SUBJECT	A recipe for performing imaging polarimetry with ISIS
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1 Configuring the spectrograph

1. **Mount the Savart (calcite) analyser** in the multislit position of the ISIS slit carriage. This operation should only be done by the support astronomer. Once loaded, type `MSLIT` at ICL in order to position the analyser in the beam.

2. **Mount the folding prism** in the blue fold slide if using the blue arm of ISIS. Note that the prism has about a 10% higher throughput than the flat mirror. This operation should only be done by the support astronomer or telescope operator (if trained). Once loaded, type `BFOLD 1` at ICL in order to position the fold in the beam. If using the red arm, it is not necessary to load anything else into ISIS; simply type `BFOLD 0` and `RFOLD 0` at ICL.

3. **Mount the filters** (colour and/or neutral density) in the modified ISIS below slit filter slides. This operation should only be done by the support astronomer. (Note that there is no modified BFILTA slide available at the moment). Unfortunately, due to the positions of the filters in the modified slides, it is possible to vignette the beam with certain combinations of slides and positions. To overcome this, it is necessary to step the filter slide to a position between ICL positions `1` and `2`. This operation should be done by the support astronomer, since it involves using engineering control rather than ICL. The support astronomer should also be able to advise on which position each slide needs to be driven to. If, for whatever reason, it is necessary for the observer to move the slide, the following list of commands should be used (carefully) at the engineering console.

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1. Initialise the filter slide by typing ISIS_INIT BLUE_FILTER_B (or
   whatever) at ICL. This sets the step count to zero.
2. Goto the engineering desk opposite the observing console and set the
   engineering control selector switch to CASS INST.
3. On the engineering terminal (marked TERMINAL A), type BFB TT (if you
   want to move the BFILTB slide). For other slides, consult the list of
   pneumonics in the table below.
5. Now type UNSEAL. Note that the characters are not echoed to the terminal.
6. Type three question marks in a row (???). The last column of the
   resulting output shows the position of the slide in encoder units. This
   should be zero at this stage.
7. Type, for example, 5100. 4 INDEX
   This will move the BFILTB slide (SMDM number 4 - see the table below)
   5100 encoder units from its current position to approximately
   three-quarters of the way between filter positions 1 and 2. This is the
   optimum position for this slide - for other filter slides consult the
   table below for the number of encoder units to move.
8. Type ??? and check the result in the last column. It should now say 5100
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   (or whatever).
9. Type 4MS to return to normal engineering control (at which you can then
   type BFB SEE at any time to check the position of the BFILFB filter
   slide, for example). Note that the ICL mimic will (wrongly) show that the
   filter is out of the beam.

   SLIDE   PNEUMONIC  SMDM   IMPOL POSITION
   ----------------------------------------
   RFILTA     RFA      3      5500
   RFILTB     RFB      4      ?
   BFILTA     BFA      3      ?
   BFILTB     BFB      4      5100
```

4. **Mount the mirror** at the appropriate position in place of the grating. This operation should only be done by the support astronomer or telescope operator (if trained). Type `CENWAVE RED 0` or `CENWAVE BLUE 0` at ICL, depending on whether the mirror is mounted on the red or blue arm.

5. **Put the half-wave plate in the beam** in preparation for observing by typing `HWIN` at ICL (`HWOUT` takes it out of the beam again).

6. **Setup the CCD** by setting an appropriate window and readout speed, as advised by your support astronomer, using the `SETUP_CCD` command.

7. **Setup ISIS to take a lamp exposure** by typing `AGCOMP`, `COMPLAMPS W`, `COMPND 2` (or whatever neutral density is required).

8. **Optimize the setup** by taking a `GLANCE` exposure, inspecting the resulting image and then moving the image close to the left-hand bias-strip using the `CENWAVE` command. This will enable you to select a much smaller window which includes the bias strip. Determine the size of the required window and enter it using the `WINDOW` command.

9. **Focus the spectrograph** by moving the collimator. First set the collimator to a rough focus using the commands `RCOLL 10000` for the red arm and `BCOLL 30000` for the blue arm. Then step in units of 500 collimator units about this nominal focus taking a `GLANCE` exposure at each setting until the edges of the dekker are at their sharpest (as determined on the DMS – the support astronomer will show you how best to do this). The spectrograph will now be in focus.

10. **Check the polarization optics** by putting a polaroid in the beam using the `MAINFILTC POL-PAR` command. Set the angle of the half-wave plate to zero with `HW_POLAR ANGLE 0`, take a `GLANCE` exposure and note the peak counts of the o and e-rays. Now set the angle of the half-wave plate to 45 degrees with `HW_POLAR ANGLE 450`, take another `GLANCE` exposure and check that the peak counts have now switched beams. Remember to remove the polaroid with the `MAINFILTC OUT` command.

2 Configuring the telescope

1. **Determine the rotator centre** on the direct-view mirror by typing `AGCOMP` at ICL and asking the telescope operator to determine the rotator centre on this mirror and mark it with a cross. It is also a good idea to write down the TV coordinates of this point in case the marks are erased.

2. **Perform a calibrate** about this point on the direct-view mirror (the telescope operator will do this for you).

3. **Crudely refocus the telescope** by subtracting 0.60 mm from its ISIS slit value (typically 97.20 mm) using the ICL command `FOCUS 96.6` (or whatever). This will enable you to take exposures and view the star roughly in focus on the CCD and on the slit-viewing mirror. To ensure that the star is also in focus on the direct-view mirror, set `TVFOCUS 15000` in `TVSCALE 5` at ICL.

4. **Determine the position of the centre of the central dekker** on the direct-view mirror by viewing a star and switching between this mirror and the slit-view mirror using the ICL commands `AGCOMP` and `AGSLIT`. Use `GLANCE` exposures to check that you have actually found the centre of the central slot. Mark the position on the direct-view screen with a cross or a pen and note the coordinates of the point in case the marks are erased.

5. **Refocus the telescope accurately** using the `FOCUSPOL` procedure. First, setup the spectrograph for observing on-sky by typing `AGSLIT` and `ROT SKY 0`. Then acquire an (of order) 11th magnitude star and centre it in the centre of the central slot of the dekker mask as found in the previous step. Take a test exposure using `GLANCE` to determine the optimum exposure time. Now run the `FOCUSPOL` procedure by typing `LOAD [OBSERVER.VSD]FOCUSPOL` and then `FOCUSPOL`. Follow the prompts, aiming for about 10 steps of 5 arcsec each and 0.1 cm focus shifts centred on the crude nominal focus set above. When the procedure is complete, display the image using SAOIMAGE on the Sparc with the `display` command. Then, using the `r` option of `imexam`, determine the FWHM of each of the stellar images. The smallest one is obviously the optimum focus. Set the telescope to this optimum focus using the `FOCUS` command at ICL and the telescope and spectrograph should now be perfectly focussed.

6. **Refocus the autoguider** by subtracting 2000 from its ISIS slit value using the ICL command `AUTOFOCUS 2000` (or whatever). You are now ready to observe.

3 Acquiring objects and taking data

1. **Acquire objects** by typing `AGCOMP` at ICL and positioning the object of interest on the desired slot, as determined by the marks drawn on the TV screen. Then type `AGSLIT` and the object should now fall directly onto the desired dekker slot. Hence this acquisition procedure does not require one to move between `LSLIT` and `MSLIT`, which would compromise the flat-fielding (since the positions of the dekker mask edges as projected onto the detector would continuously be changing).

2. **Take data** by typing `LPOL` at ICL and following the prompts. The procedure will take four exposures at half-wave plate angles 0, 45, 22.5 and 67.5 degrees. If, for whatever reason, you decide to abort `LPOL`, type ctrl-c.

4 Some useful numbers

1. There are 7 slots in the dekker mask and hence 14 slot images on the CCD (due to the action of the calcite block).

2. Each slot is approximately 6 arcseconds wide and the throw of the calcite is approximately 7 arcseconds. Hence there is a gap of width 1 arcsecond between the o and e rays. The masked spaces between the slots are approximately 11 arcseconds in width.

3. The image of the calcite block obtained on the CCD is approximately 132 by 111 arcseconds in size. Each pixel is approximately 0.3 by 0.3 arcseconds in size.

4. If the rotator position angle on the sky is zero, the slots of the dekker are aligned approximately east-west.