Instruments and Imaging Section
Technical Tips No. 6
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The Director prepares the next issue of *I&I News*

The mystery object in the previous *Technical Tips* is the domeless solar observatory housing a 13.8-inch Zeiss coudé refractor, situated on Capri, and operated by the Fraunhofer Institute in Freiburg. It was established in late 1965. The only person to identify it correctly was Philip (Tim) Withers. The now redundant observatory stands in a 5-acre estate, with planning permission for new buildings. According to the sales advertisement, 'the plans to make a residence out of an astronomical observatory are an incredible opportunity to create a tailor-made fantastic holiday getaway.' The entire estate is available for $24.6 million. The advertisement also states that Capri has been 'attracting visitors since the Ancient Roman Empire' – a rather understated view of the period when the barren rock called Goat Island was a place of exile until Emperor Augustus built a villa there, and later Emperor Tiberius, leaving Rome in the grip of Sejanus, withdrew there and surrounded himself with assorted outcasts, perverts, and murderers, including Caligula.

The mystery object at top right was presented, as a slide, at a conference at the Massachusetts Institute of Technology in 1975. Its significance left the audience 'dumbfounded... in a state of shock'. Why?

Flat fields

or

How to remove dust and field anomalies from images

John Mallett

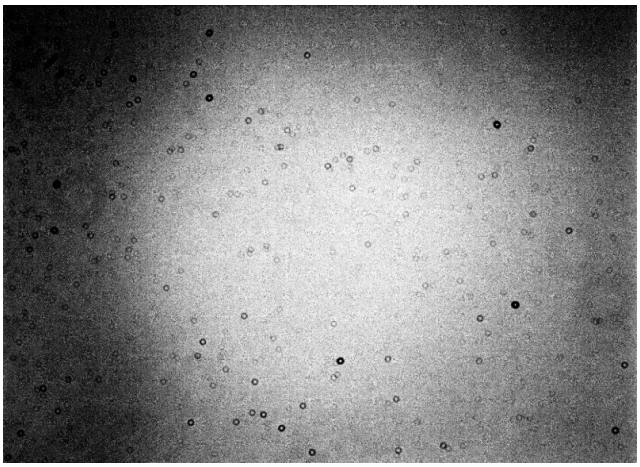
My requirement was to have a light-based system that I could place in front of the telescope at any time to obtain a really good set of flat fields. I had an SXVR-H18 which was about two years old and had some dust on the CCD glass.

The image below is an enhanced flat-field image obtained with an exposure of 5 seconds, before Terry Platt and his colleagues at Starlight Xpress invited me to their new factory to show me how to clean the CCD.

Due to the camera's having a mechanical shutter it is necessary to have minimum exposures of about 3 seconds to avoid shutter movement effects. I needed to have a light source that would give me a count well above the basic dark count, but not more than about 10% of the maximum pixel capacity – so for all pixels of the flat to be between about 5000 and 7000.

Physical requirements

No large light box and a really 'flat' light source; light, rugged, and very easy to build. The total cost needed to be as low as possible, but the most important criteria were ease of construction and no maintenance.



Having had some experience with electroluminescent (EL) panels used in advertising displays, they seemed to offer a potential solution if filtered to the correct light output.

Shopping list

- One A3 EL panel 'white light sheet' with power supply (see link below).
- Two sheets of 3-mm dark grey tinted acrylic sheet about 500 mm square (see link below).
- One roll of black plastic electrical insulation tape.
- Black adhesive Velcro (strips of both hook and loops).
- About 600 mm of non-adhesive Velcro loop tape to hang the panel on the front of the 'scope or observatory wall.

Assembly of the components

- Test the EL panel and check which side is the light-emitting side.
- Remove any protective film from one sheet of the acrylic and make sure it is relatively free of dust.
- Using black electrical tape, stick the EL panel light side down to the acrylic sheet. Leave space for the power supply slightly away from the light panel.
- Using self-adhesive Velcro tape, place two strips on the underside of the power supply and two strips matching these on the acrylic sheet a little away from the edge of the light panel. There is then no chance of heat from the power supply affecting the light output. Position it so that when you hang the finished panel the power-supply weight is in the centre and none of the cooling holes are blocked.
- To further cut down the light level I used the second sheet of dark grey acrylic and taped the edges of the two sheets to prevent any dust or moisture entering – not forgetting to remove the protective film and any dust.
- I used a couple of strips of Velcro on each corner opposite the power supply to attach the length of loop Velcro to the acrylic sheet.

The finished product

The flat fields produced were excellent, and gave counts of between 5200 (top corner) and 5500 at the centre of the image on a 5-second exposure. The panel is really thin and light, and the unit is easy to keep clean.

After writing an Astroart 5.0 script to collect a set of five flat fields for each filter and a set of dark frames for the exposure time, I could then produce a set of master flat fields that could be used for about a month, or until dust rings were evident after the flat field was applied to the images. (Please e-mail me if you require a script for Astroart.)

The accompanying images of M101 were obtained without colour filters, as it would have been necessary to take flat fields for each filter; but I have found that the worst impact results from dust on the CCD chip window. The following can be used to calculate the position of the dust:

D : distance of dust from CCD chip surface in mm
f : focal ratio
p : size of camera pixels in mm
x : diameter of dust ring in pixels

$D = f \times p \times x$

For my 8-inch astrograph and SXVR-H18:

f : 8
p : 0.0054
Size of the small dust rings on the flat image : 38 pixels

Therefore, $D = 8 \times 0.0054 \times 38 = 1.64$ mm – indicating that the dust is on the CCD window.

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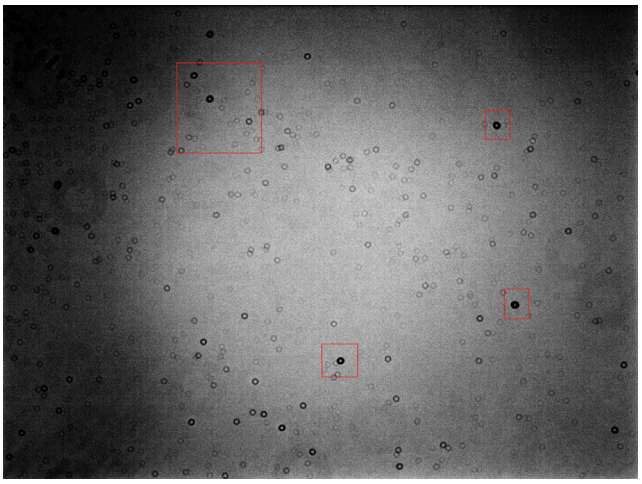
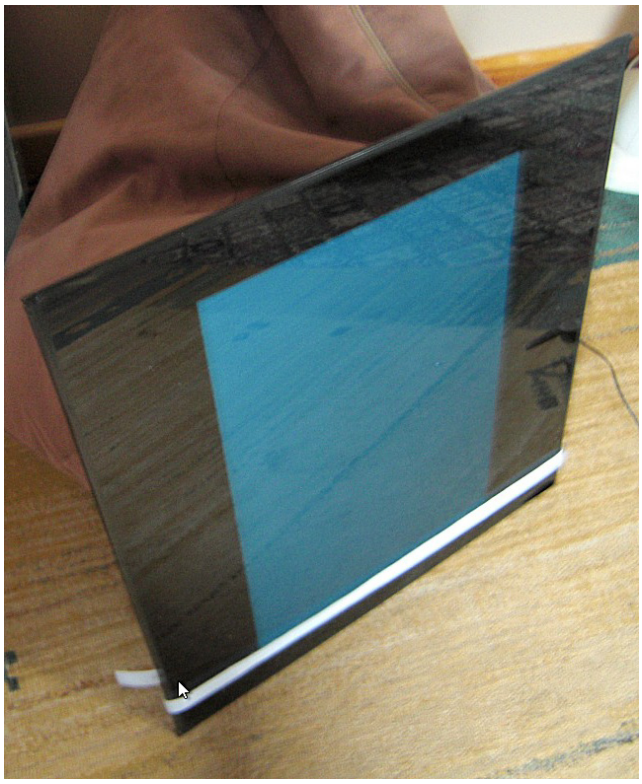
White light panels http://www.posterpoweruk.co.uk/page7.htm
Dark grey-tinted pre-cut sheet http://www.sheetplastics.co.uk

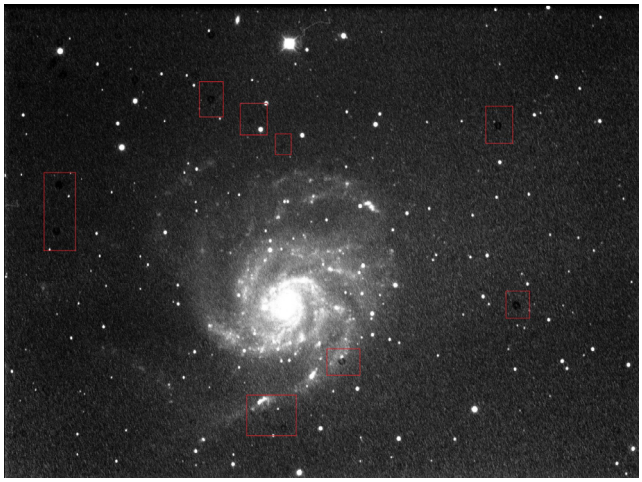
Close to my home in the Wye Valley.



A simple single flat field with red boxes marking the position of large-scale dust on the CCD chip.



The panel.



A single frame at 800 sec, without filter, but with the intensity made non-linear to show dust. When these frames are stacked the impact worsens.

Five frames stacked at 800 sec, with a single flat field used to remove dust and any non-linearity effects.