long axis of the breadboard.

6. Place the Lyot stop (iris) so that it is roughly concentric with the beam after reflection off of the second spherical mirror. The Lyot stop should be placed closer to the breadboard side of mirrors 1 and 2 than the FPM.

7. Adjust the position and tip/tilt of the third spherical mirror so that an image of the system aperture is formed on the pupil camera at a convenient location on the breadboard.

8. Insert the beam splitter and direct the beam so that the reflected beam forms an image of the “star” on the imaging camera.

9. Adjust the final focus of the system aperture on the pupil camera, and then adjust the

focus and positioning of the Lyot stop.

10. Adjust the final focus of the FPM and image on the imaging camera. This requires iterating between the position of the FPM and the position of the camera and great care must be taken here to avoid knocking the system out of alignment.

11. Check to make sure that a good coronagraphic image is formed when the FPM is blocking the beam and the Lyot stop is closed down.

12. Final tweak of alignment and verify operation.