P60 Target Submission

Example Target Lists

- SN photometric monitoring
- Imaging nearby galaxies
- Intensive photometry campaign
- Photometry + calibration

Targets

A target is a collection of observations at or near a specific location on the sky, each of which should be considered approximately equal in priority for queue-scheduling of observations.

Examples include:

- A single snapshot of a single target
- Multiple images of a single target, extending over a period of time (either continuous monitoring, or multiple epochs)
- Single-epoch images of a target in multiple filters
- Deep imaging of a target region, taken over one or more nights
- Observations of a target field along with "nearby" local calibrators
- A mosaic of images covering a specified region of the sky, in one or more filters, at one or more epochs
- A systematic monitoring campaign (at either regular or irregular intervals) on a single target

Targets may be non-fixed (e.g. asteroids or candidate Kuiper belt objects) but there must be an efficient way for the scheduler to look-up or compute the location of the target at any given time. We intend to implement a JPL minor planet database look-up for these purposes. Currently the TCS is not accepting proper motion specifications but these, also, should be allowed eventually.

If observations of a source incorporate both a low-priority long-term monitoring campaign and a high-priority short-term sequence of observations then they would have to be specified as two distinct targets.

Target Specification

Targets are specified to the scheduler via a loosely-formatted ASCII text file. Each individual target specification is as follows:

```
NAME  RA  DEC  EQUINOX
    PROPERTY1  ARG1  ARG2  ...
    PROPERTY2  ARG1  ARG2  ARG3 ...
```

The first line has `NAME RA DEC EQUINOX` with no leading whitespace. `NAME` is the target name and

need not be unique (although it will probably be helpful to you if it is). The RA and DEC are specified as either colin-delimited sexagesimal hours/degrees or as decimal degrees/degrees. EQUINOX specifies the equinox of the RA and Dec. Each parameter is separated by whitespace (of arbitrary length or type) from the others.

Once proper motion targets are supported, the initial four-parameter line will be (optionally) expanded with the addition of PMRA and PMDEC, the proper motion in arcsec per year in RA and Dec, respectively.

Subsequent lines *must begin with leading whitespace* and specify properties of the target. There may be an arbitrary number of these lines, and the ordering is not important (except for the specification of exposures and subtargets; see below). The syntax is `____PROPERTY ARG1 ARG2 [...]` where `____` is the leading whitespace, PROPERTY is the name of the property being set, and the subsequent arguments ARG1, ARG2, and so forth, specify the qualities of that target property. In general the order of these arguments, and the presence of whitespace between each, is important, while the particulars of the length and type of whitespace are not; all arguments to the property must be made before the newline (no continuations). Property names are not case-sensitive.

Nonsidereal Targets: Please see the nonsidereal targets page for an explanation of the various types of nonsidereal targets that are accepted, and how they may be specified.

Target properties

`Priority PRIORITY`

PRIORITY is the numerical priority of the target, greater than zero (zero-priority targets will not be observed). Default PRIORITY is 1.0. There is no preset "maximum priority" but in general you are restricted from setting arbitrarily high priorities by the TAC process. The priority of most targets (see time-weighting schemes, below) increases monotonically with time so that eventually all objects in the queue are observed.

`Repeat REPEAT`

REPEAT is the integer repeat count for the exposures requested for the target.

`Exp FILTER [TIME [EMULT [EDITHER1 EDITHER2 ...]]]`

Specifies an exposure in the filter FILTER of length TIME seconds, repeated EMULT times. The full filter set is UBVRIgriz along with Ha20, Ha100, and Ho20 for the three H-alpha related filters (see the P60 table for details); note that *filter names are case-sensitive* in the sense that R (Cousins) is different than r (Gunn). The default TIME is 30 seconds, and the default EMULT setting is 1 (no repeat). Exposures will be executed strictly in the order in which they are listed, and each individual exposure will be executed the full EMULT times before the next exposure in the sequence.

EDITHER settings, if provided, will specify the exact set of dither positions for the observations. An arbitrary number of positions may be specified, and the list will be cycled through as many times as necessary to exhaust the EMULT exposures. Each EDITHER gives the arcsec offset in RA and Dec from the target coordinates as a comma-joined couplet, ARCSEC_EAST,ARCSEC_NORTH, e.g. "30.0,-20.5". There must not be any whitespace in the individual EDITHER specifications, only the comma.

`Target NAME RA DEC EQUINOX`

Specify a "subtarget" of the current target. Exposures associated with this target, rather than with the parent target, must be indented by an additional quantity of white space *over and above* the indentation used for the properties of the parent (this original indentation should stay consistent, as well -- please do not mix tab and space characters!). Subtarget exposures are treated just as if they were exposures of the parent target - they are simply taken at a different place on the sky. As such, they inherit the score of the parent target, and should be located close to the parent in angular distance; otherwise the facility may attempt to observe the subtarget when it is not observable.

It is possible to change binning, region of interest, offset and dither settings, and other properties of the subtarget: simply indent the property specifications appropriately and they will apply to the subtarget only. Otherwise, the subtarget inherits all properties of its parent *except for* `Mosaic` settings.

`Mosaic NRA NDEC`

Request a mosaic set of pointings. The mosaic will be centered at the target coordinates and extend over `NRA` FOV-widths in RA, and `NDEC` FOV-heights in Dec. Default settings are `NRA=0` and `NDEC=0` for a single pointing. In executing the mosaic, a grid is defined with its origin at the target coordinates and a grid spacing of half the FOV. Images will be taken at every intersection of the grid: Every part of the region covered by the mosaic will be imaged 4 times, and the total number of pointings will be (2*`NRA`+1)*(2*`NDEC`+1). Partial coverage of this area is possible by specification of a full matrix of truth values - see the P60 mosaics page for details.

The sequence of pointings in the mosaic is executed as four successive spirals, beginning at the pointing center (target coordinates) and ending along the periphery. Each of the four individual spirals is a set of strictly non-overlapping pointings. It is probably preferable for mosaic sequences to zero out (or substantially reduce) the `Dither` setting, to maintain proper overlap of these frames.

`Dither DRA DDEC`

Specify the size of the "dither box" in arcsec of RA (`DRA`) and Dec (`DDEC`). The default dither box is currently 60 arcsec by 60 arcsec but that may change. Each exposure will be taken at a random point within a box of this size, centered on the target coordinates. The alternative to this random-dither approach is to specify the coordinates for each exposure explicitly using the `EDITHER` facility (see above). An explicit setting of `EDITHER` will "turn off" random dithering for that exposure.

`Offset DRA DDEC`

Specify an offset from the target coordinates in arcsec of RA (`DRA`) and Dec (`DDEC`). The default of (0,0) will point directly at the target coordinates; however, this is at an amplifier boundary and there is a bad column or two nearby. An offset of (180,-180) will place a small or slightly-extended target in a cosmetically nicer portion of the detector, and away from the amplifier boundary.

`Binning NBIN`

Specify the pixel binning of the observation to be `NBIN x NBIN` pixels. In general you will not want to change this from the default value of `NBIN`=1.

`ROI X1 Y1 LX LY`

Specify the region of interest for the observation. Note that the (1) The specification gives the `(X1,Y1)` coordinates of the lower-left corner of the targeted region, and the `(LX,LY)` extent of the region in `X` and `Y`, respectively. Note also that the actual on-chip ROI will be symmetric across the amplifier boundary (mirror symmetry) because of the nature of the dual-amplifier CCD readout. Our default configuration of `ROI 1 1 2048 2048` will read out the full chip. Our "first alternate" `ROI 1025 1 1024 2048` will read out the right or Northern half of the chip only. If you specify less than a full-chip ROI it is your responsibility to set an appropriate `Offset` so that your target is in the active area of the CCD.

`Weight WEIGHT CUTOFF SLOPE`

Specify the target weighting for the `WEIGHT` parameter. Possible weight parameters are: `Airmass`, `Seeing`, `Night` (fraction of the night), `Moondeg` (moon distance), `Extinction`, `Sky` (sky brightness). Currently only the `Airmass`, `Night`, and `Moondeg` weights are supported but `Seeing` will be supported soon; for a detailed description see the next section.

`Timing TIMING [ARG1 [ARG2...]]`

Specify the timing priority scheme; for a detailed description see the timing section below. The default timing scheme is `Log` timing, which means the priority of the target increases monotonically with time (as the log of the elapsed time in days). This will guarantee eventual observation of any visible target.

Alternate time-weighting schemes include: `Monitor`, for regular observations of a target; `Window`, to specify a fixed window during which to observe the target; and `Phase`, to specify observation times according to some ephemeris. Multiple time-weightings for a particular target are allowed; this would probably be most useful to jointly specify a timing window and phase ephemeris.

`Property NAME INT`

Generic facility for specifying additional properties of the target. The property `NAME` can be any string (no whitespace); the argument `INT` must be an integer (typically envisioned as 0 or 1, e.g. boolean). This facility is not yet intended for use by guest observers, and there will be some reserved property names which are restricted for facility use only. Currently the reserved property names are `ILLEGAL`, `FOCUS`, and `STANDARD`.

`Obsnum N`

Specify the number of observations taken to-date for this target. This is not usually useful on target submission (the default of zero is most appropriate here), but rather, is used by the scheduling software to keep track of the progress in observing a given target from night to night. When `Obsnum` becomes equal to `Repeat` then the target is officially Done.

`Obstime MJD`

Specify the most recent completion time of a full iteration of exposures for this target, as a floating-point MJD (modified Julian day, e.g., JD - 2400000.5). This numbers are used to implement the time-weighting scheme. When the target is first read into the scheduling system, the `Obstime` is equal to zero, and it remains such until the first epoch of exposures.

Target Scores

The target score is calculated from the raw priority and the various target weights (including the timing weights). All of these weightings are multiplied by the priority to get the final target score. If any individual weighting is zero then the final score is zero.

The generic sense of weighting is that the priority of the target will be adjusted based on the value of a certain parameter. The function which takes the parameter value to a particular weighting is linear, and specified by two values: the CUTOFF and the SLOPE. The CUTOFF is the maximum allowed parameter value; if the parameter value is greater than the CUTOFF then the weighting is zero (and the resulting target score will be zero). Moreover, all weightings are structured so that lower values of the parameter are preferred. The SLOPE is the normalized slope of the weighting function, a floating point number from 0 to 1. A SLOPE of 0 means the weighting is indifferent to the value of the parameter so long as it is less than the CUTOFF, while a SLOPE of 1 means that the weighting is maximally sensitive to the value of the parameter, increasing dramatically as the parameter value decreases.

`Weight Airmass CUTOFF SLOPE`

The Airmass weighting takes the current airmass of the target as its parameter; the parameter range is [1.0, 5.75]. The default setting is a CUTOFF of 2.5 and a SLOPE of 0.25; this gives preference to low-airmass sources.

`Weight Night 24.0 SLOPE`

The Night weighting is a special-case weighting with a CUTOFF value that is calculated by the scheduling software as the number of hours that the target will be visible during the night. The parameter of the Night weighting is the number of hours left before this visibility window for the target (including the duration of all specified exposures) closes, given its Airmass CUTOFF setting (Moon angle constraints are not considered). The parameter range is from zero to the total number of hours in the night (defined as 12-degree twilight). The default SLOPE of 0.5 gives a higher score to setting targets, and is very important in improving scheduler efficiency. If for some reason it is important not to prefer observations of your target later in the night then you should set the SLOPE for this weighting to zero.

`Weight Moondeg CUTOFF SLOPE`

The Moondeg weighting takes 180 degrees minus the current angular distance from the target to the moon as its parameter. We subtract the angle from 180 degrees to get the usual sense for the parameter, wherein smaller values of the parameter are desirable; the range is [0, 180]. The default setting is a CUTOFF of 150 and a SLOPE of 0.1. With a CUTOFF of 150, no observations will be scheduled when the source is within 30 degrees of the moon; with a SLOPE of 0.1 there is a slight preference for scheduling observations when the source is further from the moon.

`Weight Seeing CUTOFF SLOPE`

The Seeing weighting takes the current value of the atmospheric seeing (in arcsec) as its parameter; the parameter range is [0.5, 5.0]. There is no default setting for this parameter (indifferent to seeing). Not yet implemented.

`Weight Extinction CUTOFF SLOPE`

The Extinction weighting takes the current value of the *R*-band sky extinction as its parameter; the range is [0, 10]. Extinction is measured relative to the magnitudes of stars in the USNO-B1.0 catalog. The default is no setting (indifferent to sky extinction). Not yet implemented.

`Weight Sky CUTOFF SLOPE`

The `Sky` weighting takes the current *R*-band sky brightness, as a multiple of the minimum expected brightness, as its parameter; the range is [1, 20]. The default is no setting (indifferent to sky brightness). There will be some degeneracy of this weighting with the `Moondeg` weighting. Not yet implemented.

Timing Weights

The timing weights take as their arguments the current time, in MJD (JD - 2400000.5). Several different schemes are supported:

`Timing Window MJD1 MJD2`

A window for the observations; the target score will be zero outside the range `[MJD1, MJD2]`. Within the window the target score will depend on its priority and other weightings. To implement multiple windows it is currently necessary to specify multiple targets.

`Timing Log [SPEED]`

Logarithmic increase of weight with time (default). The reference time for measurement is when the target is first read into the scheduling system - from that point on the `Log` weighting increases (logarithmically) with time. Since weightings are multiplicative, this seemed the best way to guarantee ultimate execution of single-epoch observations. The `SPEED` parameter has a default of 1 which should only be altered in exceptional circumstances. Higher values of `SPEED` increase the rate with which the target score increases with time.

`Timing Monitor [SPEED]`

Irregular monitoring observations. For a target with a `REPEAT` setting of greater than one, the `Monitor` setting will execute one iteration of the full exposure set at or near a particular epoch, and then reset the `Obstime` (MJD). After the epoch reset, at least 1/`SPEED` days will pass before the target score is non-zero. After that point the `Monitor` weighting will increase logarithmically with time with speed `SPEED`. The default `SPEED` is 1.

`Timing Phase MJDREF REFPH,REFNU1[,REFNU2,...] SLOP`

Observations near phase-zero according to the designated ephemeris. The ephemeris is defined in terms of days elapsed since the reference epoch `MJDREF`, and has starting phase `REFPH`, starting frequency `REFNU1`, and higher-order corrections `REFNU2`, etc. (separated by commas, but no whitespace); phase is taken to run from 0 to 1 (cycles, not radians). The `SLOP` is a number between 0 and 1 that indicates how close to zero-phase the observations are desired - realize that the function will only be evaluated between exposures, so that arbitrary precision is not attainable. Calculation of the higher-order corrections will not incorporate the Taylor-series coefficients, so for example `REFNU2` should be provided as 0.5 times the frequency derivative of the ephemeris (and `REFNU3` should be 1/6 the second derivative, etc.).

`Timing Repeat SPEED SLOP`

Regular monitoring observations. For a target with `REPEAT` setting greater than one, this weighting will prefer to make observations at epochs that are delayed by integer multiples of 1.0/`SPEED` days from the epoch of first observation, whenever that is (until the epoch of first observation, the score increases in `Log` manner). This time weighting therefore functions as a sort of poor-man's ephemeris weighting; the `SLOP` parameter has the same meaning as with

`Phase` weighting, above.

Default Targets

The `Default` target is used to reset default values for weightings, exposure sets, and mosaic, dither, or offset settings. Within the target file, any target named `Default` which has any of these parameters defined will reset them from their default configurations (the coordinates and equinox of the `Default` target are not used). These new settings will hold for all subsequent targets until the next `Default` target entry. This makes it relatively straightforward to construct large target lists without a great deal of cutting-and-pasting.

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