

## **The spatial sensitivity gradient due to a loss of the window transparency of 2KCCD**

### **Abstract**

The error in the flat-field correction of a two-dimensional camera is an important source of photometric error. During our test of the accuracy of such correction, we found that there has been an occasional serious loss of the window transparency of 2KCCD. This causes a considerable reduce, up to 0.2 mag or more, of the light from a star focused on the CCD. Its effect on flat-field images is not so large, less than  $\sim 1\%$ , as that on the stellar photometry. Therefore thus-induced spatial sensitivity gradient cannot be corrected using the flat images. Still, the small effect on the flat images can be used to check if there was the transparency loss, and we found the two probable periods with that since 2008 April: (i) 2008 August—2008 November and (ii) 2009 August and 2010 May. The reason of the loss of the transparency has not been determined yet, but it can be prevented by regular wipes of the window. Users of 2KCCD are kindly advised to be careful in doing analysis of the images, especially those in the above periods.

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## Detection of the sensitivity variation

Our test of the sensitivity variation applies the method presented in Koch et al. (2004, *Astron. Nachr.*, 325, 299–306). We observed the field of view toward a globular cluster Palomar 5, where the SDSS photometric catalogue is available, as done by Koch et al. After the standard data reduction making use of the dome-screen flat image, our photometry was compared with the SDSS magnitudes after the filter-transformation conversion. The 2KCCD images were taken in V and Rc bands, designed to be close to the standard Johnson-Cousins system, while the SDSS photometry was done in  $u'$  ,  $g'$  ,  $r'$  ,  $i'$  , and  $z'$  filters. The predicted magnitudes from the SDSS catalogue were compared with the magnitudes we obtained with the 2KCCD camera for a few thousand stars within a  $50' \times 50'$  field of view. If the sensitivity was corrected well, the magnitude difference between the SDSS and 2KCCD results should be uniform. However, we found a large variation as indicated in Fig. 1.

## Loss of transparency of the window of 2KCCD

After the test mentioned above, we found that some kind of stain on the window of 2KCCD was causing the loss of transparency of the window (Fig.2). The stain seems to spread across the region we found the transparency loss. In fact, the spatial sensitivity gradient disappeared when we did a retest on 2010 June 9 after the stain wiped out (Fig. 3). The origin of the stain is not clear, but may be related to the air outlet of the pipe to prevent the condensation. The investigation on this stain is in progress.

## Periods with the sensitivity gradient

With the stain on the window the dome-flat image changes to the level of 1%\*. This change makes it possible to trace the periods when the window's transparency was affected by the stain. The check for the dome-flat images since 2010 April indicates that the problem existed in the images taken at: (i) 2008 August—2008 November and (ii) 2009 August and 2010 May.

## Acknowledgement

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\* The effect of this transparency loss is different very much between for the stars and for the uniformly illuminating source like the dome-flat screen. This can be understood that the stain causes a strong forward scattering.

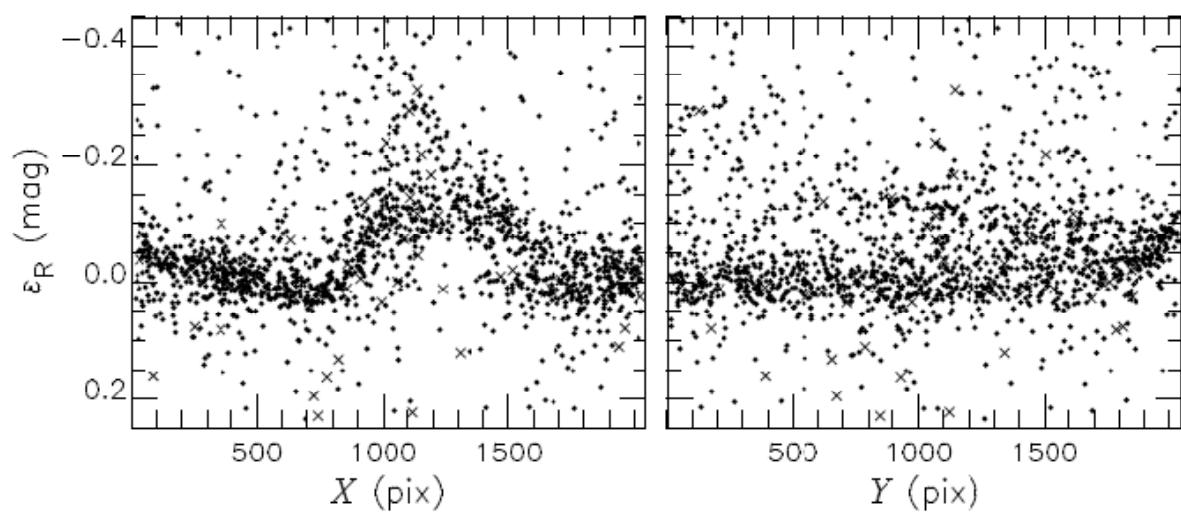


Fig. 1

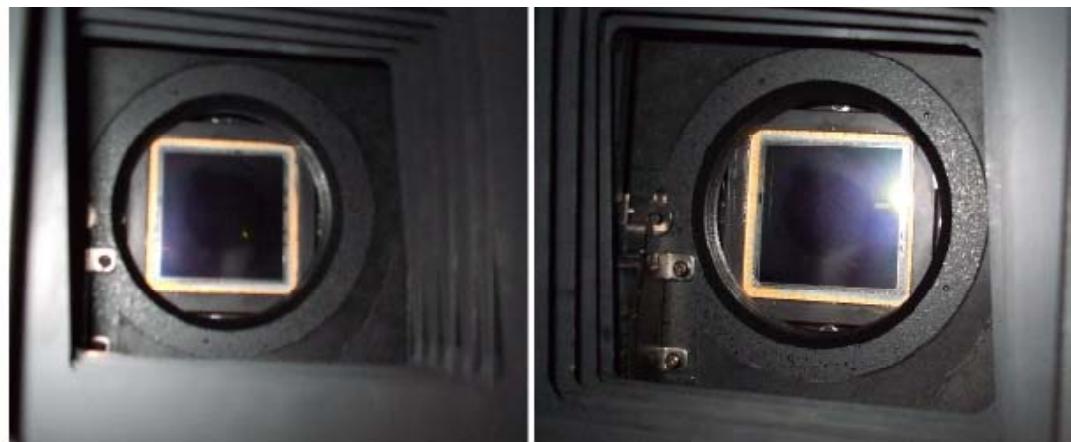


Fig. 2

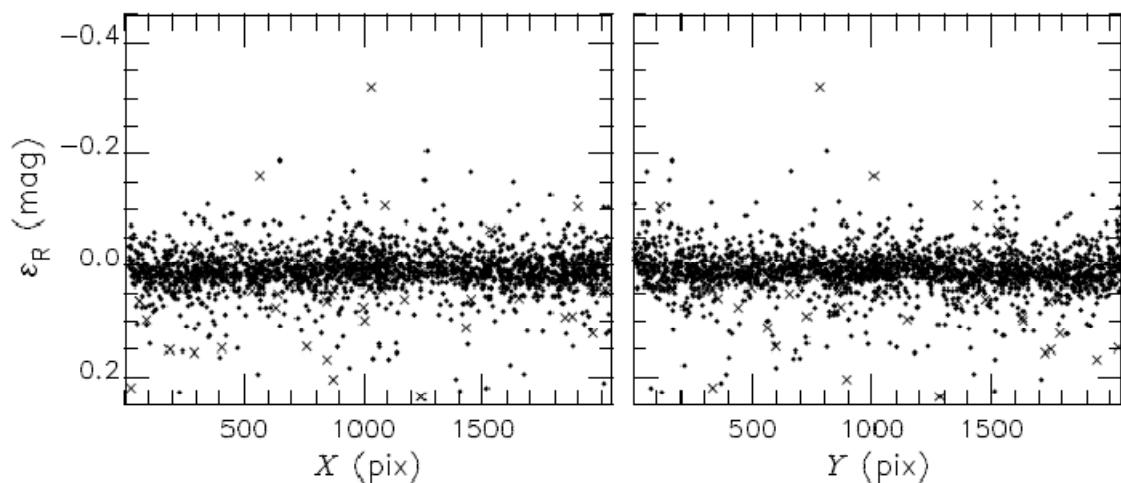


Fig. 3