

# Rotator Angles, Operation and Limits

## Observing Angles

When acquiring spectra of astronomical objects, the observer will want to select the on-sky position angle at which to orient the slit.

Often, particularly for point sources, the optimal position angle is the Parallactic Angle. This is the angle at which the slit is aligned with the direction from the target to the zenith. When observing targets that are away from the zenith, the light is dispersed in the vertical direction as a result of terrestrial atmospheric refraction. If the slit is not aligned vertically then certain wavelengths of light will fall outside the slit, and the resulting spectrum will not capture all of the light from the object. This is especially true for observations at the blue end of the optical spectrum. To track the parallactic angle, the operator can choose 'track from zero'. However, if the object is close to transit, the operator will "sweep" the parallactic angle so that, for example, instead of ending 50° away from the original PA, the angle will move from -25° to +25°. There is the option to manually guide, although this is more time-consuming and not recommended.

In some cases, the observer will want to keep the slit oriented along, for instance, the major axis (longest dimension) of an extended object such as a galaxy. This Position Angle is generally measured from north in an easterly direction. For these types of observations, the position angle should be tracked by turning the rotator on.

## The Rotator

The MMT rotator has hard limits given by the Rotator Angle. These vary by instrument. There are also imposed software limits on the rotator angle that are set by the telescope operator. The operator may need to adjust the rotator 180° in order to avoid limits before starting an exposure.

Table 1. Currently Used Limits of Rotator Angles for MMT Instruments

INSTRUMENT	HARDWARE LIMIT	SOFTWARE LIMIT
Blue/Red Channel Spectrograph	+/-105°	+/-90°
SWIRC	+/-175°	+/-150°
Hectospec/chelle	+/-105°	+/-75°
ARIES	+/-105°	+/-90°

MAESTRO	+/-110°	+/-110°
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The rotator also contains an offset of 0.5°. For the Hecto instruments, this 0.5° is accounted for in the software. However, for the Blue and Red Channel Spectrographs, this is not taken into account. Observers attempting to get two objects in the slit that are far apart may notice this small offset. The operator may need to jog the angle 0.5° in order to produce the desired result, though not all observers will require this precision. When specifying a position angle of 0°, the true position angle is -0.5°. Therefore, to get to a true position angle of 0°, you would need to increase the commanded position angle, or reduce the rotator angle.

The rotation rate is -5°/sec to +5°/sec with a ramp rate of -1°/sec<sup>2</sup> to +1°/sec<sup>2</sup>. The accuracy is <2".

### Catalog Information

In the current version of the catalog submission tool, the default uploader does not require a position angle column. The observer can add position angles by following the instructions at <http://mmt.org/node/374> and reading about the %haspa format:

%haspa This catalog has an extra column following the epoch which gives a position angle in degrees for each object. This value will be used to position the instrument rotator when a slew to that object is commanded. If no rotator motion is desired when moving to an object use the word "none" or just a dash "-" in the PA column. Omit the %haspa and the PA column if you do not want the rotator to move when the telescope slews to your objects.

Further questions about the format should be directed to Dallan Porter or Tom Trebisky.

It is not required for observers to have position angles in their catalogs. Desired angle values can be given to the operator at the time of observation. In many cases, this is the preferred way to incorporate rotation angles into the observing, simply due to the fact that the angle often has to be adjusted anyway, either due to the 180° degeneracy or due to errors in angle measurement from sources such as the NED database.

### Reading the Telstat Display

Standard telstat information (located at the web address <http://hacksaw.mmt.org.arizona.edu/telstat/telstat.php>) includes Parallax Angle, Rotator Angle, and Position Angle, located in the lower left of the screen.

There is a telstat widget entitled "Rot. Time to Limit" which contains the time in minutes until a rotator limit will be hit. This should help observers predict whether a position angle they choose might result in hitting a limit before an exposure is completed.

Due to the fact that offsets accumulate for a variety of reasons, the offsets shown on the telstat may not exactly match those that observers may have specified to the operator. This does not mean that the operator has not put the offsets in as requested.

### Online Help

Parallactic angles for objects over the course of the night can be calculated using free software such as JSkyCalc, which is installed on the 'pixel' observers machine in the MMT control room, or can be found at <http://www.dartmouth.edu/~physics/faculty/skycalc/flyer.html>. The software iObserve may be helpful and is installed on 'pixel'. There are also online calculators such as the one located at <http://www.bo.astro.it/~altavilla/parang2.html>.