Crosstalk Analysis of New CCDs of Suprime-Cam

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The detectors of Suprime-Cam were replaced in 2008/07 to full-depleted back illuminated CCDs [1]. The new CCDs show a crosstalk features between channels (Figure 1 top). Such crosstalk was reported in multichannel CCDs in other observatories [2,3,4,5,6].

In Suprime-Cam, one of the three crosstalk shadows moves parallel to the source. Default dithering sequence of Suprime-Cam does not change the position angle, and the shadow of the same parity gains S/N after coadd (Figure 2). It causes problem especially in two cases: a narrow band imaging with low sky background, and deep imaging with lots of exposures. In either case, the crosstalk affects the result, it is important to formalize the effect and correct it appropriately.

In this study, I used cosmic rays in dark frames (exposures with shutter closed). Detecting cosmic rays and compare the data at corresponding pixels in other channels, the crosstalk can be formalized. Moreover, as the dark current is very low in the new CCDs, the difficulties of background subtraction is avoided.

The results of the analysis are as follows; 1) The crosstalk of the Suprime-Cam new CCDs is a decrease of the bias level. It is proportional to the input signal in a channel (Fig. 3), and the coefficient is typically 10^{-4} . It is comparable to other observatories [2,3]. 2) No crosstalk between chips is detected. 3) The strength of crosstalk depends on the pair of channels. The central two channels shows significantly weak crosstalk. This asymmetry implies that the crosstalk is a phenomenon around on-chip amplifiers (amps). 4) The strength shows no difference among chips. It only depends on the distance between the channels. 5) Crosstalk does not change by a change of the gain of on-chip amp. It implies that the crosstalk is not an interaction of charges but an interaction of signals. 6) Crosstalk is recognized not only at the corresponding pixel but 2 pixels read after the pixel.

A correction formula is derived from the analysis of the dark frames. The correction also works well for other data frames (Fig. 1 bottom) [7], and the tool is provided to the public.



Figure 1: Example of crosstalk. (Top) before correction. (Bottom) after correction.



Figure 2: Schematic figure of coadd of dithered data.



Figure 3: Correlation between input signal and crosstalk signal in chip0 ch-B and ch-D. The solid line shows the best-fit regression.

References

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