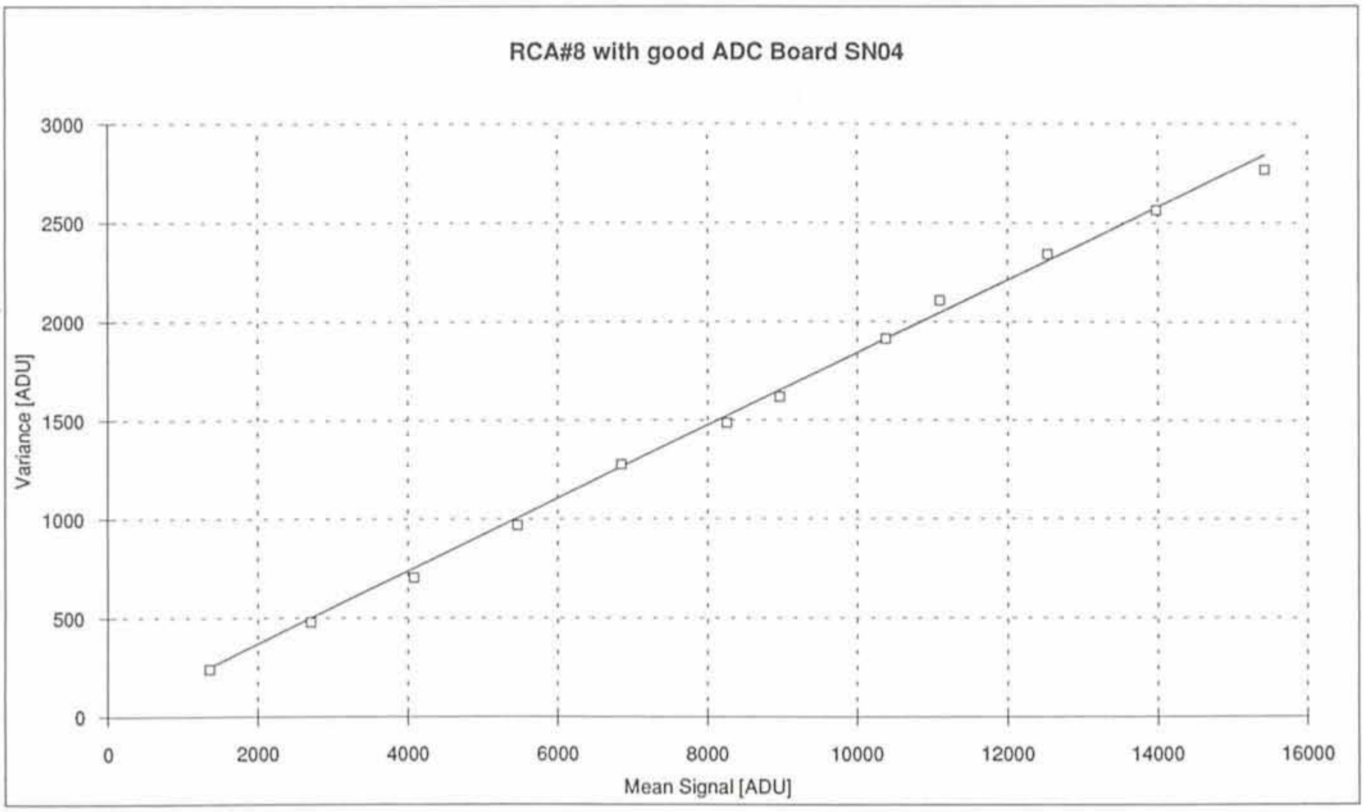

Figure 2.

sets of CCD electronics in use at La Silla:

(a) 2.2-m with adapter, EFOSC2 and Boller and Chivens. CCD used: #8

(b) 1.54-m Danish with adapter. CCDs used: #5, 15.

(c) 1.52-m with Boller and Chivens and Echelec. CCD used: #13.

(d) 0.91-m Dutch, since July 1991. CCDs: #14 (briefly in July 1991), #7.

Note that none of the Gen5 or VME systems have been affected by the problem at any time. Therefore data from Ford, Thomson and Tektronix CCDs have not been affected.

When Did the Problem First Occur?

To determine the first occurrence of the nonlinearity, data have been analysed at La Silla. The earliest known affected data were taken on the 1.54-m Danish telescope in February 1991 with CCD #15 – the effect is only marginally present. Data from 1988, 1989, and 1990 are being investigated.

What was the Nature of the Problem?

It has been found that there is an extra noise component present in the system which contributes in the range 6,000 to 10,000 ADU, just the range in which the nonlinearity occurred (Fig. 1). This measurement was made using a CCD video simulator which produces a signal with noise independent of the signal level, unlike astronomical signals where the noise varies with the square root of the signal level (shot noise). For the old (good) boards the result was a variance which was constant with signal level; the new (bad) boards showed the additional noise component. It is therefore clear that the excess noise component is linked to the observed nonlinearity.

After solving the main problem, further investigations have revealed that there are still low-level nonlinearities present which are still being studied.

Further Information

For further information, please contact the authors (hschwarz@eso.org and tabbott@eso.org) and watch *The Messenger* for further articles concerning CCDs at La Silla.

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CASPEC Improvements

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Introduction

CASPEC, the high-resolution spectrograph mounted at the Cassegrain Focus of the 3.6-m telescope, has been the object of almost constant upgrading in the last three years (Pasquini et al. 1991, 1992).

CASPEC is the only high-resolution spectrograph at La Silla which offers a broad range of options: a rather high resolving power coupled with a large spectral coverage, the possibility to easily change the central wavelength and the capability to observe in the blue and UV up to the atmospheric cut off (Baade and Crane 1990, Molaro et al. 1992). These characteristics, coupled with the large telescope aperture, have made of CASPEC a powerful and versatile instrument used by a large number of observers.

During 1992 CASPEC was not

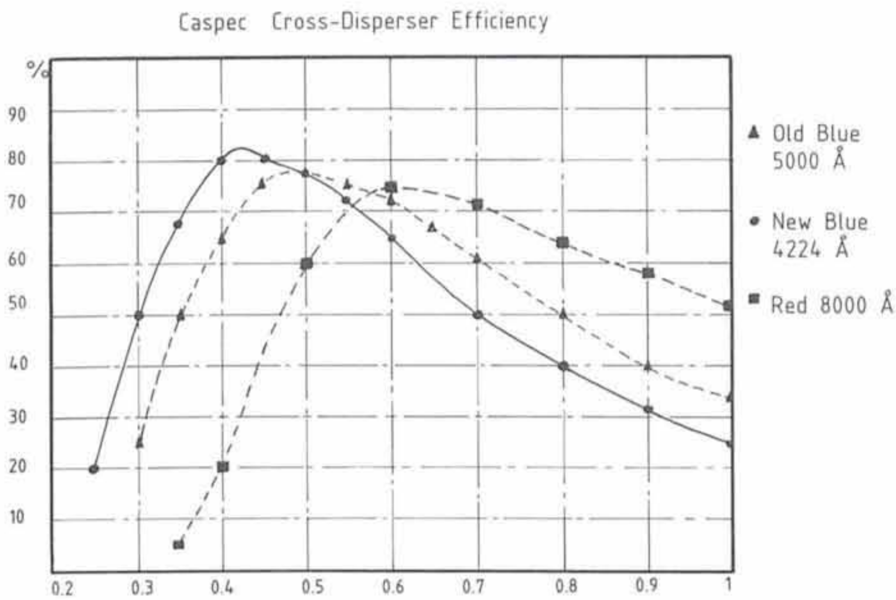

Figure 1: *Efficiency curves for (a): The new Blue crossdisperser (filled dots):; (b): The old Blue crossdisperser (filled triangles); (c): The Red crossdisperser (filled squares).*

Table 1: *Characteristics of the new Blue crossdisperser gratings.*

Type	Milton Roy 3563/90
Groove density	300/mm
Blaze wavelength	4224 Å
Blaze angle	3°36'

mounted at the telescope for three months, in the period August–November. This opportunity was taken to upgrade the instrument through two major changes: a remastering of the old Blue crossdisperser and the mounting of a new, more sensitive CCD.

A new remastering of the Blue crossdisperser was necesarry for mainly two reasons:

(1) Due to the inclined position in the CASPEC mounting, the optical surfaces of the crossdisperser gratings were quite degraded, after 10 years of use. This did affect the efficiency of the instrument and its general performances, increasing the presence of stray light and optical blemishes.

(2) With the implementation of the Red crossdisperser of CASPEC and of the High-Resolution mode on EMMI at the NTT (Melnick et al. 1982), these two spectrographs resulted in a very good performance at wavelengths longer than ~ 5500 and 4500 Å respectively. As a consequence, the CASPEC performances should be enhanced in the Blue-UV region, where EMMI cannot work at a comparable resolution. The first step towards this goal was the replacement of the old Blue CASPEC crossdisperser, which was blazed at 5000 Å, with a new one with a bluer blaze peak.

The New Blue Crossdisperser

The new crossdisperser is, as the old one, a mosaic of two gratings, whose characteristics are summarized in Table 1. In Figure 1 the grating efficiency as function of wavelength is given (filled dots), together with those of the old Blue crossdisperser (filled triangles) and of the Red crossdisperser (filled squares). The blaze peak of the new Blue crossdisperser is at 4224 Å and Figure 1 shows that it is more efficient than the old one in the 3000–4800 Å wavelength range, and only for longer wavelengths the performances are comparable or lower; the expected efficiency is doubled at 3000 Å.

Considering that above 5500 Å the Red crossdisperser can be used, the new Blue crossdisperser will represent a significative advance in the instrument performance. The dispersion of the new gratings being the same as the old ones, the spectral coverage is maintained to ~ 1400 Å per frame.

In order to limit costs and manpower, the two gratings forming the crossdisperser mosaic were remastered on the old blanks.

As soon as they came back from the manufacturer, the gratings were assembled into the mosaic. This assembling was performed at La Silla and the results were checked through interferograms.

The CCD

Together with the new crossdisperser, also a new CCD was installed on CASPEC: the 512×512 Tektronix ESO CCD #32, whose characteristics are given in Table 2, and whose response curve is shown in Figure 2. This CCD has an excellent efficiency over a broad wavelength range: the Relative Quantum Efficiency peaks at 76% at 6500 Å, is almost 50% at 3600 Å and it drops to 23% at 3200 Å (see Fig. 2). It does not need UV flooding to enhance its blue sensitivity. The other CCD parameters are very similar to those of the CCD #16 previously mounted on CASPEC. The Dark Current and Read Out Noise are higher than expected, however the CCD

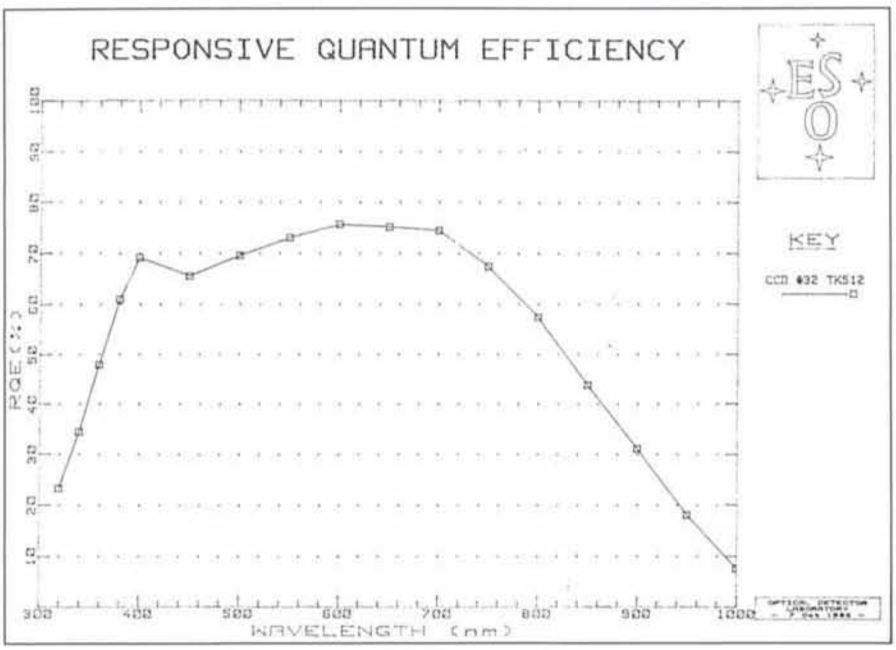

Figure 2: *R.Q.E. of CCD #32*

Table 2: *CCD #32 characteristics*

Type: Tektronix TK 512 CB, thinned, Ar-Coated, MPP	
Serial number:	BR 1456-12-10
Format:	512×512, 50 pre-scan pixel in horizontal direction
Pixel size:	27×27 μm
Conversion factor:	normally used at 3.85 e^-/ADU
Noise level:	~10e^- (measured at telescope)
Linearity	±1.2 % up to 55,000 e^-/pixel
Blemishes:	In high-level exposures in the RED a weak cold line at x=386 and a warm patch from x=366, y=146 to x=391, y=127. Those blemishes are erasable with flat fielding.
Dark current:	10±2 e^-/pixel/hour at 162 K.
Charge transfer efficiency:	CTE is 0.9999989 (parallel) and 0.9999969 (serial)
R.Q.E.:	See Figure 3
Operating temperature:	162 K
Cosmic ray events:	3.55 ± 0.30 events/min/cm^2

team at La Silla will carry out a large programme of CCD optimization in the next months, which should improve that situation.

Tests at the Telescope

The new set-up was tested in one photometric night in December 1992, using the Short Camera and both, the 31.6 and 52 lines/mm echelle.

The mounting of the crossdisperser and of the CCD was quite successful, and no major problems occurred. It was possible to obtain a homogeneous focus over the whole chip and no ghosts appeared. Only for wavelengths above ~ 6400 Å some traces of the second order of the crossdisperser were present at a low level, but, if necessary, these can be easily filtered out using the colour filters available in the CASPEC filter wheel.

The efficiency of the telescope + instrument was measured observing spectrophotometric standards from the list of Hamuy et al. 1992, and the results are shown in Figure 3, for both the 31.6 (filled squares) and the 52 lines/mm (filled triangles) echelle. Note that the efficiency refers to the peak of the order blaze. For the bluest orders of the 31.6 line/mm echelle the overall efficiency is somewhat higher than in Figure 3, due to the large order overlap achievable with this configuration.

The important gain obtained after these last improvements can be appreciated by comparing our new results with those obtained with the old configuration, which are also shown in Figure 3 (open squares).

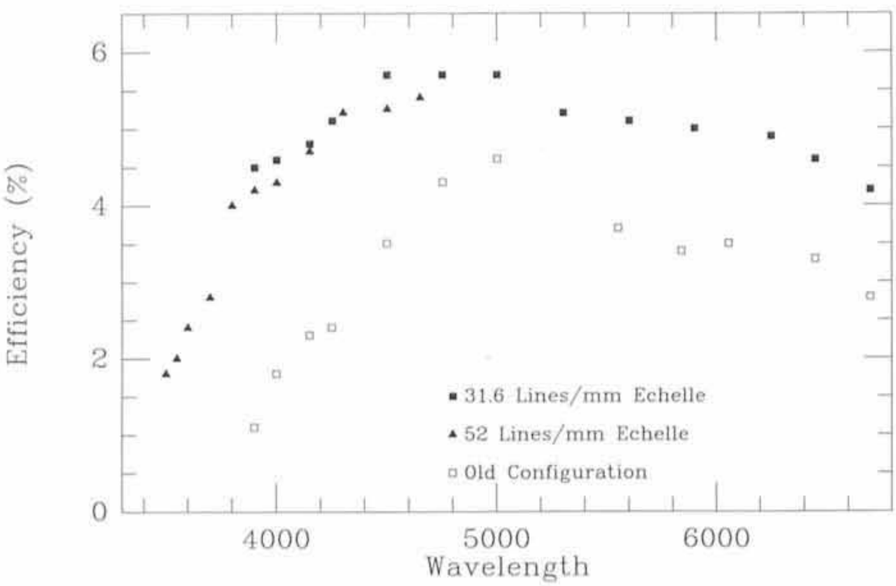

Figure 3: *Overall efficiency curve for the 3.6-m telescope + CASPEC and the new Blue crossdisperser. Short Camera plus 31.6 lines/mm echelle (filled squares) and 52 lines/mm echelle (filled triangles). The results obtained with the old configuration are also shown (open squares) for comparison.*

CASPEC is now working at high performance over the whole visual and blue spectral ranges and it has already been successfully used by several visiting astronomers.

Acknowledgements

Special thanks go to the members of the detector groups at La Silla (P. Moore, P. Sinclaire) and Garching (S. Deiries and R. Reiss) who have tested and prepared CCD #32.

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STAFF MOVEMENTS

Arrivals

Europe

CIMATTI, Andrea (I), Student
DUBATH, Pierre (CH), Associate
FENDT, Michael (D), Engineer (Systems)
MAGANA BÄRNTHALER, Anne (F/USA), Secretary/Administrative Assist. to the Director General
MORTENSEN, Lars (DK), Mechanical Engineer
MOUREAU, Serge (B), Electronic Technical Engineer
WOLOHAN, Deirdre (IRL), Administrative Clerk (Personnel)

Chile

KNEIB, Jean Paul (F), Coopérant
VAN DER BLIEK, Nicole (NL), Student

Departures

Europe

GEHRING, George (D), Student
GOUIFFES, Christian (F), Fellow
MERKLE, Fritz (D), Optical Engineer
PIENEMAN, Henk (NL), Accounting Assistant
VAN DER LAAN, Heike Renate (D), Executive Assistant/Head of Secretariat of the Director General
WILSON, Ray (GB), Senior Physicist

Chile

BECHMANN, Erling (DK), Foreman
JANSSON, Borgar (S), Electronics Maintenance Engineer