



# MULTIPLE MIRROR TELESCOPE OBSERVATORY

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Subject: New Instrument Rotator Software

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## NEW INSTRUMENT ROTATOR SOFTWARE

In an effort to improve the safety and convenience of operating the MMT instrument rotator, we have expanded the control software which resides in the mount control program. Basically, we added another position angle offset and a pair of software limits. Figure 1 shows the new format for the Lexiscope status display. The lower right-hand portion of the screen contains five position angles. The center one, ROT-PA, is the commanded rotator position angle. Recall that at the present the computer cannot read the actual position and, therefore, assumes that the rotator hardware is turned on and is following the commanded position. ROT-PA should always agree (within  $\pm 0.1^\circ$  or so) with the actual rotator angle which is displayed on the panel meter in the console. If it does not, you probably have a hardware problem in the rotator servo system. The software limits are MAX-PA and MIN-PA; they are set by the telescope operator at the mount control ADM-3A video terminal by typing

20.0 MAX-PA cr

5.0 MIN-PA cr.

There are also two offsets which may be similarly set by the operator. The first one is called ZERO-PA, and it is the actual rotator angle which puts the detector position angle to zero. For the spectrograph ZERO-PA is the rotator angle which makes the slit vertical on the sky. The second offset is SKY-PA and it should be set to the desired astronomical position angle for observing, recalling that from north to east the angle is positive and from north to west it is negative. Therefore, if the instrumental offset were  $-23.6^\circ$  and the desired position angle were  $+35^\circ$  then the operator should enter

-23.6 ZERO-PA cr

and

35.0 SKY-PA cr.

See Figure 1 for a sample status display. The commanded angle (ROT-PA) is now the sum of the angle from a line of constant azimuth to a line of constant hour angle plus ZERO-PA plus SKY-PA, so changing either of these parameters will affect ROT-PA.

When the desired value of ROT-PA is outside the software limits, three things occur. First, the desired value of ROT-PA will be accurately displayed without clipping so one can see where one has to go. Second, the actual commanded position voltage coming out of the computer will be clipped within the software limits to avoid breaking short cables or causing other problems. If the desired change is discontinuous, as may happen when changing sources, the rotator will stay at its previous position rather than run to and stop at the limit. Third, a flashing message will appear near the bottom of the display indicating that the desired angle is outside the range of the limits. See Figure 2 for an example.

Finally, recall that the possible angles are limited both in software and in hardware to  $\pm 180.0$  degrees.

#### ROTATOR PERFORMANCE SPECIFICATIONS

There are three final specifications on instrument rotator performance:

- (1) Maximum slew rate  $\geq 90^\circ/\text{minute}$
- (2) Absolute setting accuracy  $\pm 0.2^\circ$
- (3) Rotation accuracy  $\pm 2\frac{1}{2}$  arc minutes

The first two goals are met with the existing hardware. However, the third goal is not. Presently, the precision of the computer steps is 6 arc minutes, which results in steps while tracking a source two arc minutes off-axis of 0.2 arc seconds. Reducing the step size from 6 to  $2\frac{1}{2}$  arc minutes would mean worst-case steps of 0.09 arc seconds apparent image motion anywhere within the 4 arc minute field of view. Improving the present performance requires two significant jobs to be carried out. First, the computer hardware must be improved at a cost of ~\$1K and 4 man-weeks. Second, the instrument rotator mechanical assembly must be removed from the MMT for a period of ~ 1 week and readjusted. The present friction is so large that the least motion of the ring is now ~3-4 arc minutes. In fact, it takes considerably more torque to turn the rotator than it does to turn the telescope!! In view of the considerable effort required to meet the last specification, I would like to hear the opinions of the users of the MMT regarding this work. Is the extra effort required to meet the tracking resolution specification of  $2\frac{1}{2}$  arc minutes worthwhile? Please call or write if you have questions or comments.

BLU/jbr

Attachments



# FIGURE 2

SOURCE: tota cen      3 DEC 1981      UTC 14:51:59      DUT 0.064      LAST 12:17:48      HORIZON 4:38

STAR # 181      PADDLE SLOW FAST      AZ/EL 1.0 10 "/SEC      Airmass 2.893

ENCODER	166:51:11.3	AZ	20:13:41.8	EL	1950	R.A.	13:17:45.78	DEC	-36:26:59.8
ERROR	-0:00:00.1		-0:00:00.0		CURRENT		13:19:32.57		-36:36:42.7
VELOCITY	0:00:12.3		0:00:03.1		OFFSET	0.0			0.0
TRUE	166:50:42.4		20:11:18.0		ACTUAL		13:19:32.57		-36:36:42.7
INSTRUMENT	166:51:11.4		20:13:41.9		H.A.		-1:01:43.95		
MODE	Int/Track		Int/Track						
DIAL	0.0		0.0		SKY-PA		35.0		
COLLIMATION	0.0		0.0		MAX-PA		20.0		
OFFSET	0.0		0.0		ROT-PA		25.2		
REFRACTION			114.4		MIN-PA		13.0		
CORRECTION	30.2		29.6		ZERO-PA		-23.6		

FTEMP 51      PTDRR 555      REFR COEFF 42.4      ERR 0.2

Attempting to exceed software limits of image rotator !!!