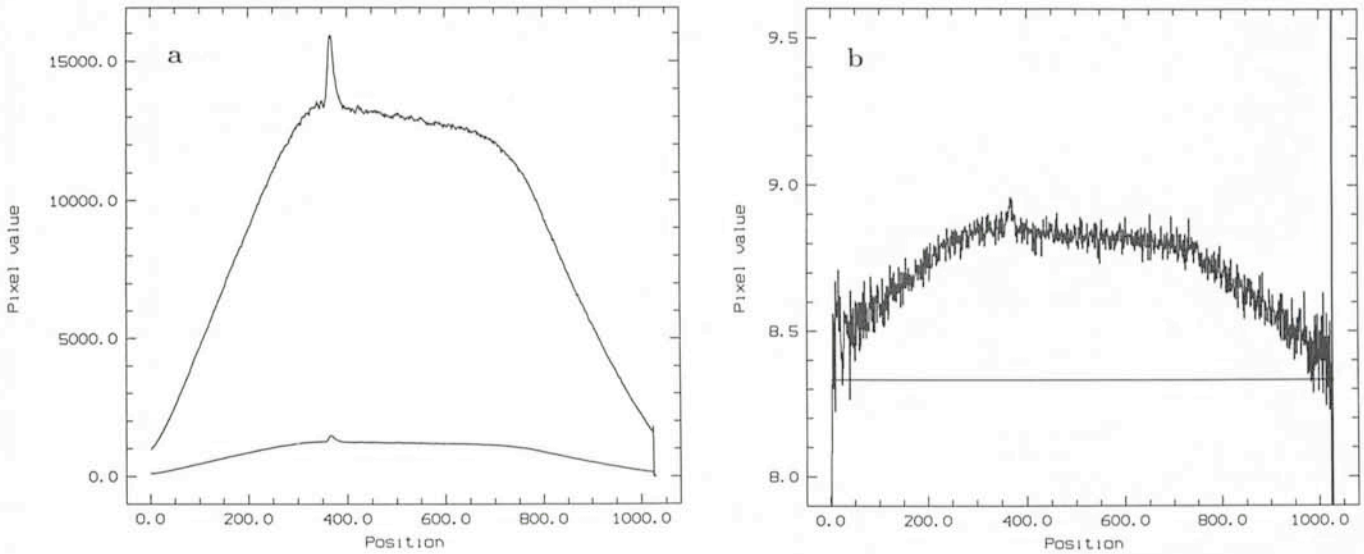

Figure 6: *Ratio of two vignetted flat fields of different exposures. Panel (a) shows the two flat fields (1000 and 120 seconds of exposure) averaged over the slit height. Panel (b) gives the ratio of the two flat fields compared to the ratio of the exposure times (the straight horizontal line).*

the pre-disperser in order to get strong vignetting of the flat fields. As an illustration, two flat fields of different exposure levels are shown in Figure 6. The ratio of the two is clearly flux dependent, showing that the response curve of CCD#9 was still clearly non linear in July 1992.

7. Conclusion

We gave evidence that ESO CCD#9 used at CAT + CES has never been linear from 1987, shortly after its installation at the CES, to 1992. The response curve seems to have been rather stable from the beginning up to March 2, 1992; this is certainly true during the years 1990 and 1991.

We briefly analysed the impact of the problem on abundance analysis works as those customarily done at CAT. We proposed a first order correction to be applied on the debiased frames. This correction is to be considered a first order one because we do not know the exact origin of the problem; the dependency of the response curve on the bias level, for example, is completely unknown.

RCA CCDs are usually thought to be pretty linear (McLean, 1989). This suggests that the problem of CCD#9 originates in fact in the electronics behind the CCD itself. This is supported by the strong dependency of the response curve on the electronic settings as evidenced after March 2, 1992.

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CCD Linearity at La Silla – a Status Report

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We believe that the non-linearities reported above by Gosset and Magain arise from a combination of two effects. First are the non-linearities reported in Schwarz and Abbott (1993), resulting from a failure in some new A/D converter chains in the Generation III CCD controllers. Secondly, in the process of replacing these converters, we discovered that many of our RCA CCDs exhibited some intrinsic non-linearities which may be related to the age of these devices. Unfortunately, we do not have adequate test data to demonstrate that our RCA CCDs were ever linear to better than 1 %, but they were certainly non-linear to as much as 8 % over their full dynamic range before March of 1993. At this time, we determined that we could reduce these non-linearities to acceptable levels by careful adjustment of the bias level of the output FET's drain voltage. It was found that a fraction of a volt may have a significant effect on the linearity. All RCA CCDs required adjustment, except RCA#13.

Below is a list of our CCDs and the most recently measured or most representative degree of non-linearity. For the RCA CCDs, data prior to adjustment of the output drain bias voltage is included. Non-linearities are expressed as the fractional amplitude of any trends in

CCD Name	Telescope & Instrument	Date	Nonlinearity (%)	Range (e^-) of Measurement	Comments
RCA#5	0.9-m Adapter	22/2/93	3	180,000	Effect unrepeatable CCD retired 3/93
GEC#7	0.9-m Adapter	3/3/93	1.3	55,000	CCD retired 12/92
RCA#8	2.2-m Adapter	19/3/93	6 < 0.6	75,000 62,000	V_{od} = 17.0V V_{od} = 18.5V
RCA#9	CAT CES Short	19/3/93	8 < 0.7	100,000 73,000	V_{od} = 16.0V V_{od} = 18.0V
RCA#13	1.52-m ECHELEC	6/4/93	< 0.5	120,000	V_{od} = 21.0V No adjustment necessary
TH#19	2.2-m EFOSC II	18/4/93	< 0.1	60,000	
FA#24	1.52-m B & C	13/4/93	< 0.5	90,000	
TK#25	NTT SUSI	19/6/93	~ 1	200,000	
TK#26	3.6-m EFOSC I	11/8/93	~ 0.5	115,000	
TK#28	1.54-m Adapter	11/6/93	< 0.5	110,000	
TK#29	0.9-m Adapter	4/8/93	~ 1	260,000	Temporary location
FA#30	CAT CES Long	11/8/93	< 0.5	47,000	Non-linear transfer curve*
TK#31	NTT EMMI Blue	24/7/93	< 0.2	150,000	
TK#32	3.6-m CASPEC	20/12/92	< 0.25	140,000	
TK#33	0.9-m Adapter	15/5/93	< 0.5	465,000	Temporarily out of service
LO#34	NTT EMMI Red	6/3/93	< 0.2	42,000	

* Although FA#30 has a linear response to incident light, we have discovered a noise source in this system which is proportional to the signal level; work continues to identify its cause.

count rate over the measured range. Most of the linearity tests were performed using a beta light placed in front of the CCD, a few utilized an LED preflash light, powered with a stable, low-noise power supply.

Please note that these results are expressed in terms of the maximum observed non-linearity. In most cases, the linearity was measured over the full, useful dynamic range of the CCD. The extent to which an observer's data will be affected is dependent on the fraction of the CCD's dynamic range which was used for the observations; normally, the effect will be insignificant. In those few cases where the non-linearity may affect observations, work continues to correct the situation.

Reference

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