2.3m echelle spectrograph June 21 2006

With the new field flattener located closer to the CCD, the aberrations induced by the field flattener are greatly reduced and the whole 2Kx2K of the CCD can now be used. There is some small residual curvature in the focal plane but the best mean collimator focus is +6.0.

The centre of the 79 g/mm echelle blaze corresponds to the echelle setting of +0d15m

The 300g/mm cross-disperser setting of 5d50 provides coverage between orders 56 and order 33, 4000A to 6900A. The orders overlap up to 6530A as defined by the width of the CCD.

A cross-disperser setting of 7d30 probably covers orders 40 to 27, from NaD to the CaII IR triplet.

The accompanying figures show (orange) the CCD window on the echelle format. The lines running down both sides of the figure define the width of the free spectral range.

To stop second order blue light overlapping 1st order red observations, there is a choice of two cutoff filters, GG13 and GG495, to remove light below 3900A and 5000A respectively.

The CCD has very good cosmetics, but there is fringing beyond 6600A that requires use of the QI flat field to remove. To improve the S/N on faint stars you can bin by 2 along the slit.

The slit width can be changed only by withdrawing the slit unit and adjusting the micrometer.
A slit width of 0.2mm projects to 1.8 arcsec on the sky and 40 microns at the CCD.
However, the slit rotation and decker width can be changed from the outside. The decker is adjusted with the central knob. A setting of 16 is the minimum decker width appropriate for 3500A. The maximum decker width is a setting of 1 for 7000A.

The telescope focus for the echelle is about -30 divisions different from the DBS. The centre of the echelle slit is not coincident with the DBS centre but is on the slit area.

The UCLES manual on the AAT webpage contains tables of the 79 gr/mm echelle
http://www.aao.gov.au/local/www/UHRF/manual/app_a2.html#Spectral%20Format%20Tables
The ThAr atlas of the 31.6g/mm echelle between about 3500A and 9400A.
http://www.aao.gov.au/AAO/astro/ucles.html

The echelle cannot be rotated very far because of problems with the liquid nitrogen running out and with the dewar striking the roof and floor. So you should observe with the rotator not in use.

The dispersion of the spectrograph is wavelength/1000 in A/mm.
At 4000A it is 4A/mm, at 6500A it is 6.5A/mm. The CCD has 13.5 micron pixels.

With the normal acquisition CCD orientation the slit is vertical with the apex defined by the decker pointing to the left. The figures for the manual calibration boxes (settings box on GUIDE option) should be X= 2.9, Y= -2.9, angle= 0 degrees. With the coordinate selection TV or SLIT,
the E button pushes the star to the left and the W button pushes to the right.
The N button pulls the star down and the S button pulls the star up.

Date: Tue, 3 Feb 2009 09:06:45 +1100
From: Mike Bessell <bessell@mso.anu.edu.au>
To: Laszlo Kiss <laszlo@physics.usyd.edu.au>
Subject: Re: 2.3m echelle documentation?

Laszlo

Do you use Figaro?

I have never worked out the S/N.
My program was to get radial velocities, Halpha emission and Li6707 EW in young KM dwarfs.
I never tried to get a star fainter than 12.
I would use 240 sec for 8th, 450 for 9th, 900 for 10th and 1800 for 11 and fainter.
I would observe from 3900 to 6720 and see CaHK to Li 6707A in the one exposure.

I can send some extracted spectra that I observed in January 2009.
I have some bright RV K star standards, a K subdwarf flux standard and a fast rotating late B star as a smooth spectrum star.
The extracted 2D spectra are dst files. The raw data is fits files.
The CCD has 2 electrons/ ADU. The read noise is about 2.3 adus. I bin by 2 along the slit.

The raw data is on my anonymous ftp area http://www.mso.anu.edu.au/~bessell/FTP/Melis/
The log file is also there. The reduced data on this area is the order 34 containing the Halpha and Li line.

I can send you the 2D extracted spectra with all the orders if you would like some of them.

Mike

> Dear Mike,
>
>>
>> I attach a few documents that may be useful for you. Most of the documents are in the 2.3m in a folder.
>
> I just quickly ran through the documents: what about the instrument's sensitivity? Any easy number, like S/N~100 at t_exp=30 min at V=.. mag for
> an A type star at 2" seeing?
>
> Cheers,
> Laszlo

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A few notes on the echelle spectrograph re: remote observing

Camera focus.
The camera is focussed by moving the collimator after loosening two screw clamps on the collimator mirror. There is a knob to turn the collimator drive and a dial gauge reads the position. Changing the focus would be hard to do remotely. However, to the best of my knowledge the spectrograph focus is very robust and insensitive to temperature and has probably not been changed for a year.

Gratings
The echelle grating is mounted on a large sector. It has a shaft clamp and the sector is moved by means of opposing push and pull screw on the shaft. However, there is full wavelength coverage blueward of Halpha and the echelle has not been moved for over a year also.

The cross-disperser grating is mounted on a very simple endshaft. It has two simple friction clamps on the cover plate and the wavelength is changed by grabbing the handles on the cover and rotating the grating. The settings are read off circular vernier scales on the cover. The cross-disperser setting is regularly changed to move from blue to red orders.
Normally, the cross-disperser is setup for a run and not changed during the night.

Slit unit
The slit width cannot be adjusted from outside the instrument. You have to withdraw the slit unit and change the slit width micrometer setting. There is a decker on the slit unit that can be turned from outside. That is used to prevent overlapping orders. The slit can also be rotated from outside to enable the slit to be perpendicular to the central order. These settings are appropriate to a given cross-disperser setting and are otherwise not changed.

Filter
There is a filter slide behind the slit to prevent overlapping cross-disperser orders. This is normally also set for a given cross-disperser setting.

Shutters
There is a dark slide over the camera. This is normally left open. There is a remotely operated iris shutter behind the slit to start and stop exposures.

QI and arc lamps
There is a solenoid operated flip mirror to interrupt the light beam and divert the arc and QI lamps into the spectrograph. This is remotely operated from the console area together with the on-off switch for the lamps. It is very fast acting.

Acquisition CCD system
There is a standalone slit viewing acquisition and autoguiding system for the echelle.

CCD dewar
The instrumental resolution could be improved by placing the field flattener lens within the dewar at the CCD focal plane. This would require a dedicated dewar as it probably could not be shared with the imager.

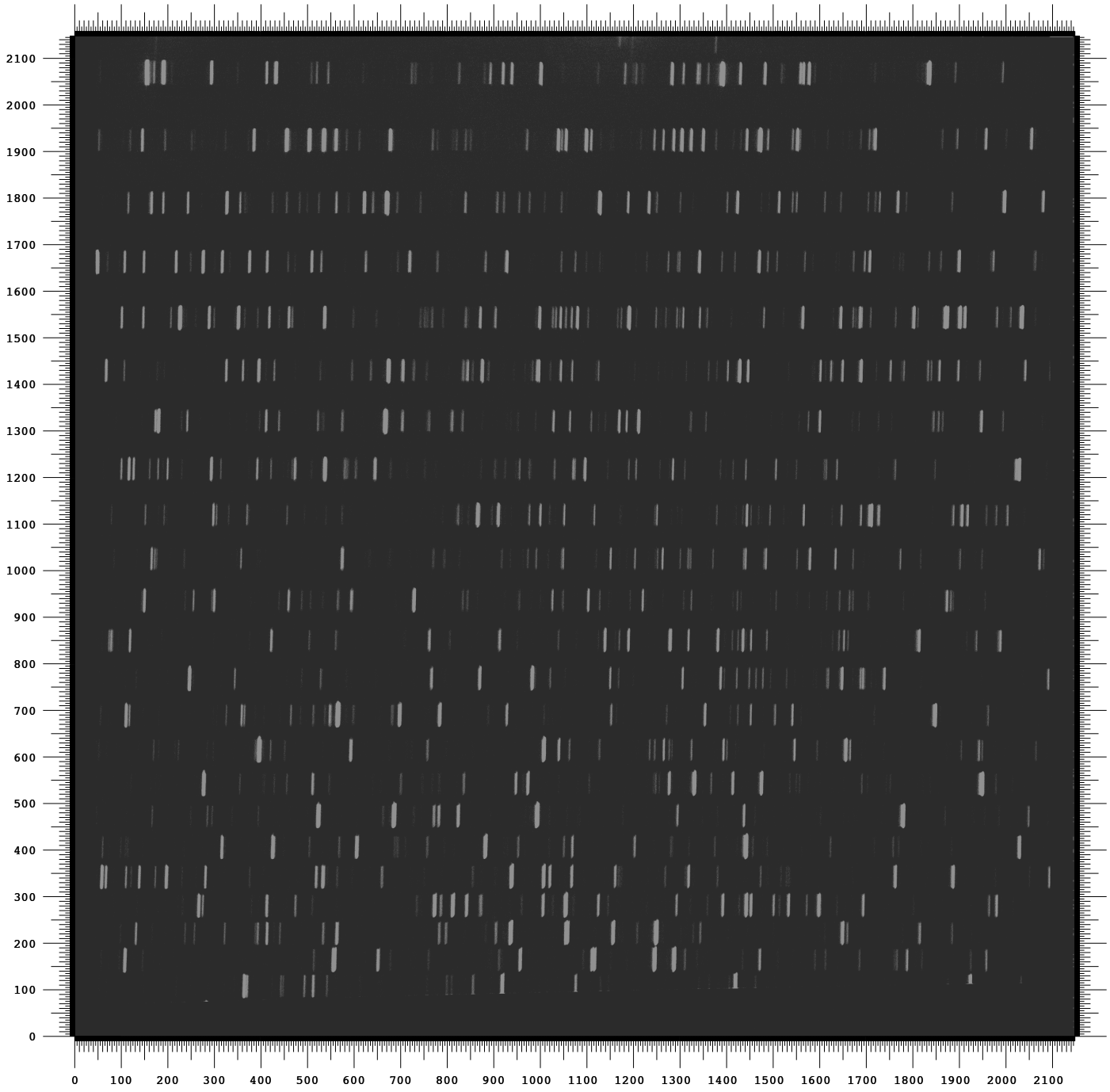
Currently the field flattener is attached to the front surface of the dewar window for the echelle and removed for the imager. At this position if introduces some spherical aberration across the field. The arc lines toward the edge of the field are asymmetrical. We moved the CCD up as close to the window as possible making significant improvement in the definition but bringing it inside the dewar would improve it and remove the asymmetries. (Alternatively the Schmidt corrector could theoretically be moved closer as in the Meinel-Schmidt.) The central resolution is currently 3 pixels, the edge resolution is 5.5 pixels.

The camera was designed so the dispersion in A/mm is the wavelength in A divided by 1000. The camera is F/2; the spectrograph is F/10.
A 200 micron slit is 1.8 arcsec; projects to 40 microns on the CCD = 3 pix.

It would seem therefore that provided the echelle and cross-disperser grating settings could be done during the day preparatory for an observing run, remote operation could be achieved by providing computer control of the flip mirror and the arc lamps.

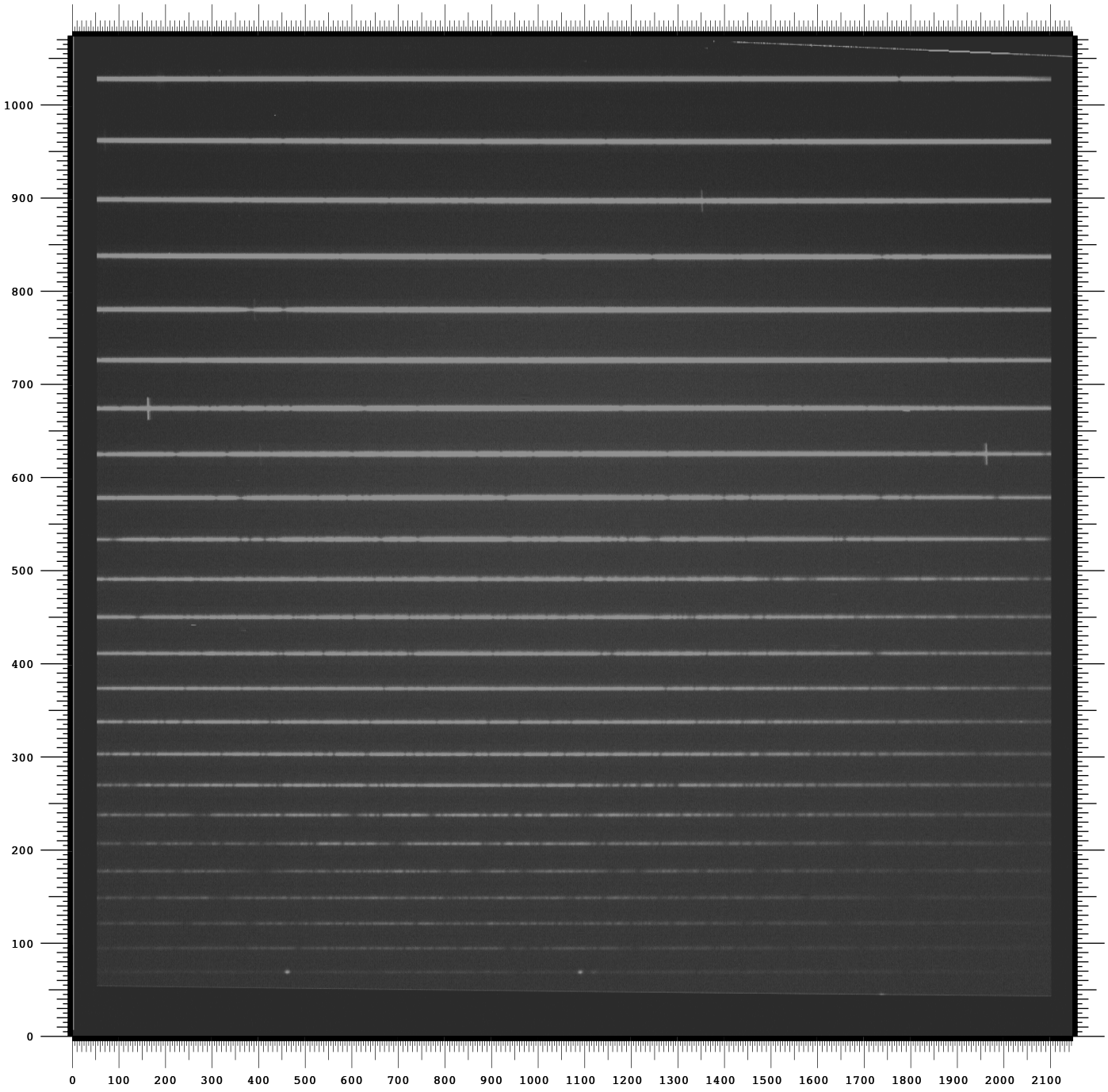
Spectral Format Tables
FSR: Free Spectral Range

ORD	WAVEMIN (A)	WAVECENTR (A)	WAVEMAX (A)	FSR (A)
65	3440.42	3467.09	3493.76	53.34
64	3493.84	3521.35	3548.86	55.02
63	3548.94	3577.33	3605.72	56.78
62	3605.78	3635.10	3664.41	58.63
61	3664.47	3694.75	3725.04	60.57
60	3725.08	3756.38	3787.68	62.61
59	3787.72	3820.09	3852.46	64.75
58	3852.48	3885.98	3919.48	67.00
57	3919.50	3954.18	3988.87	69.37
56	3988.87	4024.81	4060.74	71.87
55	4060.74	4097.99	4135.25	74.51
54	4135.23	4173.88	4212.53	77.29
53	4212.50	4252.62	4292.74	80.24
52	4292.71	4334.39	4376.06	83.35
51	4376.02	4419.35	4462.68	86.65
50	4462.63	4507.71	4552.78	90.15
49	4552.73	4599.66	4646.60	93.87
48	4646.53	4695.44	4744.35	97.82
47	4744.28	4795.29	4846.31	102.03
46	4846.22	4899.48	4952.73	106.51
45	4952.64	5008.29	5063.94	111.30
44	5063.84	5122.04	5180.25	116.41
43	5180.14	5241.08	5302.02	121.89
42	5301.90	5365.78	5429.66	127.76
41	5429.53	5496.56	5563.59	134.06
40	5563.46	5633.88	5704.30	140.85
39	5704.15	5778.23	5852.31	148.16
38	5852.15	5930.18	6008.21	156.06
37	6008.04	6090.34	6172.64	164.60
36	6172.45	6259.39	6346.33	173.87
35	6346.12	6438.10	6530.07	183.95
34	6529.85	6627.31	6724.77	194.92
33	6724.54	6827.99	6931.45	206.91
32	6931.19	7041.21	7151.23	220.04
31	7150.95	7268.18	7385.41	234.46
30	7385.11	7510.28	7635.45	250.34
29	7635.12	7769.06	7903.01	267.90
28	7902.65	8046.33	8190.01	287.37
27	8189.60	8344.13	8498.65	309.04
26	8498.19	8664.82	8831.45	333.26
25	8830.93	9011.16	9191.38	360.45
24	9190.79	9386.34	9581.89	391.10
23	9581.21	9794.13	10007.04	425.83
22	10006.26	10238.97	10471.67	465.41
21	10470.75	10726.14	10981.52	510.77
20	10980.44	11261.99	11543.53	563.10



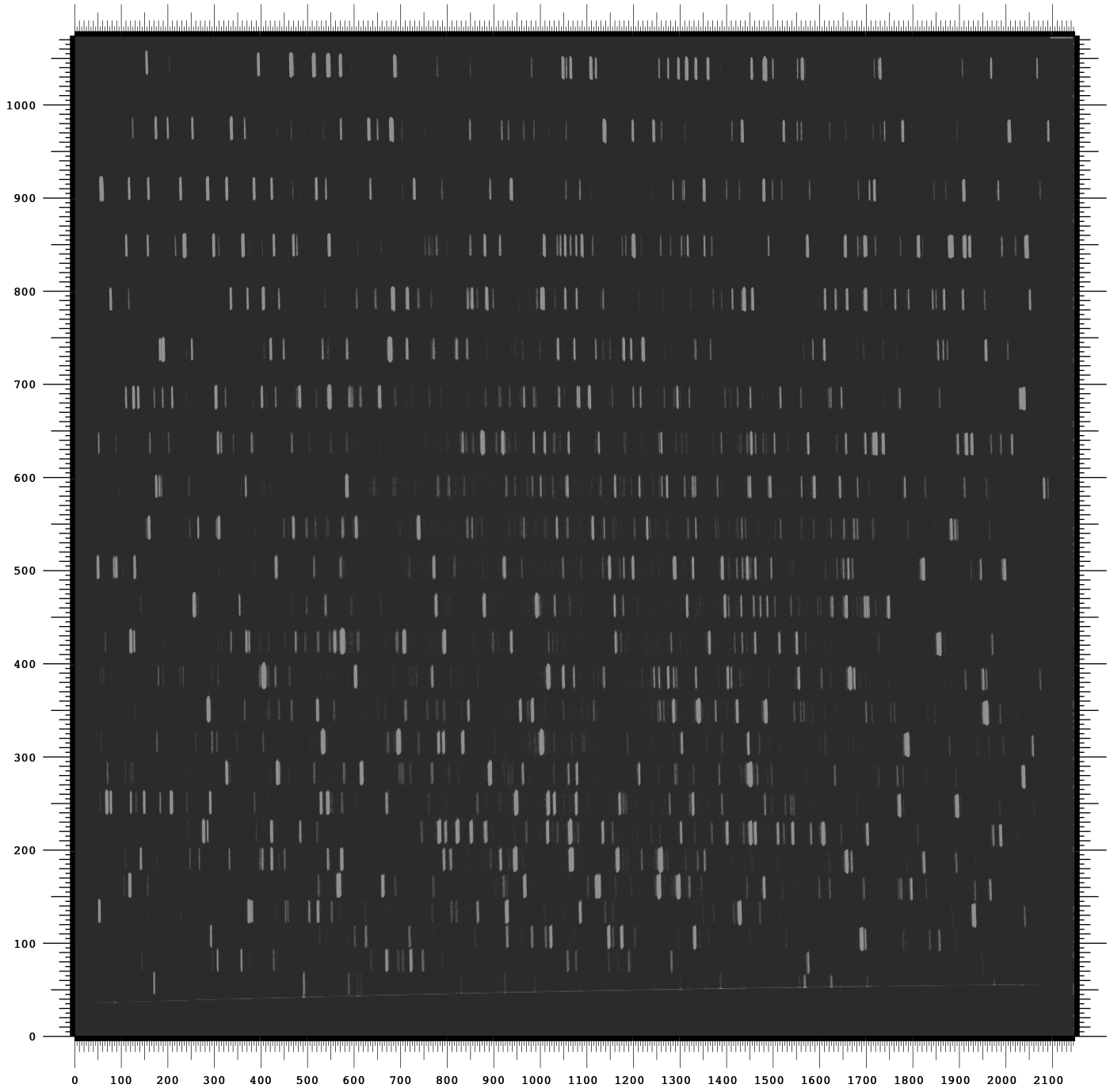
/data/moist2/bessell/echelle/2008Jun/ccd103arc

The entire image is displayed : 2148 by 2148 pixels.
Black corresponds to a data value of 50.0 , and white to 10.0 .
The image file was /data/moist2/bessell/echelle/2008Jun/ccd103arc .
Printed at Tue Jun 3 14:16:20 2008 for bessell by ILASER Version 4.0 (MCBA).



/data/moist2/bessell/echelle/2008Mar/ccd268cc

The entire image is displayed : 2148 by 1074 pixels.
The pixels were enlarged by a factor of 2.0 in the y direction.
Black corresponds to a data value of 120.6336 , and white to 3.859318 .
The image file was /data/moist2/bessell/echelle/2008Mar/ccd268cc .
Printed at Mon Jun 2 23:09:08 2008 for bessell by ILASER Version 4.0 (MCBA).



/data/moist2/bessell/echelle/2008Jun/ccd421cc

The entire image is displayed : 2148 by 1074 pixels.
The pixels were enlarged by a factor of 2.0 in the y direction.
Black corresponds to a data value of 100.0 , and white to 40.0 .
The image file was /data/moist2/bessell/echelle/2008Jun/ccd421cc .
Printed at Tue Jun 3 13:47:11 2008 for bessell by ILASER Version 4.0 (MCBA).