Procedure for SDSS M1 Mechanical Collimation

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Cautionary Notes

- Only people trained by observatory staff may execute this procedure.

Equipment Required

- Depth gauge with 1/8" spindle. This is kept in the tool cabinet in the engineering trailer.
- If the common corrector ring is mounted, you will also need:
    - Brass depth measuring jig and Allen wrench with truncated short arm. This is also kept in the tool cabinet in the engineering trailer.

Initial State of Telescope

- All instruments removed (excluding the spectrographs) and safely stowed.
- Spectrograph corrector removed and safely stowed.
- If possible, perform this procedure before mounting the common corrector mounting ring (and thus before mounting the common corrector and primary light baffle).

Notes

- VMS/DCL command ($ prompt) are indicated by a leading $. You need not type the $.
- TCC commands are listed as such. If you have a $ prompt and want to issue a TCC command you must start the TCC using `$ telrun`. If you are in the TCC and want to issue a VMS/DCL command, exit the TCC using `exit` or ^z.

- Commands within text (rather than on their own line) are shown in double quotes. Don't type the quotes.
- If you have the monitor space, consider using two TCC logins, one for VMS/DCL level commands and one for TCC commands. This is especially helpful while moving mirrors with setmir, as the TCC window will show you how long each move will take.
- ^z means control-z; similarly for ^\, etc.

Procedure

1. Move the telescope to 70 degrees, e.g. using the Menu.

2. Press a stop button.

3. Confirm that the M1 actuators are homed with TCC command `"mir status prim"`. If any are not homed you will see a warning message: `W Text="Cannot compute PrimOrient; not all axes homed"`.

4. If any M1 actuators are not homed, home them, e.g. with TCC command `"queue run=homeprim"`.

5. Check collimation. Perform this check only if you trust the Mitutoyo readings! Thus if you have changed the batteries in the Mitutoyos or have done work may have affected the Mitutoyo readings, please skip this step and go on to direct measurement.
    A. Read a recent night log to obtain the current desired Mitutoyo readings for M1 when in optical collimation.

    B. Bring up the TPM display of the mirror position (the Mitutoyos).

    C. Move M1 to its nominal optically collimated position by using setmir to talk to the primary mirror and specifying the desired orientation that you just recorded.

    D. Relax M1 using TCC command `"queue run=relax"`. While the mirror is relaxing, watch the TPM display to verify that the Mitutoyo positions are updating.

    E. What to do next depends on how close the Mitutoyos are:
        - If the Mitutoyos are much worse than 0.003" off, something is wrong. Do not trust the Mitutoyos. Continue with the rest of this procedure, directly measuring the position of M1.

- If the Mitutoyos are just a bit worse than 0.003" off, move the mirror around with setmir to try to bring the mirror into its proper position (keeping in mind that setmir translations are in μm). Remember to relax the mirror after any transverse move (relaxing isn't necessary after every change in tilt, though you should perform a final relax step to confirm the stability of your final position).

- If you can get the Mitutoyos to within 0.003" then M1 is in adequate collimation for now: skip to the very last step of this procedure. If you cannot get M1 sufficiently close, then you must continue with the rest of this procedure.

6. Use setmir to move the primary to its nominal mechanically collimated orientation 0 0 0 0 0:
   - `$ setmir`
   - tell setmir to move the primary mirror to orientation 0 0 0 0 0
   - exit from setmir **without** enabling collimation (be careful, this is not its default).
7. Relax M1 using TCC command `"queue run=relax"`.

8. Measure the position of the mirror using one of these two techniques, depending whether or not the common corrector mounting ring is mounted:
   I. If the common corrector mounting ring is not mounted: There are six measurement ports in the M1 lifting fixture (which is pinned and bolted to the PSS); they allow you to measure the distance to the inner side wall of the mirror. The holes are at N, S, just N and S of E and just N and S of W. They are marked with the correct readings. Use a depth gauge with a 1/8" spindle. Measure depth at each of the six measurement ports.

   II. If the common corrector mounting ring is mounted: Use the brass depth measuring jig. The jig allows you to measure the mirror position through one particular hole in the common corrector mounting ring. Thus you need to turn the rotator for each measurement.
      - Turn the rotator until the notched hole in the common corrector mounting ring is aligned with a measurement port in the M1 lifting fixture. See the table below for the correct angles.
      - Press a stop button to lock out rotation
      - Mount the measurement jig to the measurement port. Tighten down down the clamping screw with the associated Allen wrench with the truncated short arm. Be careful: any error in mounting the jig will directly affect your measurement.
      - Measure depth using the depth gauge and a 6" quill.

- Repeat for each of the six points:
- position desired depth rotator angle
- N 6.096 44:30
- EN 6.095 127:00
- ES 6.091 143:10
- S 6.088 225:00
- WS 6.078 306:40
- WN 6.095 322:50

9. Determine how far to move the primary, in microsteps (the units used by the Galil motion controller):

actuator	microsteps/inch	plus moves M1	
D	400,000	west	
E/F	800,000	south	(note: always set F=E)

13. Move the primary actuators. Be sure to always move E and F to the same location; this avoids rotating the mirror. The following commands will do the job:

```
$ host tcc_prim
D = desired-change-in-D
E = desired-change-in-E
F = E
XQ#MOVEREL
^\
```

Alternatively, you may set D, E and F to the desired absolute position (again, always set F=E) and use the command XQ#MOVE.

14. Relax M1 using TCC command `"queue run=relax"` (always relax the mirror after moving D, E or F).

15. Repeat the measurement and correct the position as necessary. There is no need to mechanically collimate to better than about 0.003" because final collimation is done on the sky. Also, it is difficult to get accurate measurements by reading off of the rough glass so you can easily waste time chasing noise.

16. Enter the final D, E and F positions in tdat:mir.dat as values for PrimMountOffset. Leave the A, B and C values alone (they have to be measured with other techniques).

17. To finish collimating the telescope you will need to collimate M2 (add a link!) and perform final M1 collimation on the sky (where is the procedure?).

Document History

- 2004-09-29 R. Owen: changed command to relax the primary mirror from `queue run=relax20` to `queue run=relax`. Relax is a new procedure that works much better than relax20.
- 2003-07-02 G. Van Doren: loaded on website.
- 2003-06-16 R. Owen: first release.