to any image on the Palomar Atlas. Although difficult to measure, a position could be transmitted to Dr. Marsden with the proviso that it would be wise to await confirming observations from other observatories before publication of the ESO position.

On July 27, 28 and 29 Halley was observed by Gibson at Palomar (60 inch telescope) and later, on August 1 and 4 by Seki in Japan. The magnitude of Halley on August 1 was 16, confirming our earlier estimate. These observations showed that our measurement on July 19 was within a few arcseconds of where Halley should have been, thus eliminating doubt about the correctness of the identification. The ESO observation was published on IAU circular 4090.

Although this fact in itself carries little scientific value, it bodes well for the ESO observations of Halley in mid-February 1986, when it reappears from behind the Sun, just after the perihelion passage. At that time our observations will be vastly more important, because they will contribute essentially to the navigation of the spacecraft, which are now en route to Halley for close encounters in early March 1986. And, of course, it is always nice to be the first, at least once in a while . . .!

R. WEST

The ESA PCD at the 2.2 m Telescope

S. di Serego Alighieri+, The Space Telescope European Coordinating Facility, European Southern Observatory*

S. D'Odorico, H. Dekker, B. Delabre, G. Huster, P. Sinclaire, European Southern Observatory

M.A.C. Perryman, M. Adriaens, ESTEC, Noordwijk

F. Macchetto, Space Telescope Science Institute, Baltimore*

The ESA PCD (Photon Counting Detector) (di Serego Alighieri et al., 1985a) was developed at ESTEC as a scientific model for the Faint Object Camera (FOC) of the Hubble Space Telescope (HST). It has been used at various telescopes (Asiago 1.8 m, ESO 3.6 m and 2.2 m, CFHT 3.6 m) providing us with data whose properties are very similar to those expected for FOC data (di Serego Alighieri et al., 1984 and 1985b). Since last April the PCD is offered to ESO visiting astronomers at the 2.2 m telescope within the terms of an ESA/ESO agreement, where ESA provides the detector and its computer system, the documentation and support during the first few times the instrument is operated at the telescope; ESO provides the interfaces for long slit spectroscopy and direct imaging, operational support, telescope time and data reduction software.

The PCD is a bidimensional photon counting detector consisting of a 3-stage image intensifier with magnetic focussing and bialkali first photocathode (Fig. 1), coupled by a reimaging lens to a television tube. The TV camera detects the scintillations at the output of the intensifier corresponding to the arrival of individual photons at the first photocathode. The central X-Y position of each burst is measured by a video processing electronics, and in an image memory the memory cell corresponding to that position is incremented by one. The image gradually builds up during the exposure and can be read non-destructively and displayed at any intermediate time. The detector and its electronics are controlled by a minicomputer, and the astronomer sits at a terminal in the control room. Displays are provided both for the analog output of the TV camera and for the digital data being integrated in the image memory. Experience has demonstrated that the possibility of easily and quickly monitoring the data, while these are acquired, considerably increases the efficiency and the quality of the observation. An IHAP station can also be used for the first data reduction at the telescope. The documentation available includes a Users Manual and an Installation Guide.

* Affiliated to the Astrophysics Division, Space Science Department, European Space Agency.

\+ On leave from Osservatorio Astronomico, Padova.

1. Long-Slit Spectroscopy

Because of its very low intrinsic background noise and of the absence of readout noise the PCD is particularly well suited to applications where the sky background is low. These situations also allow to exploit the best part of the dynamic range, before saturation sets in. This is certainly the case for the long-slit spectroscopy mode implemented with the Boller & Chivens spectrograph at the ESO/Max-Planck 2.2 m telescope.

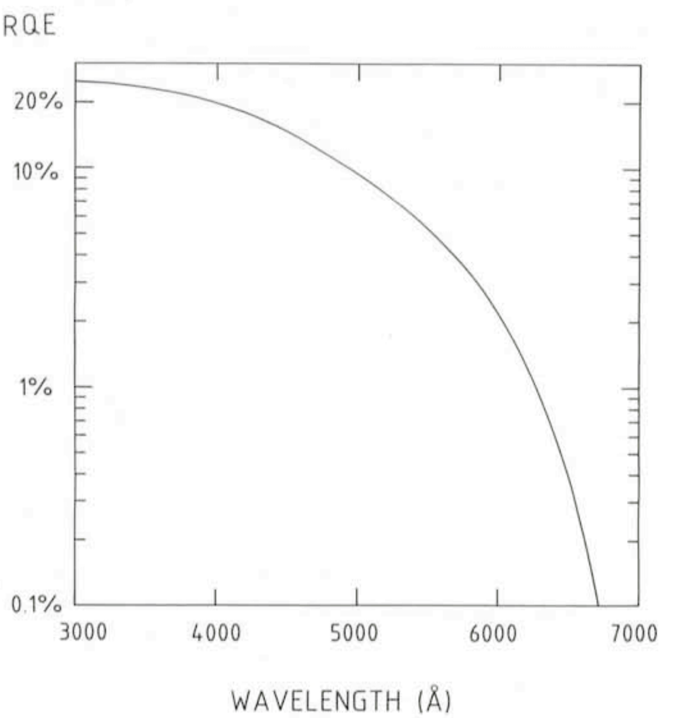

Figure 1: *The responsive quantum efficiency of the PCD image intensifier as measured by the manufacturer.*

1.1. The New Dioptric Camera

The standard solid Schmidt camera for the B & C spectrograph has too small a back focal distance to be used with the PCD, whose front head is of difficult access because of the permanent magnet surrounding the tube. For this reason a new dioptric camera was designed, tendered out, built and put into operation at the spectrograph. The whole procedure was completed with success in 10 months, that is about one half of the time normally required for this type of project. The optical design was made at ESO and is shown in Figure 2.

Tentative Time-table of Council Sessions and Committee Meetings in 1985

November 12	Scientific Technical Committee
November 13–14	Finance Committee
December 11–12	Observing Programmes Committee
December 16	Committee of Council
December 17	Council

All meetings will take place at ESO in Garching.

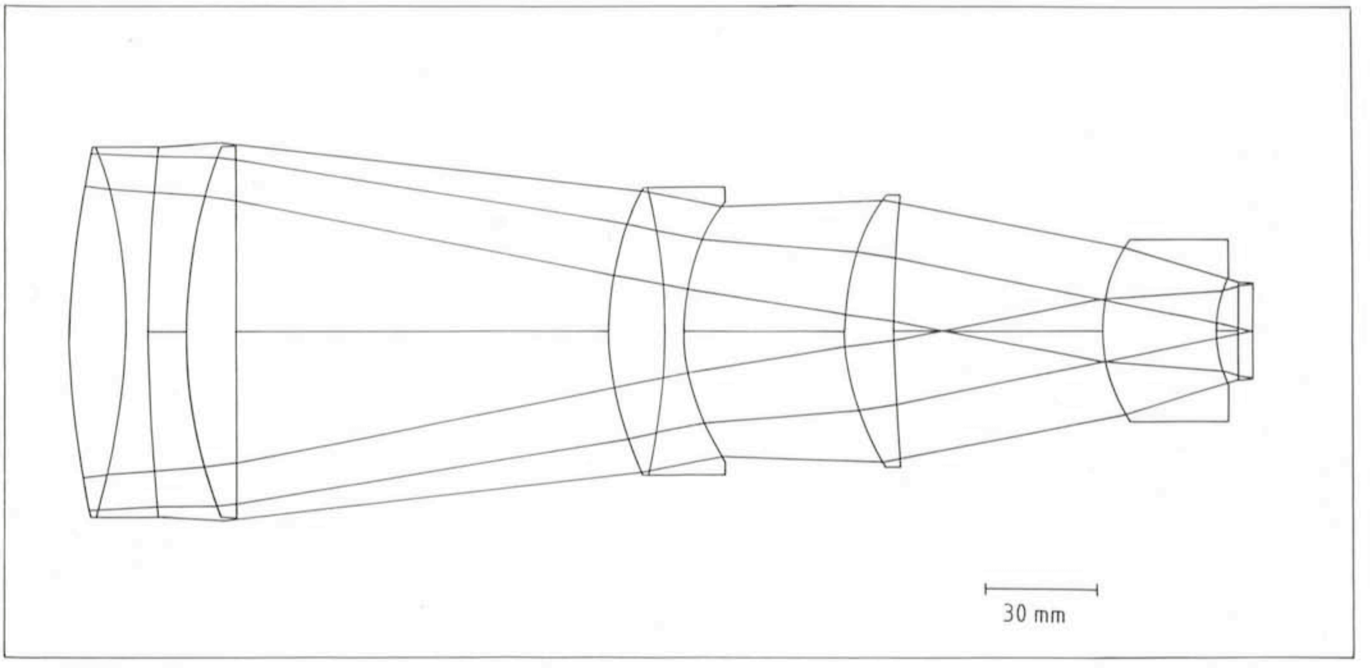

Figure 2: *The optical design of the new dioptric F/2 camera for the Boller & Chivens spectrograph and the ESA PCD.*

The characteristics of the camera are: Focal length : 190 mm; Diameter of the entrance lens : 98 mm; Aperture : F/2; Wavelength range : 3400–6600 Å; Field diameter : 25 mm; Scale factor : 1 arcsec = 22 μm at the detector.

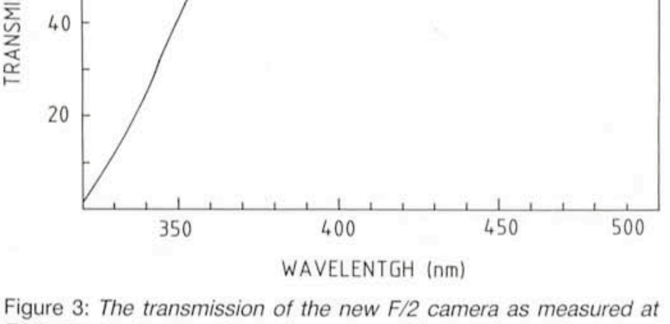

Figure 3: *The transmission of the new F/2 camera as measured at ESO. The broken line shows the average efficiency (transmission and vignetting) of the solid Schmidt camera which is used at the spectrograph with the CCD detectors.*

The image quality is about 20 μm and the vignetting is very small (5 % at 10 mm from the axis). The camera was built according to the ESO specifications by the Officine Galileo, Italy. Figure 3 shows the measured transmission curve of the new camera with that computed for the solid Schmidt. The fall at short wavelengths is due to the low UV transmission of the FK 54 glass components of the optical train. By using glass from a melt with a better UV transparency, one should be able to rise the efficiency of the camera at 3500 Å by 15 %. This option will probably be implemented at the end of the year.

1.2. Performance

The camera and the detector were mounted at the B & C spectrograph in February 1985 (Fig. 4) and have been used for several observing programs. The standard format used in the spectroscopic mode is 1024 × 256 pixels, 25 μm in size. In a typical configuration, the detector was used with the ESO grating # 7 to work in the blue, UV region. The linear dispersion is then 85 Å/mm, the spectral coverage about 2100 Å. With a slit 1.5 arcsec wide, the average FWHM of the comparison lines is 5 Å. Table 1 shows the characteristics of the gratings recommended for use with the B & C and the PCD.

By observations of standard stars close to the zenith with a widely open slit, we have derived the relative spectral response of the telescope-spectrograph-detector combination when grating # 7 is used (Fig. 5). It is also found that stars of m = 12.6, 13.8 and 13.8 give one count/sec/Å at 3500, 3800 and 4440 Å respectively. In order to stay within the linear part

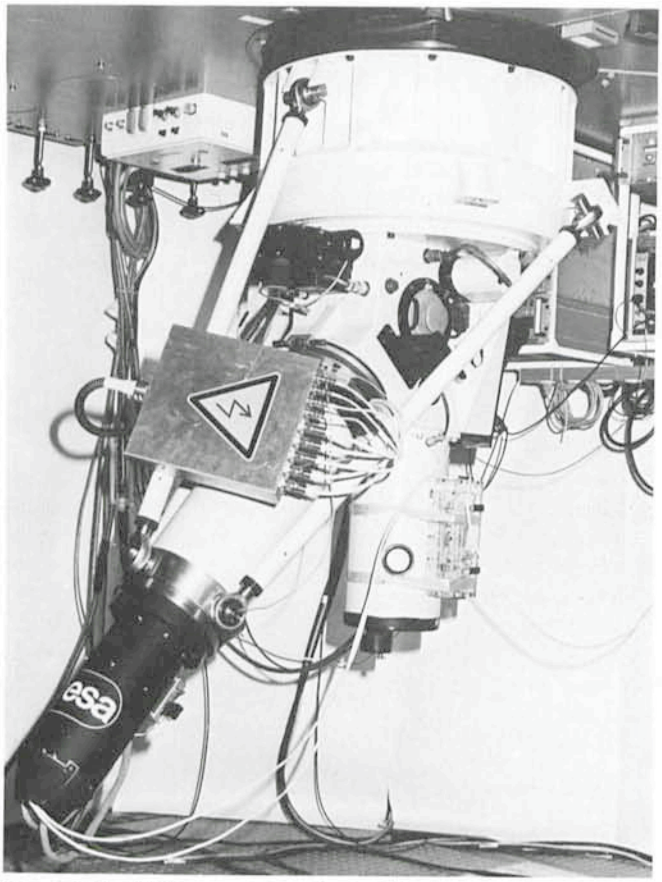

Figure 4: *The PCD mounted on the B & C spectrograph at the 2.2 m telescope.*

of the dynamic range, the observed point sources have to be at least 1.5 magnitudes fainter than those given above, at the same dispersion. Figure 6 shows a spectrum of the radio galaxy PKS 0349−27 after preliminary correction for the image tube distortion.

2. Direct Imaging

To the contrary of the flight version of the FOC, where the very expanded scale and lower sky background of the HST are particularly favorable, the PCD is not suited to broad band imaging, because the sky background considerably reduces the available dynamic range. Nevertheless, a direct imaging

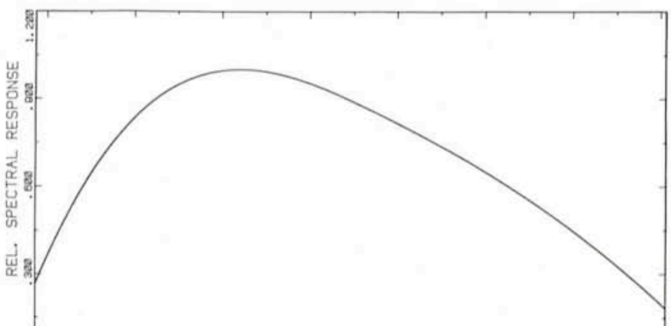

Figure 5: *The spectral response of the telescope-spectrograph-detector combination determined from the observation of a standard star with wide slit. The spectra were taken with the ESO grating # 7, at the blaze angle (8° 38′). The plot is normalized at the peak value.*

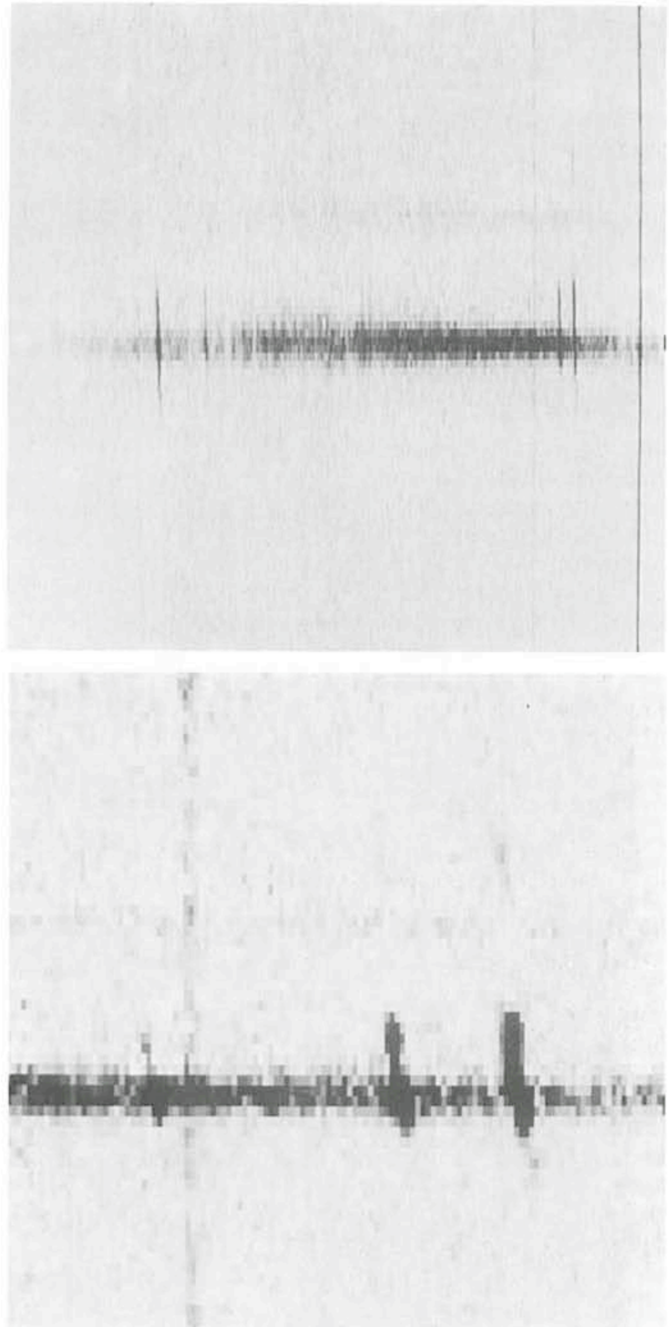

Figure 6: *The PCD spectrum of the radio galaxy PKS 0349−27, taken in a 30-minute exposure with the ESO grating # 7 at blaze angle. The bright nucleus has m (B) = 16.8, while the fainter continuum corresponds to a feature with m (B) = 20. Fig. 6a shows the whole observed range from 3500 to 5600 Å; Fig. 6b is an enlargement of the Hβ and [OIII] region. The geometric distortion has been corrected with IHAP.*

mode is implemented at the 2.2 m telescope to be used mainly with narrow-band filters. The PCD with its shutter and filter wheels assembly are mounted on the adapter (Fig. 7), so that the standard TV guider can be used. The standard 512 × 512 pixel format gives a scale of 0.3 and 0.6 arcsec per pixel over a field of 2.5 and 5 arcmin with pixel sizes of 25 and 50 μm respectively. A set of interference filters peaked at the [OII] 3727 Å and [OIII] 5007 Å emission lines is available for various redshifts. An IHAP batch program is normally used to find the best telescope focus from a focus sequence exposure. The same program is used to monitor the image quality, and Figure 8 shows a histogram of the image size (FWHM) over 12 nights

TABLE I

PCD + B & C recommended gratings

ESO grating #	gr/mm	order	Dispersion Å/mm	Å/pixel	Peak efficiency	Useful range	Comments
24	400	1	126	3.1	60% at 3000 Å	3000–6200 Å	High UV efficiency
7	600	1	85	2.1	71% at 4400 Å	3500–5600 Å	General purpose
6	600	2	43	1.07	53% at 3500 Å	3200–4200 Å	Medium disp. UV – blue
20	1200	2	21.4	0.53	47% at 4000 Å	500 Å anywhere between 3200 Å and 5300 Å	Highest disp. low eff.
On order	600	1	85	2.1	~70% at 3500 Å	3000–5100 Å	High UV efficiency

last April. We can confirm the careful control of local sources of turbulence at the 2.2 m telescope and we suggest that the high rate of occurrence of 0.7 arcsec image size may be the result of the integration of a "good seeing wing" of a nearly symmetric distribution extending down to 0.3–0.4 arcsec. Very good images would be enlarged to 0.7 arcsec FWHM by effects additional to atmospheric seeing like telescope jitter, local seeing, detector resolution and pixel sampling. More extensive tests are necessary to check this hypothesis and eventually to make better use of the excellent conditions present at La Silla.

3. Data Reduction

At ESO two data reduction systems are available at present. IHAP, based on the Hewlett Packard computers, operates at the telescopes on La Silla and can be used for data reduction in Garching. MIDAS, based on the VAX computer, is intended to become the main data reduction facility for the users of the ESO telescopes and of the HST as far as Europe is concerned. The IHAP system has so far been used for the reduction of PCD data and it has demonstrated to be able to cope with many of the needs. As an example of direct imaging data reduction, Figure 9 shows two images of the radio galaxy PKS 0349–27, in the light of redshifted [OIII] and in the nearby continuum. The third image is the difference of the previous two and shows well the ionized gas present in the galaxy. It was obtained by first geometrically registering the two original images using the positions of the stars in the field, then scaling the results to compensate for the different filter transmission and width, and finally computing a pixel by pixel difference. This procedure has been reasonably satisfactory in detecting very faint extended emission (di Serego Alighieri et al., 1984), although the geometric distortion of the PCD (mostly S distortion in the image tube) cannot be accurately corrected by the translation and rotation commands available in IHAP. Better results can be obtained with the software package developed at Rutherford and Appleton Laboratories for the FOC and now being implemented in MIDAS, which corrects for the geometric distortion using the regular grid of reseaux marks etched on the first photocathode of the PCD. This software can be applied to direct imaging data, when a relatively bright sky background allows the detection of most of the reseaux marks. This is unfortunately not the case for the long-slit spectroscopy mode, where one would also ideally like to correct for the distortions in the spectrograph. In order to make this possible, spectra of the wavelength calibration lamp are taken at the telescope through a decker with a series of

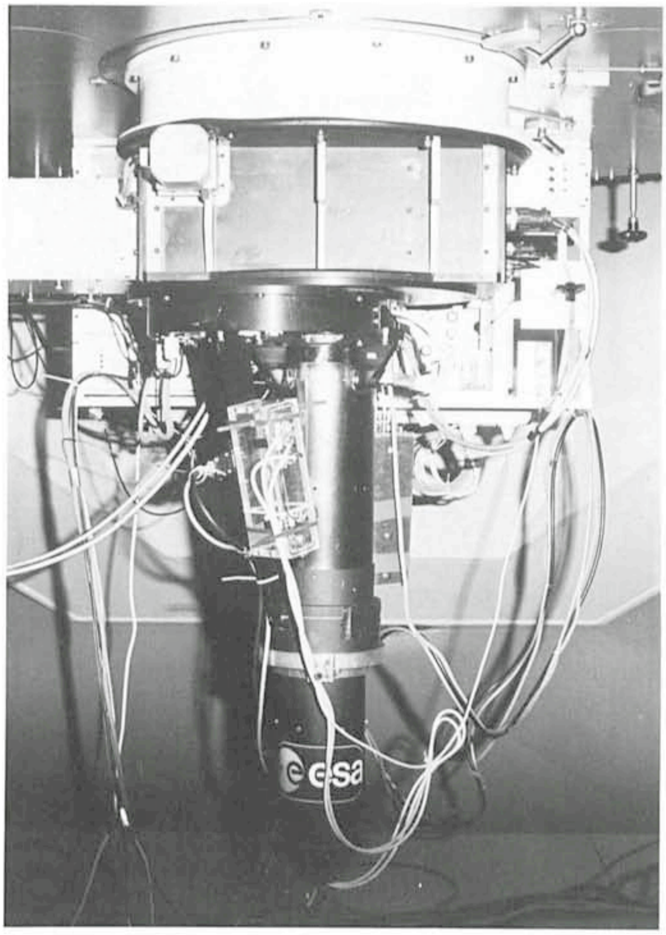

Figure 7: *The PCD mounted on the adapter of the 2.2 m telescope for direct imaging. The square box attached to the telescope flange hosts the TV offset guider, with the PCD filter/shutter unit below.*

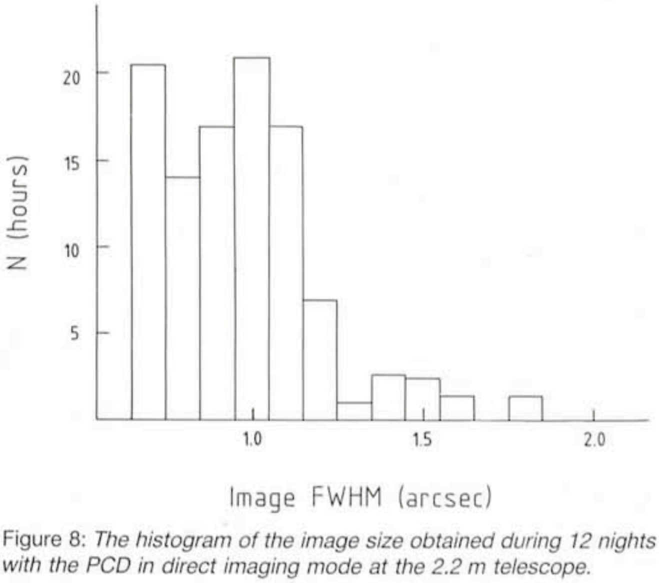

Figure 8: *The histogram of the image size obtained during 12 nights with the PCD in direct imaging mode at the 2.2 m telescope.*

small equispaced holes along the slit (spacing is 25 arcsec, i.e., 22 pixels).

Using these images, the distortion can be preliminarily corrected with a two-step IHAP command sequence operating on a single dimension. The spectrum in Figure 6 has been corrected using this method. A MIDAS procedure is now being developed to operate in the two dimensions in a single step and to transform directly from X, Y pixel coordinates into wavelength and distance along the slit.

4. Acknowledgements

We gratefully acknowledge the skillful help of the ESO technical staff at La Silla, namely Daniel Hofstadt, Paul Le Saux and Eric Allaert, in bringing the PCD into efficient operation. We also like to thank Prof. G. Setti and Dr. B.G. Taylor for their support of the project and for making the rapid conclusion of the ESA/ESO agreement possible.

References

di Serego Alighieri, S., Perryman, M.A.C., Macchetto, F., 1984, *Astrophys. J.* **285,** 567.
di Serego Alighieri, S., Perryman, M.A.C., Macchetto. F., 1985a, *Astron. Astrophys.* **149,** 179.
di Serego Alighieri, S., Perryman, M.A.C., Macchetto, F., 1985b, *ESA Bull.* **42,** 17.

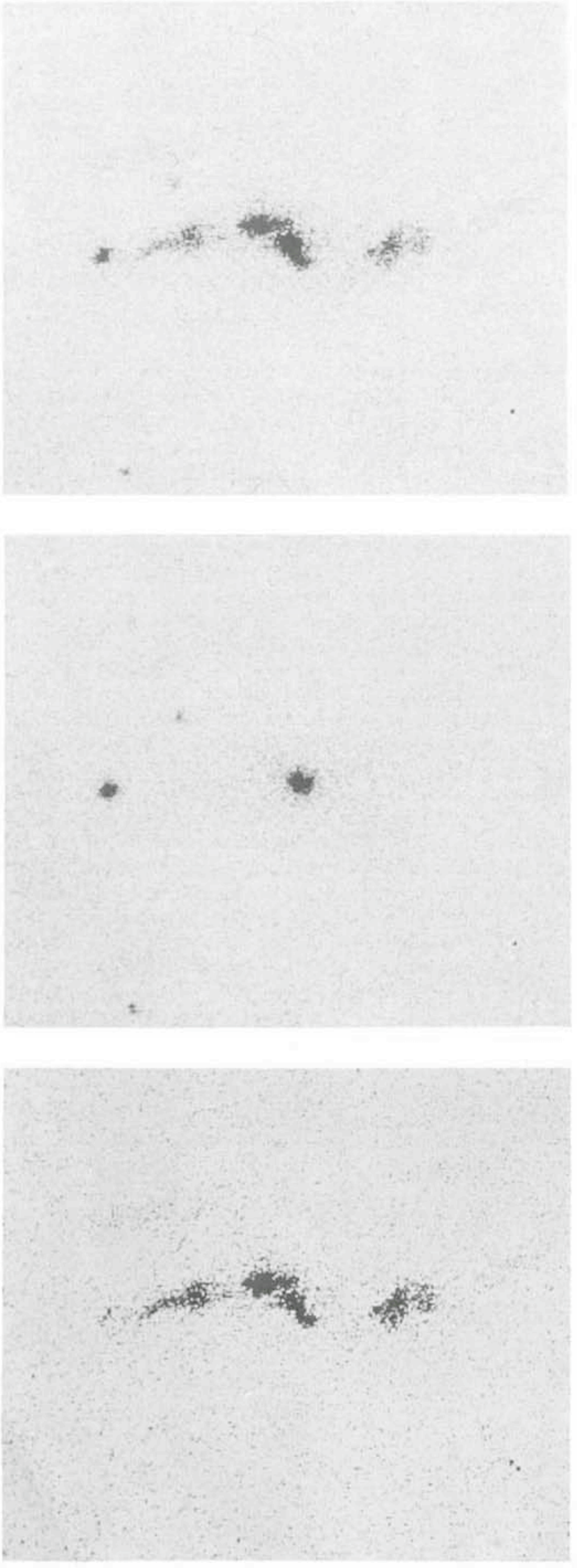

Figure 9: *The field of the radio galaxy PKS 0349–27 in the light of redshifted [OIII] (a), in the nearby continuum (b), and the difference of the previous two (c), showing well the extended ionized gas. North is at the top and east at the left. Picture size is 1.2 arcmin.*

STAFF MOVEMENTS

Arrivals

Europe

KOTZLOWSKI, Heinz (D), Senior Mechanical Engineer
RICHMOND, Alan (GB), Associate
RODRIGUEZ ESPINOSA, José (E), Fellow
WARMELS, Rein (NL), Astronomical Applications Programmer

Chile

MAGAIN, Pierre (B), Fellow

Departures

Europe

BANDIERA, Rino (I), Fellow
BÜCHERL, Helmut (D), Electro-mechanical Technician
GILLET, Denis (F), Fellow
OLIVA, Ernesto (I), Fellow
SADLER, Elaine (GB/AUS), Fellow
SURDEJ, Jean (B), Associate

An ESO/OHP Workshop on

"The Optimization of the Use of CCD Detectors in Astronomy"

will be held at the Observatoire de Haute-Provence from June 17 to 19, 1986.

Topics of discussion will include the performance of the different devices and of the control systems, flat-fielding techniques and data reduction software. Prospects for new developments will also be reviewed. The workshop will be limited to 70 participants. Further information may be obtained from S. D'Odorico at ESO or P. Véron at OHP (F-04870 Saint-Michel l'Observatoire, tel. 0033-92-766368).