

MIRC/PAVO - how to

v1 - PGT 26Sep10

1 Introduction

Basic idea is to run MIRC as a fringe tracker for PAVO, which can then integrate on stars otherwise significantly too low v^2 for normal fringe tracking. Setup/alignment notes as for MIRC and PAVO with no special optical hardware configuration.

2 Preparation

There is a small region of overlap for finding suitable calibrator stars for both MIRC and PAVO. The assumption here is that the science program is for bright targets otherwise overresolved in PAVO. Basically, you want to find B stars, or maybe early A stars which are about 4.5 mag to 3.5 mag (your favourite getcal tool, or simply search hipparcos). A diameter calculator should verify that some of these are about 0.3 to 0.4 mas in size - OK for a good psf ref and fringe-finder star in both beam combiners. Eggleton 2008 has all of the multiplicity info on Hipparcos stars brighter than 6th - a useful resource.

3 Optical Setup for MIRC/PAVO

MIRC/PAVO mode

In order to hand fringe tracking control to either MIRC or PAVO, we need to follow these steps:

- To start MIRC mode, type in PAVO server:
> vmeclose
> mirc
a message "Treating MIRC as a fringe tracker" will appear on the PAVO console. The MIRC mode could be identified because the state of the non-fix beams switches to NONE.
- To start tracking fringes with PAVO, we need to type in PAVO server:
> vmeopen
> mirc
a message "NOT Treating MIRC as a fringe tracker" will appear on the PAVO console.
Additionally, if we want to look for fringes, it is necessary to type
> servo [#beam] aoff, e.g. servo 2 aoff
then look for fringes as usual with PAVO

Coarse Cophasing

The first big challenge is getting MIRC and PAVO phased. Before the run, Judit used Classic to find the offset between the IR and visible fringe. More precisely, with the vis system in phase, she found the offset to get classic fringes on with W2 on B6 and one of W1, S1, S2, E2 on B5. The results obtained are:

Beam 5	Beam 6	From VIS fringes to IR fringes: Change in Beam5 retro mirror
W1	W2	W1irpos + 0 mm (by definition - retroreflector aligned)
E2	W2	W1irpos - 0.498 mm (shorten the path)
S2	W2	W1irpos - 0.088 mm (shorten the path)
S1	W2	W1irpos + 0.076 mm (lengthen the path)

These numbers can be used (with a diagram of the beams) to figure out the rough PAVO zaber offset to phasing with MIRC. Moving the Zaber stage to lower counts adds extra path to that beam.

Tel Config (beam 1,2,3)	B1 Splitter Zaber position	B2 Splitter Zaber position
W1 W2 S2	56400	32400
W1 W2 E2	52500	28100

First time this was done on sky by finding MIRC fringes, then finding PAVO fringes, and recording the differential delay. Notes about how to do this on sky: ??? to be added.

Glass Dispersion

First star of the night it probably makes most sense for PAVO to find the fringes. This is likely quicker, but also PAVO needs to get the glass dispersion correct. This can be done with MIRC tracking, but probably quicker/better to do it with pavo tracking the fringes. The procedure is:

If pavo is in MIRC mode, then make sure mirc is not tracking the fringes, then type in pavo server

```
> vmeopen
> aon
```

You must make sure that snon (pavo manual) is set to something reasonable, whether or not pavo is tracking. The dispersion calculation needs to know when fringes are valid. Find the fringes, and toggle the dispersion on, wait till dispersion stabilizes, then off. Fringes should jump, and messages in cosmic "moving glass fast". Command to toggle dispersion is:

```
> tg
```

Make sure to go back to pavo mirc mode (vmeclose, mirc). Also note, whenever swapping from pavo to mirc control of delay, make sure to set pavo's expected fringe velocity to 0 (zero out the linear sweep rates) or else pavo won't see good fringes.

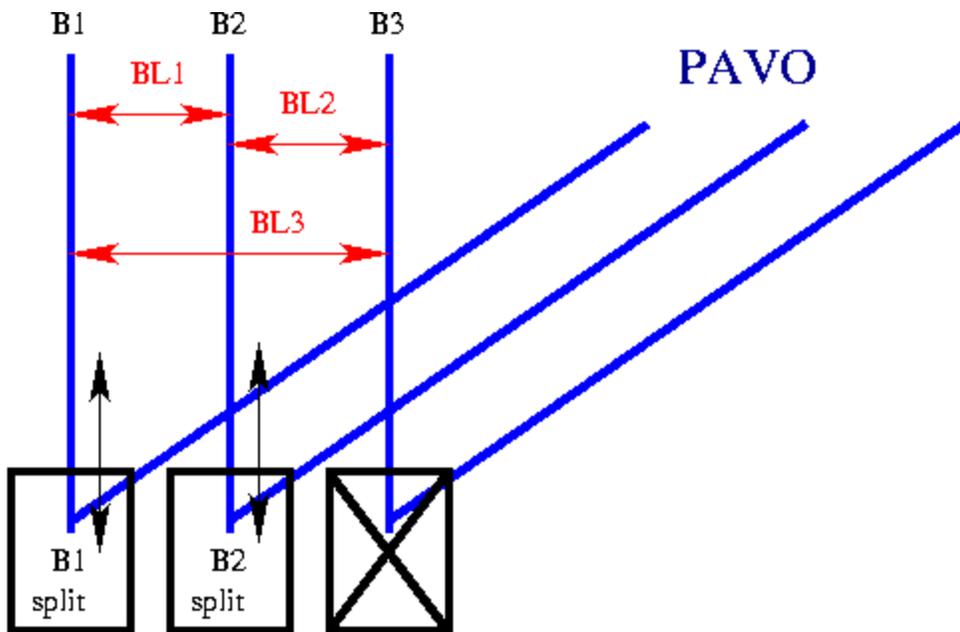
4 Observing Strategy.

Observing Sequence

- Start with normal CHARA acquisition
- MIRC will normally want to do a Fiber-Explore at acquisition (3-5min). During this time, PAVO should be taking Foregrounds (or an on-sky beam alignment when needed). To do the foreground move the carts away from fringes (easiest to click "off" or "all off" in OPLE) and click "FORE" on pavo server to flag the headers, then just take data (GO+SAVE).
- Next, MIRC will search for fringes (remember to click "track" on OPLE) and PAVO needs to stop taking foregrounds (click "save" and "fore").
- If you **really** want to squeeze the efficiency, PAVO can continue taking foregrounds up until MIRC handover by sending the zaber splitters away in delay by a few tens of microns.
- With fringes found on MIRC, then the cophasing step with PAVO needs to be performed to get simultaneous fringes (see cophasing below).
- MIRC takes reasonably long integrations. We just allowed things to go at normal MIRC cadence for this run. Integrate PAVO fringes.
- At the end of the sequence, MIRC normally takes a quite long sequence of shutters and foregrounds. As soon as MIRC begins to take a shutter, again stop the carts and take more PAVO foregrounds as above. After a bit of foreground data, worthwhile to take a shutter. MIRC sequence of background, shutter, foreground takes 6 minutes, so time for a couple of PAVO shutters and/or foregrounds here.
- Normal MIRC procedure to take two full data sets back-to-back. We decided to do this for prime heavily-resolved targets, but not for cal. Obs sequence C1-S-S-C2.

Co-Phasing

Assuming fringes are held locked by MIRC, and that coarse phasing has already been done as described above. Then the fringes for PAVO should not be very far away - usually less than 50 microns total excursion. This range can be explored using the pavo zaber engineering gui ("eng" on the client). PAVO delay lines are the last two "B1 split" and "B2 split". These can be driven to an explicit location using pavo commands e.g. `zmovabs 15 56390` (moves B1) or `zmovrel 16 -20` (moves B2). But easier to use the > < keys in the gui - first you must unlock the motor (left-most box). The picture below shows the three visible beams (blue) coming into PAVO, with the two available Zaber stages (B1/2 split). Baselines are indicated in Red.



To get fringes (assuming none are visible), simply explore delay space with B1 and/or B2 split. Step size of 30 (small) to 100 counts are reasonable (3-10 microns) increments. Previous experience with other stars and/or dead reckoning may help guide the way. If you find fringes in one of the three baselines, then the strategy can be refined.

For fringes on BL2 only, explore B1 split to find remaining fringes. For fringes on BL3 only, explore B2 split. Baseline BL1 is the Zaber-moving-cart fringe, and here you should preserve BL1 fringes by moving B1 and B2 stages in concert, same counts and direction.

Fringes on this baseline	B1 split Zaber	B2 split Zaber
BL1	> moves fringes left ←	> moves fringes right →
BL2	X No Effect	> moves fringes left ←
BL3	> moves fringes left ←	X No effect

Some efforts expended trying to get a predictive algorithm for the vis-ir offset - so far there appears to be a trend with the amount of differential glass in the beams. If we consider a given baseline, plotting the differential zaber position (delay) versus the differential glass in the two telescope beams, we get a correlation but not a tight relation. Hopefully, with more work and maybe the addition of more sophistication in correlating with other parameters, a predictive algorithm for the offsets might be found.

Heavily-Resolved observing

For very resolved targets (the whole point) then we used the following strategy. It did not seem possible, without more sophistication, to exactly predict the offset between

pavo and mirc. Offsetting from a nearby cal is close, and fringe location may be tweaked further with a prediction based on glass (or in future other systematic). However, ultimately there will be little or no fringe power visible. The key is to make sure that at least one baselin is short enough to give detectable fringes. We adopted a strategy of a minute or so integration at the best-expected location, then an equal amount of integration at zaber offsets of +20 and -20 microns OPD (i.e. zaber +100, -100) then back to 0. This explores the one remaining degree of freedom not constrained by fringes.

Bugshooting/random notes

Fringes look weird in pavo waterfall plot. Diagonal/streaky fringes occur when PAVO *thinks* the fringes should be moving at a certain velocity, but they are not (because PAVO is not driving ople). Easiest fix is to set the search velocities to zero (click "linear" then set the rates to 0). Or you can be fancy and type `fvel 2 0`, and `fvel 3 0`.

DTIME can be set in pavo server to long integrations (`dtime 4`) or short (`dtime 1`). This only affects the display. Did not find long dtime to help see fringes much.

Some useful places to look for stuff:

`~/control/cliserv/ople/server/ople_astromod.c` - astromod code
`/ctrscrut/archive/on_sky/DATE/status_primary_001.txt` - log file

How to retrieve info from ctrscrut

Folder with old logs: `/ctrscrut/archive/logfiles`

To get the glass position, the following command line will give time, telescope, old and new position:

```
cat status_primary_00* | grep 'Moving glass fast' | awk '{print $1,$8,$10,$12}'
```

To get carts position (time, cart, position, error)

```
cat README_primary | grep Ople | grep = | awk '{print $1,$4,$6,$9}'
```

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```

On the other hand, I retrieve the Zaber stage position after running `vmg_headstrip.pro` on the particular folder we want to analyze

Little script to find a log at a time:

```
# findglass time telescope
```

```
cat glass.log | grep $2 | awk 'BEGIN{a=0}{if($1<'$1' && $1>$a) print $4}'
```