Back-and—forth spectropolarimetry: computer simulation

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We simulate with a computer the integration of a stellar spectrum alternatively in two different polarizations of light on the same pixels of the CCD short enough to avoid the errors due to the temporal sky fluctuations. We read the CCD only after a series of integrations. Charges are transferred between each individual exposure without readout up or down along the chip columns synchronously with switching of polarization. The terminology used is taken mainly from (Cuillandre et al.,1994). We use the linear array detector (column) across the dispersion. The parameters of the model are:

Number of pixels used for exposure	25
Number of shifts (in pixels)	50
Individual exposure time	0.1 s
Dark for 0.1 s exposure time	$0.00 e^-$/pixel
Signal of one polarization (for 0.1s)	$4.004 e^-$/pixel
Signal of another polarization (for 0.1 s)	$4.000 e^-$/pixel
Number of individual exposures	10000

— After the shift the rest of the charges go to the nearest pixels.
— Outside the CCD charges equal zero.
— There are three charge transfers per pixel.
— The signal corresponds to a star of 10^m for the **6** m telescope, the spectral resolution is **1** Å and the quantum efficiency of the spectrograph and CCD is 3%.

The distribution of charges along the pixels is close to a rectangle for a low charge transfer efficiency. Below you can see the relation between the ratio **(N1-N2)/N1** and the charge transfer inefficiency, where **N1** and **N2** are the sums of the charges of **50** pixels of one and another polarization after **1000** s of exposure.

Charge transfer inefficiency	(N1-N2)/N1
$1 \cdot 10^{-5}$	$0.990 \cdot 10^{-3}$
$1 \cdot 10^{-4}$	$0.981 \cdot 10^{-3}$
$4 \cdot 10^{-4}$	$0.979 \cdot 10^{-3}$
$5 \cdot 10^{-4}$	$0.967 \cdot 10^{-3}$

The inefficiency of our CCD detector is $2.5 \cdot 10^{-5}$. It means that we can have an accuracy of measurements about **0.1%** in one column of the CCD.

References

Cuillandre J.C., Fort B., Picat J.P., Soucail G., Altieri B., Beigbeder F., Dupin J.P., Pourthie T., Ratier G.: 1994, Astron. Astrophys., **281**, 603.