



Guide Star Acquisition with WIRCam: A scenario using an astrometric solution

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Introduction

The arrival of WIRCam at the end of 2004 raises the important question of the procedure for guide star acquisition. It is planned that guiding with WIRCam will be done on stars located in small windows (16 x 16 pixels) distributed *over* the array; 1 to 4 guide stars might be used at once. This design introduces some significant differences over a system like MegaPrime. For instance, the number of guide stars and their flux will depend strongly on the filter used for the observation for a given exposure time. Also, direct guiding on the science targets will have to be avoided. These constraints introduce more complexity in the *selection* of the guide stars. On the other hand, the requirements on the pointing accuracy, in particular for repeated observations, must be taken into account. This could introduce complexity in the *acquisition procedure* of the guide stars.

This document very briefly explores a possible solution for guide star acquisition with WIRCam to take into account the above factors. This is not an explanatory document but it raises some questions regarding this scenario. Other scenarios, maybe more complicated to implement (e.g. pre-determined guide star selection), certainly exist....

Hypotheses

1. Accuracy of an astrometric solution with ~20 stars distributed across the mosaic would be ~ 1".
2. Pointing accuracy of 1" (~3 pixels for WIRCam) is sufficient for initial pointing AND repeated observations.
3. Absolute pointing of telescope across the sky is rms ~ 15". Offsets ("A to B") accuracy from telescope within 15" – 20" is on the order of one pixel.
4. Regions of the mosaic to be discarded for finding guide stars are determined in advance by the PIs in their phase 2 ("zones of avoidance").
5. Guide stars are not found in advance of an observation.

Scenario

The general idea is very simple: A slew is initiated by QSO/NEO to precise target coordinates; an automated astrometric solution is found and offsets are sent to the telescope; guide stars are then automatically selected and guiding starts. In this model, there is no need to take care of repeatability requirements on the QSO side since pointing is always good enough (like with MegaCam). Note that pointing can even be accurate even if guiding is not requested.

In more details, the sequence for guide star acquisition could look like this:

QSO:

- *Send tcoords*
- *Send filter info*
- *Send “zones of avoidance” (where not to guide)*
- *Send guiding requirement (guide, no-guide)*

NEO/TCS

- *Initiate slew*
- *When telescope tracking and stable, take exposure (exptime depends on filter)*
- *Calculate astrometric solution*
- *Offset telescope*
- *Exposure to select guide stars outside “zones of avoidance”*
- *Guide star acquisition: exptime automatically adjusted to take care of filter and flux of star*
- *Start Exposure*

Questions

The above scenario, which might be relatively simple to implement, raises some important questions:

1. What precision is really required for repeated observations? Is 1” ok ?
2. Can we achieve 1” accuracy with an astrometric solution with so few stars? If not, do we need to run 2 solutions to achieve it? Will that be necessary for question #1? If yes, what about question 3....
3. What overheads should we expect for this and what’s acceptable? In my view, we accept 20-30 seconds for MegaPrime now so if we say 30 seconds is ok, is it feasible?
4. Can we avoid taking the second exposure for guide star acquisition (after the offsets) and use the first one only instead by extrapolating the results of the astrometric solution?
5. What happens if acquisition on one (or more) stars is lost after a large offset in a dithering pattern? Can NEO/TCS simply redo an acquisition on other stars (but of course, this time without the astrometric solution)?

Well, will that scenario work ????

